Ecosystem Approach to Salmon Mariculture: Charting Law and Policy Coordinates from Theory, International Law, and State Practice

by

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To my family, with love and gratitude.

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ABSTRACT

The Dissertation addresses the legal dimensions of an ecosystem approach to salmon mariculture. Its objective is to identify legal features that support, enable or obstruct the operationalization of an ecosystem approach in the planning and management of the activity. This objective is pursued through three consecutive analyses: theory, international law, and State practice.

The Dissertation clarifies the concept of ecosystem approach to aquaculture through a critical analysis of the technical guidelines on ecosystem approach to aquaculture developed by the Food and Agriculture Organization of the United Nations. Building on the broader scholarship on ecosystems and the law, it develops a practical framework for analysis by identifying three distinct but interrelated dimensions of an ecosystem approach: a social process; a normative concept; and an adaptive and flexible approach. Each of these dimensions is linked to law and policy coordinates that facilitate operationalization as well as legal structures and principles in tension with the approach.

The second analysis addresses international law and aquaculture. It identifies substantive and procedural obligations and standards for salmon mariculture planning and management, identifies their limitations, and regulatory gaps. It further clarifies the extent to which international binding agreements and policy instruments reflect the law and policy coordinates for an ecosystem approach to aquaculture.

The third analysis addresses State practice through an assessment and comparison of salmon mariculture legal frameworks in four key producing countries: Norway, Chile, United Kingdom (Scotland) and Canada (Nova Scotia). Building on the three-dimensions of an ecosystem approach to aquaculture and the international obligations identified in earlier analyses, four more specific themes are assessed and compared: the recognition of ecosystem approach for aquaculture planning and management; the balancing of diverse ecological, social, and economic objectives in zoning and planning instruments; the legal instruments addressing ecosystem-level and cumulative impacts; and the adoption of adaptive and flexible management.

The three-part analysis provides insights on the increasing recognition of the ecosystem approach as an environmental principle for decision-making in the aquaculture context. It further reveals a clear, yet recent and incomplete, evolution of aquaculture legal frameworks to address the more complex social and ecological interactions of salmon mariculture.

LIST OF ABBREVIATIONS USED

AAA	Area Apropiada para la Acuicultura (Chile) (Suitable Area for Aquaculture)
AM	Adaptive Management
CAR	Controlled Activities Regulations (Scotland)
CBD	Convention on Biological Diversity
C&C	Command and Control
CCRF	Code of Conduct for Responsible Fisheries
CMAR	Centre for Marine Applied Research (Nova Scotia)
CoGP	Code of Good Practice for Scottish Finfish Aquaculture
CoP	Conference of the Parties
CSAS	Canadian Science Advisory Secretariat
DFO	Department of Fisheries and Oceans (Canada)
DS	Decreto Supremo (Chile) (Supreme Decree)
EU	European Union
EA	Ecosystem Approach
EAA	Ecosystem Approach to Aquaculture
EAF(M)	Ecosystem Approach to Fisheries (Management)
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
ICJ	International Court of Justice
FAO	Food and Agriculture Organisation of the United Nations
FCRA	Fisheries and Coastal Resources Act (Nova Scotia)
GMO	Genetically Modified Organism
IMO	International Maritime Organization
LGPA	Ley General de Pesca y Acuicultura (Chile)
LOSC	Law of the Sea Convention
MAB	Maximum Allowable Biomass
MoU	Memorandum of Understanding
MSP	Marine Spatial Planning
nm	Nautical mile
NOK	Norwegian Krone(r)
NASCO	North Atlantic Salmon Conservation Organization
NS	Nova Scotia
NSARB	Nova Scotia Aquaculture Review Board
NSDFA	Nova Scotia Department of Fisheries and Aquaculture
OIE	Office International des Epizooties

PCA	Permanent Court of Arbitration
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SEA	Strategic Environmental Assessment
SEPA	Scottish Environmental Protection Agency
SER	Social-ecological Resilience
SERNAPESCA	Servicio Nacional de Pesca y Acuicultura (Chile)
SES	Social-ecological System
SPP	Scottish Planning Policy
SUBPESCA	Subsecretaria de Pesca y Acuicultura (Chile)
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNGA	United Nations General Assembly
USA	United States of America
WFD	Water Framework Directive

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CHAPTER 1. INTRODUCTION

How can salmon mariculture[1] and healthy coastal ecosystems coexist? This seemingly simple question is anything but; it is complex, multi-dimensional, knowledge-intensive, and value-laden. Yet an answer is also increasingly relevant.

This Dissertation addresses the legal aspects of this query. Its basic premise is that strong legal and policy frameworks for aquaculture planning and management are a prerequisite for salmon mariculture that is compatible with healthy coastal ecosystems. The Dissertation's overall objective is to identify key legal and policy features – the legal and policy "coordinates" – supporting sustainable aquaculture using the framework of an ecosystem approach to aquaculture (EAA).

This introductory chapter expands, first, on the need for legal research on aquaculture planning and management in the context of an EAA. The second section elaborates on the subject of this Dissertation (namely salmon mariculture) and further conceptualizes it as a complex and dynamic system embedded in broader social-ecological systems. The chapter then outlines research objectives and methodological approaches. The fourth section addresses the expected contribution of this Dissertation. Finally, the fifth section provides the outline for the following chapters.

1.1 The Research Need

It is well known that aquaculture has been the fastest growing food producing sector since the 1970s.[2] Aquaculture currently contributes 56% of seafood for human consumption.[3] In the context of mostly stagnant or even declining wild fisheries catches,

[1] Salmon mariculture is a specific form of aquaculture: farming of salmonids in coastal or marine sites. The terms and the scope of this Dissertation are addressed further in section 1.2 of this chapter.
[2] Between 1990 and 2020, aquaculture has grown by 6.7% per year. In 2020, aquaculture animal production reached 87.5 million tonnes; additionally, 35.1 million tonnes of algae and 700 tonnes of ornamental seashells and pearls were produced. Total farm gate value was US$ 281.5 billion. This represents 49% of the estimated global production of aquatic animals (65% in value) and 56% of estimated global aquatic animal food production available for human consumption. Nevertheless, growth has slowed down in the third millennium, from 9.5% during 1990–2000 to 4.6% during 2010–2020. In the last five years of available statistics, the growth rate has decreased further to 3.3% per year (FAO, *The State of World Fisheries and Aquaculture 2022: Towards Blue Transformation* (Rome: FAO, 2022) at 1, 26, online: FAO <https://doi.org/10.4060/cc0461en> (accessed 7 October 2022) [hereinafter FAO, SOFIA 2022]).
[3] *Ibid*, at 1.

the growth in aquaculture has not only allowed to provide fish protein to a growing population, but also to increase *per capita* consumption of fish.[4]

The global distribution of aquaculture production is uneven. The vast majority of aquaculture takes place in Asia and particularly China, where freshwater finfish aquaculture dominates.[5] Aquaculture has experienced some growth in Latin America (driven mostly by Chile, Ecuador, and Brazil) but has been mostly stagnant in Europe (with the exception of Norway), North America,[6] Oceania, and Africa (with the exception of Egypt and Nigeria).[7] There is, therefore, untapped potential for aquaculture growth.

There is a political will to tap that potential. Global, regional, and national[8] policies strongly support aquaculture development. While the capacity of aquaculture to provide high-quality food is central to this endorsement, there is increasing recognition of the potential for aquaculture to provide other provisioning, regulating, supporting and cultural ecosystem services.[9]

Already in 1976, the first of four global conferences on aquaculture, organized by the Food and Agriculture Organization of the United Nations (FAO) and the Network of Aquaculture Centres of Asia (NACA), recognized the need to expand aquaculture production by levering its priority in national planning efforts and international support programs and by strengthening its science basis.[10] The second Conference in 2000

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[4] *Ibid*, at 1 and Table 1 at 3.
[5] *Ibid*, at 25.
[6] Halley E Froehlich et al, "Mind the gap between ICES nations' future seafood consumption and aquaculture production" (2021) 78 ICES J of Marine Science 468, doi:10.1093/icesjms/fsaa066.
[7] FAO, SOFIA 2022, *supra* note 2, Table 7 at 30; M Troell et al, "Perspectives on aquaculture's contribution to the SDGs for improved human and planetary health" Draft Background Paper for FAO Shanghai Symposium, Thematic Paper presented at the Global Conference on Aquaculture 2020, Shanghai, China, 22-25 September 2021, online <https://aquaculture2020.org> (accessed 5 May 2022); Marc Metian et al, "Mapping diversity of species in global aquaculture" (2020) 12 Rev in Aquaculture 1090, especially at 1093.
[8] National policies supporting aquaculture growth in the jurisdictions studied in this Dissertation will be addressed in Chapter 6.
[9] Rebecca R Gentry et al, "Exploring the potential for marine aquaculture to contribute to ecosystem services" (2020) 12 Rev in Aquaculture 429. For example, aquaculture can augment wild fisheries catches, sequester carbon, regulate acidification, remove nutrients, protect coasts, improve water clarity, provide artificial habitat, and enhance tourism (*ibid*).
[10] FAO, "Kyoto Strategy for Aquaculture Development", adopted by the FAO Technical Conference on Aquaculture (Tokyo, Japan, 1976), online: FAO <http://www.fao.org/3/ac442e/AC442e3.htm>; TVR Pillay, "Aquaculture Development: From Kyoto 1976 to Bangkok 2000", in Rohana P Subasinghe et al (eds), *Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium*, Bangkok, Thailand, 20-25 February 2000 (Bangkok, Rome: NACA and FAO, 2001) 2.

similarly concluded that "aquaculture should continue to be developed towards its full potential (…)" and "should be pursued as an integral component of development".[11] This Conference laid out the three key principles that should guide aquaculture development: "practical and economically viable farming and management practices that are environmentally responsible and socially acceptable".[12] A subsequent conference held in 2010 further called for sound policies, strategies and plans in sustained development incorporating the principles of an ecosystem approach to aquaculture.[13] The most recent Global Conference on Aquaculture held in 2021 concluded with a declaration that lays out the roadmap to optimize the role that aquaculture can play in achieving the 2030 Sustainable Development Goals[14] as part of enhanced agri-food systems.[15]

Indeed, aquaculture is central to sustainable development, in particular rural development.[16] The conferences on environment and development organized by the United Nations (UN) in 1992, 2002, and 2012 recognized the role of aquaculture in improving food security and development.[17] The UN Outcome Document of the 2012

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[11] FAO, "Bangkok Declaration and Strategy on Aquaculture Development Beyond 2000", adopted by the FAO/NACA Conference on Aquaculture Development in the Third Millennium (20-25 February 2000 Bangkok, Thailand), para 2.18 and 2.19, online: FAO <http://www.fao.org/3/a-ad351e.pdf>.
[12] *Ibid*, para 2.20.
[13] FAO, "Phuket Consensus: A re-affirmation of commitment to the Bangkok Declaration", adopted by the FAO/NACA Global Conference on Aquaculture Millennium +10: Farming the Waters for People and Food (Phuket, Thailand, 22-25 September 2010), online: FAO <http://www.fao.org/tempref/FI/DOCUMENT/aquaculture/aq2010/Phuket_Consensus_13-12-2010.pdf> (accessed 26 December 2022).
[14] United Nations General Assembly (UNGA), *Transforming our world: the 2030 Agenda for Sustainable Development* (25 September 2015), A/RES/70/1 (21 October 2015) [Agenda 2030 and Sustainable Development Goals]; see online: UN <https://sdgs.un.org/goals> (accessed 12 May 2022).
[15] FAO, "Shanghai Declaration", adopted by the participants to the Global Conference on Aquaculture Millennium +20 held in Shanghai, 22-25 September 2021, online: <https://aquaculture2020.org/declaration/> (accessed 6 April 2022).
[16] FAO, *The 2030 Agenda and the Sustainable Development Goals: The challenge for aquaculture development and management*, by J Hambrey. FAO Fisheries and Aquaculture Circular No 1141 (Rome: FAO, 2017); Troell et al, *supra* note 7.
[17] Agenda 21, adopted during the Rio Summit in 1992, recognizes the value of aquaculture as an alternative livelihood and encourages the development of environmentally sound aquaculture that also considers social factors (United Nations Conference on Environment and Development, *Agenda 21: Programme of Action for Sustainable Development*, UN Doc. A/Conf. 151/26 (1992). See paras 14.25 and 14.26; 16.3 (calling to "increase to the optimum possible extent the yield of major crops, livestock, and aquaculture species, by using the combined resources of modern biotechnology and conventional plant/animal/micro-organism improvement, including the more diverse use of genetic material resources, both hybrid and original"; 17.79 (calling to increase aquaculture production, in particular in developing countries); 17.83 (calling for studies on potential for aquaculture development and safeguards against non-native species); 17.87 and 17.92 (on financial and technical cooperation and technology transfer); 17.94 (on establishing sustainable aquaculture development strategies); 18.76(i) and 18.40 (on water resources management and particularly

Conference on Sustainable Development "The Future We Want" recognizes the role of aquaculture in the following manner:

> We reaffirm the necessity to promote, enhance and support more sustainable agriculture, including crops, livestock, forestry, fisheries and *aquaculture*, that improves food security, eradicates hunger and is economically viable, while conserving land, water, plant and animal genetic resources, biodiversity and ecosystems and enhancing resilience to climate change and natural disasters. We also recognize the need to maintain natural ecological processes that support food production systems [emphasis added].
>
> We also stress the crucial role of healthy marine ecosystems, sustainable fisheries and sustainable aquaculture for food security and nutrition and in providing for the livelihoods of millions of people.[18]

The UN General Assembly has supported these policy recommendations through its annual resolution on sustainable fisheries since 2004.[19]

Climate change has reinforced the need for sustainable aquaculture development.[20] Aquaculture is a key component of a "more productive, efficient, resilient, climate-smart and socially and environmentally responsible agri-food systems",[21] contributing to food security and nutrition[22] of a growing population in the

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freshwater resources in support of, *inter alia*, aquaculture). Similarly, the Johannesburg Plan of Implementation recognizes the need to support the sustainable development of aquaculture considering its contribution to food security and economic development (World Summit on Sustainable Development, *Johannesburg Declaration on Sustainable Development and Plan of Implementation of the World Summit on Sustainable Development: the final text of agreements negotiated by governments at the World Summit on Sustainable Development, 26 August-4 September 2002, Johannesburg, South Africa* (New York: UN, 2003), section 31(h)).

[18] UNGA, *The future we want* (27 July 2012), Doc A/RES/66/288 (11 September 2012), online: UN <https://research.un.org/en/docs/ga/quick/regular/66> (accessed 26 December 2022).

[19] Following the text of resolutions adopted in previous years, the resolution on sustainable fisheries adopted in 2021 highlights the contribution of aquaculture to food security, nutrition, and poverty alleviation. It calls on States to consider sustainable aquaculture as a means to promote diversification of the food supply and of income while ensuring that aquaculture is conducted responsibly. It also calls upon States, specialized agencies, and intergovernmental bodies to cooperate in achieving sustainable aquaculture (UN, "Sustainable fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments", Doc A/RES/76/71 (17 December 2021), online: UN Division for Ocean Affairs and the Law of the Sea <https://www.un.org/Depts/los/index.htm> (accessed 13 May 2022)). The annual resolution on oceans and the law of the sea, in turn, highlights aquaculture in the context of decent work, child labour, and trafficking in persons and forced labour, highlighting current cooperation between the International Labour Organization and FAO and the UN Office on Drugs and Crimes. See online: Division for Ocean Affairs and the Law of the Sea, *ibid.*

[20] Christopher M Free et al, "Expanding ocean food production under climate change" (2022) 605 Nature 490.

[21] Shanghai Declaration, *supra* note 15.

context of climate change.[23] Climate-smart aquaculture[24] could contribute to climate change mitigation, either directly by capturing carbon dioxide[25] or buffering ocean acidification,[26] or indirectly by producing less carbon-intensive animal protein.[27] It can also contribute to adaptation by providing alternative livelihood and diversifying economic opportunities, in particular in the context of reduced fisheries productivity and shifting stock in a changing marine environment.[28] Further, it can improve environmental conditions and support resilience of freshwater and marine ecosystems.[29] Aquaculture has recently been endorsed as a nature-based solution to environmental problems and climate change.[30] And while aquaculture itself has been and will be affected by climate-induced

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[22] High Level Panel of Experts on Food Security and Nutrition (HLPE), *Sustainable fisheries and aquaculture for food security and nutrition*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (Rome: HLPE, 2014). "Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, access, utilization and stability." (FAO, *Global Strategic Framework for Food Security and Nutrition* (ROME: FAO, 2014), online: FAO <https://www.fao.org/fileadmin/templates/cfs/Docs1314/GSF/GSF_Version_3_EN.pdf> (accessed 6 April 2022).

[23] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022: Impacts, Adaptation and Vulnerability*. *Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H-O Pörtner, DC Roberts, M Tignor, ES Poloczanska, K Mintenbeck, A Alegría, M Craig, S Langsdorf, S Löschke, V Möller, A Okem, B Rama (eds)] (Cambridge, UK; New York, NY, USA: Cambridge University Press, 2022), doi:10.1017/9781009325844, chapter 5, para 5.8.2.1 at 764.

[24] FAO, "Climate Smart Agriculture", online: FAO <https://www.fao.org/climate-smart-agriculture/en/> (accessed 23 April 2022). FAO states that "[t]he CSA approach pursues the triple objectives of sustainably increasing productivity and incomes, adapting to climate change and reducing greenhouse gas emissions where possible" (*ibid*). See also: FAO, "Strategic Framework 2022-31" (Rome: FAO, 2021), online: <https://www.fao.org/3/cb7099en/cb7099en.pdf> (accessed 23 April 2022).

[25] Alice R Jones et al, "Climate-Friendly Seafood: The Potential for Emissions Reduction and Carbon Capture in Marine Aquaculture" (2022) 72 BioScience 123. Jones et al note that both seaweed and bivalve farming have the potential to sequester carbon. While seaweed farming has the greatest potential of sequestering carbon under certain circumstances, the authors note that "his would be unlikely to result in meaningful amounts of carbon sequestration" and further warn that the potential negative impacts are unknown (*ibid*, at 136). Further barriers for seaweed or bivalve farming at relevant scales are also noted, including the lack of recognition of seaweed carbon in current carbon accounting and trading markets (*ibid*).

[26] IPCC, *supra* note 23, Chapter 3, para 3.4.2.3 at 418.

[27] Jones et al, *supra* note 25; Jessica A Gephart et al, "Environmental performance of blue foods" (2021) 597 Nature 360.

[28] IPCC, *supra* note 23, Chapter 3, para 3.6.3.1.2 at 476.

[29] For example, farming of filter species can improve water quality and remove nutrients; mangrove reforestation and kelp aquaculture can recreate habitat (eg nursery grounds) and provide coastal protection.

[30] Eg: R Le Gouvello, C Brugère & F Simard, *Aquaculture and Nature-based Solutions: Identifying synergies between sustainable development of coastal communities, aquaculture, and marine and coastal conservation* (Gland, Switzerland: IUCN, 2022).

changes to freshwater and marine environments,[31] there is a broader scope for technical and management interventions that increase the adaptive capacity of the sector in the face of abrupt changes and slow onset events.[32]

Further endorsement for the expansion and intensification of aquaculture comes from blue growth, blue economy,[33] sustainable ocean economy,[34] blue transformation,[35] and blue food[36] policies. Aquaculture is recognized as a key sector to support equitable and sustainable livelihoods and opportunities.

1.1.1. The Search for Sustainable Aquaculture

While the policy initiatives briefly outlined above support aquaculture growth for the multiple benefits it can provide to humans and the environment, they recognize that poorly planned and managed aquaculture can have environmental and social impacts. Intensive farming and monoculture can reduce biodiversity, destroy coastal habitats, and

[31] IPCC, *supra* note 23; Lynne Falconer et al, "Insight into real-world complexities is required to enable effective response from the aquaculture sector to climate change" (2022) 1 PLOS Clim e0000017, https://doi.org/10.1371/journal. pclm.0000017.
[32] For reviews of adaptation options, see: Falconer et al, *supra* note 31; FAO, *Adaptation strategies of the aquaculture sector to the impacts of climate change*, by Pedro B Bueno & Doris Soto, FAO Fisheries and Aquaculture Circular No 1142 (Rome, Italy: FAO, 2017); Louis Lebel et al, "Innovation, Practice, and Adaptation to Climate in the Aquaculture Sector" (2021) 29 Rev in Fisheries Science & Aquaculture 721.
[33] World Bank & UN Department of Economic and Social Affairs, *The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries* (Washington DC: World Bank, 2017); EU, *Transforming the EU's Blue Economy for a Sustainable Future*, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a new approach for a sustainable blue economy in the EU, Brussels, 17 May 2021, COM(2021) 240.
[34] High Level Panel for a Sustainable Ocean Economy, *Transformations for a Sustainable Ocean Economy A Vision for Protection, Production and Prosperity* (December 2020), online: Ocean Panel <https://oceanpanel.org/ocean-action/transformations.html> (accessed 23 April 2022). By 2030, the parties commit to restore wild fish stocks and harvest them sustainably, sustainably grow aquaculture to meet global needs, and minimise and manage waste throughout the value chain.
[35] FAO, *Blue Transformation - Roadmap 2022–2030: A vision for FAO's work on aquatic food systems* (Rome: FAO, 2022), online: FAO: <https://doi.org/10.4060/cc0459en> (accessed 10 March 2023). See also: FAO, SOFIA 2022, *supra* note 2.
[36] Stockholm Resilience Centre et al, "The Blue Food Assessment", online: Blue Food Assessment <https://bluefood.earth/> (accessed 23 April 2022); World Economic Forum, World Resources Institute & Department for Environment, Food & Rural Affairs (UK), "Blue Food", online: World Economic Forum <https://www.weforum.org/blue-food-partnership> (accessed 23 April 2022); Michelle Tigchelaar et al, "The vital roles of blue foods in global food systems" (2022) 33 Global Food Security 100637.

reduce ecological, social and economic resilience.[37] Therefore, all these instruments emphasize the need for *sustainable* aquaculture growth.[38]

Closely aligned with the Brundtland Report,[39] FAO defined sustainable agricultural development, which includes aquaculture,[40] as

> the management and conservation of the natural resource base, and the orientation of technological change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Sustainable agriculture conserves land, water, and plant and animal genetic resources, and is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.[41]

Sustainability in this definition encompasses four dimensions – namely economic viability, technology appropriateness, environmental integrity, and social acceptability – which should be achieved through governance.[42] FAO further developed five principles

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[37] While aquaculture provides positive influences such as food security and livelihoods, there are negative concerns over environmental impacts (including high nutrient loads from sites) and socio-economic conflicts. The balance of different objectives is dependent on particular user groups and regions. See: IPCC, *supra* note 23, para 5.9.3.2.4 at 5-90; Gentry et al, *supra* note 9; Heidi K Alleway et al, "The Ecosystem Services of Marine Aquaculture: Valuing Benefits to People and Nature" (2019) 69(1) BioScience 59.

[38] See, eg, UNGA, *The Future We Want*, *supra* note 18, para 111: "We reaffirm the necessity to promote, enhance and support more sustainable agriculture, including crops, livestock, forestry, fisheries and *aquaculture";* FAO, "Bangkok Declaration", *supra* note 11, emphasizing "practical and economically viable farming and management practices that are environmentally responsible and socially acceptable"; Shanghai Declaration, *supra* note 15; UNGA, "Sustainable Fisheries", *supra* note 19.

[39] World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1987) [also known as Brundtland Report after her Chairperson, Gro Harlem Brundtland].

[40] FAO, Constitution, article I.1 defines agriculture and its derivatives as to include fisheries, marine products, forestry and primary forestry products (FAO, *Basic Texts of the Food and Agriculture Organization of the United Nations*, Vol I and II, 2017 edition, online: FAO <https://www.fao.org/3/mp046e/mp046e.pdf> (accessed 15 September 2022)). Thus, agriculture subsectors include crops and livestock production, forestry, fisheries, and aquaculture (see, eg, FAO, *Building a Common Vision for Sustainable Food and Agriculture* (Rome: FAO, 2014), online: FAO <https://www.fao.org/3/i3940e/i3940e.pdf > (accessed 12 May 2022)[hereinafter FAO, "Building a Common Vision"]).

[41] FAO, *Progress Made Towards Sustainable and Environmentally Sound Development*, Addendum, Report submitted by the Food and Agriculture Organization of the United Nations, 11 September 1989, A/44/339/Add4, para 11 at 3, online: FAO <https://www.fao.org/3/z5278en/z5278en.pdf> (accessed 23 April 2022). The definition was prepared by the FAO ad hoc working group on sustainable development (*ibid*).

[42] Eg: D Soto, J Aguilar-Manjarrez & N Hishamunda (eds), *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and Aquaculture Proceedings No 14, at 1 (Rome: FAO, 2008). In traditional definitions, sustainability comprises three pillars: environment, society, and economy. Osmundsen et al adapt the 'Circles of Sustainability' concept to aquaculture to create the 'Wheel of Sustainability' comprising four dimensions (economic, environment, governance, and culture), each with seven sustainability sub-components. They assessed the criteria of 8 main certification programs to conclude that there is a clear bias towards environmental and governance dimensions of sustainability (Tonje C

of sustainable agriculture and four pillars for implementation.[43] The five principles include: 1) efficiency in the use of resources; 2) direct action to conserve, protect and enhance natural resources; 3) protection and improvement of rural livelihoods, equity and social well-being; 4) enhanced resilience of people, communities and ecosystems; and 5) responsible and effective governance mechanisms. Key requirements for implementation are integration across scales and disciplines, collaboration, transparency, and adaptability.

The need to strengthen support to achieve sustainable aquaculture has been noted at the highest levels. In 2018, the Committee of Fisheries of FAO recommended the development of global Guidelines for Sustainable Aquaculture.[44] The Guidelines are expected to be released in 2023.[45]

1.1.2. An Ecosystem Approach to Aquaculture

Aquaculture governance, planning, policy, and strategy are necessary for sustainable aquaculture development.[46] Increasingly, it is recognized that aquaculture planning and management requires a holistic ecosystem approach to ensure that its development balances, or promotes synergies between, economic, environmental, and social objectives.[47] Most recently, the Shanghai Declaration adopted by the Global Conference on Aquaculture in 2021 states:

Osmundsen et al, "The operationalisation of sustainability: Sustainable aquaculture production as defined by certification schemes" (2020) 60 Global Environmental Change 102025).

[43] FAO, "Building a Common Vision", *supra* note 40.

[44] FAO, Report of the Thirty-fourth Session of the Committee on Fisheries. Rome, 1–5 February 2021. FAO Fisheries and Aquaculture Report No 1336 (Rome: FAO, 2022), online: FAO <https://doi.org/10.4060/cb8322en> (accessed 11 April 2022). The Committee "welcomed the further development of the voluntary Guidelines for Sustainable Aquaculture in 2021 as a tool towards further development of national policies for the aquaculture sector, including through the organization of regional consultations towards their development. In that context, the Committee requested FAO to consider guidance for concrete actions for the sector – according to national contexts, capacities, and priorities – on the social, economic and environmental dimensions of sustainable development and on climate change adaptation and mitigation" (*ibid* at 10(j)).

[45] FAO, "Guidelines for Sustainable Aquaculture", online: FAO <https://www.fao.org/in-action/gsa/background/fr/> (accessed 11 April 2022).

[46] Or are a sustainability dimension in itself. See: *supra* note 42. See also: Hambrey, *supra* note 16; Ian P Davies et al, "Governance of marine aquaculture: Pitfalls, potential, and pathways forward" (2019) 104 Marine Policy 29.

[47] FAO, "Building a Common Vision", *supra* note 40, especially at 18. Note how EAA is a technical guideline for operationalizing the five principles of sustainable agriculture identified in the report (at 23, 27, 29, 31, 33). See also: World Bank & UN Department of Economic and Social Affairs, *supra* note 33, at 16; IPCC, Summary for Policy Makers, *supra* note 23, para SPM.C.2.2 at SPM-24.

> Recognizing that aquaculture, when not developed in a sustainable way, can have a negative impact on the environment, and therefore the importance of applying an Ecosystem Approach to Aquaculture […] and acknowledging that some forms of aquaculture, such as pond fish farming, bivalve aquaculture or algae farming can provide a range of ecosystem services.[48]

While the concept was formally construed for aquaculture only recently,[49] it builds on significant theory and practice developed in other sectors and in particular in oceans management. An ecosystem approach to management has been endorsed in international, regional, and national frameworks as a management strategy and tool that focuses on whole ecosystems, rather than its individual components. It is considered a more suitable framework to achieve ecological sustainability (as the approach recognizes the interlinked components of the ecological system), but also economic and social sustainability, as the approach recognizes that humans are part of the system.[50]

An ecosystem approach to aquaculture (EAA) is "a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity, and resilience of interlinked social-ecological systems."[51] The integrative nature and the objectives of EAA are reflected in its three guiding principles:

> Principle 1. Aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society.
>
> Principle 2. Aquaculture should improve human well-being and equity for all relevant stakeholders.
>
> Principle 3. Aquaculture should be developed in the context of other sectors, policies and goals.[52]

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[48] Shanghai Declaration, *supra* note 15, section 2 para 17. See also: sections 3.A.6 calling for States to adopt holistic and inclusive approaches, such as EAA, that link human, plant and animal and environmental health for a more sustainable and equitable aquaculture sector that is an integral part of a sustainable global agri-food system. Section 3.B.3. also promotes EAA in the context of spatial planning.
[49] FAO, *Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010) [hereinafter FAO, Technical Guidelines EAA]. See also: Soto et al, *supra* note 42.
[50] Cecilia Engler, "Beyond rhetoric: navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management" (2015) 23 Envtl Rev 288. See also chapter 2 for a more comprehensive description of the ecosystem approach and EAA.
[51] FAO, Technical Guidelines EAA, *supra* note 49, at 2.
[52] *Ibid*, at 5-6.

1.1.3. The Legal Scholarship Gap

Despite the intuitive appeal of a holistic ecosystem approach to management, its implementation has not been easy.[53] That has reportedly also been the case in aquaculture.[54] And while there is not one but many causes for this implementation deficit,[55] the lack of adequate legal framework is often cited as a crucial factor.[56]

An enabling legal framework is central to supporting sustainability. It is explicitly cited as a minimum requirement for the implementation of an EAA.[57] Further, it has been identified as one of the key barriers for EAA implementation and for sustainability.[58] It is key, therefore, to understand what such an enabling legal framework looks like, and which legal features constitute obstacles for the operationalization of an ecosystem approach. Yet, surprisingly, legal scholarship has hardly addressed this question. Indeed, there is a double gap in the academic literature: a (general) gap on legal scholarship on aquaculture, and a gap on legal scholarship on the ecosystem approach.

Legal scholarship is particularly underrepresented in academic studies on aquaculture.[59] The limited legal scholarship focuses on aquaculture laws and policies in specific countries (with some contributions comparing different domestic legal

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[53] David Langlet & Rosemary Rayfuse, "Challenges in Implementing the Ecosystem Approach: Lessons Learned" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance Perspectives from Europe and Beyond* (Leiden; Boston: Brill Nijhoff, 2019) 445.
[54] C Brugère et al, "The ecosystem approach to aquaculture 10 years on: A critical review and consideration of its future role in blue growth" (2019) 11 Rev in Aquaculture 493.
[55] Other factors may include the complexity of the concept itself, different interpretations around the concept, the amount and diversity of information required to implement it, and industry interests. See: Engler, *supra* note 50.
[56] Brugère et al, *supra* note 54; Barry Antonio Costa-Pierce, "The Principles and Practices of Ecological Aquaculture and the Ecosystem Approach to Aquaculture" (2021) World Aquaculture 25.
[57] FAO, Technical Guidelines EAA, *supra* note 49.
[58] Brugère et al, *supra* note 54; Costa-Pierce, *supra* note 56.
[59] Early scholarship includes: William Howarth, *The Law of Aquaculture* (Oxford: Fishing New Books, 1990); Henry D McCoy, *American and International Aquaculture Law* (Peterstown, WV: Supranational Publishing Company, 2000); and David L VanderZwaag & Gloria Chao (eds), *Aquaculture Law and Policy: Towards Principled Access and Operations* (London; New York: Routledge, 2006). A more recent volume of aquaculture and the law is Nigel Bankes, Irene Dahl & David L VanderZwaag, *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, USA: Elgar, 2016).The scholarship gap also affects social sciences, although there is evidence of increasing academic and policy attention to social dimensions of aquaculture. See generally: Cecile Brugère et al, "Humanizing aquaculture development: Putting social and human concerns at the centre of future aquaculture development" (pre-conference version, 30 August 2021), thematic paper presented at the Global Conference on Aquaculture Millennium +20 held in Shanghai, 22-25 September 2021, online: <https://aquaculture2020.org/> (accessed 6 April 2022); Gesche Krause et al, "Visualizing the social in aquaculture: How social dimension components illustrate the effects of aquaculture across geographic scales" (2020) 118 Marine Policy 103985; Brugère et al, *supra* note 54.

frameworks), or on specific themes (e.g. genetic resources, fish health, fish welfare, allocation of space, marine spatial planning, adaptation to climate change). The analysis of aquaculture in the context of international law is seldom addressed in the literature.[60] The legal scholarship addressing EAA is particularly scarce, with a few articles or contributions developed mostly in the context of the FAO work on EAA.[61]

It is somewhat paradoxical that an industry as promising as aquaculture and that intersects with so many legal disciplines[62] (administrative law, animal law, food law, environmental law, trade law, climate change law, planning law, labor law, human rights law, law of the sea) has received such limited attention in legal scholarship. Further, there is an obvious need for legal scholarship on aquaculture, as many countries (including leading aquaculture countries) acknowledge limitations in, and are seeking to improve, their sectoral legal frameworks.[63]

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[60] But see: Jana Roderburg, "Marine Aquaculture: Impacts and International Regulation" (2011) 25 Austl & NZ Maritime L J 161; David R Percy, Nathanael Hishamunda & Blaise Kuemlangan, "Governance in marine aquaculture: the legal dimension" in A Lovatelli, J Aguilar-Manjarrez and D Soto (eds), *Expanding mariculture farther offshore: technical, environmental, spatial and governance challenges*, 245. FAO Technical Workshop, 22–25 March 2010, Orbetello, Italy. FAO Fisheries and Aquaculture Proceedings No 24 (Rome: FAO, 2013); David L VanderZwaag, "The international law and policy seascape for aquaculture: navigating tangled currents" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016) 11; Irene Dahl, "Adaptation of Aquaculture to Climate Change: The Relevance of Temporal International Framework from a Norwegian Perspectives" in Elise Johansen, Signe Veierud Busch & Ingvild Ulrikke Jakobsen (eds), *Law of the Sea and Climate Change: Solutions and Constraints* (Cambridge: Cambridge University Press, 2021) 289; Tricia K Barry & David L VanderZwaag, "Preventing Salmon Escapes from Aquaculture in Canada and the USA: Limited International Coordinates, Divergent Regulatory Currents and Possible Future Courses" (2007) 16 RECIEL 58.

[61] Jorge Bermúdez, "Legal Implications of an Ecosystem Approach to Aquaculture" in D Soto, J Aguilar-Manjarrez, N Hishamunda, N (eds), *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings* No 14 (Rome: FAO, 2008) [hereinafter Bermúdez, Legal Implications]; Jorge Bermúdez, "Legal and policy components of the application of the ecosystem approach to aquaculture to site selection and carrying capacity" in LG Ross et al (eds), *Site selection and carrying capacities for inland and coastal aquaculture.* FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6–8 December 2010, Stirling, the United Kingdom of Great Britain and Northern Ireland. FAO Fisheries and Aquaculture Proceedings No 21 (Rome: FAO, 2013) [hereinafter Bermúdez, Legal and Policy Components].

[62] See: Bermúdez, Legal Implications, *supra* note 61.

[63] See, eg: Department of Fisheries and Oceans (Canada), "Proposed Federal Aquaculture Act", online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/act-loi/index-eng.html> (accessed 6 May 2022); NS Department of Fisheries and Aquaculture (NSDFA), "Aquaculture Regulatory Review" (2022-2024), online: NSDFA <https://novascotia.ca/fish/aquaculture/laws-regs/aquaculture-regulatory-review.asp> (accessed 1 November 2022); Scottish Government, "A Review of the Aquaculture Regulatory Process in Scotland", Report by Russel Griggs (February 2022), online: Scottish Government <https://www.gov.scot/publications/review-aquaculture-regulatory-process-scotland/> (accessed 6 May

Similarly, the legal dimension of the ecosystem approach more generally has also received little academic attention.[64] The approach – often referred together with the precautionary principle as a pillar of environmental management – has received considerably less attention than the precautionary approach in international legal scholarship.[65] There is also a legal gap in addressing the legal requirements of the ecosystem approach in national legislation. Bohman notes that "[w]hile an ecosystem approach is central in environmental management and policy – including approaches related to research on social-ecological resilience – such measures are still rather new in law or legal contexts."[66]

This legal gap is particularly surprising considering the increasing mention of the ecosystem approach in international, regional, and national policy and legislative frameworks.[67] These frameworks call for a holistic approach to environmental and natural resources management that recognize the multiple ways in which human activities interact with complex and dynamic systems, and that seek to balance environmental

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2022); Ministry of Trade and Industry (Norway), *A Sea of Opportunities: Government's Aquaculture Strategy* (6 July 2021), [Et hav av muligheter: regjeringens havbruksstrategi] [Google Translate], ch 8, cited in Markus Sørlie, "An introduction to the Government's new aquaculture strategy" (30 August 2021), online: Simonsen Vogtwiig <https://svw.no/en/insights/an-introduction-to-the-governments-new-aquaculture-strategy>; Anders Furuset, "Norway unveils new aquaculture strategy, seeks to overhaul wide range of regulations" (8 July 2021), online: IntraFish <https://www.intrafish.com/aquaculture/norway-unveils-new-aquaculture-strategy-seeks-to-overhaul-wide-range-of-regulations/2-1-1036872> (accessed 5 May 2022); Aqua, "Julio Salas en AquaForum Puerto Montt anunció una nueva Ley General de Acuicultura" [Julio Salas, Undersecretary for Fisheries and Aquaculture, announces a new Act on Aquaculture](10 November 2022), online: Aqua <https://www.aqua.cl/2022/11/10/julio-salas-en-aquaforum-puerto-montt-anuncio-una-nueva-ley-general-de-acuicultura/#> (accessed 16 November 2022). See also: Carole R Engle & Jonathan van Senten, "Resilience of Communities and Sustainable Aquaculture: Governance and Regulatory Effects"(2022) 7 Fishes 268.

[64] David Langlet & Rosemary Rayfuse, "The Ecosystem Approach in Ocean Planning and Governance: An Introduction" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance Perspectives from Europe and Beyond* (Leiden; Boston: Brill Nijhoff, 2019) 1 at 4, 5.

[65] Elisa Morgera, "The Ecosystem Approach and the Precautionary Principle" in Elisa Morgera & Jona Razzaque (ed), *Biodiversity and Nature Protection Law* (Cheltenham, UK: Edward Elgar, 2017) 70. Morgera poses three research questions for further legal scholarship: Is ecosystem approach a principle of environmental law? What legal guarantees are necessary for the EA to realize equity in addressing interconnected, multi-scalar environmental challenges? And is the ecosystem approach transforming international environmental law into international ecological law? (*ibid*, at 78).

[66] Brita Bohman, *Legal Design for Social-Ecological Resilience* (Cambridge: Cambridge University Press, 2021) (Kindle) at 39. See also: Murray A Rudd et al, "Ocean Ecosystem-Based Management Mandates and Implementation in the North Atlantic" (2018) 5 Frontiers in Marine Science, https://doi.org/10.3389/fmars.2018.00485 at 2.

[67] See chapters 2 and 5. See also: Andrea Bryndum-Buchholz, Derek P Tittensor & Heike K Lotze, "The status of climate change adaptation in fisheries management: Policy, legislation and implementation" (2021) 22 Fish and Fisheries 1248, at 1254.

protection, economic development, and social equity. To what extent are current legal frameworks and tools apt to face that challenge? What new legal tools address these complexities? Which legal features represent obstacles for ecosystem-based management? This Dissertation explores these questions in the specific context of aquaculture.

1.2 The Object of Study: Aquaculture and Salmon Mariculture

The previous section has addressed the need for legal research on aquaculture without explaining what aquaculture is. This section addresses the complex and diverse concept of aquaculture and further delimits the scope of the Dissertation to one type of aquaculture, namely salmon mariculture.

1.2.1. Aquaculture

Aquaculture is an ancient practice.[68] However, as a commercial and global food production industry, it has a more recent history. Scientific and technological advances, together with seafood demand, have enabled the intensification of aquaculture production in the last five decades.[69]

> The term aquaculture is defined by FAO as
>
> the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated (…).[70]

This broad definition of aquaculture relies on two features to characterize aquaculture activities and distinguish it from fishing activities: the intervention in the rearing process to enhance production; and the individual or corporate ownership of the stock being cultivated.

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[68] Colin E Nash, *The History of Aquaculture* (Ames, Iowa: Blackwell Publishing, 2011).
[69] DC Little, RW Newton & MCM Beveridge, "Aquaculture: a rapidly growing and significant source of sustainable food? Status, transitions and potential" (2016) 75 Proceedings of the Nutrition Society 274, at 275.
[70] FAO, "Definition of Aquaculture", online FAO <https://www.fao.org/fishery/en/aquaculture> (accessed 11 May 2022).

The term aquaculture comprises a wide variety of practices that take place in different aquatic environments;[71] for different cultured species;[72] in different farming systems;[73] with different forms and levels of intervention in the rearing process; and for different purposes.[74] The variety of activities that fall within the general concept of aquaculture and the varied nature of these activities can make classification difficult. Welcomme classified various practices into capture fisheries and aquaculture.[75] Many identified activities fall in a "grey area"[76] (e.g. enhanced fisheries). Additionally, in some cases aquaculture is strongly linked to agriculture.[77]

These complexities are legally relevant. The categorization as fisheries, aquaculture or agriculture may determine the legal regime applicable to a specific aquaculture activity. In jurisdictions without a dedicated aquaculture act, it can affect the industry as a whole. Canada[78] and the United States of America (USA)[79] provide just two

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[71] These include land-based facilities, freshwater, inland saline water, brackish-water, coastal waters, and marine waters.

[72] FAO reports aquaculture production for 652 "species items" (including 494 taxonomically recognized species: 313 species of finfish (in 186 genera); 88 species of molluscs; 49 species of crustaceans; 31 species of algae; 2 species of cyanobacteria; 6 species of marine invertebrates; 3 species of frogs (amphibians) and 2 species of aquatic turtles (reptiles)). Nevertheless, "only a small number of "staple" species dominate aquaculture production". Atlantic salmon accounted for a high 32.6% ((2.7 million tonnes in 2020)) of marine and coastal finfish aquaculture (FAO, SOFIA 2022, *supra* note 2).

[73] These include: coastal and offshore open-net pens or cages; closed containment cages; earthen ponds; irrigated or flow-through systems, tanks and raceways; aboveground tanks; floating rafts, lines, and stakes; suspended lines, net-bags or lanterns; trestles or trays; ocean ranching; integrated agriculture; hatcheries or land-based facilities (Elvira A Baluyut, *Aquaculture Systems and Practices: A Selected Review*, ADCP/REP/89/43 (Rome, FAO: 1989).

[74] Aquaculture can be developed for subsistence, commercial production of food, commercial production of other products (e.g. medicinal and cosmetics, feed for animals, cleaner fish, ornamental use), for the production or enhancement of other ecosystem services (e.g. carbon capture), for ornamental purposes, or for research and development.

[75] RL Welcomme, "World inland fisheries and aquaculture: Changing attitudes to management" in DA Hancock et al (eds), *Developing and sustaining world fisheries resources: The state of science and management,* 443 at 450 (Collingwood Australia: CSIRO, 1997), as cited in Stefano Cataudella, Fabio Massa & Donatella Crosetti, "Interactions between capture fisheries and aquaculture" in Stefano Cataudella, Fabio Massa & Donatella Crosetti (eds), *Interactions between aquaculture and capture fisheries: a methodological perspective*. Studies and Reviews. General Fisheries Commission for the Mediterranean No 78 (Rome: FAO, 2005).

[76] *Ibid.*

[77] This is particularly the case for integrated agriculture-aquaculture such as rice-fish systems. Also, as noted, aquaculture is one of the subsectors of agriculture in FAO's definition of the term.

[78] In the 2009 decision on *Morton v British Columbia (Minister of Agriculture and Lands)* [2009] BCJ No 193, 2009 BCSC 136 (hereinafter 2009 Morton Decision), the court found impugned provincial legislation addressing aquaculture as involving the provincial Crown in the management and regulation of fisheries, constituted an interference with the core of a matter within the exclusive jurisdiction of Parliament (i.e. federal jurisdiction) under the *Constitution Act 1967*, s 91(12). This conclusion is based on the finding that aquaculture is a fishery in itself or part of a fishery. While this decision affected only the Canadian

examples in which the concept of aquaculture was litigated, leading to shifts in the legal regime applicable to the sector. These two cases highlight the need for legal recognition of aquaculture. As noted by the Canadian Senate, "it appears that aquaculture is not aligned with being a fishery, but it is not an agricultural activity either. In the Committee's opinion, it is something different: aquaculture is aquaculture and it deserves its own recognition."[80]

The complexity of aquaculture as a food production industry is also relevant to law in another way. An aquaculture endeavour usually comprises a wide and varied range of activities, from wild seed catch to post-harvest practices and international trade. They can include, among others: installation of structures in freshwater or marine environments; the use of fish oil and meal as feed; use of chemicals in structures, feed, and bath treatments; deterrent of wild predators; capture and use of cleaner fish; transfer of live fish; slaughtering and processing of fish; and disposal of waste. Because of the diversity of activities in the rearing process, various aspects of aquaculture are governed by different statutes, regulations, and authorities, creating a complex legal and institutional patchwork.[81]

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province of British Columbia, it triggered an overhaul of the legal regime applicable to the aquaculture sector in that province (see: Aquaculture in British Columbia, online: DFO https://www.dfo-mpo.gc.ca/aquaculture/pacific-pacifique/index-eng.html (accessed 1 December 2021)).

[79] In *Gulf Fishermen Ass'n v Nat'l Marine Fisheries Serv*, 968 F 3d 454, 48 ELR 20175 (2020), the applicants challenged the Fishery Management Plan for Regulating Offshore Aquaculture in the Gulf of Mexico approved by the National Fisheries Service and the Gulf of Mexico Fishery Management Council under the *Magnuson-Stevens Fishery Conservation and Management Act* (MSA), 16 USC 1801 - 1891(d) [USA]. The Court concluded that, considering the text, structure, history, and purpose of the MSA, aquaculture is not a fishery governed by that legislation. Therefore, a regulatory regime created by the National Marine Fisheries Service for offshore aquaculture in the Gulf of Mexico was declared invalid. As pointed out by the dissenting opinion, the effect of this decision was to invalidate "over a decade of state and federal officials' efforts, along with private experts, to draft a 'fishery management' plan that reconciles myriad commercial, environmental, and recreational interests" (*ibid*, 460ff). The decision of the US Fifth Circuit Court of Appeal was not appealed to the Supreme Court. Thus, other regions may (and indeed are) proceeding to adopt Aquaculture Plans under the Magnuson-Stevens Act. See also: 341 F Supp 3d 632; Sierre Anton & Katherine Hupp, "One Step Forward, Two Steps Back: NOAA's Assertion of Jurisdiction Over Aquaculture Faces Continuing Challenges'" (2021) Sea Grant L & Pol'y J 70.

[80] Parliament of Canada, Senate, *An Ocean of Opportunities: Aquaculture in Canada*, Vol III (H Fabian Manning) (June 2016), at 23.

[81] Brugère et al, *supra* note 54; Costa-Pierce, *supra* note 56.

1.2.2. Salmon Mariculture

This Dissertation addresses one particular type of aquaculture: salmon farming in the marine environment.[82] Several factors justify this scope. First, salmon aquaculture was one of the first successful marine farming industries and continues to be the most important coastal and marine finfish farming industry. Second, salmon aquaculture is a highly controlled activity with a significant level of human and technological intervention in each stage of the rearing process. The highly controlled and technical nature of the activity also drives the intensification of interactions with other components of the marine environment.[83] This intensification, in turn, justifies and even exacerbates the need for holistic EA approaches to management. The following sections explain each of these elements in more detail.

a) The Salmon Aquaculture Industry

Salmonids, and particularly Atlantic salmon (*Salmo salar*),[84] was one of the first finfish species to be domesticated, i.e., its entire life cycle could be controlled in captivity.[85] Domestication, in turn, is partially correlated with production.[86] Atlantic salmon is one of the first successful marine finfish aquaculture industries[87] in the Western hemisphere and remains its most important form of finfish farming.[88] Indeed, salmonids (mostly farmed)

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[82] Unless otherwise indicated, references to aquaculture in this Dissertation should be understood as references to marine open-net cage finfish farming. The rationale for choosing marine salmon farming as the subject-matter is explained below.

[83] Young and Matthews refer to this high intensity of interactions as a "serious intrusions that may disrupt or destroy ecosystems that are already fragile from years of exploitation and pollution" (Nathan Young & Ralph Matthews, *The Aquaculture Controversy in Canada: Activism, Policy, and Contested Science* (Vancouver, BC: UBC Press, 2010) at 5).

[84] Salmon farming also includes salmon trout *Oncorhynchus mykiss* and Coho salmon *Oncorhynchus kisutch* (the latter mostly by Chile) (Frank Asche et al, "Salmon Aquaculture: Larger Companies and Increased Production" (2013) 17 Aquaculture Economics & Management 322, at 324).

[85] Salmon trout was domesticated earlier than Atlantic salmon and dominated the industry in the 1980s. Since then, the mature Atlantic salmon industry has dominated finfish aquaculture (Asche et al, *ibid*, at 324).

[86] Claude E Boyd et al, "Achieving sustainable aquaculture: Historical and current perspectives and future needs and challenges" (2020) 51 J World Aquaculture Society 578, at 614.

[87] Salmon hatcheries were established in the late 19th century for repopulation purposes. Experimental net-pens marine farming was initiated in Norway in the 1960s.

[88] According to FAO, Atlantic salmon accounted for 32.6% of marine and coastal aquaculture of all finfish species (FAO, SOFIA 2022, *supra* note 2, at 46). See also: *supra* note 72; Asche et al, *supra* note 84.

account for 18% of the total value of aquatic products exported in 2020.[89] Further, demand for Atlantic salmon continues to increase.[90]

The salmon farming industry is concentrated in a relatively small number of countries[91] and companies, is horizontally and vertically integrated,[92] and knowledge- and technology-intensive.[93] Indeed, technological innovations have had a significant role in the intensification of the industry, the reduction of costs, the improved competitiveness of aquaculture products, and the improvement of the industry's environmental performance.[94]

The farming of a diadromous species like salmon is complex as it requires different cultivation systems for the various stages of development. There are three stages in the farming process. In the first stage, salmon eggs are hatched in hatchery trays or freshwater tanks.[95] Following yolk sac absorption, the alevin is fed either in the hatchery or freshwater tanks. Feeding fry and fingerling (fry that reaches an average of 5g) are maintained in freshwater tank or in freshwater cage systems for approximately one year. Once the salmon reaches smolt stage (100 to 150g[96]), they are transferred to open net-pen (cages) in marine waters for grow-out until they reach harvest size (generally 3 to 5 kilograms and above).

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[89] FAO, SOFIA 2022, *supra* note 2, at 104-105.
[90] *Ibid*, at 89, 105; Audun Iversen et al, "Production cost and competitiveness in major salmon farming countries 2003–2018" (2020) 522 Aquaculture 735089, citing EH Brækkan et al, "The demands they are a-changing'" (2018) 45 *European Review of Agricultural Economics* 531.
[91] Iversen et al, *supra* note 90. See also *infra* note 126 and accompanying text.
[92] Asche et al, *supra* note 84.
[93] Heidi Moe Føre et al, "Technological innovations promoting sustainable salmon (*Salmo salar*) aquaculture in Norway" (2022) 24 Aquaculture Reports 101115; Tim Ellis et al, "Trends during development of Scottish salmon farming: An example of sustainable intensification?" (2016) 458 Aquaculture 82.
[94] Føre et al, *supra* note 93. Key innovations include improved feed formulation and nutrition, fish health management and vaccines, selective breeding genetic, automation and fish ad environmental monitoring. See also: Jennifer L Bell et al, "Environmental Monitoring Tools and Strategies in Salmon Net Pen Aquaculture" (2022) 18 Integrated Environmental Assessment and Management 950.
[95] In some cases, ova are exported to support salmon farming in different countries (see: Ellis, *supra* note 93, at 85-87).
[96] The industries sometimes opt to maintain post-smolts in land facilities (RAS) until they reach 200-500g and even 1kg to reduce the length of the grow-out period at sea (Gardner Pinfold Consultants Inc, "State of Salmon Aquaculture Technologies". Report prepared for Fisheries and Oceans Canada, the Ministry of Agriculture (British Columbia) and Sustainable Development Technology Canada (2019), available online: <https://www.dfo-mpo.gc.ca/campaign-campagne/aquaculture/study-eng.html> (accessed 12 May 2022)). See also: Ellis et al, *supra* note 93, at 88.

Salmon cages are traditionally installed in sheltered areas along the coast. Ideal water conditions for salmon include temperature ranges between 6° - 16° Celsius (with ideal feeding conditions between 8 and 12°[97]), salinities close to oceanic levels (33-34%) and well oxygenated waters (above 8 mg L^{-1}).[98] Most current marine sites consist of an array of square or circular cages. While the size of the cages and array varies, bigger cages have 100 metre (m) diameter or 24m^2 surface and reach depths of 8-15m or more.

The rearing process in marine net-pen cages is highly controlled, including through extensive and increasing use of technology, remote sensors, and artificial intelligence.[99] The optimum growth, health and welfare of salmon is supported by genetic enhancements, especially formulated feed, vaccines and medicines, artificial lights, protection from predators, adequate farming densities, and daily monitoring, among other management practices. Extreme events (e.g. water freeze, harmful algal blooms, extreme weather events) that may affect the integrity of the cages or fish health and welfare are also closely monitored.

New technologies are being developed and tested to replace the coastal and marine open-net systems, driven by the need to minimize environmental interactions, minimize conflicts of use in coastal waters, and to avoid increased threats to farmed fish in the context of climate change.[100] Three new technologies include: land-based recirculating aquaculture systems (RAS), floating closed containment systems, and offshore (or high energy environment) production systems.[101] Despite successful operation of some of these technologies, they are still technically, financially, and logistically demanding and therefore less competitive.[102]

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[97] Leigh Michael Howarth, Margo Coughlin & Gregor Reid, *Assessing climate change vulnerability of seafood industry dependent communities in Nova Scotia: Informing adaptation* (Dartmouth, NS: Centre for Marine Applied Research (CMAR), 2021) online: CMAR <https://cmar.ca/research/complete-project-list/> (accessed 16 May 2022).
[98] *Ibid.*
[99] Jennifer L Bell et al, "Environmental monitoring tools and strategies in salmon net-pen aquaculture" (2022) 18 Integrated Environmental Assessment and Management 950; Martin Føre et al, "Precision fish farming: A new framework to improve production in aquaculture" (2018) 173 Biosystems Engineering 176.
[100] Gardner Pinfold Consultants Inc, *supra* note 96.
[101] *Ibid.* The authors consider a fourth technology, the hybrid land and marine system, which consists of the transfer of post-smolt (up to 1kg) salmon to marine sites.
[102] *Ibid.*

b) Salmon Mariculture Interactions with the Ecological and Social Systems

The last stage of salmon farming, namely the grow-out phase occurring in open systems in the marine environment (common resources[103]), is the phase that has the most diverse and intensive interactions with the surrounding environment, including local communities. These include both positive and negative externalities (impacts). There is extensive literature on the interactions of marine fish farming and the ecological[104] and, to a lesser extent, the social[105] systems at the farm, watershed, and global level. Aquaculture interactions with the environment, with positive and negative effects, include: physical impacts on habitat; physical interactions with marine wildlife; emissions of nutrients (organic and inorganic matter), chemicals (metals, therapeutants) and pollutants (microplastics); introduction of alien species; biological and genetic interactions of escapees and wild populations; transmission of disease organism and parasites; use of wild juveniles for grow-out or for cleaner fish[106]; harvesting industrial fisheries for fish feed; and interference with fish welfare.[107]

Economic and particularly social impacts have received much less systematic attention in the literature.[108] Identified social and economic benefits of salmon farming

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[103] Stefan Partelow et al, "Governing aquaculture commons" (2021) 14 Reviews in Aquaculture 729.

[104] For synthesis of aquaculture interactions with the environment and social effects, see: ICES, Working Group on Environmental Interactions of Aquaculture (WGEIA). ICES Scientific Reports, online: ICES <https://doi.org/10.17895/ices.pub.7619> (accessed 1 November 2022); Carlos Brais Carballeira Braña et al, "Towards Environmental Sustainability in Marine Finfish Aquaculture" (2021) Front Mar Sci 8:666662. doi: 10.3389/fmars.2021.666662; Jenny Weitzman et al, "Far-Field and Near-Field Effects of Marine Aquaculture" in Charles Sheppard (ed), *World Seas: An Environmental Evaluation, Vol III Ecological Issues and Environmental Impacts,* 2nd ed (London, UK: Academic Press, 2019) 197; Ministry for Primary Industries (New Zealand), *Literature Review of Ecological Effects of Aquaculture* (Cawthron Institute; NIWA: August 2013); CE Nash, PR Burbridge & JK Volkman (eds), *Guidelines for Ecological Risk Assessment of Marine Fish Aquaculture,* US Dept Commer, NOAA Tech Memo NMFS-NWFSC-71.

[105] FAO, "Report of the Expert Consultation on the Assessment of Socio-economic Impacts of Aquaculture", Ankara, Turkey, 4–8 February 2008, FAO Fisheries Report. No 861 (Rome: FAO, 2008); Pedro B Bueno, "Social risks in aquaculture" in MG Bondad-Reantaso, JR Arthur & RP Subasinghe (eds), *Understanding and applying risk analysis in aquaculture*. FAO Fisheries and Aquaculture Technical Paper No 519 (FAO: Rome, 2008) 219.

[106] Adam J Brooker et al, "Sustainable production and use of cleaner fish for the biological control of sea lice: recent advances and current challenges" (2018) 183 Veterinary Record 383; Enrique Blanco Gonzalez & Femke de Boer, "The development of the Norwegian wrasse fishery and the use of wrasses as cleaner fish in the salmon aquaculture industry" (2017) 83 Fisheries Science 661.

[107] FA Huntingford & S Kadri, "Taking account of fish welfare: lessons from aquaculture" (2009) 75 Journal of Fish Biology 2862; Tore S Kristiansen et al, "Theoretical basis and principles for welfare assessment of farmed fish" (2020) *Aquaculture* 193.

[108] Krause et al, *supra* note 59; Jenny Weitzman & Ramón Filgueira, "The evolution and application of carrying capacity in aquaculture: towards a research agenda" (2020) 12 Rev in Aquaculture 1297.

include: increase in fish supply (contributing to food access, quality, safety, and stability); positive impacts on human health; reduction in fish price; export earnings; creation of employment (either directly by the industry, indirectly in support industries, and induced by aquaculture); conservation of social structure; education and training; and improved infrastructure in rural areas. Identified social and economic costs, in turn, include: environmental damage; conflict over resource usage (space and water); creation of resource sinks (i.e. consuming capital, labour and intermediate products while generating few benefits in return); disruption of social structures; overfishing and reduced fish supply (in particular due to the demand for fish oil and fish meal for salmon feed); reduced fish price (affecting fishing communities); loss of traditional occupations; and negative impacts on human health resulting from food safety problems or transfer of antibiotic resistant bacteria.[109]

It is beyond the scope of the chapter to provide a detailed description and explanation of the externalities (benefits and costs) of salmon farming. The Dissertation, however, will explain the complexities of these interactions, which justify the need for a holistic or integrative approach to aquaculture management.

c) Salmon Mariculture as a Complex and Dynamic System

Marine finfish farming has been defined as a wicked problem,[110] an ecosystem,[111] and a social-ecological system.[112] While the theoretical foundations of these conceptualizations differ, they are driven by the diverse, interrelated, complex, and dynamic interactions between different elements of the farming process, the natural environment in which it takes place, and the economic, social, and cultural values assigned to them. Indeed, a fish farm interacts with the ecological (biophysical) and the social (human) sub-system in

[109] FAO, "Report of the Expert Consultation on the Assessment of Socio-economic Impacts of Aquaculture", *supra* note 105; AE Neiland, SA Shaw & D Bailly, "The social and economic impact of aquaculture: a European review", in N De Pauw & J Joyce (eds), *Aquaculture and the Environment* (European Aquaculture Society Special Publication No. 16, Gent, Belgium, 1991) (see in particular table IV at 475).

[110] Tonje C Osmundsen, Petter Almklov & Ragnar Tveterås, "Fish farmers and regulators coping with the wickedness of aquaculture" (2017) 21 Aquaculture Economics & Management 163.

[111] Alleway et al, *supra* note 37, refer to aquaculture as an "agroecosystem in estuarine, coastal, and marine seascapes".

[112] Teresa R Johnson et al, "A Social-Ecological System Framework for Marine Aquaculture Research" (2019) 11 Sustainability 2522. See also: Robin Kundis Craig, "Fostering adaptive marine aquaculture through procedural innovation in marine spatial planning" (2019) 110 Marine Policy 103555.

multiple and often uncertain ways, with positive and negative effects on the farmed fish, the farming operation, the environment, the natural resources, and the communities, at different spatial and temporal scales. The complexity, direction and magnitude of these interactions is determined by the farming system, the farmed species, the scale of the activity, the farming practices, and the location.[113]

There is not one but multiple ways in which finfish farming and its related activities act as stressors to the marine environment and the coastal communities. Aquaculture involves the construction, maintenance, and the later removal of farming structures in the marine environment. It generates noise from farming activities and support vessels, as well as artificial light used to accelerate growth. It introduces a high biomass of fish into the marine waters, as well as organic and inorganic substances to raise the fish and to treat diseases (feed, chemicals). It generates waste (organic and inorganic waste, chemical residues, and other debris) directly to the marine environment. Fish may escape the farm. Pathogens thrive in net cages and can increase exposure to wild fish. All these activities, substances and phenomena associated to finfish farming impact the environment and the communities in which they take place.

The multiple stressors affect different components of the marine ecological system. Fish farming affects the benthic and pelagic environment as well as wild animals, including wild fish, marine mammals, and seabirds. The effects occur at different spatial scales from localized (e.g. the chemical and biological composition of the benthos, accumulation of metals in sediment) to regional (e.g. water eutrophication or impacts on wild salmon) and global (e.g. pressure on wild forage fish).

The relationship between stressors and the ecological and social systems is complex. Stressors can act cumulatively, synergistically, or antagonistically. For example, a farm can increase abundance of wild fish in the area as wild fish find refuge in the structures, are attracted to artificial lights, and access feed waste. But wild fish are also affected by deteriorated water conditions. Further, a higher abundance of wild fish around the farm is vulnerable to increased commercial or recreational fisheries (with

[113] Little, Newton & Beveridge, *supra* note 69, at 280.

added economic benefits) or to the attack of predators, which in turn may have consequences for biodiversity composition and structure.

Effects also operate at distinct temporal scales, with some manifesting immediately (e.g. killing of marine mammals that pose a threat to structures) while others may take considerably longer time to be detected (e.g. decreased genetic diversity in wild salmon).

Aquaculture activities also affect the social and economic system at different spatial scales. As a commercial activity – a business – it brings economic and social benefits to the community and to the State: increased direct and indirect employment, positive migration (or a halt of negative migration), increased and enhanced secondary industries and services (e.g. infrastructure, accessibility, community services), tax revenue, increase in Gross Domestic Product, exports, and investments. As a food business, it provides food security and quality to targeted markets, but can also pose risks to food safety and food nutrition. As an activity that takes place in public waters and may impact the environment (including with visual pollution), it competes with other legitimate users of the marine environment and affects other local interests. These interests include commercial and recreational fishing, navigation, energy production, tourism, defense, coastal land ownership, conservation, and recreation. Aquaculture activities impact vulnerable populations (Indigenous communities, women, and youth) differently. Indigenous rights to develop and benefit of their land, resources and cultural heritage can be particularly impacted by salmon mariculture.

As is the case of ecological impacts, social and economic impacts can be cumulative, synergistic, or antagonistic. For example, in a theoretical scenario, salmon farming could create direct and indirect employment opportunities, increase food security, and promote aquaculture-related economic activities. At the same time, it can negatively impact commercial fisheries or recreational tourism due to displacement, effects of therapeutants in non-target species, and loss of critical habitats and biological diversity.

The interactions with the ecological and social-economic systems also impact the farmed species and the aquaculture sector. Aquaculture is dependent on the quality of the environment and therefore of management decisions regarding other sectors from the

local to global level. Aquaculture can be affected, for example, by agricultural nutrient run-off and polluting activities. It can also be impacted by climate-induced ocean changes, including slow-onset events (changes in the average water temperature, stratification, oxygenation, pH) as well as extreme events (storms, water heat and freezing events).

The mix of positive and negative impacts both in the ecological and the social-economic system is highly dependent on site-specific and regional circumstances. These include bio-physicochemical conditions (e.g. currents, water depth, water exchange, temperature, salinity, pH, dissolved oxygen); conservation status of the environment (e.g. status of wild fish, marine mammals, and seabirds); the choice of farmed species or strain (e.g. native, non-native or genetically modified or enhanced organisms); the scale of the activity; and the operational and management practices. As a consequence, impacts are site-specific and contextual.

This feature has two related implications. First, aquaculture negative and positive ecological and social effects will vary between States, regions within a State, and even sites. Second, aquaculture activities entail a risk that needs to be assessed based on specific local considerations. With the right combination of suitable environment and sound management and control, negative ecological or social effects of aquaculture can be limited, minimal and reversible in short periods of time (that is, it can be low risk).

A further feature to note is that the interactions between aquaculture and ecological and social-economic systems are in constant change due to scientific and technological innovations as well as changing ecological, social, or economic conditions. For example, while some diseases and the available treatments represented a sustainability concern in the 1980s, the development of effective vaccines have reduced the significance and scale of the problem in some parts of the world.[114] While reliance on wild fish for feed (in the form of fish meal and fish oil) is a significant sustainability concern, improvements in feed efficiency and use of alternative sources of feed have reduced the relative impact of farmed salmon (although it may remain significant in

[114] At least in some jurisdictions. See: World Health Organization, "Vaccinating salmon: how Norway avoids antibiotics in fish farming" (29 October 2015), online: World Health Organization <https://www.euro.who.int/en/countries/norway/news2/news/2015/10/vaccinating-salmon-how-norway-avoids-antibiotics-in-fish-farming> (accessed 13 May 2022).

absolute terms).[115] In turn, as salmon farming evolves, new challenges may arise. For example, the distribution of disease pathogens can shift and expand due to climate-induced changing ocean conditions; new offshore farm locations may increase physical interaction with highly migratory species or other users (e.g. navigation).

d) Salmon Mariculture and an Ecosystem Approach

The features highlighted in the previous paragraphs lead to the conclusion that aquaculture is best understood as a *system* with ecological, social, and economic dimensions or components interacting in complex and dynamic manner. Furthermore, aquaculture is embedded in a broader system – the marine or coastal system.[116]

Understanding aquaculture as a system (an ecosystem[117] or a social-ecological system) embedded in a broader marine and coastal ecosystem highlights the complexity of nature and the human interactions with nature. It also requires management and regulatory approaches that acknowledge this complexity and focus on the whole system (rather than individual components in isolation). In other words, the multiple and complex interactions of salmon mariculture with the ecological, social, and economic system intensifies the need for holistic and ecosystem approaches for its management.

Understanding how the interactions between salmon mariculture and the wider ecosystem are being addressed and managed is increasingly necessary in the context of an expansion and intensification of aquaculture under the Blue Transformation agenda.[118] Fed aquaculture has already outpaced non-fed aquaculture, which stands at only ca. 25% of total aquatic animal production.[119] For aquaculture to fill the gap of nutritious food for a growing global population, further intensification of aquaculture practices will become necessary. Salmon mariculture, as the first and most important intensive finfish farming

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[115] Gephart et al, *supra* note 27.
[116] Johnson et al, *supra* note 112, at 2.
[117] The Convention on Biological Diversity (CBD) defines ecosystem as a "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (*Convention on Biological Diversity* (5 June 1992) 1760 UNTS 69, art 2 [hereinafter CBD]). Humans, with their cultural diversity, are an integral component of many ecosystems (CBD, Decision V/6 adopted by the Fifth Ordinary Meeting of the Conference of the Parties, 15 - 26 May 2000, Nairobi, Kenya, para A.2).
[118] FAO, *Blue Transformation - Roadmap 2022–2030: A vision for FAO's work on aquatic food systems* (Rome: FAO, 2022), online: FAO <https://doi.org/10.4060/cc0459en> (accessed 7 March 2023).
[119] FAO, SOFIA 2022, *supra* note 2, at 39.

industry to date, can provide important insights into the scientific, technical and regulatory needs of newer intensive fish farming developments.

For these reasons, understanding how the ecosystem approaches to aquaculture management are recognized in the particular context of salmon mariculture is a pertinent, necessary, and timely research endeavour.

1.3. Research Objectives and Methodological Approaches

The previous sections have described the general broad support for aquaculture industry as a "more productive, efficient, resilient, climate-smart and socially and environmentally responsible agri-food systems".[120] They also emphasized that aquaculture needs to be sustainable (i.e. economically feasible, environmentally responsible, and socially acceptable) and that the EAA is endorsed as a strategy and tool to achieve sustainable aquaculture. Further, the implementation of an EAA requires an enabling legal framework.

There is, however, a research gap on the legal features that support (or obstruct) the implementation of an EA generally, and of EAA in particular. The overall objective of this Dissertation is to explore this question by identifying the key law and policy coordinates for operationalizing an EAA, as well as obstacles for implementation. This objective is pursued through three consecutive analyses, each building on the conclusions of the previous ones. The first analysis seeks to understand the concept of EAA and its legal implications from a theoretical perspective (chapters 2 and 3). The second analysis seeks to identify international obligations and standards for aquaculture management (chapter 4 and 5). The third analysis addresses State practice. It analyzes whether the law and policy coordinates for EAA operationalization are present in salmon mariculture legal frameworks, in which form, and with what limitations (chapters 6 and 7). Each of the analyses, separately and cumulatively, contribute to a more comprehensive and deeper understanding of the complex and demanding task of planning and managing aquaculture "within the broader ecosystem" to ensure economic viability, technical feasibility, social acceptability, and ecological sustainability.

[120] FAO, Shanghai Declaration, *supra* note 15.

1.3.1. An Ecosystem Approach to Aquaculture in the Literature

The EAA is the theoretical framework for this Dissertation. Thus, understanding what the concept means and what its operationalization entails is a pre-requisite for the inquiry. This objective is addressed by contextualizing the EAA within the broader ecosystem approach literature[121] and by analyzing relevant FAO documents promoting and describing the concept of EAA. A review of the academic literature addressing or mentioning EAA supplemented this analysis and provided further insights into the conceptualization and description of the term.

The concept of EAA, as the concept of EA more generally, is complex and has been interpreted or implemented in diverse ways. Further, EAA is a newer concept and has been much less debated and implemented. Thus, understanding the concept of EAA is not only a descriptive exercise but also a critical one. This critical assessment leads to defining the concept of EAA more precisely for the purposes of this Dissertation, while acknowledging other interpretations. EAA in this Dissertation is understood as a multi-dimensional concept comprising procedural and substantive elements and focusing on aquaculture interactions (externalities) within defined and nested ecosystems (farm and watershed level).

A clearer understanding of EAA allows to address the task most important to the goals of this Dissertation: identifying legal features (principles, structures, processes, and standards) that support and enable the operationalization of an EAA. Equally, perhaps more important, is to identify the legal features that obstruct its operationalization. The Dissertation first looks into the legal dimension of an EAA as identified in the FAO Technical Guidelines for EAA, other FAO Reports and the limited academic literature. This analysis is complemented, supported, and expanded with a literature review for legal scholarships addressing, in broad terms, the relationship between ecosystems and the law. The open nature of the topic under review required a qualitative literature review that identified different streams of legal scholarship addressing, from different perspectives, the challenges of managing human activities within complex and dynamic systems.

[121] The concept of ecosystem approach is addressed briefly in chapter 2. A more extensive description of the concept, its implementation and recognition under international law can be found in Engler, *supra* note 50.

1.3.2. Aquaculture in International Law

The second analysis of the Dissertation places aquaculture in the context of international law through a doctrinal analysis of relevant international agreements. While the relevance of international law for aquaculture is mostly indirect, it provides the foundation for State action. First, international law clarifies the rights of States to operate or authorize the operation of aquaculture farms in the different maritime zones recognized under the 1982 *United Nations Convention on the Law of the Sea.*[122] Second, international law enshrines States' obligations in operating, or authorizing the operation, of such farms vis-à-vis other States and the global community. These obligations are a building block for the sustainability of aquaculture activities in the marine environment.

The analysis of international law is also relevant to ascertain the extent to which States have an obligation to implement an ecosystem approach or principles associated to an ecosystem approach. Indeed, international environmental law has increasingly focused on ecological systems, rather than its individual components,[123] and has expanded its remit through intersections with other bodies of international law and particularly human rights law.[124] Whether binding or just hortatory, international environmental law strengthens the need to adopt a holistic ecosystem approach to management.

Finally, the analysis of international law applicable to aquaculture also provides a critical assessment of the existing international obligations regarding aquaculture operations. It highlights potential legal gaps that may leave some environmental impacts unregulated, underregulated, or that may affect the development of new technologies.

1.3.3. State Practice: Legal Frameworks for Aquaculture in the light of an Ecosystem Approach to Aquaculture

In its third analysis, the Dissertation turns to assessing whether and to what extent aquaculture laws and regulations for salmon mariculture reflect the legal features identified as relevant for EAA operationalization, or the legal obstacles for EAA

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[122] 10 December 1982, 1833 UNTS 397 (entered into force 16 November 1994).
[123] This is arguably the case with the recognition of ecosystems under the CBD, *supra* note 117. See further chapter 5.
[124] Lavanya Rajamani & Jacqueline Peel, "International Environmental Law: Changing Context, Emerging Trends, and Expanding Frontiers", in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 1.

implementation. This research objective is addressed through an analysis and comparison of salmon mariculture legal frameworks in selected jurisdictions.

Salmon mariculture is a complex industry, and legal frameworks addressing aquaculture are equally complex. Further, EAA is multi-dimensional concept with holistic and integrative aspirations. These two characteristics (the complexity of both salmon mariculture regulation and EA) presented a particular methodological challenge. A reductionist approach to delimit the scope of the comparison runs against the very essence of the concept under study yet addressing each and every aspect of salmon mariculture legal frameworks in a meaningful way is an exceedingly ambitious task.

To delimit the scope of the Dissertation without compromising the holistic nature of EAA, the assessment and comparison of State practice focuses on two fundamental decisions of salmon mariculture planning and management, namely: where aquaculture can be located, and how much fish can be farmed. Further, operational requirements addressing three ecosystem-level impacts (escapes, sea lice, and emissions) are addressed in more detail. Building on the findings of earlier chapters, the assessment and comparison of State practice focus on the identified core elements of EAA and legal and policy coordinates for their operationalization. More specifically, the comparison addresses the following four questions:

- Do salmon mariculture laws and policies endorse EAA?
- How do legal structures or tools, and particularly aquaculture zoning and planning, balance multiple ecological, social, and economic objectives and marine and coastal uses?
- How do legal instruments address "beyond the farm" impacts (i.e. ecosystem-level and cumulative interactions)?
- How do salmon mariculture legal frameworks support adaptive management?

While these questions do not exhaust legal analysis relevant for EAA, they address key aspects in which EAA can contribute to a more sustainable salmon mariculture sector.

1.4. Expanding on Methodological Approach to Comparative Study

The methodological approach to compare salmon mariculture legal frameworks requires further clarifications in relation to selection of jurisdictions, defining salmon mariculture

legal framework, methodological approach to describing and assessing legal frameworks, and methodological approaches to the comparison of legal frameworks.[125]

1.4.1. Selection of Jurisdictions

The distribution of salmon mariculture is limited by natural environmental conditions. Currently, few States report Atlantic salmon farming and only four countries dominate the world production.[126] The Dissertation focuses on these four main salmon producing countries, namely Norway, Chile, United Kingdom of Great Britain and Northern Ireland (UK), and Canada. Three of these countries are developed States while one (Chile) is a developing economy,[127] all are high-income countries,[128] all are OECD members,[129] and all have relatively robust governance.[130] The assumption is that countries with a long

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[125] These themes are generally consistent with the four steps draw by de Cruz as a general blueprint for comparison: identify the topic of comparison and state its scope as precisely as possible; identify the foreign jurisdiction that you wish to compare to the home jurisdiction; examine the primary sources of law; critically consider and analyse all possible answers to the problem, or compare carefully the range of approaches, bearing in mind possible cultural differences or socio-economic factors, where relevant (Peter de Cruz, "Comparative Law, Functions and Methods" (2009) Max Planck Encyclopedia of Public International Law (last updated April 2009), online: <https://opil-ouplaw-com.ezproxy.library.dal.ca/home/MPIL> (accessed 26 December 2022), para D.3).

[126] Main producers are Norway, Chile (together producing ca 80% of salmonids), United Kingdom of Great Britain and Northern Ireland (UK) (Scotland), and Canada (British Columbia, New Brunswick, Newfoundland and Labrador, Nova Scotia (NS)) (together producing ca 10% of salmonids). Other salmon farming countries include Australia (Tasmania), Faroe Islands, Iceland, Ireland, Japan, New Zealand (non-native Chinook or King salmon), Russian Federation and United States of America (together accounting for approximately 9% of salmonid production). Additional countries report salmon farming in freshwater environment or land-based recirculating aquaculture systems (Denmark, Bulgaria, Switzerland, and United Arab Emirates). Further, Spain, Democratic People's Republic of Korea, and the Republic of Korea have reported salmon from experimental farming operations over one or more of the last 4 years (see: FAO, Global Aquaculture Production Quantity 1950-2020, online: https://www.fao.org/fishery/statistics-query/en/aquaculture/aquaculture_quantity (accessed 25 April 2022); search for: Atlantic salmon, Australian salmon, Coho (silver) salmon, Chum (keta, dog) salmon, Chinook (spring, king) salmon, Pacific salmons nei, Pink (humpback) salmon, Masu (cherry) salmon, and Sockeye (red) salmon, in all (marine, brackish, freshwater) environments).

[127] UN, *World Economic Situation and Prospects* (New York: UN, 2020), Statistical Annex, Country Classifications, online: UN <https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2020_Annex.pdf> (accessed 25 April 2022).

[128] *Ibid.*

[129] See: List of OECD Member countries, online: OECD <https://www.oecd.org/about/document/ratification-oecd-convention.htm> (accessed 25 April 2022).

[130] The World Bank's World Governance Indicators assigns Norway, Chile, UK, and Canada relatively similar and consistently high scores (above 80%) for all measured variables (Voice and Accountability; Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption), with Chile scoring slightly lower than the other countries. The only exception worth noting is a lower rating (60%) for Political Stability and Absence of Violence/Terrorism assigned to UK and Chile (with Chilean score decreasing from ca 70% in 2010 to 50% in 2020). See: World Bank, World Governance Indicators, Interactive Data Access, online: World Bank

history of Atlantic salmon farming, with well established industries, and with robust governance would have developed mature regulatory frameworks for the sector.

In the case of UK, salmon production is concentrated in Scotland and, therefore, the Scottish legal and regulatory framework for aquaculture is analyzed.[131] In the case of Canada, four provinces report marine salmon farming: British Columbia, New Brunswick, Newfoundland and Labrador, and Nova Scotia (NS). While fish aquaculture in British Columbia is under the responsibility of the federal government after the 2009 Morton decision,[132] in the other provinces the provincial government has lead responsibility. As a consequence, the legal framework for each province differs, although presenting common elements. The analysis focuses on one province to limit the substantive scope of the Dissertation. The selection of this province did not rely on production volume but rather legislative and policy developments. NS, although having the smallest production in Canada, has recently engaged in a regulatory reform following a comprehensive regulatory assessment undertaken by and independent panel that made legal and regulatory recommendation.[133] It is worth noting, however, that many elements of the analysis undertaken in this Dissertation may provide valuable lessons for other Canadian provinces, as well as other jurisdictions, as they develop or reform legal frameworks for effective finfish aquaculture planning and management.

The relatively uniformity of the industry in the four selected jurisdictions represent advantages for a comparative analysis. Indeed, the industry has faced and will continue to face similar challenges that require technical and regulatory interventions. Assessing how these similar problems have been addressed in the context of different legal systems[134] can contribute to a better understanding of the ways in which legal

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http://info.worldbank.org/governance/wgi/Home/Reports (accessed 14 April 2022). See Davies et al, *supra* note 46. The authors use the World Bank's World Governance Indicators (WGI) as a proxy for aquaculture governance due to difficulty to ascertain aquaculture governance for their study.

[131] As will be explained in chapter 6 in more detail, Scotland has devolved authority over aquaculture. Nevertheless, UK legislation and European Union (EU) Directives are also relevant to the applicable legal framework.

[132] 2009 Morton Decision, *supra* note 78.

[133] Meinhard Doelle & William Lahey, *A New Regulatory Framework for Low-Impact/High-Value Aquaculture in Nova Scotia*. The Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia (2014), online: NS Government https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf>.

[134] The legal traditions of the selected case studies differ: common law in Canada and UK (with Scottish system being considered mixed system of common and civil law); civil law in Chile and Norway (Sigrid

frameworks can support or obstruct a holistic, ecosystem approach. The relative uniformity of the case studies also has disadvantages, however. The industry and the regulatory agencies in these countries have engaged in ample cooperation and exchange of information,[135] potentially reducing regulatory diversity.

1.4.2. Defining Salmon Mariculture Legal Framework

The focus of the Dissertation is on legal frameworks for salmon mariculture. This requires two precisions. First, *legal framework* is understood to encompass statutory law, case law, and regulations and standards adopted by the executive branch of governments under the authority of a statute (i.e. law as authoritative rules backed by coercive force, exercised by a legitimately constituted state[136]). It also includes policies and guidelines, as they often interpret rules in laws and regulations or provide further details on implementation. This scope is consistent with the aim of the Dissertation, i.e., understanding the extent to which aquaculture laws and regulations enable the implementation of a holistic EAA. Second, the focus is on legal frameworks *for salmon mariculture*, which includes aquaculture acts but also all legal instruments directly applicable to the planning, permitting and management of salmon mariculture. When

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Eskeland Schütz & Ann-Michelle Slater, "From strategic marine planning to project licences: Striking a balance between predictability and adaptability in the management of aquaculture and offshore wind farms" (2019) 110 Marine Policy 103556, at 1). Nevertheless, extensive comparative studies of environmental law have found that despite the initial impression of extreme diversity across jurisdictions, there are common patterns and limited set of building blocks underlying the organization of responses given by environmental law to common problems (Jorge E Viñuales, "Comparative Environmental Law: Structuring a Field" in Emma Lees & Jorge E Viñuales (eds), *The Oxford Handbook of Comparative Environmental Law* (Oxford: Oxford University Press, 2019) 3 at 24). While this finding does not minimize the importance of legal systems and legal context for an accurate understanding of how "environmental law 'works'", it affirms that the comparison of regulatory solutions to common problems is a worthy endeavour that can provide useful academic and practical insights (Emma Lees, "Value in Comparative Environmental Law" in Emma Lees & Jorge E Viñuales (eds), *The Oxford Handbook of Comparative Environmental Law* (Oxford: Oxford University Press, 2019) 35, especially at 47 and 55-56).

[135] See, eg: "Joint statement between Canada, Chile, Norway, and Scotland on Aquaculture", signed by the Minister, Fisheries and Oceans (Canada), Undersecretary, Fisheries and Aquaculture (Chile), Minister of Trade, Industry and Fisheries (Norway) and Minister, Environment, Climate Change and Land Reform (Scotland) in Ottawa (31 of July 2015) and Trondheim (16 August 2015), online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/statement-declaration-eng.html> (accessed 7 October 2022).

[136] Bronwen Morgan & Karen Yeung, *An Introduction to Law and Regulation: Text and Materials* (Cambridge, UK: Cambridge University Press, 2017) at 5.

necessary to address the research questions, the linkages between the legislation directly applicable to salmon mariculture and the broader legal framework are also addressed.[137]

Laws and regulations are only one of the governance arrangements apt for addressing complex and global environmental and social problems.[138] In addition to the State regulatory powers, market-based, civil-society-based, and self-regulation arrangements have gained significant influence to deal with environmental and social interdependencies.[139] These arrangements are also an important component of aquaculture governance. For example, the salmon industry is increasingly a certified industry,[140] and private certifications ensure economic, environmental, governance, and cultural sustainability to different degrees.[141] Information strategies[142] and industry self-regulation[143] arrangements also play a role in aquaculture governance. Nevertheless, the role of the State in regulating aquaculture (as other activities with environmental externalities) remains significant.[144] Further, alternative governance instruments often depend on State's regulatory intervention or otherwise operate "on the shadow" of the State.[145] When relevant, these linkages will be mentioned in the description and assessment of legal frameworks.

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[137] For the relevance and challenges of considering legal context in comparative (environmental) law, see Lees, *supra* note 134.
[138] Simon R Bush & Peter Oosterveer, *Governing Sustainable Seafood* (London: Routledge, 2019) at 26.
[139] *Ibid*, at 26-29.
[140] O Luthman, M Jonell & M Troell, "Governing the salmon farming industry: Comparison between national regulations and the ASC salmon standard" (2019) 106 Marine Policy 103534.
[141] Osmundsen et al, *supra* note 42; FAO, "Building a Common Vision", *supra* note 40.
[142] For example, the Chilean salmon industry association publishes annual sustainability reports with information on labor, community action, several fish health parameters, escapes, and voluntary certification schemes (See: Salmon Chile, VII Informe de Sustentabilidad, Gestión 2021 [Sustainability Report 2021], online: SalmonChile <https://www.salmonchile.cl/informe-sustentabilidad-2021/> (accessed 14 November 2022). Norway launched an aquaculture sustainability web portal with information on 26 environmental, social, and economic indicators (available in English and Norwegian). See: Barentswatch, "Sustainability in Aquaculture" <https://www.barentswatch.no/havbruk/?lang=en> (accessed 1 December 2022).
[143] Eg: Salmon Scotland, Scottish Salmon Farming Code of Good Practice (2014), online: <https://www.salmonscotland.co.uk/code-of-good-practice> (accessed 28 April 2022).
[144] Viñuales, *supra* note 134, at 12; Griggs, *supra* note 63.
[145] Neil Gunningham & Cameron Holley, "Next-Generation Environmental Regulation: Law, Regulation, and Governance" (2016) 12 Annu. Rev. Law Soc. Sci. 1. Gunningham & Holley use legislation to refer to "state-based law, that which is promulgated by parliament, implemented by agencies, and interpreted by the courts." Regulation in their article is a broader category that includes more flexible and innovative forms of social control (eg persuasion, self-regulation, co-regulation) but still involve the state as a central player "because even mechanisms that are not reliant on legislation for their authority are negotiated directly with the state and operate in the shadow of the state" (*ibid*, at 14).

The focus of the Dissertation is on legal frameworks and their features; in other words, on legal design enabling the implementation of an EAA. It is acknowledged at the outset that legal design is only one of the factors required for the practical implementation of an EAA,[146] and that legal design does not equate to implementation. Further, enforcement actions and civil or criminal liability for environmental damage or non-compliance with legal requirements are not directly addressed.[147] It is also recognized that enforcement of laws and regulations can be a critical driver of unsustainable aquaculture practices.[148]

1.4.3. Methodological Approaches to Description and Assessment of Legal Frameworks

The analysis of State practice requires, first, a description and assessment of the relevant legal frameworks for salmon mariculture in each of the jurisdictions selected, that is, the study of foreign law.[149] To this end, the Dissertation undertakes a doctrinal analysis of the laws, regulations, and case law applicable to marine salmon farming in each jurisdiction.[150]

The doctrinal analysis is supported by several complementary sources. First, the practical implementation of laws and regulations is further explored through the examination of selected individual instruments (e.g. planning instruments and permits).[151] This examination is undertaken as a complement to doctrinal research, with the purpose of supporting a better understanding of the legal framework as a whole and the scope and challenges of individual legal instruments. A systematic assessment of implementation through planning instruments or permits is outside of the scope of the Dissertation.

The doctrinal analysis is also supplemented by secondary sources. Further, the research has also been greatly supported by several projects in which I had the privilege

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[146] See: Lees, *supra* note 134.
[147] Nevertheless, the distinction between implementation and enforcement can be blurry, in particular in the implementation of adaptive management and managerial compliance as will be explained in Chapter 3.
[148] Percy, Hishamunda & Kuemlangan, *supra* note 60.
[149] John C Reitz, "How to Do Comparative Law" (1998) 46 Am J Comp L 617, at 618-619.
[150] The list of material by jurisdiction is included in the References of this Dissertation.
[151] See References, National Documents, Supplementary Material for a list of instruments analyzed.

to participate during the PhD Programme, although they are not directly used as material.[152]

The author is fluent in English and Spanish. The language barrier in relation to the Norwegian case study merits further comments. Norway has publicly available and official translation of main pieces of legislation and many official reports; yet the regulations (which mostly set out the detailed regulatory approaches), many government documents, and judicial decisions are not available in English. Rather than omitting the valuable case study (Norway being widely considered an industry and regulatory leader[153]), a special approach to the case study was adopted. First, this case study relies more heavily on the relatively abundant secondary sources and gray literature.[154] Second, some key regulatory instruments or reports were translated using free machine translation services.[155] While these sources could not be used on their own as the basis for the doctrinal analysis,[156] they were used as a complement or clarification to the information provided in other sources.

1.4.4. Methodological Approach to Comparative Analysis

The second part in the analysis of State practice is the comparison of legal approaches adopted by different jurisdictions to address salmon mariculture and its externalities. The salmon farming industry in all jurisdictions studied have similarities: they share farming technology, environmental requirements, and most (but not all) ecological and social

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[152] The following projects are particularly acknowledged: ICES Working Group on Aquaculture Interactions with the Environment; and FIPA Project 2017-17 "Propuesta de Política Nacional de Acuicultura de Chile para las Siguientes dos Décadas" [Proposal for Chile's National Aquaculture Policy for the Next Two Decades].

[153] Griggs, *supra* note 63, especially at 21; Osmundsen, Almklov & Tveterås, *supra* note 110, at 172.

[154] Reitz, *supra* note 149, at 633.

[155] Google Translate was used for Norwegian texts. Deepl was used as a support tool for Spanish-English translations, although the author is fluent in both languages.

[156] Google Translate has significantly improved the accuracy of the translation services (Haifeng Wang et al, "Progress in Machine Translation" (2021) Engineering https://doi.org/10.1016/j.eng.2021.03.023 (in press)) in particular for non-fictional texts (Jonni Salimi, "Machine Translation of Fictional and Nonfictional texts: An examination of Google Translate's accuracy on translation of fictional versus non-fictional texts" (2014), online: <http://www.diva-portal.org/smash/get/diva2:737887/FULLTEXT01.pdf>). Machine translation of legal texts has been found useful for assimilation and information retrieval purposes (C Kit & TM Wong, "Comparative Evaluation of Online Machine Translation Systems with Legal Texts" (2008) 100 Law Library Journal 299; Salimi, *ibid*). However, accuracy is lower for "resource-poor" languages (Milam Aiken, "An Updated Evaluation of Google Translate Accuracy" (2019) 3 Studies in Linguistic and Literature 253). For this reason, its use in this Dissertation was used with caution and as an aid to understand information contained in other sources.

externalities.[157] The industry structure is also similar, with multinational companies operating in all or most jurisdictions under study. Regulators are faced, therefore, with similar challenges within distinct legal frameworks and systems.

A functional methodological approach to comparative analysis can shed light on how different jurisdictions, operating within different legal frameworks, have addressed these challenges. A functional approach to comparative law focuses on the function, or the problem, addressed by a given arrangement.[158] The point of departure for the comparison can be either a real-life problem or an ideal, that acts as a comparator (the *tertium comparationis*).[159]

In this Dissertation, the comparison starts with a factual configuration:[160] the salmon farm interacting with the ecological and social system in multiple and uncertain ways at multiple scales. The point of departure for the comparison are the key procedural and substantive coordinates to implement an EAA identified in earlier analyses in the Dissertation. The objective of the comparison is to understand whether those key coordinates for EAA implementation are considered in the legal frameworks, to reveal alternative options and common approaches to operationalize EAA, and legal obstacles to EAA.

1.5. Expected Scholarly Contribution of the Dissertation

The main objective of this Dissertation is to identify and analyze key law and policy coordinates for EAA operationalization. Through the different analyses undertaken to answer that key question, the Dissertation can advance legal scholarship in several ways.

The main expected contribution is to strengthen legal scholarship addressing aquaculture. Two main pathways serve to achieve this goal. First, the theoretical analysis of legal requirements for an EAA (informed by the analysis of an ecosystem approach

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[157] See eg: Nathan Young et al, "Limitations to growth: Social-ecological challenges to aquaculture development in five wealthy nations" (2019) 104 Marine Policy 216, at 220.
[158] Viñuales, *supra* note 134, at 12. Viñuales notes that functional approaches to comparative law have a prominent place in comparative law generally as well as environmental law, which is explained by the commonality of the problems, the novelty of the subject, and the technical nature of the discipline. The focus on the environmental realities as a starting point for comparison and as criterion for selecting countries for comparison is also highlighted in Nicholas A Robinson, "Comparative Environmental Law: Evaluating How Legal Systems Address 'Sustainable Development'" (1997) 27 Env Pol'y & L 338, at 340.
[159] Reitz, *supra* note 149, at 622.
[160] Viñuales, *supra* note 134, at 12.

and the law more generally) provides a framework for assessing aquaculture laws and policies and for identifying legal approaches that can contribute to a supportive legal framework for sustainable aquaculture. The most important contribution, however, lies in the doctrinal and comparative analysis of legal frameworks for aquaculture.

A comparative analysis can serve several (and related) functions.[161] In this Dissertation, it has three interrelated goals. First, it has an epistemological and critical function, seeking a more comprehensive and critical understanding of the salmon mariculture laws and the capacity to implement EAA. Second, it seeks to identify "legal trends" by emphasizing similarities and best practices. Third, it seeks to support legal reform. The last of these functions deserves further comments.

It is tempting to try to extract, from this exercise, the "best" or "better" legal framework – the model legislation - for EAA and for sustainable aquaculture,[162] or a "check-list" of elements to be included in aquaculture legislation.[163] The relevance of law in context[164] cannot be underestimated, however, as the fate of some legal transplants have shown.[165] Additionally, attempting a judgment of "better" or "best" legislation requires clear and objective criteria, in itself a difficult and even controversial task.

Thus, the aim of the comparative analysis is both more modest and more nuanced. Its aim is not to find one "golden rule" but different pathways (procedural and substantive) in which legal frameworks can support EAA, identify legal trends ("best practices") in managing aquaculture based on the ecosystem, and identify legal obstacles

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[161] See: Reitz, *supra* note 149; Elisa Morgera, "Global Environmental Law and Comparative Legal Methods" (2015) 24 RECIEL 254; de Cruz, *supra* note 125, para C; Ralf Michaels, "The Functional Method of Comparative Law" in M Reimann & R Zimmermann (eds), *The Oxford Handbook of Comparative Law* (Oxford: Oxford University Press, 2006). Different functions recognized for comparative (environmental) law include: epistemological function (providing tools for a more critical understanding of the law in one's own country); identifying similarities (which in turn can be relevant for identifying best management practices or, in some contexts, universal aspects or general principles of law; both aspects are particularly relevant for international law); an harmonization function; an evaluative function (identifying the "better law"); and supporting legal reform.

[162] Indeed, many functional comparative law methodologies consider that one of the objectives of the comparative analysis is to assess which one is the "better" response (Viñuales, *supra* note 134, at 13).

[163] FAO/EAF-Nansen Project, *A How-to Guide on legislating for an ecosystem approach to fisheries*. FAO EAF-Nansen Project Report No 27 (Rome: FAO, 2016).

[164] Lees, *supra* note 134, especially at 37-38.

[165] Reitz states: "[t]he argument for domestic law reform has to be made in terms of normative claims acceptable within the domestic legal system, and probably the foreign transplant will have to be modified in significant ways precisely because each legal system reflects an at least partially unique legal system" (Reitz, *supra* note 149, at 625).

to implementing such management. While the focus of the analysis is salmon farming, the lessons and recommendations are expected to be useful in other finfish mariculture contexts as well as for broader aquaculture development.

The insights in this Dissertation also contribute to scholarship on law and ecosystems (that is, the legal institutions, principles, processes, and rules required to manage complex and dynamic systems) and the implementation of an ecosystem approach. While the Dissertation draws on the existing literature to build its theoretical framework for analysis, its empirical application to a specific ocean sector can provide valuable lessons and insights for the sustainable planning and management of other established and emerging ocean-based industries. These include, for example, inshore and offshore renewable energy, ocean and coastal tourism, or marine biotechnology.[166]

The Dissertation also strengthens the academic literature on international law and aquaculture. This analysis highlights both the vast scope of issues of concern in international law that need to be taken into account in aquaculture management, but also the limited "hard international law" concerning activities under national sovereignty. It further addresses potential gaps in international law or international standards, in particular in the face of evolving technology. It also provides insights in the way in which specific international environmental responsibilities and obligations are adopted, and adapted, in domestic frameworks.

The ultimate goal is that this Dissertation will contribute to aquaculture sustainability. Sustainability is a shared responsibility for industry, communities, governments, scientists, and academia. The role of law in the search for sustainability should not be overlooked.

1.6. Outline of the Dissertation

Having outlined the scope, theoretical framework, research objectives, analyses and methodologies of this Dissertation, this last section lays out the content of the following chapters. The Dissertation is divided in three main parts, each comprising two chapters, addressing the theoretical foundation of an EAA and its legal implications, the

[166] Organization for Economic Cooperation and Development (OECD), *The Ocean Economy in 2030* (Paris: OECD, 2016), ch 1.

international dimension of aquaculture regulation, and the assessment and comparison of State practice.

Chapter 2 explores the concept of EAA within the broader concept of EA and its legal implications. Chapter 3 deepens the legal analysis by synthesizing the academic literature addressing the relationship between ecosystem and the law. It further lays out the practical framework for assessment and comparison of salmon mariculture legal frameworks.

Chapter 4 addresses the jurisdictional aspects relevant to aquaculture in the law of the sea, that is, the right to regulate and control aquaculture activities. Chapter 5 complements this analysis with an assessment of the obligations of States in the regulation and control of aquaculture activities under international environmental law.

Chapter 6 contains a brief description of the salmon mariculture legal frameworks (i.e. a description of foreign law) in each of the jurisdictions studied in this Dissertation. Chapter 7 compares the regulatory approaches to answer the four specific research questions for EAA implementation outlined in the practical framework for assessment and comparison.

Chapter 8 concludes with a brief overview of the main lessons of the analyses, the limitations of the work and outlines future research directions.

CHAPTER 2. UNDERSTANDING AN ECOSYSTEM APPROACH TO AQUACULTURE

The introductory chapter explored how salmon mariculture is best understood as complex ecosystem, or social-ecological system, itself embedded in larger coastal systems. This understanding of aquaculture demands that its management acknowledges and addresses the interlinked components of the aquaculture system, as well as external influences. One key concept proposed to achieve that is an ecosystem approach to aquaculture (EAA). This chapter explores EAA. It starts with a brief overview of ecosystem approach to management or ecosystem-based management (section 2.1).[1] It then addresses the history and foundations of EAA (section 2.2) and a general description of the FAO Technical Guidelines on EAA (section 2.3). Section 2.4 provides a critical assessment of the Guidelines. Finally, section 2.5 addresses in more detail the legal and institutional requirements for EAA, which also serves as an introduction for chapter 3.

2.1. An Ecosystem Approach to Management

An ecosystem approach (EA) to management developed as a response to the limitations of traditional natural resources management and its focus on a single sector, species, activity, or concern in isolation. It is currently a central paradigm for natural resources governance and management, and particularly for oceans management. While the status of EA as a principle of customary international law is generally rejected,[2] its influence is vast and deep. It has been endorsed as the primary framework of action by the

[1] Section 2.1 is based on a more comprehensive discussion of ecosystem approach published in the context of the PhD programme See: Cecilia Engler, "Beyond rhetoric: Navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management" (2015) 23 Environ Rev 288.

[2] Trouwborst rejects the status of the EA as a principle of customary international law. He states: "The [precautionary] principle is a standard feature of modern environmental treaties and must be deemed part of customary international law. The ecosystem approach is neither." (Arie Trouwborst, "The Precautionary Principle and the Ecosystem Approach in International Law: Differences, Similarities and Linkages" (2009) 18 RECIEL 26). Enright and Boteler, in turn, citing Tanaka, note that the "normative content of the ecosystem approach has been described as weak and unclear in terms of its obligations on States" (Sarah Ryan Enright & Ben Boteler, "The Ecosystem Approach in International Marine Environmental Law and Governance" in TG O'Higgins et al (eds), *Ecosystem-Based Management, Ecosystem Services and Aquatic Biodiversity* (Springer: 2020) 333, https://doi.org/10.1007/978-3-030-45843-0_17). Morgera argues that the status of the ecosystem approach as a principle of international law is a research question that is yet to be tackled in legal scholarship (Elisa Morgera, "The ecosystem approach and the precautionary principle" in Elisa Morgera & Jona Razzaque (eds), *Biodiversity and Nature Protection Law* (UK, Edward Elgar Publishing, 2017) 70).

Contracting Parties to the *Convention on Biological Diversity* (CBD).[3] Its implementation in oceans management is an international commitment under the Aichi Biodiversity Targets,[4] the Johannesburg Plan of Implementation,[5] and the Sustainable Development Goals.[6] It is endorsed and promoted as a main framework for sustainable fisheries management by the Food and Agriculture Organization of the United Nations (FAO).[7] It plays a role in adaptation to climate change.[8] It has been explicitly adopted by global and regional environmental[9] and fisheries agreements[10] (in some cases as a legally binding

[3] CBD, Decision II/8 adopted by the Second Ordinary Meeting of the Conference of the Parties to the CBD held in Jakarta, Indonesia, 6-17 November 1995, at para. 1.
[4] CBD, Decision X/2 on Strategic Plan for Biodiversity 2011-2020, adopted at the tenth meeting of the Conference of the Parties held in Nagoya, Japan, 18-29 October 2010, Annex, Aichi Biodiversity Target 6, online: https://www.cbd.int/decisions/cop/ (accessed 10 September 2021).
[5] World Summit on Sustainable Development, Johannesburg Declaration on Sustainable Development and Plan of Implementation of the World Summit on Sustainable Development: the final text of agreements negotiated by governments at the World Summit on Sustainable Development, 26 August-4 September 2002, Johannesburg, South Africa (New York: UN, 2003), Resolution 2, para 30(d).
[6] See Sustainable Development Goal 14.2 and particularly its Indicator. United Nations UN, Department of Economic and Social Affairs, Sustainable Development, online: https://sdgs.un.org/goals/goal14 (accessed 10 September 2021).
[7] FAO Fisheries Department, *The ecosystem approach to fisheries*. FAO Technical Guidelines for Responsible Fisheries No 4, Suppl 2 (Rome: FAO, 2003).
[8] MR Shaw, JT Overpeck & GF Midgley, "Cross-chapter box on ecosystem-based approaches to adaptation—emerging opportunities", in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, CB Field, VR Barros, DJ Dokken, et al, (eds) (Cambridge, UK; New York, NY, USA: Cambridge University Press, 2014), at 101-103.
[9] Eg, *Convention on Wetlands of International Importance Especially as Waterfowl Habitat* (Ramsar Convention), 2 February 1971, 996 UNTS 245, 11 ILM 969 (1972) (entered into force 21 December 1975), art 2(6) and 3(1) calling on States to ensure the "wise use" of wetlands in their territory; and definition of "wise use" agreed in RAMSAR Resolution IX.1 Annex A adopted during the 9th Conference of the Parties (2005): "Wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development " (online: RAMSAR <https://www.ramsar.org/documents>.) See also: Baltic Marine Environment Protection Commission (Helsinki Commission - HELCOM) and OSPAR Commission for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR), "Statement on the Ecosystem Approach to the Management of Human Activities: Towards an Ecosystem Approach to the Management of Human Activities", adopted during the Joint Ministerial Meeting of the Helsinki and OSPAR Commissions held in Bremen, Germany, 25-26 June 2003.
[10] Eg, *Convention for the Conservation of Antarctic Marine Living Resources*, 20 May 1980, 1329 UNTS 47 (entered into force 7 April 1982); *Convention on Future Multi-lateral Co-operation in the Northwest Atlantic Fisheries*, 24 October 1978, 1135 UNTS 370 (entered into force 1 January 1979), as amended, Preamble, para 8. Other Conventions endorse elements of the EA to fisheries management without mentioning the ecosystem approach explicitly. See: *Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean*, 5 September 2000, 2275 UNTS 43 (entered into force 19 June 2004), Preamble, para 5; *Convention on Future Multi-lateral Cooperation in North-East Atlantic Fisheries*, 18 November 1980 (entered into force 17 March 1982), Preamble, para 3. See also: *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* (Fish Stocks Agreement or UNFSA), 4 August 1995, 2167 UNTS 3

principle).[11] It has also been recognized in supra-national[12] and national legislative frameworks.[13]

Despite its wide recognition and endorsement, there is still some debate on what EA means and significant implementation challenges.[14] Three main reasons can explain the divergent interpretations of the concept.[15] First, the literature ascribes different normative content of EA, ranging from deeply anthropocentric to bio- and eco-centric.[16] Second, EA has different implementation paradigms. These paradigms have been characterized as lying in a continuum from traditional management (sector-specific, mono-specific and focus on productivity), to ecosystem approaches to sectoral management (sectoral management that considers some ecosystem considerations, such as trophic relationships or habitat protection), to multisectoral ecosystem-based management (in which all the activities within a spatially delineated ecosystem are managed in an integrated manner).[17] There is increased consensus to refer to the latter conceptualization as "ecosystem-based management" or "ecosystem management", while

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(entered into force 11 December 2001), Preamble, para 7 and arts 2 and 5. See also: UN, Report on the Work of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its seventh meeting, A/61/156 (17 July 2006), available online: DOALOS <https://www.un.org/depts/los/consultative_process/consultative_process.htm>.

[11] *Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean*, 14 November 2009, 2899 UNTS 211 (entered into force 24 August 2012), art 2.

[12] Eg, *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*, [2000] OJ L 327/1 (hereinafter, EU Water Framework Directive or WFD); *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy*, [2008] OJ L 164/19. See also: Niko Soininen & Froukje Maria Platjouw, "Resilience and Adaptive Capacity of Aquatic Environmental Law in the EU: An Evaluation and Comparison of the WFD, MSFD, and MSPD" in David Langlet and Rosemary Rayfuse (eds), *Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Leiden: Brill Nijhoff, 2018) 17.

[13] Eg, Ley General de Pesca y Acuicultura (General Fisheries and Aquaculture Act) (Chile), art 1.C(c); *Fisheries Act* RSC, 1985, c F-14 (Canada), art 2.5(a). The recognition of EAA in the legal frameworks of the jurisdictions under study is analyzed in Chapter 7, section 7.1.

[14] See eg, Froukje Maria Platjouw, *Environmental Law and the Ecosystem Approach: Maintaining ecological integrity through consistency in law* (Oxon; New York: Routledge, 2016), in particular chapter 2.

[15] Engler, *supra* note 1.

[16] *Ibid*; Vito de Lucia, "Competing Narratives and Complex Genealogies: The Ecosystem Approach in International Environmental Law" (2015) 27 J Envtl L 91.

[17] UNEP, *Taking steps toward marine and coastal ecosystem-based management: an introductory guide* (Nairobi: UNEP, 2011) at 11-12; FAO, The State of World Fisheries and Aquaculture 2016: Contributing to food security and nutrition for all (Rome: FAO, 2016) [hereinafter SOFIA 2016] at 85. See also: Jason S Link & Howard Browman, "Integrating What? Levels of marine ecosystem-based assessment and management" (2015) 75 ICES J of Marine Science1170; Steven L Yaffee, "Three Faces of Ecosystem Management" (1999) 13 Conservation Biology 713.

sectoral management that takes ecosystem components into considerations is referred to as the/an ecosystem approach or ecosystem approaches to management.[18] Third, the concept of EA is in itself complex, including substantive (normative), cognitive and procedural elements.[19]

While some differences in the conceptualization of EA may persist, there is increasing consensus on the use of terminology and on the principles and elements of an EA. The decisions of the Contracting Parties to the *Convention on Biological Diversity* on principles and implementation guidelines for the EA (based on the Malawi principles) are generally recognized as an authoritative formulation. The decision of the CoP defines EA "in light of the objectives of the Convention"[20] as

> a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.[21]

It further defines 12 principles for EA and associated operational guidelines for its implementation.[22] Other official documents[23] and academic articles[24] have also

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[18] See: UNEP, *supra* note 17, at 11; FAO, SOFIA 2016, *supra* note 17, at 85. In this Dissertation, both "the EA(A)" and "an EA(A)" are used; however, it is acknowledged that some authors prefer the term "an EA" to reflect that the concept can be interpreted and applied differently in different circumstances (See: Engler supra note 1, at 300).

[19] Engler, *supra* note 1, citing SM Garcia, "The ecosystem approach to fisheries: implementation framework and agenda" in UN, *Ecosystem Approaches and Oceans:* Panel Presentations during the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (Consultative Process) Seventh meeting, United Nations Headquarters, New York, 12 to 16 June 2006 at 34-35.

[20] Enright & Botelier, *supra* note 2, at 337.

[21] CBD, Decision V/6 on Ecosystem Approach adopted by the Fifth Ordinary Meeting of the Conference of the Parties held in Nairobi, Kenya, 15 - 26 May 2000, and Decision VII/11 on Ecosystem Approach adopted by the Seventh Ordinary Meeting of the Conference of the Parties held in Kuala Lumpur, Malaysia, 9 - 20 February 2004, Annex I, paragraph A.1.

[22] Decision VII/11, *supra* note 21, Annex I, Table 1.

[23] UN, *supra* note 10.

[24] R Edward Grumbine, "What is Ecosystem Management?" (1994) 8 Conservation Biology 27; Karen L McLeod et al, "Scientific Consensus Statement on Marine Ecosystem-Based Management", released 21 March 2005 and signed by 221 academic scientists and policy experts with relevant expertise and published by the Communication Partnership for Science and the Sea at http://compassonline.org/?q=EBM; Katie K Arkema, Sarah C Abramson & Brian M Dewsbury, "Marine ecosystem-based management: from characterization to implementation" (2006) 4 Front Ecol Environ 535; Rachel D Long, Anthony Charles & Robert L Stephenson, "Key principles of marine ecosystem-based management" (2015) 57 Marine Policy 53; Engler, *supra* note 1.

synthesized the main elements ascribed to an EA. These elements or principles are briefly addressed here.

A central feature of the ecosystem approach is its *holistic* and *integrative* nature. The ecosystem approach is "an integrated approach to management that considers the entire ecosystem, including humans."[25] Considering the entire ecosystem implies that the focus of management lies in the "ecosystem structure, functioning and productivity (…) rather than individual species, habitats or landscapes".[26] Several features follow from this holistic or integrative nature. An EA accounts for interconnectedness within systems, among the social and ecological systems, and among adjacent or nested ecosystems.[27] An EA assesses and considers the *cumulative impacts* of multiple human activities on ecosystems.[28] EA requires *coordinated, integrated*[29] *and inter- and multidisciplinary*[30] assessment and management of natural resources, including economy and other social sciences.

The EA considers *multiple objectives*, and explicitly acknowledges trade-offs among them.[31] The EA strives to combine and balance the "conservation of the structure and functioning of ecosystems with efforts to meet social needs and the sustainable use of ecosystem services for human purposes."[32] This feature of EA makes it an appropriate framework to achieve *sustainability*, as it requires balancing conservation and sustainable use.

As in the case of sustainability, however, it has also opened the door to criticism regarding the vagueness of the concept, its feasibility as a management paradigm, and the lack of legal content.[33] The ambivalence of the concept in this regard is apparent from the CBD Principles. While the first principle emphasizes that management decisions are a

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[25] McLeod et al, *supra* note 24.
[26] Platjouw, *supra* note 14, at 13.
[27] UN, *supra* note 10, Part A, para 6(c) and (d).
[28] *Ibid*, Part A, para 6(k).
[29] CBD, Decision VII/11, *supra* note 21, Annex I, Table 1, Principle 12; UN, *supra* note 10, Part A, para 6(i). See also Platjouw, *supra* note 14, in particular at 24. Note that the need for inter-sectoral coordination is also highlighted in the context of another feature of EAA: the need to balance different societal objectives.
[30] UN, *supra* note 10, Part A, para 6(l).
[31] CBD, Decision VII/11, *supra* note 21, Annex I, Table 1, Principle 10; UN, *supra* note 10, Part A para 6(e).
[32] Platjouw, *supra* note 14. See also: UN, *supra* note 10, Part A, para 6(m).
[33] Platjouw, *supra* note 14, at 22.

matter of societal choice considering inter- and intra-generational equity,[34] other principles emphasize the need to *maintain the structure and function of ecological* systems so they can continue to provide the multiple *ecosystem services* that humans need.[35] Balancing multiple societal objectives has been identified as one of the key obstacles in the effective implementation of an EA.[36]

Spatial and temporal scales are an important consideration in the EA to management. The EA requires the identification of *ecologically meaningful spatial boundaries* for management.[37] Considering that ecosystems are embedded, or nested, in larger ecosystems, EA should also take into account adjacent ecosystems.[38] Management decisions should be *decentralized at the lowest possible level*[39] within nested governance for multiple relevant scales. Different *temporal scales* are also relevant in EA to management. "The dynamic and complex nature of ecosystems requires a long-term focus and the understanding that abrupt, unanticipated changes are possible."[40]

An EA to management should *be based on transparent, participatory, and collaborative decision-making*.[41] Indeed, the required trade-off between multiple objectives requires societal decisions taken within participatory governance that accounts for both local interests and those of the wider public.[42]

An EA to management is based on *best information available*.[43] This includes (western) science as well as traditional and local knowledge. Information should be improved and updated through regular *monitoring*[44] of relevant ecological, social, and economic variables.

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[34] CBD, Decision VII/11, *supra* note 21, Annex I, Table 1, Principle 1; Long, Charles & Stephenson, *supra* note 24, table 2.
[35] CBD, Decision VII/11, *supra* note 21, Annex I, Table 1, Principles 5, 6; UN, *supra* note 10, Part A, para 6(a), (j) and (n). See also: Long, Charles & Stephenson, *supra* note 24, table 2; McLeod et al, *supra* note 24.
[36] Platjouw, *supra* note 14, at 27. Platjouw considers the maintenance of ecosystem integrity as the priority objective of an EA (*ibid*, chapters 2 and 3, see in particular 75). Other authors share this position (e.g. Grumbine, *supra* note 24).
[37] UN, *supra* note 10, Part A, para 6(b).
[38] *Ibid*, Part A, para 6(d).
[39] CBD, Decision VII/11, *supra* note 21, Annex I, Table 1, Principle 2.
[40] McLeod et al, *supra* note 24.
[41] UN, *supra* note 10, Part A, para 6(f).
[42] McLeod et al, *supra* note 24.
[43] CBD, Decision VII/11, *supra* note 21, Annex I, Table 1, Principle 11; UN, *supra* note 10, Part A, para 6(g).
[44] Long, Charles & Stephenson, *supra* note 24, table 2; McLeod et al, *supra* note 24.

Ecosystems are complex and dynamic and therefore involve uncertainty, even in data-rich scenarios. To address uncertainty, an EA adopts a *precautionary approach* and *adaptive management*.[45]

Table 1. **Ecosystem Approach to Management: Key Concepts**

Holistic
Humans are part of the ecosystems
Integrated and coordinated management at multiple (nested) scales
Cumulative impacts
Inter and multi-disciplinary management
Multiple (ecological, social, economic) objectives
Sustainability
Maintain the structure and function of ecological systems to continue to provide ecosystem services
Appropriate spatial and temporal scales
Management decentralized at the lowest possible level
Best available (scientific, traditional, and local) knowledge
Monitoring
Transparent, participatory, and collaborative decision-making
Precautionary approach
Adaptive management

2.2. Ecosystem Approach to Aquaculture: History and Foundations

With EA becoming a paradigm for oceans and fisheries management, it is not surprising that it was explicitly developed to address sustainable management of aquaculture activities. The most influential work on ecosystem approach to aquaculture (EAA) has been conducted by the Food and Agriculture Organization of the United Nations (FAO). In 2006, FAO's State of World Fisheries and Aquaculture (SOFIA) Report addressed the sustainable growth and expansion of aquaculture and the need for an ecosystem

[45] CBD, Decision VII/11, *supra* note 21, Annex I, Table 1, Principle 9; UN, *supra* note 10, Part A, para 6(h).

approach.[46] The short publication stresses that the intensification of aquaculture demands more holistic and integrated approaches to aquaculture management consistent with a growing expectation for ecologically sustainable development. It provides a preliminary definition of EAA based on the definition of ecosystem approach to fisheries (addressed in next section), outlines developments that would facilitate the implementation of an EAA and identifies key challenges.

Also in 2006, during the third meeting of the Sub-committee on Aquaculture of the Committee on Fisheries, FAO member countries requested the FAO Department of Fisheries and Aquaculture to convene an expert consultation or workshop to address improved aquaculture planning and policy development, including enhanced socio-economic impacts of aquaculture.[47] The Aquaculture Management and Conservation Service of the FAO Fisheries and Aquaculture Department and the Universitat de les Illes Balears jointly organized an expert workshop on "Building an ecosystem approach to aquaculture", which was held in Palma de Mallorca in May 2007. Nineteen experts of 11 countries and one non-governmental organization (NGO) and three FAO experts participated in the workshop. Its proceedings were published in 2008.[48]

Building on the 2007 workshop, FAO published its Technical Guidelines No 5 Supplement 4 on the EAA in 2010.[49] Three further documents complete the five milestone FAO publications on EAA.[50] They address spatial planning using the EAA,[51]

[46] FAO, *The State of World Fisheries and Aquaculture 2006*, 76 (Rome: FAO, 2007) [hereinafter SOFIA 2006].
[47] D Soto, J Aguilar-Manjarrez, N Hishamunda, N (eds), *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings* No 14 (Rome: FAO, 2008) [hereinafter Soto et al, *Building an EAA*], at iv. See also: Cecile Brugère et al, "The ecosystem approach to aquaculture 10 years on: A critical review and consideration of its future role in blue growth" (2019) 11 Rev in Aquaculture 493; FAO Committee on Fisheries. Report of the third session of the Sub-Committee on Aquaculture. New Delhi, India, 4–8 September 2006.
[48] Soto et al, *supra* note 47.
[49] FAO, *Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010) [hereinafter FAO, EAA Technical Guidelines].
[50] Brugère et al, *supra* note 47, at 494-5.
[51] J Aguilar-Manjarrez, JM Kapetsky & D Soto, *The potential of spatial planning tools to support the ecosystem approach to aquaculture*. FAO/Rome. Expert Workshop. 19–21 November 2008, Rome, Italy. FAO Fisheries and Aquaculture Proceedings No 17 (Rome: FAO, 2010).

aquaculture governance and policy aligned with the principles of an EAA,[52] and site selection and carrying capacity for aquaculture development.[53]

FAO explicitly acknowledges that, in conceptualizing an EAA, it builds upon previous developments. One particularly relevant source of EAA is the FAO Code of Conduct for Responsible Fisheries (CCRF).[54] Indeed, EAA is presented as guidelines to support the implementation of articles 9 and 10 of the CCRF.[55] Other sources of EAA include the work of the CBD on EA (including the definition of EA, principles and means of implementation); FAO's technical guidelines on ecosystem approach to fisheries and subsequent work to support its implementation; and initiatives related to integrated natural resource management such as integrated coastal zone management (ICZM) or integrated watershed management.[56]

Other concepts put forward by previous or concurrent scholarship are linked to EAA. One of these concepts is "ecological aquaculture". Some authors understand EAA and ecological aquaculture to refer to the same concept,[57] while others consider EAA as the implementation strategy for ecological aquaculture.[58]

The model of ecological aquaculture is ancient and widespread in Asia, and its history in the Western world has been tracked back to 1976.[59] Barry Costa-Pierce defines it as an "alternative model of aquaculture development that uses ecological principles and

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[52] C Brugère et al, *Aquaculture planning: policy formulation and implementation for sustainable development*. FAO Fisheries and Aquaculture Technical Paper No 542 (Rome: FAO, 2010) [hereinafter Brugère et al, Policy Formulation].
[53] LG Ross et al, (eds), *Site selection and carrying capacities for inland and coastal aquaculture.* FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6–8 December 2010, Stirling, the United Kingdom of Great Britain and Northern Ireland. FAO Fisheries and Aquaculture Proceedings No 21 (Rome: FAO, 2013) [hereinafter Ross et al, Site selection].
[54] FAO Doc. 95/20/Rev/1; UN Sales No. E98.V.11 (1998); 1995 WTS 3 [hereinafter CCRF].
[55] FAO, EAA Technical Guidelines, *supra* note 49, at 1.
[56] *Ibid*, at 2.
[57] Ahmed et al explain that "EAA has also been termed 'ecological aquaculture' that encompasses integrated management of land, water and aquatic living resources for sustainability" (Nesar Ahmed et al, "Can greening of aquaculture sequester blue carbon?" (2017) 46 Ambio 468, at 470).
[58] Hui Liu & Jilan Su, "Vulnerability of China's nearshore ecosystems under intensive mariculture development" (2017) 24 Envtl Science and Pollution Research 8957, at 8959.
[59] Barry Antonio Costa-Pierce, "The Principles and Practices of Ecological Aquaculture and the Ecosystem Approach to Aquaculture" (2021) World Aquaculture 25 [hereinafter Costa-Pierce, Principles and Practices], provides an overview of the history of ecological aquaculture in Western world. Ecological aquaculture was the focus of a special session of the World Aquaculture Society in 1983. In 2002, Costa-Pierce published the book "Ecological Aquaculture" (Barry A Costa-Pierce, *Ecological aquaculture: the evolution of the blue revolution* (Oxford, UK; Malden, USA: Blackwell Science, 2002). In 2006, Laurence Hutchinson published *Ecological Aquaculture: A Sustainable Solution* (Permanent Publications, 2006).

practices as the paradigm for development of aquaculture systems".[60] More precisely, ecological aquaculture "plans, designs, develops, monitors and evaluates ocean/aquatic farming ecosystems that preserve and enhance the form and functions of the natural and social environments in which they are situated".[61] This conceptualization shares several core elements with FAO's EAA. A key difference, which is a matter of emphasis rather than substance, is that ecological aquaculture requires (rather than allows) designing aquaculture undertakings to "mimic the form and function of natural ecosystems"[62] using multi-trophic aquaculture or integrated agriculture-aquaculture.

The International Union for the Conservation of Nature (IUCN) has also developed and promoted the concept of EAA and ecosystem-based aquaculture. EAA is included in IUCN's 2009 Guide for the Sustainable Development of Mediterranean Aquaculture.[63] IUCN's Commission on Ecosystem Management established a special task force, the Ecosystem-based Aquaculture Group,[64] to foster the sustainable development of aquaculture and to promote the conservation of related marine and freshwater biodiversity. Specific projects undertaken by the task force include addressing sustainability of fish feed[65] and the opportunities and synergies of aquaculture and marine protected areas.[66] It has been noted that "IUCN's ecosystem-based approach to the management of aquaculture and ecosystems signals a (re)interpretation and adaptation"

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[60] Costa Pierce, Principles and Practices, *supra* note 59, at 25.
[61] *Ibid*, at 26.
[62] *Ibid*. Costa-Pierce adds that: "They are sophisticated, knowledge-based, designed farming ecosystems that are planned as combinations of land and water-based aquatic plant, agronomic, algal and animal subunits that are embedded in the larger context of social systems" (*ibid*).
[63] IUCN, Guide for the Sustainable Development of Mediterranean Aquaculture No 2: Aquaculture site selection and site management (Gland, Switzerland; Malaga, Spain: IUCN, 2009). See in particular Guide O on "The ecosystem approach" at 179. See also: IUCN, *Sustainability indicators for aquaculture sea cages in the Mediterranean* (Madrid, Spain: IUCN, 2011).
[64] IUCN, Ecosystem Based Aquaculture, online: https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-task-forces/ecosystem-based-aquaculture.
[65] See: IUCN, Sustainability of Fish Feed in Aquaculture: Reflections and Recommendations, online: IUCN <https://portals.iucn.org/library/sites/library/files/documents/2017-026-Summ.pdf> (accessed 27 December 2022)[Summary of the publication R Le Gouvello and F Simard (eds), *Durabilité des aliments pour le poisson en aquaculture: Réflexions et recommandations sur les aspects technologiques*, économiques, sociaux et environnementaux (Gland, Switzerland; Paris, France : IUCN, 2017)].
[66] See: Raphaëla le Gouvello et al, "Aquaculture and Marine Protected Areas: Exploring Potential Opportunities and Synergies" (2017) 27(S1) Aquatic Conserv: Mar Freshw Ecosyst 138; IUCN, *Aquaculture and Marine Protected Areas: Exploring Potential Opportunities and Synergies* (2017) (brochure, available online: IUCN https://www.iucn.org/sites/dev/files/content/documents/aquaculture_and_marine_protected_areas.pdf);

of FAO's EAA concept."[67] Arguably, the IUCN places a stronger emphasis on the ecological components of the aquaculture system compared with FAO's balanced consideration of EAA's ecological and social components. The same can be said about the European research project ECASA (Ecosystem Approach for Sustainable Aquaculture) implemented between 2004 and 2007.[68]

EAA has also been endorsed by U.S.A's National Oceanic and Atmospheric Administration (NOAA), which has formulated its own definition of EAA building on their definition of an ecosystem approach to fisheries management. Aligning closely to the elements of an ecosystem approach to management identified in the previous section, NOAA defines EAA as "a systematic method of managing aquaculture that: a) is in a geographically specified area; b) contributes to the resilience and sustainability of the ecosystem; c) recognizes the physical, biological, economic, and social interactions among the affected aquaculture-related components of the ecosystem, including humans; d) seeks to optimize benefits within a diverse set of environmental and social constraints; [and] e) is adaptive over time."[69]

Despite these alternative formulations for ecosystem approaches to aquaculture, the EAA literature refers mostly to FAO's publication on EAA, its definition and principles. Consequently, FAO's concept will be the foundation of this chapter.

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[67] Brugère et al, *supra* note 47, at 4.

[68] Soto et al, Building an EAA, *supra* note 47, at 86; ECASA, Ecosystem Approach to Sustainable Aquaculture, was a project financed by the European Union (Sixth Framework Programme Priority) executed between 2004 and 2007 with three objectives: (a) to identify quantitative and qualitative indicators of the effects of aquaculture on the environment and vice-versa, and to assess their applicability; (b) to develop operational tools, including models, to establish and describe the relationship between environmental conditions and aquaculture activities over a range of ecosystems and aquaculture production systems; and (c) to develop effective environmental impact assessment and site selection methods for coastal area management (ECASA, Final Report Summary, https://cordis.europa.eu/project/id/6540/reporting).

[69] Katherine A McGraw & Michael B Rust, "Defining an ecosystem approach to aquaculture (EAA) for federal waters in the United States" in Proceedings of the 45th US-Japan Cooperative Program in Natural Resources (UJNR) Aquaculture Panel Scientific Mini Symposium "Potential of aquaculture to mitigate impacts of environmental change" held in Hiroshima, Japan, 17-18 October 2017, published in Special issue of the Bulletin of Japan Fisheries Research and Education Agency, at 81 and 90, online: https://www.fra.affrc.go.jp/bulletin/bull/bull49/49-0511.pdf (accessed 13 September 2021).

2.3. FAO Technical Guidelines on EAA: General Description

The FAO Technical Guidelines is a 46 page document structured in 5 main sections: 1) Introduction; 2) The EAA in Practice: Preparation and Initiation; 3) Implementing the EAA: The Plan; 4) Monitoring and Evaluation, and 5) Future Developments. It also includes an Abstract, a Background section, References, and an Appendix.[70]

Section 1 introduces the concept of EAA by providing a definition, its objective or "aim", principles, and key components. Sections 2 and 3 address the practical implementation. These are the longest sections of the guidelines and include several "processes", "measures" and "tools". Section 4 addresses short and long-term monitoring in one short paragraph, compounding monitoring of particular sub-components of the ecosystem with a review strategy for the EAA plan itself. Section 5 is a one-page section that highlights challenges and further requirements for effective implementation.[71] A synthesis of the key elements of an EAA, as described in the Technical Guidelines, is presented next, followed by a critique of FAO's conceptualization of the approach.

2.3.1. Definition

FAO's 2006 SOFIA Report offered a first definition of EAA, building on the existing definition of EA to fisheries management. This descriptive definition states that EAA

> strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties of biotic, abiotic and human components of ecosystems including their interactions, flows and processes and applying an integrated approach to aquaculture within ecologically and operationally meaningful boundaries. The purpose of EAA should be to plan, develop and manage the sector in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by aquatic ecosystems.[72]

[70] The Appendix addresses Main potential effects and/or issues related to aquaculture inputs, resource use and outputs at different spatial scales.
[71] These include overcoming sectoral and intergovernmental fragmentation, the development of institutional mechanisms for effective coordination, tighter coupling of science, policy and management, and the need for further practical guidance on different implementation aspects.
[72] FAO, SOFIA 2006, *supra* note 46, at 79.

The experts working group meeting in Spain in 2007 agreed on a much shorter definition of EAA, building on the definition of EA provided by the CBD and principle 9 of the FAO CCRF.[73] It states that the EAA is a

> strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity and resilience of interlinked social-ecological systems.[74]

This definition was also included in FAO Technical Guidelines[75] and is most often cited in the literature.

A key element stressed in both definitions is the holistic nature of EAA. EAA calls for the integration of aquaculture within the wider ecosystem, considering all biotic, abiotic and human components. The reference to both ecological and social components (the "social-ecological system") and to present and future generations links EAA to the concept of sustainable development.[76]

2.3.2. Goals and Objectives

Throughout the Technical Guidelines, different aims, goals, and objectives are identified. At the most simple and synthetic level, the goal (or overall objective) of EAA is to "make the aquaculture sector more sustainable".[77] Brugère et al. word it as an "ambition" of EAA to "create the enabling environment necessary for the sustainable production and governance of aquatic ecosystems."[78]

The Technical Guidelines add that EAA is based on the principles of sustainable development, where "sustainable" is not restricted to ecological considerations but includes economic and social considerations and their interaction with ecological ones.[79] Thus, EAA has three main goals: 1) ensuring ecological well being; 2) ensuring human well being; and 3) facilitating the achievement of both (i.e. effective governance). Tett relates these dimensions of sustainable aquaculture to the concepts of environmental

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[73] Soto et al, Building an EAA, *supra* note 47, at 17.
[74] *Ibid*, at 17.
[75] FAO, EAA Technical Guidelines, *supra* note 49, at 2.
[76] *Ibid* at 22.
[77] *Ibid.*
[78] Brugère et al, *supra* note 47, at 500, citing FAO, *The State of World Fisheries and Aquaculture 2014* (Rome: FAO, 2014).
[79] FAO, EAA Technical Guidelines, *supra* note 49, at 2-3.

license, economic license, and social license, all of which are acquired and maintained in the context of an EAA.[80] Carrying capacity in its different forms (i.e. physical, production, ecological, and social carrying capacity) has also been associated to the different dimensions of aquaculture sustainability relevant for EAA.[81]

The definition of EAA adds two additional goals: EAA promotes equity and social-ecological resilience.[82] To add to the confusion, in the section addressing the "aim" of EAA, the Guidelines redefine the primary goal of EAA. This section states that the aim of EAA is to

> overcome the sectoral and intergovernmental fragmentation of resources management efforts and to develop institutional mechanisms for effective coordination among various sectors active in the ecosystems in which aquaculture operates and between the various levels of government. The two outcomes of this should be:
> (i) a "truly" sustainable aquaculture sector […]
> (ii) change in the public's (understood as broadly as possible) attitude and perception of aquaculture.[83]

Neither of these objectives, goals and aims, or their relationship among them, is dealt with more precision in the Guidelines. Implicitly, the guidelines consider all these concepts as complementary, if not synonymous.[84] This is an unsettled issue in the literature, however. For example, while some authors interpret the terms sustainability and resilience as complementary,[85] others consider them to be in tension with each other or outright incompatible and commanding different normative standards and legal

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[80] Paul Tett, "The Ecosystem Approach to Aquaculture" (Oban: Scottish Association for Marine Science, 2017).
[81] Ross et al, Site selection, *supra* note 53, at 22. See also: Jenny Weitzman & Ramón Filgueira, "The evolution and application of carrying capacity in aquaculture: towards a research agenda" (2020) 12 Rev in Aquaculture 1297.
[82] FAO, EAA Technical Guidelines, *supra* note 49, at 2.
[83] *Ibid*, at 5.
[84] Costa-Pierce, discussing principle 1 of EAA, notes that: "The key issue is to estimate resilience capacity, or the limits to 'acceptable environmental change'" and refers to various different terms that address those limits, including environmental carrying capacity, environmental capacity, limits to ecosystem functions, ecosystem health, ecosystem integrity, and fully functioning ecosystems (all of which are subject to a specific social/ cultural/political context). Barry A Costa-Pierce, "Sustainable Ecological Aquaculture Systems: The Need for a New Social Contract for Aquaculture Development" (2010) 44 Marine Technology Society Journal 88 at 92.
[85] Jennifer L Johnson et al, "Interplays of Sustainability, Resilience, Adaptation and Transformation", in Walter Leal Filho, Robert W Marans & John Callewaert (eds), *Handbook of Sustainability and Social Science Research* (Springer, 2018) 3.

interventions.[86] Some stated objectives (e.g. equity), are in turn a component of other stated goals (e.g. sustainable development and arguably resilience).[87]

The ambiguity of EAA's goal(s) can be considered an advantage, as it allows for a flexible interpretation and implementation that accounts for different local conditions, including legal mandates. However, as in the case of EA more broadly, the resulting ambiguity can also contribute to implementation challenges.

2.3.3. Principles

The FAO Guidelines identify three main guiding principles of the EAA which reflect the integration required for sustainable aquaculture management. These are:

> *Principle 1. Aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society.*
>
> *Principle 2. Aquaculture should improve human well-being and equity for all relevant stakeholders.*
>
> *Principle 3. Aquaculture should be developed in the context of other sectors, policies and goals.*

These three principles emphasize the holistic or integrative nature of the concept. For aquaculture to be integrated into the wider ecosystem, its planning and management needs to recognize, consider, assess (and valuate) all the subcomponents of the ecosystem: the ecological, the human (socio-economic), and other human activities that share resources and space.[88]

Principle 1: Aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society

[86] Robin Kundis Craig & Melina Harm Benson, "Replacing Sustainability" (2013) 46 Akron Law Rev 841.
[87] See: Johnson et al, *supra* note 85.
[88] "An ecological approach to aquaculture involves understanding that success depends on both biophysical and social linkages beyond the immediate production system" (Conner Bailey, "Human dimensions of an ecosystem approach to aquaculture" in Soto et al, *supra* note 47, 37 at 40).

Principle 1 affirms that sustainable aquaculture needs to be environmentally sustainable.[89] According to FAO, Principle 1 involves defining ecosystem boundaries (at least operationally), estimating some assimilative and production carrying capacities, and adapting farming practices accordingly.[90] Consistent with the holistic approach, an EAA ensures that aquaculture planning and management considers all interactions between aquaculture and the environment, at different scales. Brugère et al. note that this technical-ecological-biological component of EAA is the more prevalent in the literature, probably as a result of the practical "entry point" for EAA in environmental management and spatial planning as well as the general scarcity of social sciences literature on aquaculture generally[91] and for EAA in particular.[92]

The concept of ecosystem services is explicitly mentioned in Principle 1.[93] EA requires to consider and balance multiple ecosystem services, from provisioning (e.g. fish) to regulating services (e.g. protection from coastal erosion) and should provide special protection to ecosystem functions that are unique, essential or threatened.[94] The consideration of ecosystems services in principle 1 can be interpreted with two slightly different emphases, however.

On one hand, the FAO Technical Guidelines and other authors emphasize a passive interpretation of principle 1, directed to ensure that aquaculture activities do not have a detrimental effect on the structure and function of the ecological system in which it takes place or with which it interacts, and therefore does not threaten the sustained

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[89] Ecological sustainability as an important objective of EAA is also explicitly mentioned in NFMS's formulation of EAA: aquaculture and its management will contribute to the resilience and sustainability of the ecosystem. McGraw and Rust, *supra* note 69.

[90] FAO, EAA Technical Guidelines, *supra* note 49, at 5.

[91] See, eg Caitriona Carter, *The Politics of Aquaculture: Sustainability Interdependence, Territory and Regulation in Fish Farming* (London; New York: Routledge, 2018), at 1-2.

[92] The selected literature for the literature review includes only few articles by, or in cooperation with, social scientists, including economists. See, eg: Peter J Cranford et al, "An Ecosystem-based approach and management framework for the integrated evaluation of bivalve aquaculture impacts" (2012) 2 Aquaculture Environment Interactions 193.

[93] Grebe et al encapsulate the content of Principle 1 with the headline "ecosystem services" (Gretchen S Grebe et al, "An ecosystem approach to kelp aquaculture in the Americas and Europe" (2019) 15 Aquaculture Reports 100215).

[94] FAO, EAA Technical Guidelines, *supra* note 49, at 5; Costa-Pierce notes that the EAA plans, develops and manages the sector "in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by aquatic systems" (Barry A Costa-Pierce, "An ecosystem approach to marine aquaculture: a global review" in Soto et al, *supra* note 47, 81 at 82). See also: Pierre-Alexandre Willot et al, "Ecosystem service framework and typology for an ecosystem approach to aquaculture" (2019) 512 Aquaculture 734260.

delivery of ecosystem services[95] (or, in other words, to reduce negative externalities[96]). The Technical Guidelines make an explicit reference to the existence of "environmental limits" for aquaculture activities.[97] A key issue, in this respect, is to determine the acceptable limits of change,[98] a determination that has both science and policy components. EAA does provide the framework and process, i.e. the steps, for a science-based and participatory definition of acceptable limits to change. The precautionary approach is fleetingly mentioned in this context. Valuation of ecosystem services has been proposed as a tool to provide accurate forecast of the environmental and socio-economic impacts of aquaculture development and support decision-making within an EAA framework.[99]

Other authors adopt a more proactive interpretation, highlighting that aquaculture, when managed based on the EAA, has the potential to improve, enhance, increase the efficiency of or maximize[100] ecosystem services, including but not limited to food provisioning services[101] (in other words, to encourage positive externalities[102]). In this perspective, an EAA seeks to plan – engineer, even - aquaculture activities as a system that maximizes the multiple benefits that it provides to humans.[103] Proponents of this emphasis of EAA highlight aquaculture planning in the context of integrated aquaculture-

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[95] Jenny Weitzman et al, "Far-field and near-field effects of marine aquaculture" in Charles Sheppard (ed), *World Seas: An Environmental Evaluation Volume III: Ecological Issues and Environmental Impacts* (Elsevier, 2019) 197 at 197, states that EAA requires that aquaculture be developed with "no degradation of [ecosystems functions and services] beyond their resilience"; Carlos Molinet et al, "Relation of mussel spatfall on natural and artificial substrates: Analysis of ecological implications ensuring long-term success and sustainability for mussel farming" (2017) 467 Aquaculture 211; Doris Soto et al, "Addressing aquaculture-fisheries interactions through the implementation of the ecosystem approach to aquaculture (EAA)" in Rohana P Subasinghe et al (eds), *Farming the Waters for People and Food*. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand. 22–25 September 2010 (Rome; Bangkok: FAO; NACA, 2012).

[96] Brugère et al, Policy Formulation, *supra* note 52, at 32.

[97] FAO, EAA Technical Guidelines, *supra* note 49, at 3,9.

[98] *Ibid*, at 34; See also: Costa-Pierce, *supra* note 84; Cranford et al, *supra* note 92.

[99] Marco Custódio et al, "Valuation of Ecosystem Services to promote sustainable aquaculture practices" (2020) 12 Rev in Aquaculture 392; see also: Willot et al, *supra* note 94; Cranford, *supra* note 92.

[100] Willot et al, *supra* note 94. Ahmed et al call it increased ecosystem productivity (Ahmed et al, *supra* note 57, at 469; Costa-Pierce, *supra* note 84.

[101] Costa-Pierce, Principles and Practices, *supra* note 59; Costa Pierce, *supra* note 84; Custódio et al, *supra* note 99, identify different ecosystem services provided by aquaculture, including four provisioning services, six regulation services, and seven cultural services.

[102] Brugère et al, Policy Formulation, *supra* note 52, at 32.

[103] Costa Pierce, Principles and Practices, *supra* note 59, at 26, explicitly refers to designing and aquaculture systems that "mimic" the form and function of natural ecosystems, resulting in accelerated environmental profits. See also Costa-Pierce, *supra* note 84, at 90,

agriculture systems, integrated multi-trophic aquaculture,[104] and link it to concepts such as restorative aquaculture,[105] blue economy,[106] climate change mitigation[107] or adaptation,[108] and blue carbon.[109]

Principle 2: Aquaculture should improve human well-being and equity for all relevant stakeholders

The concept of sustainability in the EAA context "is not restricted to ecological considerations but includes economic and social considerations and their interactions with ecological ones."[110] This social component (closely linked to concepts such as the "human dimensions"[111] of EAA, "social justice"[112], "social license"[113], or "social carrying capacity"[114]) is considered a key consideration in the development of aquaculture strategies and policies.

Principle 2 of the EAA requires that aquaculture provides equitable opportunities for development; provides equitable sharing of its benefits; and does not result in undue detriment for any groups within society and particularly the most vulnerable.[115] It requires that "all the social costs and benefits be assessed as comprehensively as possible, taking into consideration the costs and benefits of other alternative activities".[116] It further requires that the resulting choices be made for the benefit of society as a whole, considering not only net benefits but also the distribution of costs and benefits.[117] It also acknowledges that EAA needs to consider the necessary trade-offs between social and

[104] Amir Neori et al, "The need for a balanced ecosystem approach to blue revolution aquaculture" (2007) 49 Environment: Science and Policy for Sustainable Development 36.
[105] The Nature Conservancy, *Global Principles for Restorative Aquaculture* (Arlington, VA: The Nature Conservancy, 2021), online: The Nature Conservancy <https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_PrinciplesofRestorativeAquaculture.pdf> (accessed 15 March 2023).
[106] Brugère et al, *supra* note 47, at 496.
[107] Eg Grebe et al, *supra* note 93.
[108] Brugère et al, *supra* note 47, at 496.
[109] Ahmed et al, *supra* note 57.
[110] FAO, EAA Technical Guidelines, *supra* note 49, at 2-3.
[111] Bailey, *supra* note 88.
[112] Grebe et al, *supra* note 93.
[113] Tett, *supra* note 80.
[114] FAO, EAA Technical Guidelines, *supra* note 49, at 43 and box 15 at 44.
[115] *Ibid*, at 5.
[116] *Ibid*, at 16.
[117] *Ibid*, at 38.

economic benefits and environmental costs,[118] as the biophysical or ecological dimension and the social dimension are tightly linked.[119]

Issues around social costs and benefits (human well-being) and the distribution of those costs and benefits (equity) that are explicitly addressed in the Technical Guidelines include economic benefits[120] such as entrepreneurial opportunities and employment generation, highlighting the need for fair wages, opportunities for small-scale farmers, and employment opportunities for local community members.[121] Also emphasized are food security,[122] diversification of livelihoods,[123] interactions with other sectors,[124] and the need to avoid negative impacts on the livelihoods of local communities.[125]

The social issues raised in the Technical Guidelines are generally echoed in the scholarship,[126] but without providing a deeper analysis. The operationalization of the social concerns in concrete instruments has also received limited attention. Environmental impact assessments (EIA) and strategic environmental assessments (SEA) that include social considerations are one proposed means of operationalization.[127] The consideration of socio-economic indicators and monitoring is explicitly mentioned.[128]

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[118] *Ibid*, at 7.
[119] *Ibid*, at 3. See also: *supra* note 88.
[120] *Ibid.*
[121] *Ibid*, Box 12 at 38. This objective was addressed at the Baleares workshop under the item "balances in wealth, income and power" with a stronger emphasis on power imbalance and potential consequences of inequitable distribution of benefits, ranging from illegal farming or fishing practices to violent acts.
[122] *Ibid*, at 6 (as key component of principle 2) and 15.
[123] *Ibid*, at 15 and Box 12 at 38.
[124] *Ibid*, at 15.
[125] *Ibid*, Box 12 at 38. It is worth noting that the Guidelines mention, among social indicators, some that refer to broader social issues that fall outside of the responsibilities of aquaculture management public sector, such as education and family home facility indicators (at 42).
[126] The Baleares expert workshop, in turn, had raised other issues within the social dimension of EAA that received limited attention in the Technical Guidelines: gender relations and infrastructural development (Bailey, *supra* note 88, at 41-42). The scholarship addresses equitable access rights (e.g. Ibon Galparsoro et al, "Global stakeholder vision for ecosystem-based marine aquaculture expansion from coastal to offshore areas" (2020) 12 Rev in Aquaculture 2061. The authors summarize principle 2 stating that EAA shall "improve human well-being with equity for all relevant stakeholders, including access rights and fair share of income"). Grebe et al, *supra* note 93, go even further and suggest that EAA "mandates" "equal access" for all stakeholders. Other authors stress that aquaculture development should not result in any loss to any group of society, especially the poor (e.g. Costa-Pierce, *supra* note 84). Two additional social benefits of EAA are highlighted: education, training, and knowledge dissemination and adaption to current and future climate change (climate resilience) (Grebe et al, *supra* note 93).
[127] FAO, EAA Technical Guidelines, *supra* note 49, at 28 and 34.
[128] *Ibid*, at 41 and box 12 at 42.

Community-based management has also been proposed as a tool to ensure the equitable distribution of benefits to the local communities.[129]

One aspect that is highlighted both in the Technical Guidelines and in the literature as necessary for the social dimension of EAA and the implementation of Principle 2 is to promote public participation in governance and decision-making processes.[130] Transparent and participatory decision-making is required to identify and prioritize issues,[131] define ecological, social and economic operational objectives,[132] and develop an implementation plan.[133] Participatory decision-making process will increase awareness of consequences and effectiveness of regulatory decisions,[134] ensure well-being,[135] reduce user conflicts,[136] and contribute to the social acceptability of aquaculture[137] (that is, it helps to acquire and maintain social license). Participatory processes for decision-making have been particularly recommended or required for aquaculture development plans,[138] spatial planning and zoning,[139] and site selection.

A key issue that needs to be addressed during EAA implementation is the scope of participation. As Ross et al, citing Little et al, note, "careful consideration must be given to who is encouraged and supported to participate, in what ways and for what specific purpose."[140] Generally, the scholarship recommends broad[141] (and to broaden[142])

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[129] Jessica Bradford, Ramón Filgueira & Megan Bailey, "Exploring community-based marine aquaculture as a coastal resource management opportunity in Nova Scotia, Canada" (2020) 5 Facets 26, argue that community-based aquaculture management has potential to bring equity into resource management and in this way, support the social dimension of EAA.
[130] FAO, EAA Technical Guidelines, *supra* note 49, in particular at 13. See also, eg: Bradford et al, *supra* note 129, Grebe et al, *supra* note 93; Costa-Pierce, *supra* note 84; Cranford et al, *supra* note 92.
[131] FAO, EAA Technical Guidelines, *supra* note 49, at 23. See also: e.g. Soto et al, *supra* note 47; Weitzman and Filgueira, *supra* note 81.
[132] FAO, EAA Technical Guidelines, *supra* note 49, at 22-23.
[133] *Ibid*, at 23.
[134] Costa-Pierce, *supra* note 84.
[135] Grebe et al, *supra* note 93; Bradford, Filgueira & Bailey, *supra* note 129.
[136] Bradford, Filgueira & Bailey, *supra* note 129.
[137] *Ibid*
[138] Costa-Pierce, *supra* note 84.
[139] Ross et al, Site selection, *supra* note 53; P Sánchez-Jerez et al, "Aquaculture's struggle for space: the need for coastal spatial planning and the potential benefits of allocated zones for aquaculture (AZAs) to avoid conflict and promote sustainability" (2015) 8 Aquaculture Environment Interactions 41.
[140] Ross et al, Site selection, *supra* note 53.
[141] Soto et al, *supra* note 47; Costa-Pierce, *supra* note 84.
[142] Soto et al, *supra* note 47, at 29.

public participation. The FAO Technical Guidelines provide a "guide" to stakeholder selection, including a list of criteria and examples of potentially relevant stakeholders.[143]

Principle 3: Aquaculture should be developed in the context of other sectors, policies and goals

Aquaculture does not occur in isolation.[144] It interacts with, and is embedded in, broader social-ecological system, not least of which because it uses and competes for valuable coastal and marine space. Principle 3 recognizes the "interactions between aquaculture and the larger system", and in particular "the influence of the surrounding natural and social environments on aquaculture practices and results".[145]

Principle 3 can be considered to comprise two main aspects. One is the integration of the activity itself (i.e. the aquaculture activity) to other sectors, through institutions such as agriculture-aquaculture, or fisheries-aquaculture.[146] FAO notes that the principle "acknowledges the opportunity of coupling aquaculture activities with other production sectors to promote materials and energy recycling and better use of resources in general."[147] The second is governance integration (i.e. integration of policies and goals), that is, the integration of aquaculture planning and management with other legitimate stakeholders and users of the natural environment, to avoid negative feedbacks and conflict and to improve synergies between aquaculture and other sectors.[148] The governance integration entails coordination of institutions, of overarching objectives (policies and goals), and the use of appropriate regulatory tools (such as in integrated coastal zone management or marine spatial planning).

2.3.4. Cross-cutting Components

The FAO Technical Guidelines highlight cross-cutting elements that are at the core of EAA, consistent with the principles of EA included in section 2.1, although it does not refer to them as "principles." The most important element of an EAA is its holistic or

[143] FAO, EAA Technical Guidelines, *supra* note 49, at 13.
[144] Costa-Pierce, *supra* note 84.
[145] FAO, EAA Technical Guidelines, *supra* note 49, at 6.
[146] Costa-Pierce, *supra* note 94.
[147] FAO, EAA Technical Guidelines, *supra* note 49, at 6.
[148] Soto et al, *supra* note 47; Ross et al, Site selection, *supra* note 53; Costa-Pierce, *supra* note 84.

integrative nature. The previous section has addressed integration of aquaculture management to the ecological system, the social system, and to the human activities that share resources or space with aquaculture. Stakeholder and public participation were also highlighted in the discussion of Principle 2. The importance of collaboration and institutional, policy and regulatory coordination, cooperation and integration were addressed in the discussion of Principle 3. Other key elements include: a) spatial and temporal scales; b) use of best available information; and c) precaution and adaptive management.

a) Spatial and Temporal Scales

The Technical Guidelines explicitly acknowledge the need to address aquaculture planning and management in the context of, and cognizant of, the different spatial, temporal, and political scales in which aquaculture interacts with the ecological and social systems in which it develops.[149] It identifies three different spatial scales: farm; watershed (aquaculture zone, geographic region); and global.

Spatial scales are relevant in the definition of the system's spatial boundaries in which an EA-based strategy is designed and implemented, whether it is the whole country, a region, or a specific aquaculture system within the country or region.[150] Considering that ecosystems are open systems, defining boundaries for implementation of an EAA is a difficult task that shall be guided based on geological, physico-chemical, biological, ecological, socio-economic and administrative factors. While correspondence between ecological boundaries and socio-economic and administrative boundaries is desirable, that is not usually the case. Furthermore, in some cases there is a need for transboundary management, which adds a "political scale" in implementation efforts.

EAA also requires an understanding of the effects of aquaculture at different spatial scales in order to plan and manage the activity at the appropriate level.[151] Furthermore, aquaculture planning and management should consider that ecosystems are

[149] FAO, EAA Technical Guidelines, *supra* note 49.
[150] FAO, EAA Technical Guidelines, *supra* note 49; Ross et al, Site selection, *supra* note 53; Grebe et al, *supra* note 93; Cranford et al, *supra* note 92.
[151] Brugère et al, *supra* note 47.

nested.[152] The farm scale is the most studied scale[153] and where most of the pollution impacts of an individual farm can be detected. However, the increasing size and intensity of aquaculture production makes it possible that individual farms have effects at the regional or waterbody level (ecosystem or far-field effects).[154] Watershed/regional assessment and planning is relevant for some ecological (i.e. disease) and social (i.e. user conflict) concerns[155] as well as cumulative impacts.[156] The effects at watershed level are more difficult to establish due to the complexity of interactions.[157] However, moving from traditional near-field to far-field assessment and monitoring is considered a key requirement, and challenge, for implementing a holistic EAA.[158] The global scale, also referred to as the "market-trade scale",[159] relates to the international trade of commodities, including feed.

The Guidelines also acknowledge that aquaculture planning and management needs to be cognizant of the temporal dimension of social-ecological system. Ecosystems can be affected by external forcing factors (population growth, global trade, climate change) that create constant changing conditions and permanent uncertainty. Thus long-term objectives and monitoring are considered requirements for EAA.[160]

b) Evidence-based (Use of Best Available Information)

Another pillar of the EAA (a "fundamental element") is the collection and use of best available information[161] in the development of an EAA strategy, including scientific,

[152] Willot et al, *supra* note 94.
[153] Daniele Brigolin et al, "Modelling biogeochemical fluxes across a Mediterranean fish cage farm" (2014) 5 Aquaculture Environment Interactions 71; Ross et al, Site selection, *supra* note 53.
[154] Costa-Pierce, *supra* note 84.
[155] *Ibid*.
[156] Brigolin et al, *supra* note 153.
[157] Weitzman et al, *supra* note 95.
[158] Eg, Costa-Pierce, *supra* note 84; Ramón Filgueira et al, "Inferring the potential for nitrogen toxicity on seagrass in the vicinity of an aquaculture site using mathematical model" (2021) 282 J of Envtl Management 111921; Lynne Falconer et al, "Using physical environmental parameters and cage engineering design within GIS-based site suitability models for marine aquaculture" (2013) 4 Aquaculture Environment Interactions 223; Leigh Michael Howarth et al, "Using macroalgal bioindicators to map nutrient plumes from fish farms and other sources at a bay-wide scale" (2019) 11 Aquaculture Environment Interactions 671.
[159] Cranford et al, *supra* note 92.
[160] FAO, EAA Technical Guidelines, *supra* note 49, at 27.
[161] *Ibid*, at 8. See also: Cranford et al, *supra* note 92; José Aguilar-Manjarrez, Doris Soto & Randall Brummett, *Aquaculture zoning, site selection and area management under the ecosystem approach to*

traditional and local knowledge.[162] EAA has been characterized as a "knowledge-based" enterprise.[163] This element is further reinforced with the development of long-term goal-oriented research and dissemination of knowledge that considers both ecosystem functioning/services and human components of ecosystems.[164]

c) Precautionary Approach and Adaptive Management

The precautionary approach is mentioned in the Guidelines as a core element of an EAA. Precautionary approach is mentioned nine times, in three specific contexts: as a principle to be implemented when scientific information is incomplete;[165] in the context of defining acceptable limits to change (noting that there are different perspectives on an adequate level of precaution); and in relation to the introduction of species to natural environments. The academic literature also emphasizes the importance of implementing a precautionary approach considering the complexity of ecosystems.[166] The implementation of a precautionary approach, and precautionary thresholds, is considered an important step in ensuring ecological resilience. It is argued as well that precautionary approaches will promote social acceptability of the industry.[167] Costa-Pierce warns, however, that precaution is often inadequate and misused by decision-makers.[168]

Adaptive management receives scarce attention in FAO's technical guidelines, with only two mentions. However, adaptive management is implicit in the implementation "cycle" of an EAA strategy, constructed on the premise of periodic short- and long-term review of EAA implementation coupled with adjustment of priorities, objectives, and measures. The academic literature, in turn, recognizes adaptive management as a component of EAA (and EBM more generally)[169] and necessary in the context of complex and dynamic social-ecological systems. Brugère et al argue that a

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aquaculture. Report ACS113536 (Rome: FAO and Washington, DC: World Bank Group, 2017); Weitzman and Filgueira, *supra* note 81.

[162] FAO, EAA Technical Guidelines, *supra* note 49 at 2.

[163] Costa-Pierce, *supra* note 84.

[164] FAO, EAA Technical Guidelines, *supra* note 49 at 27.

[165] See also Grebe et al, *supra* note 93.

[166] Eg, Weitzman & Filgueira, *supra* note 81.

[167] Sánchez-Jerez et al, *supra* note 139.

[168] Costa-Pierce, *supra* note 84.

[169] Brugère et al, *supra* note 47; Bradford, Filgueira & Bailey, *supra* note 129; Willot et al, *supra* note 94; Costa-Pierce, *supra* note 84; Soto et al, *supra* note 47; Weitzman and Filgueira, *supra* note 81.

revitalised EAA needs to build in considerations for flexible and adaptive management under a range of scenarios at the local planning level.[170] Key components of adaptive management include monitoring at appropriate scales, defining limits to acceptable change, and relying on flexible management approaches with the ability to adapt to new information and to a changing climate.[171]

2.3.5. Implementation

The Technical guidelines address the implementation of EAA, based on implementation paradigms for EAFM. The relevant sections are particularly confusing, as they compound objectives, principles, processes and practical tools and measures. The content can be organized under three headlines: the minimum requirements for EAA, the process, and measures and tools.

The Technical Guidelines discuss the *minimum requirements* for implementing an EAA in section 3, which are necessary foundations that allow and facilitate its implementation. These necessary foundations relate to knowledge, human capacity, institutional arrangements, and legal framework. The two latter will be addressed in more detail below.

A general *process* for implementing the EAA is presented, following closely the framework provided for the implementation of EAF. This framework identifies steps for aquaculture planning and management based on an EAA: defining/identifying high level policy goal(s); identifying and prioritizing issues (with the use of risk analysis methods); defining operational objectives (encompassing economic, ecological, and social aspects); and drafting an implementation plan with both short and long-term feedback loops to refine the implementation plan and high-level policy goals, considering monitoring of relevant indicators. According to FAO, the process should consider different geographical (farm, watershed, global) and temporal scales. The literature does not address implementation *processes* for EA to aquaculture management.[172]

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[170] Brugère et al, *supra* note 47.
[171] Eg Sánchez Jerez et al, *supra* note 139.
[172] Brugère et al, *supra* note 47, at 498-499. This observation is consistent with the findings of the literature review performed for this chapter.

Finally, the Technical Guidelines further address management *measures* and *tools* that can facilitate the implementation of EAA, albeit not in a very systematic manner. Broadly, they can be conceptualized as regulatory measures and tools (i.e. measures recognized in legal instruments) or practical tools (i.e. technical solutions or applications, or "hardware" and "software").[173] The practical tools have benefited from a significant contribution of the academic literature addressing EAA, particularly in recent years. A synthesis of those tools and measures is provided in table 2.

Table 2. **Measures and Tools for Implementing EAA**[174]

Regulatory Measures and Tools	Practical Measures and Tools
Sectoral Integration	
Strategic environmental assessment	Modelling
Environmental impact assessment	Indicators of impact
Monitoring obligations	Thresholds of acceptable impacts
Co-management	Monitoring
Environmental quality standards and ecologically quality objectives	Carrying capacity (production, ecological, social carrying capacity)
	Risk assessment
	Integrated multitrophic aquaculture
Spatial Planning Tools	
Zoning	Mapping
ICZM	GIS
MSP	
Management areas	
Zones of influence	

[173] See Paul Tett, "The Ecosystem Approach to Aquaculture and Spatial Planning" (2008), online: AquaSpace <http://www.aquaspace-h2020.eu/wp-content/uploads/2018/04/AquaSpaceMM-02-EAA-MSP-5Apr18.pdf> (accessed 26 October 2022).

[174] See, eg: FAO, EAA Technical Guidelines, *supra* note 49; Jorge Bermúdez, "Legal Implications of an Ecosystem Approach to Aquaculture" in Soto et al, *supra* note 47, 67 [hereinafter Bermúdez, Legal implications]; Jorge Bermúdez, "Legal and policy components of the application of the ecosystem approach to aquaculture to site selection and carrying capacity" in L Ross et al, Site selection, *supra* note 53, 117 [hereinafter Bermúdez, Legal and policy components]; Tett, *supra* note 173; Sánchez-Jerez et al, *supra* note 139; Ross et al, Site selection, *supra* note 53; Galparsoro et al, *supra* note 126 ; Richard A Corner et al, "Multi-stakeholder perspectives on spatial planning processes for mariculture in the Mediterranean and Black Sea" (2020) 12 Rev in Aquaculture 347; Francisco Bravo & Jon Grant, "Modelling sediment assimilative capacity and organic carbon degradation efficiency at marine fish farms" (2018) 10 Aquaculture Environment Interactions 309; Dror Angel and Shirra Freeman, "Integrated aquaculture (INTAQ) as a tool for an ecosystem approach to the marine farming sector in the Mediterranean Sea" in D Soto (ed), *Integrated mariculture: a global review*. FAO Fisheries and Aquaculture Technical Paper No 529, 133 (Rome: FAO, 2009).

2.4. Critical Assessment: What Role for EAA?

The Technical Guidelines had the ambition of providing a general framework for the implementation of EAA and for the promotion of enhanced sectoral management at different scales,[175] but it has reportedly fallen short.[176] Undoubtedly, there are several reasons for the lag in implementation, some of which result from the complexity of the concept of ecosystem approach to management itself. Indeed, similar assessments have been made for EAF despite its much longer history.[177] However, I argue that the Technical Guidelines are partly responsible because they fail to clearly delineate the concept of EAA and its scope. I support this assessment in the conclusions and statements made by some of the participants of the Expert Consultation reflected in a retrospective review of EAA.[178] These statements relate to the relationship between EA and EBM, the different understandings of EAA, and the discussion of alternative ocean policy concepts.

Despite unambiguous declarations in the Guidelines (see below), Brugère et al. note that the 2016 FAO Report on the State of Fisheries and Aquaculture treats EAA as a sectoral management approach under the multisectoral umbrella of EBM and lament that this accounts to a "downgrading" of the EAA and a departure of the "initial ambitious and holistic remit and aspirations of the concept."[179] Brugère et al. point out that this highlights an interesting conceptual discussion around those terms and their relationship.

The authors also conclude that there is no "completely uniform understanding of what the EAA is, what it entails and what it can be used for."[180] Two main understandings of EAA are identified in their systematic literature review. One understanding treats EAA in conceptual terms, as a guiding principle or strategy to

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[175] FAO, EAA Technical Guidelines, *supra* note 49, at 46.
[176] Brugère et al., *supra* note 47; Costa-Pierce, Principles and Practices, *supra* note 59.
[177] See, eg: Bianca Haas et al, "Factors influencing the performance of regional fisheries management organizations" (2020) 113 Marine Policy 103787; Maria José Juan-Jordá et al, "Report card on ecosystem-based fisheries management in tuna regional fisheries management organizations" (2018) 19 Fish and Fisheries 321; Jason S Link et al, "Changing how we approach fisheries: A first attempt at an operational framework for ecosystem approaches to fisheries management" (2020) 21 Fish and Fisheries 393. More broadly, the lack of implementation of an ecosystem-based management has also been noted (see, eg: Murray A Rudd et al, "Ocean Ecosystem-Based Management Mandates and Implementation in the North Atlantic" (2018) 5 Frontiers in Marine Science, https://doi.org/10.3389/fmars.2018.00485).
[178] Brugère et al, *supra* note 47.
[179] *Ibid*, at 504.
[180] *Ibid*.

conceptualize the development of the sector.[181] The second understanding of EAA considers it in practical terms, as a tool for the sustainable *management of aquaculture projects,* mostly operationalised through existing regulatory tools for coastal and aquaculture management (the "entry points" in Brugère et al study): spatial planning, site selection, and zoning.

Brugère et al. also note that there is "lack of uptake" of the EAA, especially at the governance level. Exploring this observation, the authors note (and lament) that EAA may be losing ground to other policy developments, in particular blue growth strategies.[182] The authors note that for EAA to remain relevant, it would need to focus on the local planning level rather than the "high-level governance dimension" where other non-sectoral approaches may be better suited.[183]

The comments in Brugère et al. reflect a profound ambiguity in the meaning and scope of an EAA that deserve some critical comments. There is a need to explore the ambitious aspiration of EAA acting as a "high level governance" policy akin to (or even a substitute for) ecosystem-based management or Blue Growth Strategies. I argue that such aspiration is an overreach of the concept of ecosystem approach to aquaculture management.

EAA is, in name and by definition, a sectoral implementation of an ecosystem approach. The technical guidelines acknowledge its sectoral nature explicitly: it stresses that the guidelines have a sectoral perspective.[184] The EAA places high value in the integration principle, as it is sectoral planning and management that is coordinated, consistent and/or cognizant of other sectors affecting, or being affected by, common elements in the system.[185] Nevertheless, it applies to those aspects that are within the ability of the aquaculture sector to change or modify.[186]

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[181] Authors that lean on this understanding of EAA focus on broad policy issue such as food security. Eg, Miao Weimin, "Recent developments in rice-fish culture in China: A holistic approach for livelihood improvement in rural areas" in Sena S De Silva & F Brian Davy, *International Development Research Centre, and Network of Aquaculture Centres in Asia-Pacific, Success Stories in Asian Aquaculture* (Ottawa; Bangkok; Dordrecht; New York: Springer, 2010).
[182] Costa-Pierce, *supra* note 94.
[183] Brugère et al, *supra* note 47, at 505, 509.
[184] FAO, EAA Technical Guidelines, *supra* note 49 at 3.
[185] *Ibid*; see, in particular Principle 3 at 6.
[186] *Ibid*.

Brugère et al note that there is an interesting conceptual discussion to be had analyzing the concept of EAA and EBM. This conceptual discussion has a precedent in the conceptualization of EAF and ecosystem-based management referred to in section 2.1 in this chapter. In that context, there is an increasingly accepted understanding that both terms have distinct meanings but lie in an integration continuum: ecosystem-based management is a multi-sectoral place-based management (i.e. the management of all human interventions in an ecosystem with ecologically meaningful boundaries), while an ecosystem approach refers to a sectoral management that addresses broader ecosystem issues and relationships (or a framework to address and manage complex systems).[187] It is also broadly accepted that EBM does not render sectoral management irrelevant or superfluous.[188] Even within a fully integrated EBM, sectoral management consistent with the broad outlines of EBM would still be required.

Similarly, the stated aspiration of EAA to act as a high-level governance policy can be questioned. As noted in the introduction to this chapter, the EA originated with a strong spatial focus – it requires the management of an activity to consider the other elements of the ecosystems *within geographically defined boundaries*. While some definitions of EA may not include this element explicitly or may not require a strict definition of boundaries, it is still management of an objective entity: a particular fishery considering its distribution range, a forest, a watershed, or a wetland.

This spatial element that links EAA to a specific and defined physical environment and its living and non-living components was also included in the first definition of EAA developed by FAO. This definition highlighted that EAA operates within *ecologically and operationally meaningful boundaries*. The working definition provided by NOAA also puts place-based management at the center of EAA.

As noted, Brugère *et al*. conclude that EAA should focus on local planning level rather than the high-level governance dimensions where other approaches appear more suited. It can be argued that this is the sphere of influence of EAA in the first place. This Dissertation adopts, therefore, this arguably narrower but also more practical understanding of EAA as a place-based and multi-dimensional concept that focuses on

[187] FAO, SOFIA 2016, *supra* note 17, at 85; Link and Browman, *supra* note 17.
[188] FAO, SOFIA 2016, *supra* note 17, at 85.

aquaculture interactions (externalities) within defined and nested ecosystems, focusing on farm and watershed (rather than global) level.

Two further comments regarding the narrower understanding of EAA are warranted. One appears rather obvious: understanding EAA as a place-based management of aquaculture does not mean that national and general policies are irrelevant. Indeed, high level policies (and, as will be argued in this Dissertation, legal rules) should enshrine the principles, structures, and processes necessary for an EA to aquaculture management.

The other observation is more nuanced and conjectural, addressing the reason Brugère et al. would consider that EAA *should* encompass multiple sectors (as required by EBM) or *should* serve as a high-level planning strategy competing with (rather than complementing) policies such as Blue Growth initiatives. It can be argued that EAA *needs* high-level, multi-sectoral ocean policies and planning to be implemented, or at least to be implemented fully. For example, it can be argued that EAA (and particularly principle 3 of EAA) can only be realized effectively in the context of non-sectoral (i.e. multi-sectoral or holistic) planning initiatives such as marine spatial planning or integrated coastal zone management. Similarly, Principle 1 of the EAA requires the definition of "environmental limits" (i.e. limits to acceptable change) for the ecological sub-components of the system (e.g. wild stocks, marine mammals, water quality). These definitions, however, may fall outside of the aquaculture planning and management sector. In the absence of a robust ocean governance and management framework, the effective fulfilment of the principles of EAA may be, at the very least, more difficult. Of course, a robust ocean governance and management framework benefits all marine sub-sectors. However, it is the diversity and complexity of pathways of interactions between aquaculture and other components of the marine system that increases the dependence on broader ocean management institutions. This aspect of EAA will be explored further in this Dissertation.

2.5. Legal and Institutional Components

The minimum requirements for EAA implementation considered in the FAO Guidelines include enhanced institutional arrangements and an adequate legal framework. Meeting

this requirement is, however, an outstanding challenge. Inadequate legal and institutional frameworks have been identified as a major barrier for EAA implementation and sustainable aquaculture development. [189] Key identified legal challenges include legal and institutional fragmentation, farm-by-farm regulatory approaches to siting and management, and reliance on technical regulations that perpetuate compartmentalized, sectoral, and rigid decision-making inconsistent with the holistic imperative of an EAA.[190]

The question that follows is, then: what are key requirements for a legal and institutional framework supportive of an EAA and sustainable aquaculture? Identifying these key law and policy coordinates for EAA implementation is not an easy task. Indeed, Bermúdez notes that "the translation of such a complex aim [the aims of EAA], into specific legal terms is quite complicated, in particular when taking into consideration the diversity of aquaculture activities."[191] The Technical Guidelines provide few answers to this question, while the Baleares workshop addressed it in more detail.[192]

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[189] Brugère et al, *supra* note 47; Costa-Pierce, Principles and Practices, *supra* note 59; Laura Steeves & Ramón Filgueira, "Stakeholder perceptions of climate change in the context of bivalve aquaculture" (2019) 102 Marine Policy 121.

[190] FAO, EAA Technical Guidelines, *supra* note 49, at 5, states that: EAA seeks to overcome "the sectoral and intergovernmental fragmentation of resources management efforts and to develop institutional mechanisms for effective coordination among various sectors active in the ecosystem in which aquaculture operates and between the various levels of government". Brugère et al note the challenges of institutional and legal fragmentation in most (if not all) jurisdictions, with multiple agencies responsible of a variety of decision-making processes and controls (Brugère et al, *supra* note 47, at 506). They further identify the following barriers to EAA: "legislative and regulatory issues, ineffective interagency integration and coordination, financial constraints, lack of human resources, and an ambiguity in the perceived benefits of these approaches by administrators and producers alike" (*ibid,* at 499-500). See also: Costa-Pierce, Principles and Practices, *supra* note 59, at 30. Bermúdez highlights the need for comprehensive, flexible and regional approaches to aquaculture management. He notes the challenge of considering environmental consciousness, socioeconomic equity, and interaction of sectors (Bermúdez, "Legal Implications", *supra* note 174, at 77). He further notes "the effectiveness of general solutions and the need to adapt to specific conditions" is a challenge for legal solutions (*ibid*). He also notes that site-by-site regulatory mechanisms ignore that many of the major concerns of aquaculture involve regional or cumulative impacts (Bermúdez, "Legal and policy components", *supra* note 174, at 120).

[191] Bermúdez, "Legal Implications", *supra* note 174, at 74-75.

[192] *Ibid*. The broader literature on EAA does not provide substantive insights on the legal implications of EAA. Social sciences, and particularly legal scholarship, for aquaculture management is underrepresented (Brugère et al, *supra* note 47; Carter, *supra* note 91; Gesche Krause et al, "A revolution without people? Closing the people-policy gap in aquaculture development" (2015) 447 Aquaculture 44). For another useful resource, see: Brugère et al, Policy Formulation, *supra* note 52. The legal literature on aquaculture does not address EAA directly; however, that work is also helpful in delineating legal implications for EAA (see, in particular, David L VanderZwaag & Gloria Chao (eds), *Aquaculture Law and Policy: Towards Principled Access and Operations* (London; New York: Routledge, 2006); Nigel Bankes, Irene Dahl & David L VanderZwaag, *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham,

A first aspect highlighted in the legal scholarship is the need for national legislation to be consistent with, and implement, international environmental law,[193] including principles of international environmental law[194] and obligations under environmental agreements.[195] Non-binding instruments reflecting widely endorsed societal values can also be influential as they provide insights into best environmental practices.[196]

A second issue highlighted is the need to ensure coherence (integration) of national legislation. Indeed, Bermúdez notes that the "[l]egal issues linked to aquaculture are quite diverse. (…) This means that many aspects are covered by different areas of law, e.g. environmental protection, public health, trade, property, land use, planning, animal health."[197] It is important, therefore, that the legal frameworks applicable to aquaculture (often included in a diversity of non-sectoral instruments) are consistent.[198] It is also important that the legislation and aquaculture policies are coherent and mutually supportive.[199] The imperative for coherent national legislation would be facilitated with broad and flexible legislative approaches (or "more general perspective of legislation"[200]) as a means to allow a better integration with other sectoral legislation.[201]

Furthermore, the literature calls for legal frameworks to recognize EAA explicitly, the three dimensions of EAA, or to provide indirect support to key success

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UK; Northampton, USA: Elgar, 2016), in particular Chapter 19 on Conclusions: A Summary of Common Themes)

[193] Bermúdez, Legal implications, *supra* note 174, at 68ff.

[194] Bermúdez, *ibid*, identifies the following principles relevant mostly to Principle 1 on ecological wellbeing: sovereignty over natural resources and the responsibility not to cause damage to the environment of other states or to areas beyond national jurisdiction; principle of preventive action; precautionary principle; responsibility or polluter pays principle; cooperation principle; sustainable development; principle of common but differentiated responsibility.

[195] *Ibid*; Cranford et al, *supra* note 92, at 195, note that "international environmental conservation and protection legislations pertaining to the utilization of coastal areas generally reflect societal values, and an analysis of pertinent policy statements can provide useful insights towards identifying regulatory triggers/thresholds".

[196] Cranford et al, *supra* note 92.

[197] Bermúdez, Legal implications, *supra* note 174, at 72.

[198] *Ibid*, Box 6 at 74. Brugère et al, Policy Formulation, *supra* note 52, Box 4 at 32: "non-aquaculture-specific legislation should be considered for its support or hindrance to aquaculture policy implementation…".

[199] Brugère et al, Policy Formulation, *supra* note 52, at 31. Brugère et al note, however, that not all policy initiatives need to be "hardwired" into formal legislation (*ibid*).

[200] Bermúdez, Legal implications, *supra* note 174, at 76.

[201] *Ibid*; Brugère et al, Policy Formulation, *supra* note 52, Box 4 at 32.

factors.[202] Success factors cited in the literature include decentralization of decision-making, developing monitoring systems and data repositories, and promoting human capacity, financial resources, scientific research, and enforcement capabilities.

Institutional coordination and cooperation are also crucial components of enhanced legal and institutional frameworks.[203] New institutional arrangements are required that reflect new ways of interaction between public institutions at different jurisdictional level (vertical and horizontal integration), and between public institutions and private organizations (e.g. co-management arrangements and multi-stakeholder processes).[204]

Legislation should enshrine enhanced decision-making processes and principles. Participation is highlighted both in the development and implementation of legislation supporting sustainable aquaculture policies.[205] In this context, transparency of regulatory frameworks and communication of consequences and effectiveness of regulatory decisions are also highlighted.[206] Considering that EAA calls for trade-offs between multiple regulatory objectives, it also calls for institutional and procedural dispute resolution mechanisms.[207] The need to streamline legislative and administrative procedures and to promote good practices and soft law is recognized.[208]

Ensuring security and enforceability of rights is also highlighted as a key element of aquaculture legal frameworks ("legally binding and fair regulation and allocation of user rights").[209] This aspect is mostly focuses on legal certainty for fish farmers, in the context of economic well-being. It is equally important, however, for competing activities and interests, contributing to social wellbeing and acceptability.

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[202] FAO, EAA Technical Guidelines, *supra* note 49 at 24; Brugère et al, Policy Formulation, *supra* note 52, Box 4 at 32.
[203] FAO, EAA Technical Guidelines, *supra* note 49 at 25-26.
[204] Bermúdez, "Legal and policy components" *supra* note 174, at 125.
[205] Brugère et al, *supra* note 47; Cranford et al, *supra* note 92.
[206] Brugère et al, Policy Formulation, *supra* note 52, at 33; Cranford et al, *supra* note 92.
[207] Brugère et al, Policy Formulation, *supra* note 52, Box 4 at 32.
[208] *Ibid*, at 33; Corner et al, *supra* note 174.
[209] Brugère et al, Policy Formulation, *supra* note 52, Box 4 at 32; Aguilar-Manjarrez, Soto & Brummett, *supra* note 161, at 4.

Brugère et al, in the context of an "invigorated" EAA, highlight flexible and adaptive management under a range of scenarios.[210] A broad and flexible framework enables a "choice over strategic options, with detailed mechanisms set out in regulation" than can be changed if necessary.[211] Further on flexibility, authors recommend the periodic review of legislation and regulation to assess its relevance and effectiveness.[212]

The more distinctive legal implication of EAA is the need to transition from (or at least complement) reactive, "farm-by-farm" regulatory approaches to proactive, regional approaches more suited to address ecological (far-field) effects of fish farming as well as cumulative effects.[213] The relevance of scale is also highlighted by recommendations of decentralization of decision-making authority. "[I]t is expected that the institutional or governmental structures should be compatible with the multiple level of decision required to address" aquaculture interactions.[214]

Regulatory tools available to facilitate the implementation of objectives and guidelines described above were highlighted in Box 2.2. It is worth mentioning that the official FAO documents do not mention marine spatial planning directly,[215] and only briefly mention integrated coastal management.[216]

The key institutional and legal issues identified and briefly summarized above provide some insights for designing a legal framework supportive of EAA. Nevertheless, the existing literature does generally not explore in depth how those aspects can be considered in legal and institutional frameworks, nor how existing legal frameworks for aquaculture comply or fall short with those requirements. The next chapter will explore

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[210] Brugère et al, *supra* note 47, at 509 ; Brugère et al, Policy Formulation, *supra* note 52, at 31 note that "[i]t may also be appropriate to have an overriding national framework/legislation and then local community management norms/rules to reflect different situations".

[211] Brugère et al, Policy Formulation, *supra* note 52, Box 4 at 32. See also: Bermúdez, Legal implications, *supra* note 174.

[212] Brugère et al, Policy Formulation, *supra* note 52, at 32, noting that this review would "lessen the likelihood of overlapping laws, regulations and jurisdictions that contribute to inefficiency and bureaucratic rigidity".

[213] Bermúdez, "Legal and policy components", *supra* note 174, at 120,121 and 125.

[214] *Ibid*, at 125.

[215] Marine spatial planning and its relationship with EAA was addressed in the broader literature on EAA. See, eg: Sánchez-Jerez et al, *supra* note 139; Ramón Filgueira, Jon Grant & Øivind Strand, "Implementation of marine spatial planning in shellfish aquaculture management: modeling studies in a Norwegian fjord" (2014) 24 Ecological Applications 832.

[216] Bermúdez, Legal implications, *supra* note 174, Box 7 at 75.

the legal requirements for an EAA in more detail, drawing from a literature review of the scholarship on law and ecosystems.

CHAPTER 3. ECOSYSTEMS AND THE LAW

The FAO Technical Guidelines on ecosystem approach to aquaculture (EAA) analyzed in the previous chapter identify an enabling legal framework as one of the minimum requirements supporting an EAA implementation. The guidelines provide useful but limited information on how such enabling legal framework should look like. This is not surprising; it has been noted elsewhere that the role of law has not yet been thoroughly assessed in the discussion on ecosystem approach (EA).[1] Nevertheless, there is a relatively recent[2] body of theoretical and empirical research addressing the relationship between ecosystems (and social-ecological systems) and the law. Scholars have highlighted the governance and management requirements of complex and dynamic social-ecological systems and the discrepancies between those requirements and traditional legal structures, processes, principles, and objectives. They also have outlined pathways to re-interpret or transform law and policy generally, and especially environmental law and policy,[3] to overcome those discrepancies. The task of this chapter is to review and synthesize those developments with two related objectives: a) identify key legal features (principles, goals, processes, tools) for implementing an EAA, and b) lay down a practical and functional framework for the assessment, analysis and comparison of aquaculture regulations and the extent to which they endorse and support an EAA.

The stated task is not trivial. The legal scholarship, although recent, is increasing rapidly,[4] with climate-change being a key driving force for research. It is a scholarship intertwined with other disciplines, including conservation ecology, political sciences, economy, and public policy. The scholarship encompasses different research streams that

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[1] Froukje Maria Platjouw, *Environmental Law and the Ecosystem Approach: Maintaining ecological integrity through consistency in law* (Oxon; New York: Routledge, 2016), at 25; Annika K Nilsson & Brita Bohman, "Legal prerequisites for ecosystem-based management in the Baltic Sea area: The example of eutrophication" (2015) 44(Suppl 3) AMBIO 370–380, doi 10.1007/s13280-015-0656-6, at 370.

[2] See Robin Kundis Craig, "Learning to Think about Complex Environmental Systems in Environmental and Natural Resource Law and Legal Scholarship: A Twenty-Year Retrospective" (2017) 24 Fordham Envtl L Rev 87.

[3] Environmental law and policy in this Dissertation include natural resources law. It also includes legislation that has environmental protection as primary objective (e.g. protected areas, EIA) and legislation that, although pursuing other primary objectives, includes environmental considerations or provisions (e.g. land use law). See: Todd S Aagaard, "Environmental Law Outside the Canon" (2014) 89 Ind LJ 1239.

[4] See: Miguel F Frohlich et al, "The relationship between adaptive management of social-ecological systems and law: a systematic review" (2018) 23 Ecology & Society 23; Tracy-Lynn Humby, "Law and Resilience: Mapping the Literature" (2014) 4 Seattle J Envtl L 85.

are contributing to outlining legal requirements for environmental and natural resources management that puts "ecosystems" at the center. Some authors address new "generations of environmental law"[5] to refer to the evolution of environmental law driven by a better understanding of ecology, although there is no uniformity in the way to characterize the generations or the number of generations in that evolution.[6] New environmental governance has had a particular influence in new generations of environmental law.[7] Some authors address the law for ecosystem management or ecosystem services.[8] Yet others address law in relation to social-ecological systems, and in particular social-ecological resilience.[9] This scholarship is strongly related to, and

[5] Richard B Stewart, "A New Generation of Environmental Regulation?" (2001) 29 Cap U L Rev 21; Daniel C Esty, "Next Generation Environmental Law: A Response to Richard Stewart" (2001) 29 Cap U L Rev 183; Mary Jane Angelo, "Embracing uncertainty, complexity and change: an eco-pragmatic reinvention of a first-generation environmental law" (2006) 33 Ecology LQ 105; Craig Anthony (Tony) Arnold, "Fourth-Generation Environmental Law: Integrationist and Multimodal" (2010-2011) 35 Wm & Mary Envtl L & Pol'y Rev 771; Neil Gunningham & Cameron Hollis, "Next Generation Environmental Regulation: Law, Regulation and Governance" (2016) 12 Annu Rev Law Soc Sci 1.1; Brian C Chaffin et al., "Transformative Environmental Governance" (2016) 41 Annu Rev Environ Resour 399.

[6] See: Arnold, *supra* note 5, at 788-789.

[7] See, eg: Cameron Holley, Neil Gunningham & Clifford Shearing, *The New Environmental Governance* (Oxon, UK; New York, USA: Earthscan, 2011); Brita Bohman, *Legal Design for Social-Ecological Resilience* (Cambridge: Cambridge University Press, 2021)(Kindle), at 21-22, citing the Communication from the Commission of 25 July 2001 "European governance - A white paper" [COM(2001) 428 final - Official Journal C 287 of 12.10.2001].

[8] Important scholarship includes: Robert B Keiter, "Ecosystems and the Law: Towards an Integrated Approach" (1998) 8(2) Ecological Applications 332; Bradley C Karkkainen, "Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism" (2002) 21 Va Envtl LJ 189 [Karkkainen, Collaborative Ecosystem Governance]; Bradley Karkkainen, "Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward a Bounded Pragmatism" (2003) 87 Minn L Rev 943 [Karkkainen, Adaptive Ecosystem Management]; Bradley Karkkainen, "Marine Ecosystem Management & a 'Post-Sovereign' Transboundary Governance" (2004) 6 San Diego Int'l L J 113; JB Ruhl, Steven E Kraft & Cristopher L Lant, *The Law and Policy of Ecosystem Services* (Island Press, 2007); Craig, *supra* note 2; Barbara A Cosens, "Legitimacy, Adaptation, and Resilience in Ecosystem Management" (2013) 18(1) Ecology and Society 3; Christina Voigt (ed), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law* (New York: Cambridge University Press, 2013); Froukje Maria Platjouw, "The need to recognize a coherent legal system as an important element of the ecosystem approach" in Christina Voigt (ed), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law* (New York: Cambridge University Press, 2013) 158; JB Ruhl, "In Defense of Ecosystem Services" (2015) 32 Pace Envtl L Rev 306; Ori Sharon et al, "Ecosystem services and judge-made law: A review of legal cases in common law countries" (2018) 29 Ecosystem Services 190; Platjouw, *supra* note 1; Nilsson & Bohman, *supra* note 1.

[9] Ahjond S Garmestani, Craig R Allen & Heriberto Cabezas, "Panarchy, adaptive management and governance: policy options for building resilience" (2008) 87 Neb L Rev 1036; Melinda Harm Benson & Ahjond S Garmestani, "Embracing panarchy, building resilience and integrating adaptive management through a rebirth of the National Environmental Policy Act" (2011) 92 J Envt'l Management 1420; JB Ruhl, "General design principles for resilience and adaptive capacity in legal systems - with applications to climate change adaptation" (2011) 89 NC L R 1373 [hereinafter Ruhl, General Design Principles]; Ahjond S Garmestani, Craig R Allen & Melinda Benson, "Can Law Foster Social-Ecological Resilience?" (2013)

encompasses, legal implications of adaptive governance and adaptive management.[10] Climate change, in turn, has been a driver for a particular subset of scholarship highlighting resilience and adaptive governance and management.[11] Scholarship on the rule of law for nature[12] and ecological law[13] also contribute to reframing the relationship between humans and nature.

Some of the scholarship discusses existing law and regulatory frameworks, shedding light into regulatory innovations adopted to address the more complex environmental problems of our time. Some (arguably most[14]) address *lege ferenda*, proposing new approaches that are deemed necessary to halt and reverse the current pathways of human activity that are incompatible with maintaining healthy and functioning Earth systems. A significant portion of the literature focuses on complex issues at the global or transboundary scale.[15] While the findings may not be directly applicable to sectoral management at the national or local level (the focus of this Dissertation), they nevertheless provide insights on the substantive and procedural legal features that may facilitate and support the management of salmon mariculture as a complex and dynamic system.

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18 Ecology and Society 32; Jonas Ebbesson & Ellen Hey, "Where in Law is Social-Ecological Resilience" (2013) 18(3) Ecology and Society 25; Bohman, *supra* note 7.

[10] Adaptive governance is considered an emergent form of environmental governance, building on at least two main research strains: resilience theory, and community-based natural resource management. Chaffin et al define adaptive governance as the "range of interactions between actors, networks, organizations and institutions emerging in pursuit of a desired state for social-ecological systems". First coined by Dietz et al., it was presented by Folke et al as a strategy to mediate the conflicts that plague adaptive management of complex systems. For a review of the concept, its main features, its relationship with adaptive management, and the difficulties inherent to such an endeavour, see: Brian C Chaffin, Hannah Gosnell & Barbara A Cosens, "A Decade of Adaptive Governance Scholarship: Synthesis and future directions" (2014) 19 Ecology & Society 56. See also: Frohlich et al, *supra* note 4; Humby, *supra* note 4.

[11] Alejandro E Camacho, "Transforming the Means and Ends of Natural Resources Management" (2011) 89 NC L Rev 1405; Daniel Schramm & Akiva Fishman, "Legal Frameworks for Adaptive Natural Resource Management in a Changing Climate" (2010) 22 Geo Int'l Envtl L Rev 491; Jan McDonald & Megan C Styles, "Legal Strategies for Adaptive Management under Climate Change" (2014) 26 J Envtl L 25.

[12] Voigt, *supra* note 8.

[13] Rakhyun E Kim & Klaus Bosselmann, "Operationalizing Sustainable Development: Ecological Integrity as a Grundnorm of International Law" (2015) 24 RECIEL 194; Geoffrey Garver, "Moving from environmental law to ecological law: Frameworks, priorities and strategies" in Laura Westra et al (eds), *Ecological Integrity, Law and Governance* (Routledge, 2018) 141.

[14] Craig notes, in her retrospective study focused on the US, that "While scholars may accept the new realities of complexity theory, much of environmental and natural resources law remain based in paradigms of complicatedness, predictability, and stationarity" (Craig, *supra* note 2, at 101).

[15] For example, Bohman, *supra* note 7, addresses international and European law.

The reviewed literature is deeply inter-connected, and the different concepts and trends cannot be neatly compartmentalized in self-contained sections. With that in mind, I organized the information on legal design for the governance and management of complex and adaptive systems in a narrative that attempts to be clear, complete, and succinct while reflective of its complexity.

The chapter proceeds as follows. First, I address a common starting point for all streams of scholarship and legal research: the shortcomings of "traditional" environmental law (or first-generation environmental law). Next, I address the innovations in environmental law to overcome those deficiencies. I generally follow the "generations" metaphor and the categorization of each generation presented by Stewart[16] and Arnold.[17] However, I address his description of "third generation environmental law" under the term "adaptive ecosystem management"; and the fourth generation foreshadowed by Arnold as social-ecological resilience and the law. Two additional sections focus on two sub-components of particular importance for EA: adaptive management and substantive laws. A final section summarizes key lessons and distills key concepts for legal frameworks supporting the practical implementation of an EAA.

3.I. The Shortcomings of "Traditional" Environmental Law

The need for different approaches to natural resources management and environmental law stems from the realization that traditional environmental law[18] is not adequate to manage complex and dynamic ecosystems or social-ecological systems. Key shortcomings of law generally, and environmental and natural resources law in particular, result from both the philosophical assumptions and the structure of the law: anthropocentrism and utilitarianism; reductionism and fragmentation; reliance on technical solutions and centralism; uniformity, predictability, and stationarity.[19]

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[16] Stewart, *supra* note 5.
[17] Arnold, *supra* note 5.
[18] Traditional environmental law is what Stewart calls "first generation environmental law", focusing on the environmental laws adopted in the early 1970s (Stewart, *supra* note 5).
[19] Craig Anthony (Tony) Arnold & Lance H Gunderson, "Adaptive Law and Resilience" (2013) 43 Env L Reporter News & Analysis 10426, identify 4 categories of "mal-adaptive law". The four categories include: (1) systemic goals that are too narrowly focused on advancing the stability of political and economic goals; (2) monocentric (centralized), unimodal (uniform models), and fragmented structures of government; (3) inflexible methods that employ rules and legal abstractions and promote resistance to change; (4) rational,

The idea of anthropocentrism assumes that "human beings and human society as separate from, independent of, and above the natural world."[20] In short, it believes that nature is "the other".[21] This dualism inspires both a preservationist objective ("keeping nature unimpaired")[22] and a utilitarian view of nature which equates the natural environment with natural resources.[23] Further, traditional environmental law is rooted in a balance-of-nature metaphor,[24] the understanding that nature has one natural state and that the maintenance of that state will ensure the provision of natural resources that humans need. The role of law is to ensure stability, certainty, and security of supply,[25] mandating optimal use of nature but also multiple uses, resulting in simultaneous pushes for optimization by different interest groups.[26] Environmental law is thus an optimization problem: it seeks to "'optimise' utility by pursuing the underlying economic activity while reducing its negative side effect".[27]

Traditional environmental law is also built on the premise that the components of the environment and the environmental problems could be understood in isolation of the bigger system,[28] and that scientific and technical expertise (in particular western-based science) could identify solutions that will be "direct, appropriate, feasible, and effective

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linear, legal-centralist processes that assume uncertainty away. In her systematic literature review on resilience and the law (including adaptive management and adaptive governance and the law). Humby identifies similar categories describing shortcomings of legal rules. These are: perspectives of nature, substantive goals, structure and governing authorities, and nature of legal process and values. She notes, however, that "literature is of course predominantly focused on the administrative system and environmental laws of the United States of America, so it is not clear whether these shortfalls apply in other jurisdictions." (*supra* note 4, at 107). See also: JE Viñuales & J-F Mercure, "Pathway to Reframing Environmental Law" (2020) 50 Envtl Pol'y & L 509.

[20] Klaus Bosselman, "Losing the Forest for the Trees: Environmental Reductionism in the Law" (2010) 2 Sustainability 2424, at 2430. See also: Humby, *supra* note 4.

[21] Bosselman, *supra* note 20, at 2434.

[22] Camacho, *supra* note 11, at 1407.

[23] Bosselman, *supra* note 20, at 2430. See also Ward, cited by Humby, *supra* note 4, at 108. Robert B Keiter, "Beyond the Boundary Line: Constructing A Law of Ecosystem Management" (1993-1994) 65 U Colo L Rev 293, at 294-297.

[24] Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, citing *inter alia* TH Profeta, "Managing Without a Balance: Environmental Regulation in Light of Ecological Advances" (1996) 7 Duke Envtl L & Pol'y F 71.

[25] Humby, *supra* note 4, at 108; Arnold & Gunderson, *supra* note 19.

[26] Humby, *supra* note 4, at 108, citing Sandi Zellmar & Lance Gunderson, "Why Resilience May Not Always be a Good Thing: Lessons in Ecosystem Restoration from Glen Canyon and the Everglades" (2008) 87 Neb L Rev 893.

[27] Viñuales & Mercure, *supra* note 19, at 510.

[28] Or, as noted by Craig, treated environmental problems as complicated rather than complex (Craig, *supra* note 2). See also: Alyson C Flournoy, "Integrative environmental law: a prescription for law in the time of climate change" (2020) 30 Duke Envtl L & Pol'y F 225, at 247ff.

over most relevant spatial and temporal scales."[29] These solutions could be enacted and enforced by States' exclusive jurisdiction through "universally applicable legal abstractions"[30]: uniform[31] and mandatory rules (top-down State-centered command-and-control tools[32]) developed in highly fragmented legal and institutional contexts.[33] Fragmentation results from the subject, as a consequence of reductionist focus on the components of the ecosystem rather than the ecosystem as a whole (horizontal or sectoral fragmentation[34]). It also results from the political and legal jurisdictional boundaries (vertical fragmentation), and from the governance structures responsible for management (institutional fragmentation).[35]

The reliance on human capacity to understand problems and design solutions also leans regulatory solutions towards anticipatory tools (front-end evaluations and decision-making[36]). The anticipatory (preventative) science-based measures would be effective in halting degradation and returning ecosystems to their "natural" state. These assumptions relied on predictability (the assumption that man can understand the effects of its

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[29] CS Holling & Gary K Meffe, "Command and Control and the Pathology of Natural Resource Management" (1996) 10 Conservation Biology 328, at 329. See also: Flournoy, *supra* note 28, at 255-256. According to Karkkainen, problems have "a right and wrong about any questions" (Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, at 200). See also Frohlich et al, *supra* note 4, noting that legal frameworks favor "accurate connections between cause and effect".

[30] Humby, *supra* note 4, at 114.

[31] Frohlich et al, *supra* note 4.

[32] Stewart, *supra* note 5. Command and control (C&C) tools are regulations imposed and enforced by government and that direct a specific behavior or standard. OECD defines command-and-control environmental policy as one that "relies on regulation (permission, prohibition, standard setting and enforcement)" (OECD, Glossary of Environment Statistics, Studies in Methods, Series F, No 67 (New York: United Nations, 1997). Viñuales considers the following instruments under C&C regulations: environmental planning, protection of sites, command-and-control standards (also called direct regulation, eg permit/license, best technology standard and emissions standards) and the assessment of environmental impact (Jorge E Viñuales, "Comparative Environmental Law: Structuring a Field" in Emma Lees & Jorge E Viñuales (eds), *The Oxford Handbook of Comparative Environmental Law* (Oxford: Oxford University Press, 2019) 3 at 30). See also: Viñuales & Mercure, *supra* note 19, at 511.

[33] Legal fragmentation has been defined as the "emergence of specialized and (relatively) autonomous rules or rule-complexes, legal institutions and spheres of legal practice" (Platjouw, *supra* note 1, at 99-100, citing United Nations General Assembly, "Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law. Report of the Study Group of the International Law Commission (18 July 2006) A/CN.4/L.702)).

[34] Platjouw, *supra* note 1, at 70, 99. The focus of Platjouw's book is horizontal fragmentation.

[35] *Ibid,* at 99. The jurisdictional fragmentation also comprises the division between public and private land, an issue that affects ecosystem perspectives to management as noted, for example, in Keiter, *supra* note 8. Nevertheless, as marine areas are generally public waters, including in the jurisdictions of the case studies in this Dissertation, this aspect will not be addressed further.

[36] Robin Kundis Craig & JB Ruhl, "Designing Administrative Law for Adaptive Management" (2014) 67 Vand L Rev 1.

intervention in the system) and stationarity (the assumption that "natural systems fluctuate within an unchanging envelope of variability").[37] These assumptions are also rooted in legal processes and values, including key rule of law values such as certainty, predictability, non-discrimination, and finality (i.e., that management decisions should not only be made up front, but that they are a final decisions either in administrative or judicial setting).[38]

Those premises, indeed, were successful in addressing the first signs of environmental problems: "well-bound, clearly defined, relatively simple, generally linear with respect to cause and effect."[39] These "first generation" (or low-hanging fruits) environmental problems,[40] gave rise to what Hirsh has called "smokestack" environmentalism designed for a manufacturing economy.[41]

Soon, however, the critical assessments of environmental law deemed the structures inadequate to face the challenges of "modern" environmental problems. "Modern" environmental problems are characterized by both our increased understanding of nature as a complex and dynamic system (the ecological system or ecosystem paradigm), the interconnection between human and environmental systems (the social-ecological paradigm), as well as our unprecedented capacity to disrupt those vital systems (the Anthropocene paradigm). Modern environmental problems are complex and dynamic.[42] Complexity and dynamism result from the multiple interactions among biotic and abiotic components at multiple geographical and temporal scales, resulting in emergence and self-organization.[43] Ecosystems do not have a single equilibrium.[44]

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[37] Robin Kundis Craig, "'Stationarity Is Dead': Long Live Transformation: Five Principles for Climate Change Adaptation Law" (2010) 34 Harv Envtl L Rev 9, at 15, citing PCD Milly et al, "Stationarity Is Dead: Whither Water Management?" (2008) 319 SCIENCE 573.
[38] Frohlich et al, *supra* note 4.
[39] Holling and Meffe, *supra* note 29, at 329.
[40] Stewart, *supra* note 5.
[41] Dennis D Hirsch, "Symposium Introduction: Second Generation Policy and the New Economy" (2001) 29 Cap UL Rev 1, at 20.
[42] Karkkainen, Collaborative Ecosystem Governance, *supra* note 8; Platjouw, *supra* note 1, at 62ff; Holling and Meffe, *supra* note 29, at 332, note that "ecological change is not continuous and gradual; rather, it is episodic. […] Spatial attributes are not uniform of scale-invariant".
[43] Platjouw, *supra* note 1, at 62-63. Emergence means that the interactions between multiple and diverse components of the ecosystems bring forth novel patterns that cannot be understood by an analysis of the individual components. In other words, "the whole is more than the sum of the parts" (*ibid*). Self-organization, in turn, means that the system is "constantly changing to maintain adaptivity, but they also exhibit a stability of basic structure in the face of externally caused stress" (*ibid*).
[44] Holling & Meffe, *supra* note 29, at 332.

Natural variability is compounded and exacerbated by the ever-expanding pathways through which humans are, directly or indirectly, intervening with natural bio-geo-chemical cycles.[45] Concrete manifestations of this complexity and dynamism are cumulative impacts, transboundary effects, non-linear responses, delayed responses, surprises, and tipping points. Furthermore, complexity and dynamism highlight the importance of context for ecosystem management.[46]

Addressing these environmental problems requires structures and values that are not consistent, and even antithetical, to the structures and values of traditional (i.e. first generation) environmental law. Fragmentation and the reliance on technical solutions is the opposite of the holistic and integrative approach required to govern complex systems.[47] Uniform, top-down responses are too rigid. Certainty, stability and finality are in tension with the dynamism and uncertainty that characterize ecosystems.[48] A search for better approaches, approaches that are less rigid, less prescriptive, less committed to uniform outcomes, and less hierarchical in nature,[49] arose both in the practice of environmental and natural resources law and in legal scholarship.

3.2. Second Generation Approaches: Flexibility and Economic Instruments

Command and control (C&C) approaches were held as costly, inflexible, short-sighted, insensitive to local variations, and stifling innovation.[50] A "second" generation of environmental law emphasizes regulatory flexibility and the harnessing of economic

[45] Viñuales & Mercure, *supra* note 19, at 512.
[46] Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, addressing environmental (ecosystem) management.
[47] See: Platjouw, *supra* note 1, at 114.
[48] Frohlich et al, *supra* note 4.
[49] Gráinne de Búrca & Joanne Scott, "Introduction" in Gráinne de Búrca & Joanne Scott (eds), *Law and New Governance in the EU and the US* (Oxford; Portland, OR: Hart Publishing, 2006) 1 at 2.
[50] Bradley C Karkkainen, "Information-forcing Regulation and Environmental Governance" in Gráinne de Búrca & Joanne Scott (eds), *Law and New Governance in the EU and the US* (Oxford, Portland: Hart, 2006) 293 at 293. Stewart summarizes the shortcomings of "first generation" environmental law in the following paragraph: "criticisms of the "first generation" system of centralized federal command-and-control regulation are by now familiar. It has been criticized on the grounds that it is unduly rigid, cumbersome, and costly; fails to accommodate and stimulate innovation in resource-efficient means of pollution prevention; fails to prioritize risk management wisely; is patchwork in character, focusing in an uncoordinated fashion on different environmental problems in different environmental media and often ignoring functional and ecosystem interdependencies; and relies on a remote centralized bureaucratic apparatus that lacks adequate democratic accountability." (Stewart, *supra* note 5, at 21)

incentives to overcome the rigidity and costly nature of traditional C&C.[51] New policy instruments achieve these objectives, including economic instruments, reflexive law, voluntarism (or self-regulation), and information-based regulations.[52]

Economic instruments establish, directly or indirectly, a price that must be paid for each unit of residuals generated but leave each actor free to decide on the level that it generates.[53] Reflexive law, in turn, aims to promote the internalization of environmental norms by firms and other organizational actors as opposed to directly controlling their external conduct.[54] It addresses the various shortcomings in direct regulation through alternative means for aligning the incentives of organizational actors with the views and concerns of other societal stakeholders in order to appropriately advance societal goals.

Voluntary agreements can take the form of quasi-contractual agreements between the government (the administration) and the industry, affecting either one specific facility or the whole industry, and committing to specific environmental measures. They can also take the form of industry-driven voluntary agreements for self-regulation. Information-based regulations rely on information disclosure (e.g. product labeling and emissions reporting) to alter the behavior of industries that have an impact on the environment.

The widening scope of regulatory tools available promised to achieve more effective (environmental) controls that reflect the diversity of regulated activities and locations, while providing incentives for innovation. It also had the explicit goal of minimizing the role and magnitude of state intervention in the production processes. State (and state-driven measures, including laws and regulations) is not eliminated, however, in two main ways. First, many of the second-generation tools require some level of state intervention (for example, by establishing market mechanisms or requiring

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[51] Arnold, *supra* note 5, at 791.
[52] Stewart, *supra* note 5. Different authors identify different categories of policy instruments although addressing the same regulatory techniques. Similar to Stewart, Gunningham & Holley, *supra* note 5, identify C&C, economic regulatory instruments, voluntarism, and light-handed regulation (reflexive law). Viñuales & Mercure, *supra* note 19, consider four categories: command and control, market mechanisms (taxation and trading schemes), informational techniques (EIA, public participation and labelling) and injury-based mechanisms (liability regimes, human-rights approaches).
[53] Stewart, *supra* note 5, at 94.
[54] *Ibid*, at 127.

information disclosure). Second, the new regulatory instruments could not replace C&C completely but rather complement C&C approaches.[55]

3.3. Adaptive Ecosystem Management

While second generation environmental law introduces regulatory flexibility to improve efficiency and efficacy in achieving environmental objectives, it does not focus on those objectives or on how these are defined. Thus, they "perpetuate regulatory and resource management fragmentation at a time when integration is increasingly recognized as ecological imperative".[56] The third generation of environmental law, including adaptive ecosystem management,[57] focuses on structures and processes for defining environmental goals. In particular, it focuses on: outcomes-based instrument choice,[58] scale (or fit),[59] the growing use of collaborative and participatory processes[60] at the local or ecosystem level, and increased information and monitoring.[61] Some authors also highlight distributive

[55] Gunningham proposes that "smart regulation" (or regulatory pluralism) allows "the implementation of complementary combinations of instruments and participants tailored to meet the imperatives of specific environmental issues, and will result in a more flexible, efficient and effective approach to environmental regulation" (Neil Gunningham, "Environmental Law, Regulation and Governance: Shifting Architectures" (2009) 21 J Envtl L 179 at 200).

[56] Stewart, *supra* note 5, at 152.

[57] Arnold includes adaptive ecosystem management explicitly within third-generation environmental law. While Stewart does not address it as such, the elements identified (and the steps to get there) are consistent with the ecosystem approach to management as described in Chapter 2. For example, the chronological steps identified to implement third generation law (selecting a goal, selecting sub-goals at the sectoral or ecosystem level, selection of appropriate regulatory instruments, and participation of local stakeholders in the selection of local or regional goals and instruments) correspond to the steps described by FAO for EAF and EAA implementation. Angelo, following Daniel Farber, refers to "eco-pragmatism" in terms consistent with adaptive ecosystem management. She emphasizes, *inter alia*, a presumption for environmental conservation (environmental baselines), flexible regulatory approaches, adaptive management, and decentralization (Angelo, *supra* note 5).

[58] Arnold, *supra* note 5, at 774.

[59] Layzer refers to "planning at a landscape scale" (Judith A Layzer, "The Purpose and Politics of Ecosystem-based Management" in Michael P Weinstein & R Eugene Turner (eds), *Sustainability Science: The Emerging Paradigm and the Urban Environment* (New York: Springer, 2012) 177). See also: Keiter, *supra* note 23.

[60] Arnold, *supra* note 5, at 791; Karkkainen, *supra* note 8, at 223, calls collaborative and participatory processes "the most pronounced trend in environmental law and policy over the last decade or more". Holley, Gunningham & Shearing focus on a particular set of new environmental governance characteristics associated with deliberative and participatory governance: a) collaboration between stakeholders; b) participatory dialogue and deliberation; c) devolved and decentralized decision-making; d) flexibility (rather than uniformity); e) inclusiveness; f) knowledge generation and processes of learning; g) transparency; and e) institutionalized consensus building practices (Holley, Gunningham & Shearing, *supra* note 7).

[61] Arnold, *supra* note 5, at 774, 791, refers to monitoring and adaptive management as "reflexive law principles".

justice concerns and sustainable development principles as characteristic of this generation.[62] Karkkainen notes that these features

> respond to very particular needs. These include: the need for locally tailored and context-specific environmental management; the need to build ongoing institutional learning capacities at local and regional scales appropriate to the ecosystems to be managed; the need for flexibility and adaptability in response to complexity, dynamic conditions, and the trajectory of our knowledge; the need for collaboration arising from the nested scales of interests implicated in managing ecosystems; and the need to re-legitimize rulemaking processes to get local buy-in.[63]

Third generation environmental law highlights the need for outcome-oriented regulations (or "goal-oriented regulatory regimes focusing on environmental status"[64]) and integrated goals defined at the sectoral or ecosystem level.[65] Law must provide a coherent structure or process for defining overall goals that understand and respect ecological and economic interdependencies, and for linking means to ends.[66] Once the objectives are defined, regulations can turn to establish the appropriate legal and institutional structure for accomplishing those ends and to selecting the appropriate regulatory tools.[67]

The process of defining overall sectoral or ecosystem environmental goals should be based on extensive scientific information and standardized data. Overall goals must be operationalized by specific and quantified biological and environmental objectives as measured by carefully selected biological and physical "indicators" of (or measurable proxies of) ecosystem health.[68] Ecosystem-based management approaches therefore favour environmental quality standards, or ambient standards, which consider the totality of adverse effects on the environment from different sources.[69] Ebbesson warns,

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[62] Arnold, *supra* note 5, at 791. Distributive justice principles are not discussed in Stewart, *supra* note 5.
[63] Karkkainen Collaborative Ecosystem Governance, *supra* note 8, at 237.
[64] Nilsson & Bohman, *supra* note 1, at 374. The authors, discussing ecosystem based management in a regional setting (the Baltic sea), consider this type of regulation a pre-requisite for ecosystem-based management, providing flexibility to adjust implementation to national circumstances but within a clearly defined substantive framework.
[65] Stewart, *supra* note 5, at 155-156.
[66] *Ibid*, at 153. Stewart argues, in the US context, that goal setting should be a top-down process (centralized planning), but regional or ecosystem-based subsidiary goals should be defined with participation of local authorities and stakeholders (*ibid* at 156).
[67] *Ibid*, at 152. See also: Jonas Ebbesson, "The rule of law in governance of complex socio-ecological changes" (2010) 20 Global Environmental Change 414, at 418-419.
[68] Karkkainen Collaborative Ecosystem Governance, *supra* note 8, at 202.
[69] Ebbesson, *supra* note 67, at 419. See also: Stewart, *supra* note 5.

however, that these standards are only relevant if there are means for ensuring compliance.[70]

Further, adaptive ecosystem management highlights the need for continuous regulatory monitoring and information systems that allow new learning and dynamic adjustment of regulatory strategies.[71] Rather than codifying knowledge in rules that are hard to change, the new model favors institutions that seek to foster a process of knowledge creation.[72]

Ecosystems' context and distinctive characteristics are an important consideration in regulatory design, in contrast with uniform, one-size-fit-all approaches of earlier environmental law. The definition of (subsidiary) goals and the choice of instruments at the regional or ecosystem level allow setting environmental requirements based on their specific objectives and needs.[73]

Regional and local authorities and local stakeholders should be active participants in the process of defining (subsidiary) goals and appropriate regulatory instruments to achieve those goals.[74] Participation empowers local communities and other stakeholders to engage in 'on the ground' decision-making. It also provides "extraordinary opportunities for pooling a rich and diverse array of resources and capacities that no individual participant in the collaborative arrangement, acting alone, could possibly hope to muster."[75] Decentralization of decision-making is therefore important part of regulatory design.[76] Some authors stress, however, that this participation should be subject to central government oversight to ensure coordination, and accountability.[77]

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[70] Ebbesson, *supra* note 67, at 419.
[71] Stewart, *supra* note 5, at 169; Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, at 193; Layzer, *supra* note 59, identifying flexible and adaptive management as key features of ecosystem based management (together with landscape planning and stakeholder collaboration).
[72] Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, at 203.
[73] Stewart, *supra* note 5; Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, at 193.
[74] Keiter, *supra* note 23, at 330, considers public participation as a mechanism to ensure that "all interests are considered and addressed".
[75] Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, at 219.
[76] Stewart, *supra* note 5, at 27, 154, 157. See also Angelo, *supra* note 5, at 143, arguing that decentralized systems tend to be more flexible and to respond more quickly to new information. As a note of caution, Layzer notes that cooperative and participatory management (together with flexible arrangements) have not yielded the ecological benefits that the scholarship had foreseen (Layzer, *supra* note 59).
[77] See, eg: Stewart, *supra* note 5, at 157; Gunningham, *supra* note 55, at 207. Karkkainen notes that locally and regionally tailored solutions must be embedded in broader structures of coordination and public accountability (Karkkainen, Collaborative Ecosystem Governance, *supra* note 8, at 193). He also highlighting two types of decentralization processes: a shift from central to decentralized decision-making;

3.4. Social-ecological Resilience and the Law

In 2011, Arnold proposed that environmental law was entering a "fourth generation" in its evolution to address complex and multidimensional environmental problems that evade unimodal and fragmented solutions.[78] These problems are characterized by multiplicity, diversity, mutual effects, complexity, multiscalarity, dynamism, non-linearity, and uncertainty.[79] He characterized this emerging generation of environmental law as "integrationist multimodality". Although Arnold did not mention "social-ecological system" (or SES) in name, the proposed fourth-generation environmental law is closely linked with this concept of SES. Indeed, he notes that integrationalist multimodality is required to address the features of "complex ecological systems, complex social systems, and the relationships between ecological and social systems, which multiply the complexity of each system".[80]

There is an expanding literature on social-ecological systems and social-ecological resilience (SER),[81] a framework used generally to understand adaptability of social-ecological systems to meet novel challenges and navigate ecosystem dynamics without comprising long-term sustainability.[82] Building on the understanding of ecosystem as complex and dynamic systems (rather than stationary visions of balance and stability) as well as resilience theory, SER shifts the focus from maintaining stable systems to protecting its resilience. Resilience, in its most known definition, is the

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and permeability of decision-making to non-state actors (*ibid*, at 238). The structure combines "the virtues of localism, decentralization, and direct citizenship participation with discipline of national coordination, transparency and public accountability" (Bradley C Karkkainen, Archon Fung & Charles F Sabel, "After backyard environmentalism: Towards a performance-based regime of environmental regulation" (2000) American Behavioral Scientist 692, at 692). Angelo proposes to couple decentralization with national minimum standards or national oversight as safeguard against the risks of decentralization (Angelo, *supra* note 5).

[78] Arnold, *supra* note 5, at 821.

[79] *Ibid*, at 798.

[80] *Ibid*.

[81] See: Johan Colding & Stephan Barthel, "Exploring the social-ecological systems discourse 20 years later" (2019) 24 Ecology & Society 2; Humby, *supra* note 4, at 100, warning that the literature is USA-centric.

[82] Colding & Barthel, *supra* note 81, citing Fikret Berkes, Johan Colding and Carl Folke, *Navigating social-ecological systems: building resilience for complexity and change* (Cambridge UK: Cambridge University Press, 2003), http://dx.doi. org/10.1017/cbo9780511541957.

capacity of a system to absorb disturbance and still retain its basic structure and function.[83]

The literature has identified several features for adaptive governance promoting SER. These governance features, in turn, provide insights into the legal features (or "legal design"[84]) that would facilitate such a governance.[85] While these principles are consistent with the principles identified in the previous section, they put stronger emphasis on some key features: the need for a system perspective; polycentric, multiscale, and open governance structures; and adaptability and flexibility.

Law for SER adopts a system view when regulating natural resources.[86] Rather than focusing on a single species, resilience requires law to comprehensively explore the

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[83] Humby, *supra* note 4, at 90, citing B Walker and D Salt, Re*silience Thinking: Sustaining Ecosystems and People in a Changing World* (Washington, DC: Island Press, 2006). Holling & Meffe, *supra* note 29, at 330, define (ecological) resilience as "the magnitude of disturbance that can be absorbed or accommodated before the system changes its structure by changing the variables and processes that control system behavior". The concept stands in contrast to "engineering resilience", the time required for a system to return to an equilibrium or steady state following a disturbance (Ruhl, General Design Principles, *supra* note 9, at 1376). Engineering resilience therefore favors recovery as the design goal (devoting system resources to staying near the equilibrium), where ecological resilience favors resistance as the design goals (i.e. avoiding "flips" from one structural state to another) (*ibid,* at 1376-1377). Chaffin et al explore transformative governance, a concept that builds from adaptive governance and the dynamic cycle of SES. "In contrast to adaptive governance, which has the goal of building resilience and enabling adaptive management in a desirable SES regime, the goal of transformative governance is to actively shift a SES to an alternative and inherently more desirable regime by altering the structures and processes that define the system" (Chaffin et al, *supra* note 5, at 400-401).

[84] Bohman, *supra* note 7, in particular at 61ff.

[85] The synthesis presented in this section is based on the features identified in Bohman, *ibid*; Humby, *supra* note 4; Frohlich et al, *supra* note 4; and Daniel A de Caro et al, "Legal and institutional foundations of adaptive environmental governance" (2017) 22 Ecology & Society 32. The features are generally consistent, although the organization and some components vary. Bohman identifies four clusters of features relevant for SER and the law: a) adaptability, flexibility, transformability; b) multi-dimensional and polycentric structures; c) stakeholders and structures for participation; and d) operationalization, monitoring, compliance and trust building. While her focus is international and European law, several of her findings are applicable to domestic law as well. In her systematic literature review, Humby identifies the following categories: the need to cognize the social-ecological system; the proceduralization of the law and governance for resilience; structuring polycentric multiscalar and open governance; and ensuring adaptability of the law itself. De Caro et al draw from a range of disciplinary traditions, including dynamic federalism, reflexive law, new governance, political economy, public participation, social justice, and SER to identify candidate legal and institutional design principles: reflexive, legal sunsets, legally binding authority, legally binding responsibility, tangible support, well-defined boundaries, participatory decision-making, internal enforcement, and internal conflict resolution. Ebbesson & Hey, *supra* note 9, address four factors that foster the capacity to sustainably engage with social-ecological systems: effective multi-level governance; openness of institutions so as to provide for extensive participation; flexibility in social systems and institutions to deal with change; and social structures that promote learning and adaptability without limiting option for future developments.

[86] Humby, *supra* note 4. Platjouw also stresses the need for a systems approach referring not to the SES but to the law itself. She claims that for the protection of ecosystem and ecosystem integrity, a system of environmental law (and governance) is of overriding importance (Platjouw, *supra* note 1, at 184, 214). Law

full range of ecosystem functions and services and the multiple social pressures on them.[87] A system view requires broader substantive objectives or a plurality of goals, taking into account environmental social and economic aspects.[88]

A practical application of a system view to environmental regulation can be found in more integrative and comprehensive permitting processes, considering a broad scope of effects, risks, and concerns.[89] Environmental impact assessments are particularly mentioned as a tool with the potential to improve useful knowledge in the decision-making procedure, but also reveal and expand the scope of relevant concerns and identify gaps in knowledge or information.[90]

The literature on SER governance emphasizes the need for polycentric, multiscalar, and open governance structures.[91] The assumption is that governance needs to be pluralistic to respond to the complexity of social-ecological systems. Polycentric, multiscalar, and open governance structures are characterized by multiple, overlapping levels of control (polycentricity, redundancy or nesting);[92] horizontal and vertical transfer of information and coordination of decision-making (integration or connectivity); meaningful public participation; local capacity building; and authority to respond to change in circumstances across a wide range of scenarios.

Pluralistic structures are considered necessary to match ecosystem scales ("spatial fit") and to provide a diversity of responses to environmental problems.[93] Nevertheless, from a legal perspective this diversity (and fragmentation) of responses risks

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as a system exhibits a degree of consistency and coherence across the different legislative acts (*ibid* at 184). Three forms of consistency are identified: consistency and coherence of objectives (formal consistency); of the procedures used to value ecosystem services and balance them against other concerns; and of practical attainment of environmental objectives (substantive consistency) (*Ibid*, chapter 8 section 3 at 196ff).

[87] Humby, *supra* note 4, at 116.

[88] Niko Soininen & Froukje Maria Platjouw, "Resilience and Adaptive Capacity of Aquatic Environmental Law in the EU: An Evaluation and Comparison of the WFD, MSFD, and MSPD" in David Langlet & Rosemary Rayfuse, *Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Leiden: Brill Nijhoff, 2018) 17, at 26 and 30.

[89] Ebbesson, *supra* note 67, at 417-418, noting that permitting procedures can present various degrees of integration, and that the tendency has been to make the process more integrative and comprehensive.

[90] *Ibid*, at 418.

[91] In Bohman, *supra* note 7, multi-dimensional and polycentric structures. In Humby, *supra* note 4, structuring polycentric, multiscalar (and open) governance.

[92] Commenting on adaptation to climate change and building on dynamic federalism, Ruhl notes that "attempting to resolve this tension to find the just-right scale of governance for adaptation would be a futile undertaking – adaptation policy must operate at all scales in an interconnected network of decision making" (Ruhl, General Design Principles, *supra* note 9, at 1396).

[93] Bohman, *supra* note 7, at 91.

inconsistency and inefficiency. Thus, coordination structures and ecosystem match are particularly important for a regulatory design.[94] De Caro et al highlight the importance of clear legal authority and responsibility at different relevant scales for cooperative management required in complex environmental problems.[95] This includes decentralization of responsibilities, but only when accompanied by sufficient resources.[96] The subsidiarity principle has also been proposed as fulfilling a coordinating role.[97] The role of environmental principles and goal-oriented instruments in the coordination of responses by multiple actors at different scales is also highlighted.[98]

Public participation is a feature of open governance for SER.[99] Public participation allows to support and integrate local knowledge, to bridge scales, to build bottom-up approaches, to engage those affected by the environmental problem ("fit"), and to promote self-organization. Further, public participation is increasingly important for legal values and the rule of law, and in particular for democratic, accountable, and transparent governance and for trust building. Legal designs need to include pathways for formal participation as well as structures to include local and social knowledge into decision-making.

A further key feature of law for SER is adaptivity and flexibility. Law and governance for resilience mandates a certain level of "proceduralization of the law in the service of science that is focused on knowledge generation, information flows, and reflexivity amongst key agents."[100] Adaptive management, underpinned by a procedural logic and scientific protagonism, is an essential feature in SER governance. Legal design choices affecting adaptive management include the baseline setting and monitoring requirements, periodic adjustment and review (reflexivity), facilitating and mandating

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[94] *Ibid*.
[95] De Caro et al, *supra* note 85.
[96] *Ibid*.
[97] Bohman, *supra* note 7, at 100, highlighting the subsidiarity principle in EU law, according to which the EU only intervenes when a regional response is necessary, thus matching the legal response to the scale of the environmental problem.
[98] *Ibid*.
[99] *Ibid*, addressing it as an independent legal design feature in the context of SER. See also de Caro et al, *supra* note 85; Humby, *supra* note 4; Frohlich et al, *supra* note 4.
[100] Humby, *supra* note 4, at 118. Ebbesson & Hey, *supra* note 9, refer to social structures that promote learning and adaptability without limiting options for future development as one of the factors that foster the capacity to sustainably engage with SES.

information sharing across bureaucratic categories,[101] and the incorporation of a scientific standard into legal standard for decision-making (such as "best scientific data available").[102]

Regulatory flexibility is also necessary as rigid solutions do not fit the changing and dynamic nature of SES. While adaptive management introduces some level of flexibility, discretion is another feature identified as legal avenues to introduce required flexibility in legal responses.[103] Justifying the need for discretion while dealing with environmental issues that are complex and with multiple interests involved, Bugge notes that

> it is difficult to see how these complex types of conflicts can be regulated in a just and reasonable way through simple, clear-cut legal rules. Therefore it is difficult to make conflict-solving here a legal exercise alone, in the sense of applying a given rule to a given fact and getting the answer. If one does this, the risk is that the decisions are neither environmentally acceptable, nor socially just, nor efficient in the economic sense of the word.[104]

Discretion, coupled with process-oriented developments and reflexivity of the law, carries concerns about the need to balance flexibility and change with certainty and accountability. As noted by Humby, "there is still much work to be done in understanding how the need for flexibility intersects with the important and time-honored legal values of certainty, finality and accountability."[105] The risks of proceduralization of law at the expense of substantive law and environmental goals has been noted.[106]

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[101] Humby, *supra* note 4, at 120; Schramm & Fishman, *supra* note 11.
[102] *Ibid*, at 121-122, citing Holly Doremus, "Adaptive Management, the Endangered Species Act, and the Institutional Challenges of 'New Age' Environmental Protection" (2001) 41 Washburn L J 50.
[103] Bohman, *supra* note 7, especially at 206-208. Layzer recognizes implementation that is flexible and adaptive as a critical element of ecosystem-based management. Her description of flexible implementation relies on the use of diverse instruments broadly included here in the section on second-generation law (Layzer et al, *supra* note 59, at 184).
[104] Platjouw, *supra* note 1, at 130, citing HC Bugge, "Environmental Law's Fragmentation and Discretionary Decision-making. A Critical Reflection on the Case of Norway", in E Røsæg, HB Schäfer & E Stavang (eds) *Law and Economics: Essays in Honour of Erling Eide* (Cappelen Damm Akademisk, 2010).
[105] Humby, *supra* note 4, at 129. Froehlich et al, *supra* note 4, in their literature review, also conclude that innovative ways will have to be pursued to balance the flexibility needed for adaptive management and the stability demanded by law, an exercise that needs to be conducted "carefully and responsibly because it can leave room for political and economical interferences". In turn, Ebbesson, *supra* note 67, at 415, notes that the "the popular view of law exaggerates the static and fixed nature of law".
[106] Annecoos Wiersema, "A Train without Tracks: Rethinking the Place of Law and Goals in Environmental and Natural Resources Law" (2008) 38 Envtl L 1239.

Some options to balance flexibility with certainty have been provided. De Caro et al propose that reflexive law approaches coupled with legal sunsets (i.e., planned windows for revision) can balance flexibility with certainty and predictability required by the rule of law.[107] The role of environmental principles and substantive standards in ensuring consistency and certainty[108] has also been highlighted.[109] Safeguards for impartiality and transparency are recommended, including: enforceable information collection and disclosure requirements, insulating research design and data collection from political influence, and data dissemination.[110]

Bohman highlights that in the context of adaptive, flexible and dynamic legal tools, compliance in a traditional sense is harder to establish. Additionally, compliance does not equate efficiency (that is, the achievement of the substantive goals). She suggests that adopting a managerial approach to compliance and focusing on monitoring changes in protected or selected ecological components may provide an alternative approach that overcomes the difficulties of addressing often vague, flexible obligations of conduct. Indeed, the monitoring of ecological values and feedbacks (with emphasis on indicators of slow ecological change that define sustainability) are highlighted as necessary in the context of SES.[111]

3.5. Adaptive Management and the Law

Collaborative ecosystem management and SER highlight adaptive management as a necessary tool to navigate the complexity, uncertainty, and dynamism inherent to ecosystems or social-ecological systems. Indeed, as mentioned in the previous chapter, adaptive management is considered a key component of the EA and EAA. The legal scholarship on adaptive management is relatively vast and has a particular niche in the broader study of legal responses to the challenges of climate change. It is worth, therefore, to provide a more focused analysis of the scholarship addressing legal requirements for adaptive management.

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[107] De Caro et al, *supra* note 85.
[108] Platjouw, supra note 1, at 124ff.
[109] de Caro et al, *supra* note 85.
[110] Humby, *supra* note 4; Doremus, *supra* note 102.
[111] Bohman, *supra* note 7, at 169ff. Monitoring is also highlighted in the concept of "reflexive law" as noted above.

Adaptive management has been defined as a "decision-making process based on the structured and iterative implementation of management measures, with comprehensive monitoring of relevant system indicators, in the attempt to achieve specific management goals or objectives, reduce uncertainty, or increase knowledge about the system that an agency is charged with managing."[112] As noted by Craik, at the core of adaptive management approaches is the "recognition that *ex ante* predictive approaches to managing activities in complex, dynamic ecosystems are insufficient due to the limitations of scientific knowledge respecting human-ecosystem interactions."[113] While *ex ante* (or front-loaded) approaches remain necessary,[114] they are insufficient to address environmental concerns that cannot be modelled, predicted or fully known in advance. Therefore, they need to be complemented (rather than replaced) with a structured process for iterative or continuous decision-making that is learning-based[115] and focused on knowledge generation.

Adaptive management can take different forms. In "active" adaptive management, managers "implement different management policies for a resource at different places at the same time, they monitor any differences in outcomes over time, and those differences in outcomes help answer questions about which management policies might be more or less successful for achieving management goals."[116] The experimental approach of active adaptive management makes it rarely a suitable practice for regulatory agencies, considering spatial and time scales of ecosystems, institutional constraints and

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[112] Craig & Ruhl, *supra* note 36, at 63. See also: Robin K Craig et al, "A proposal for amending administrative law to facilitate adaptive management" (2017) 12 Environ Res Lett 074018. It should be mentioned that adaptive management and adaptive governance are related but different concepts. Adaptive management is a component of adaptive governance; adaptive governance is the "social context that facilitates adaptive management" (Chaffin, Gosnell & Cosens, *supra* note 10).

[113] Neil Craik, "Implementing Adaptive Management in Deep Seabed Mining: Legal and Institutional Challenges" (2020) 114 Marine Policy 103256 at 1.

[114] *Ibid*, at 2; Craig & Ruhl, *supra* note 36, at 7.

[115] Craig et al, *supra* note 112, at 4. Three distinct but related "learning loops" identified: the technical learning loop (i.e. knowledge and understanding about a natural resource system and how it responds to management interventions); institutional learning (i.e. learning about the decision making process itself); and socio-political and governance learning. The three distinct learning loops are summarized in the following questions: Are we doing things right? Are we doing the right things? and Who has the rights? (*ibid*).

[116] Eric Biber, "Adaptive Management and the Future of Environmental Law" (2013) Akron L Rev 933 at 934.

accountability concerns.[117] A most common form, in the administrative practice, is "passive" adaptive management. Passive adaptive management does not use active experimentation to reduce uncertainty, but rather relies on historical data and models of ecosystem's functions, uses those models to identify a single best-practice for management, implements that practice, and monitors and evaluates results to update the model and the management practices.[118] Some authors argue further that the practice of adaptive management has slipped into "adaptive management lite", a "basic trial and error learning in which explicit learning hypothesis are either absent or vague".[119]

McDonalds and Style identify further forms – legal tools[120] - in which adaptive management has been operationalized in law or administrative practices. Staged (or contingent) approvals allow an activity to be approved in stages; "only if mandatory monitoring and evaluation show the impacts of the first stage are acceptable will further approvals be granted."[121] The different stages may relate to the duration of the consent, the area over which the consent is granted, the scale or intensity of the activity, or the nature of the activity.[122] At the programmatic level, tiered decision-making allows to address risks associated to broad plans and strategies to be addressed early in the cycle, including broad-scale and cumulative impacts.[123] Conditional approvals and environmental triggers allow adaptive management to be operationalized through "conditions that can be modified upon the occurrence of a specific event or environmental indicator."[124]

The form that adaptive management can take in any regime depends on several factors, ranging from the definition of normative goals to the resources available. Not

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[117] *Ibid* at 957. Biber addresses these limitations for both active and passive adaptive management but notes that they "more seriously limit" active adaptive management (*ibid*). See also: McDonald & Styles, *supra* note 11, at 29-30.
[118] Biber, *supra* note 116, at 934.
[119] Craig & Ruhl, *supra* note 36, at 10-11. McDonald & Styles, *supra* note 11, at 29, note that "trial and error or evolutionary approach involves early management strategies being decided on a haphazard basis, with subsequent decisions then made by learning from past errors".
[120] McDonald & Styles, *supra* note 11, at 40ff.
[121] *Ibid*, at 44.
[122] *Ibid*, citing the *Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012* (New Zealand), s 64(3). The authors note that this is the only piece of legislation that links adaptive management with staged approvals explicitly (*ibid* at 33). See also: Craik, *supra* note 113, at 6.
[123] McDonald & Styles, *supra* note 11, at 44, linking the first tier of decision-making to Strategic Environmental Impact Assessment. The authors caution, though, that tiered decision-making also entails some risks and that the first tier of decision-making should be guided by clear guidance and objectives.
[124] *Ibid*, at 45.

least among them are the risk tolerance of the regime and the amount of discretion afforded to the regulatory agency implementing adaptive management. In regimes that avoid riskier forms of adaptive management, its implementation has taken the form of staged (or contingent) approvals.[125] In regimes with limited afforded discretion, a highly structured adaptive management may be less oriented towards knowledge generation and rather focused on limiting operational uncertainty, effectively seeking to ensure compliance with predicted outcomes.[126]

While adaptive management is widely endorsed as a mechanism to address both uncertainty and dynamism of ecosystems, its legal recognition is reportedly limited.[127] Only a few Acts explicitly recognize adaptive management; if they do so, they often do not provide details on what the terms entail or how to implement it.[128] In the absence of enabling legislation, adaptive management practices have been implemented through discretion afforded to decision-makers.[129] Most commonly, adaptive management is implemented through flexible conditions on project approvals.[130] This assumes, however, that there is a legal text providing discretion; further, its exercise is constrained by the limits of the afforded discretion, a determination that may be subject to conflict or litigation.[131]

There are three further limits, or challenges, to the adoption of adaptive management that need to be considered. First, adaptive management is not necessarily practical or advisable for all environmental decisions. Rather, it should be reserved for situations in which "the management-problem context presents a dynamic system for which uncertainty and controllability are high and risk is low".[132] If the system is not dynamic and uncertainty is low, investment in learning is unnecessary. If the system (or the human activity addressing the system) cannot be controlled, adaptive management is pointless. And if the risk is too high and intervention could lead to severe or irreversible

[125] Craik, *supra* note 113, at 6.
[126] *Ibid*, at 7.
[127] McDonald & Styles, *supra* note 11, at 32.
[128] *Ibid*, at 32-34.
[129] Craig & Ruhl, *supra* note 36, at 40.
[130] McDonald & Styles, *supra* note 11, at 38 (these permit conditions include conditions in environmental impact assessment reports). See also: Craig & Ruhl, *supra* note 36, at 27.
[131] Craig & Ruhl, *supra* note 36, at 40.
[132] *Ibid*, at 19.

consequences, adaptive management is dangerous[133] and a precautionary approach should be taken instead.[134]

Further, adaptive management has a set of prerequisites.[135] It must be possible and practical to adopt an iterative decision-making process (a condition that would not be met for large infrastructure projects, or in cases where the legal authority to exercise post-approval regulatory controls is limited or absent[136]). The agency implementing adaptive management must have clear management goals using measurable performance metrics.[137] There must be technologically reliable means of monitoring relevant indicators.[138] The agency implementing adaptive management must have consistent financial and institutional resources and political and stakeholder support. Further, adaptive management cannot offend inviolable norms associated with the problem context (such as human rights).

Another important challenge in the implementation of adaptive management is its contradiction (or apparent contradiction) with key legal principles and tenets guiding administrative decision-making processes. These include a front-end analytical mode

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[133] Ibid.

[134] See Craik, *supra* note 113, at 5-6; in particular, see the discussion about jurisprudence addressing the relationship between adaptive management and precautionary approach in Canada and New Zealand. See also McDonald & Styles, *supra* note 11, at 38-39. The authors note that current approaches (in Australia and Canada) are premised on adaptive management being used as a tool to give effect to the precautionary principle. "Adaptive management is the mechanism used to control for the margin of error in relation to uncertain impacts and to achieve proportionality and cost-effectiveness, as required under the precautionary principle". Further, they note that adaptive management ("precautionary learning" approach) is preferable to a "purely" precautionary approach in situations where the status quo is simply not an option (*ibid*). Bohman, considers AM as an "expression" of the precautionary principle (Brita Bohman, "The Ecosystem Approach as a Basis for Managerial Compliance: An Example from the Regulatory Development in the Baltic Sea Region" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Brill E-Book, 2019) 80 at 86). Other authors refer to AM as a mechanism to "offset" precaution (rather, the paralyzing effects of precaution). Yet others consider that the concepts do not offset each other but that they have a different area of influence. Kwasniak notes: "Although both adaptive management and the precautionary principle deal with uncertainty the precautionary principle deals with risks that are identified but there is not scientific certainty that they will occur. There is however, some, and perhaps even considerable, evidence that they may occur. Adaptive management by contrast deals with highly unpredictable uncertainty." (Arlene J Kwasniak, "Use and Abuse of Adaptive Management in Environmental Assessment Law and Practice: A Canadian Example and General Lessons" (2010) 12 J Envtl Assessment Pol'y & Management 425 at 461).

[135] Craig & Ruhl, *supra* note 36, at 21-26.

[136] See also: Craik, *supra* note 113, at 3.

[137] See also: Schramm & Fishman, *supra* note 11, at 497-498, note that the absence of long-term tangible objectives is an obstacle for adaptive management because it creates a tendency toward reactive rather than proactive policies.

[138] *Ibid*, at 497.

(e.g. EIA, cost-benefit analysis), requirements for public participation, judicial review, and the finality of administrative and judicial decisions.[139] Balancing a knowledge-focused and continuous decision-making processes with traditional administrative practices and core values of the rule of law has been a particular concern in the literature. Some authors have called for a reform to administrative law to "embrace and absorb adaptive management's periodicity. Specifically, [it would] recast administrative procedure not as a one-time, final-agency-decision-then-judicial-review process, but rather as a recurring process of punctuated "final" decision-making, public participation, and judicial review".[140]

Whether as exercise of licensing or permitting discretion or as a new legislation,[141] case law and scholars have identified some key features of a legal design that facilitates adaptive management. These include:

a) Defining project or management-measure goals and their relative priorities;[142]

b) Requiring the collection of baseline data and information about the existing environment;[143]

c) Establishing mandatory objective and transparent monitoring requirements[144] based on agreed indicators;[145]

d) Identifying trigger points and incorporating them into enforceable conditions for adaptive responses.[146] Triggers should be set at a level that prevents irreversible damage.[147]

e) Considering legal sunsets (mandatory windows for revision);[148] and

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[139] Craig & Ruhl, *supra* note 36, at 34-38; Schramm & Fishman, *supra* note 11, at 497; Biber, *supra* note 116, at 937.
[140] Craig & Ruhl, *supra* note 36, at 42.
[141] Craig & Ruhl proposal for adaptive management legislation includes further elements relevant in that context: criteria for defining what sorts of projects or management measures qualify for adaptive management (and for ending the adaptive management path); public participation in the development and timebound revisions of an adaptive management plan (the punctuated final administrative acts or programmatic stages; and emergency intervention triggered by the agency or the public in certain situations (*ibid*, at 41ff).
[142] *Ibid*, at 52ff.
[143] McDonald & Styles, *supra* note 11, at 38.
[144] Craig & Ruhl, *supra* note 36, at 53ff, 56; McDonald & Styles, *supra* note 11, at 39.
[145] McDonald & Styles, *supra* note 11, at 37.
[146] Fischman notes: "Practitioners of adaptive management need new legal frameworks that force them to state measurable objectives for an action and to identify thresholds that will trigger specific responses to monitoring" (See: Robert L Fischman, "Letting Go of Stability: Resilience and Environmental Law" (2019) 94 Ind LJ 689). See also McDonald & Styles, *supra* note 11, at 30 and 45 (noting that triggers may be included in management plan or as condition of a permit or license); Craig & Ruhl, *supra* note 36, at 55ff.
[147] McDonald & Styles, *supra* note 11, at 47.

f) Providing capacity to alter conditions of permits or management arrangements,[149] including withdrawal.[150]

3.6. Substantive Law

The literature summarized in the previous sections denotes a trend to emphasize the process of environmental law rather than its substantive content.[151] As noted by Platjouw, "[t]he main focus has been institutional design, advocating procedures that will allow institutions to be responsive to science, to be flexible and adaptive to new information, to encourage deep collaboration, and to operate non-hierarchically in a manner cognizant of multiple scales of time and spaces".[152] The proceduralization of law has been criticized, however, for not providing sufficient substantive guidance for decision-makers and ultimately compromising environmental protection.

Wiersema notes that "we now have an approach that uses a combination of broad goals and flexible benchmarks, neither embodied in law, and relies on procedural law to reach those goals and benchmarks."[153] Broad goals may not be sufficient to deter long-term goals to be sacrificed for short-term (economic) gain, however.[154] Further, long-term protection goals may be further eroded when social and economic (short-term) goals are integral to ecosystem goals, a corollary of humans themselves being part of the ecosystems.[155] She adds that "without attention to these goals, some of the interests that are crucial to ensuring long-term protection will be left out of decision-making processes and the procedures advocated in the new models".[156]

Platjouw also addresses this shortcoming of environmental law while analyzing the role of discretion in decision-making. She argues that discretion (together with

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[148] Ebbesson *supra* note 67, at 418, asserting that permits should be granted for a limited time only.
[149] McDonald & Styles, *supra* note 11, at 48.
[150] Ebbesson, *supra* note 67, at 418.
[151] Humby notes that there is a "trend away from specifying particular substantive standards in the law, towards law structuring and framing the science-based inquiries of administrative agencies" (Humby, *supra* note 4, at 12).
[152] Platjouw, *supra* note 1, at 137. See also: Fischman, *supra* note 146, at 696, citing Tarlock: "Tarlock found that environmental law is less concerned with consistent outcomes than it is toward fidelity to process". See also: Keiter, *supra* note 23, at 304.
[153] Wiersema, *supra* note 106, at 1262.
[154] *Ibid*, especially at 1275-1282.
[155] *Ibid*, especially at 1291-4.
[156] *Ibid*, at 1300.

fragmentation of decision-making authority) does not ensure the legal protection of ecosystems.[157] "[W]hen it comes to the actual protection of the environment, the legal core is neither very precise nor very 'hard'".[158]

Similarly, Karkkainen notes that "the absence of clear, legally enforceable, fixed procedural rules and substantive standards will translate into a kind of open-ended discretion likely to yield to unprincipled compromise, self-dealing, and a lack of accountability in basic governance processes".[159] In simple terms, discretionary, participatory, flexible, and adaptive decision-making does not, by itself, ensure the achievement of environmental protection goals. Process needs to be supplemented with hard, substantive rules of law.[160]

The substantive law that is needed is, however, different from the objectives embedded in early environmental law: fragmented pollution-oriented end-of-pipe objectives that narrowly focus on one media, often with human health as a primary concern, and inspired by static perceptions of nature (the now debunked "nature in balance" myth).[161] Rather, a legal system that puts ecosystems at the center must include holistic, integrative, ambitious and consistent goals[162] that are not based on stationarity.[163] Frohlich et al note that "[l]egal frameworks must then have and require the definition of goals that are not only flexible, but also clear, specific, and measurable, in order to avoid adaptive management lite practices."[164]

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[157] Platjouw, *supra* note 1, at 124. She identifies two sources of discretion: the widely formulated competence to weigh and balance various interests and values, and undefined or ambiguous terms that in themselves may require balancing of interests. Platjouw also notes that discretion is exacerbated in the context of fragmentation of environmental law, where decision-making among different public entities is not necessarily consistent or coherent.

[158] *Ibid*, at 133, citing HC Bugge, "Environmental Law's Fragmentation and Discretionary Decision-making: A Critical Reflection on the Case of Norway", in E Røsæg, HB Schäfer, and E Stavang, (eds) *Law and Economics: Essays in Honour of Erling Eide* (Cappelen Damm Akademisk, 2010).

[159] Karkkainen, Adaptive Ecosystem Management, *supra* note 8, at 944. See also: Humby, *supra* note 4, at 115.

[160] Platjouw, *supra* note 1, at 184; Wiersema, *supra* note 106, at 1300, notes that: procedural law must be supplemented with "sufficiently detailed substantive goals to guide their activity and that these substantive goals be embedded in law." She does not expand on the nature of content of these detailed goals, however.

[161] Camacho, *supra* note 11.

[162] Flournoy, *supra* note 28, at 251, critiques "insufficiently ambitious non-integrative goals"; Platjouw, *supra* note 1, emphasizes the need for consistency. Keiter, *supra* note 23, at 328, also addresses coherent substantive standards.

[163] Frohlich et al, *supra* note 4.

[164] *Ibid*.

The role of environmental principles in providing that substantive guidance has been highlighted, with particular mention of the precautionary principle, the principle of prevention, principle of integration, and polluter pays principle.[165] The explicit consideration of environmental principles in legal instruments has been recommended to provide its rules with a greater normative power.[166] "Ruling by principles imply stating a certain normative direction and indicating different possible factors that may be taken into account and weighed against another, without the aspiration of exactly denoting or determining the outcome of the decisionmaking".[167] Environmental principles may also reduce the problems of fragmentation by supporting consistent environmental decisions.[168] The potential of environmental principles is, however, limited; they can serve as guideposts for decision-making processes but they are too broad and their interpretation and implementation too diverse to ensure consistent environmental protection.[169]

Sustainability (or sustainable development) and resilience[170] are recognized in the literature as concepts providing normative guidance to address human-nature interactions and social-ecological systems. Sustainability (or sustainable development) has been widely endorsed in international policy instruments since at least 1987.[171] While resilience has a much shorter history, it has also been increasingly relevant in policy

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[165] Platjouw, *supra* note 1, at 124ff.
[166] *Ibid*, at 126.
[167] Ebbesson, *supra* note 67, at 418.
[168] Platjouw, *supra* note 1, at 127.
[169] *Ibid*, at 127ff.
[170] See *supra* 83 and accompanying text. See also: McDonald & Styles, *supra* note 11.
[171] The concept of sustainability dates back at least to the nineteenth century but has gained increased recognition during the 1980s and 1990s, after the recognition of the related concept of sustainable development in the 1987 Report of the World Commission on Environment and Development (Brundtland Report) and in the 1992 Rio Declaration. Currently, sustainability and sustainable development are pillars of international policy instruments (e.g. Sustainable Development Goals) and are considered principles of international environmental law. In essence, sustainability refers to the ability to keep in existence; or relating to, or being a method of, harvesting or using a resource so that the resource is not depleted or permanently damaged. The broader concept of sustainable development is defined as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report). See: Robin Kundis Craig & Melina Harm Benson, "Replacing Sustainability" (2013) 46 Akron L Rev 841; Jennifer L Johnson et al, "Interplays of Sustainability, Resilience, Adaptation and Transformation", in Walter Leal Filho, Robert W Marans & John Callewaert (eds), *Handbook of Sustainability and Social Science Research* (Springer, 2018) 3.

instruments.[172] While many authors consider sustainability and resilience closely related concepts,[173] Craig and Benson argue that sustainability is rooted in stationary visions of nature, which are not only inaccurate but also increasingly futile.[174] They propose to replace sustainability with resilience paradigms that are considered more suited to new ecological knowledge. The normative potential of both sustainability and resilience have been questioned, however, on several grounds, including its flexibility and conceptual vagueness.[175]

The literature and international and domestic law and policy instruments[176] also recognize ecosystem integrity as a holistic goal for legal frameworks. While the concept has been defined in different ways,[177] in essence "[m]aintaining ecosystem integrity includes maintaining diversity at the generic [sic], population, species and ecosystem levels, as well as the maintenance of the ecological patterns and processes that support both biodiversity and resource productivity."[178] Ecosystem integrity is closely related to sustainability and resilience. Pursing ecosystem integrity allows the system to continue to provide the services that humans rely on and need.[179] Further, a system is considered to have integrity if it exhibits resilience, that is, it is able to maintain its organization in the

[172] Resilience emerged only in the 1980s as a paradigm or policy goal for environmental management arising from resilience thinking. Its recognition in international instruments is increasing, largely driven by the search of new normative directions in the environment threatened by climate change (see, eg *United Nations Framework Convention on Climate Change*, 9 May 1992, 1771 UNTS 107, 31 ILM 849 (entered into force 21 March 1994), art 1(1) 'adverse effects of climate change'; United Nations Secretary Generals' High-Level Panel on Global Sustainability, *Resilient People, Resilient Planet: A Future Worth Choosing* (New York: UN, 2012)). Resilience, in its most known definition, reflects the "amount of shock a system can absorb without flipping into an alternate regime or stability domain". Resilience thinking assumes "that change and disturbance are an integral part of every system, but that some systems are more resilient to destructive change than others" (Craig & Benson, *supra* note 171). By focusing on the limits of systems' capacity to endure, resilience allows to shift from stabilizing a few valued ecosystem services ("sustainable" ecosystem services) to act in terms of entire systems and considering multi-scale interactions. It also promotes, as is argued, more flexible and responsive approaches to management (*ibid*). See also: Johnson et al, *supra* note 171.
[173] Johnson et al, *supra* note 171.
[174] Craig & Benson, *supra* note 171.
[175] Johnson et al, *supra* note 171.
[176] See: Klaus Bosselmann, "The ever-increasing importance of ecological integrity in international and national law" in Laura Westra et al (eds), *Ecological Integrity, Law and Governance* (Routledge: 2018) 225 at 230-231.
[177] Platjouw, *supra* note 1, at 72.
[178] *Ibid*. Wiersema, *supra* note 106, warns, however, that "ecological integrity" is too broad a goal to act as an effective guidepost for decision-makers.
[179] Platjouw, *supra* note 1, at 74.

face of changing environmental conditions.[180] "If a system is unable to maintain its organization, then it has lost its integrity."[181]

Considering the role of ecosystems structure, functions and processes to support life and provide ecosystem services, the literature argues that maintaining ecosystem integrity should be considered a priority objective for the ecosystem approach.[182] Ecosystem integrity explicitly acknowledges that there are ecological limits that constrain economic development.[183] Similarly, resilience theory "supports the notion that there are ecological limits to social systems, which are ultimately all reliant on a natural resource base,"[184] although not necessarily requiring that ecological values should trump economic values whenever conflict arises. Yet, there is little recognition in existing law of this form of primacy, and key aspects of this primacy that have not been the subject of legal research.[185]

The substantive content of environmental law is closely related to the debate on its moral justification, and the clash between anthropocentrism and ecocentrism that has existed since the beginning of environmental law.[186] The current and accelerated environmental crisis has brought the ethical foundations of law to the forefront of scholarship and policy, generally addressed under the concept of ecological law[187] but also in related terms such as rule of law for nature,[188] rights of nature, sustainability law,

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[180] *Ibid* at 72, citing JJ Kay, "A Nonequilibrium Thermodynamic Framework for Discussing Ecosystem Integrity" (1991) 15 Environmental Management 483.
[181] *Ibid*.
[182] *Ibid*, at 75.
[183] Humby, *supra* note 4, at 109. Angelo, *supra* note 5 at 133ff, citing Farber, refers to a presumption in favor of environmental protection that is operationalized through an "environmental baseline". She further identifies ecological integrity as such a baseline, citing both international and domestic (US) law. Note that environmental limits can be interpret as absolute limits or relative to the level of technology and governance structure (Carole R Engle & Jonathan van Senten, "Resilience of Communities and Sustainable Aquaculture: Governance and Regulatory Effects"(2022) 7 Fishes 268, at 2).
[184] Humby, *supra* note 4, at 109.
[185] *Ibid*. She notes that "The place of substantive standards linked to ecological limits, particularly impairing or taking away existing rights, requires urgent attention as it appears that, in many instances, such rights impair longterm sustainability" (*ibid*, at 129).
[186] Bosselmann, *supra* note 176, at 227.
[187] See, eg: Ecological Law and Governance Association, online: ELGA https://elgaworld.org/ (accessed 15 February 2022), and its Oslo Manifesto and Sienna Declaration (*ibid*).
[188] Christina Voigt (ed), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law* (Cambridge University Press, 2013); UNEP*, Environmental Rule of Law: First Global Report* (Nairobi: UNEP, 2019).

Earth Jurisprudence, Harmony with Nature,[189] environmental constitutionalism,[190] or Earth system law.[191] This scholarship generally promotes an ecological approach to law based on ecocentrism, holism and intra and intergenerational and interspecies justice,[192] founded in human rights perspectives (right to life, to health and to a healthy environment) as well as in the intrinsic value of Nature.[193]

Ecological law tackles the design flaw of substantive environmental law: the absence of a fundamental rule prohibiting harm to the integrity of ecosystems.[194] At its core, ecological law requires the acceptance of ecological integrity - the integrity of Earth's life support systems[195] - as a fundamental ethical and legal principle,[196] or a "grundnorm" of international law.[197] This realization has two steps: recognizing the reality of a complex Earth system with planetary boundaries; and the integration of responsibilities for ecological integrity into the design and interpretation of laws governing human behavior.[198] Importantly, ecological limits (or planetary boundaries)

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[189] See: United Nations General Assembly, "Harmony with Nature", Resolution 64/196 adopted by the General Assembly on 21 December 2009, A/RES/64/196 (12 February 2010), and subsequent annual resolutions on "Harmony with Nature", all available online: UN <http://www.harmonywithnatureun.org/chronology/> (accessed 15 February 2022).

[190] Eg: David R Boyd, *The Environmental Rights Revolution: A Global Study of Constitutionalism, Human Rights and the Environment* (Vancouver: UBC Press, 2012).

[191] See, eg: Louis J Kotzé & Rakhyun E Kim, "Earth System Law: The juridical dimension of earth system governance" (2019) 1 Earth System Governance 100003). For a more critical view of these normative critiques of environmental law see: Viñuales & Mercure, *supra* note 19.

[192] Laura Westra, "The Ethics of Integrity and the Law in Global Governance" (2003-2004) 27 Environs Envtl L & Pol'y J 127.

[193] *Ibid*, at 138.

[194] Bosselmann, *supra* note 20.

[195] Kim & Bosselmann, *supra* note 13, at 194.

[196] Bosselmann, *supra* note 20.

[197] Kim & Bosselmann, *supra* note 13. The article argues for developing ecological integrity as a fundamental principle or grundnorm of international law, which is similar to the grundnorm character that human rights or the rule of law have in domestic and international law. See also Westra, *supra* note192, arguing that applying the principles approach of *jus cogens* norms can be helpful in recognizing the primacy of rights to life and survival (at 139) and right to life as the focus of *erga omnes* obligations (at 142).

[198] Klaus Bosselmann, "The Framework of Ecological Law" (2020) 50 Envtl Pol'y & L 479, at 482. Even more progressive than ecological law, there is a recent scholarship promoting Earth system law. This scholarship pushes the environmental law transformation in two main aspects. First, in terms of the regulatory object of law, it attempts to overcome the distinctions between anthropocentric and ecological law (which may become a myth in the Anthropocene) and "considers neither humanity nor nature as a central reference point, but rather the entire community of life as the central fulcrum around which it revolves". Second, in term of geographical scope, this new paradigm of law is informed by a planetary boundaries perspective that transcends geographic and jurisdictional boundaries. Importantly, as planetary law acknowledges both the existence of an ecological ceiling and of a social foundation, it not only seeks to

operate as a "non-negotiable bottom-line for human activities. More particularly, and in the context of the concept of sustainable development, it demands a hierarchical order of its element's 'environment', 'economy' and 'society': ecological integrity has priority and sets the parameters for social and economic development."[199]

The imperatives of ecological law resonate with the content of EA and EAA as described in Chapter 2.[200] The EA could be viewed, therefore, as a principle or a tool advancing the fundamental moral responsibility to sustain Earth, its ecosystems, and all life in the planet. Indeed, some authors consider that EA embraces an eco-centric perspective to environmental protection.[201] Yet other authors argue that the formulations of EA are in many cases ambiguous, straddling between anthropocentrism and ecocentrism and with an emphasis on process (of balancing interest) over substance (of maintain ecosystem integrity).[202] The place of substantive law in EA, as in the case of adaptive management and governance, remains unsettled.[203]

3.7. Summary and Lessons for an Ecosystem Approach to Aquaculture

What are the key lessons resulting from the review in this chapter? And how can they be applied in a more pragmatic manner to the assessment of legal frameworks for EA to salmon mariculture management?[204]

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maintain integrity of Earth's ecosystem but also that questions of justice and inequality relating to global patterns of consumption and production are addressed (see: Kotzé & Kim, *supra* note 191).

[199] Bosselmann, Framework of Ecological Law, *supra* note 198, at 482. See also Westra, *supra* note192, at 139.

[200] For example, the Oslo Manifesto and the Sienna Declaration developed by the Ecological Law and Governance Associated highlight the following features: considering the entire Earth, the ecological whole, in decision-making; viewing humans as part of ecosystems; recognizing that specificity and contextuality is required to ensure health of ecosystems; advancing the precautionary principle; advocating for Earth democracy philosophy with broad participation of ecological citizens; understanding the critical importance of the voice of Indigenous communities; advancing legal mechanisms that prioritize preserving ecosystem functionality (see: Oslo Manifesto and Sienna Declaration online: ELGA <https://elgaworld.org/> (accessed 18 February 2022)).

[201] Lavanya Rajamani & Jacqueline Peel, "International Environmental Law: Changing Context, Emerging Trends, and Expanding Frontiers", in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 1, at 6.

[202] Vito de Lucia, "Competing Narratives and Complex Genealogies: The Ecosystem Approach in International Environmental Law" (2015) 27 J Envtl L 91. See also: Cecilia Engler, "Beyond rhetoric: navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management" (2015) 23 Environmental Reviews 288.

[203] Humby, *supra* note 4, at 109.

[204] The focus of this Dissertation is regulatory approaches. Some of the design features discussed in this chapter address governance rather than government, including informal networks for resource management

A first key point arising from the literature is that principles and processes of traditional environmental law are in tension with the principles and processes required for the management of complex and dynamic systems. Traditional environmental law is fragmented, state-centered (top-down), rigid and uniform, focused on narrow, static and often utilitarian substantive goals. Complex and dynamic systems require legal frameworks that support decentralized and collaborative (bottom-up), participatory, flexible, adaptive, and contextual management with holistic goals that focus on maintaining systems' integrity. In doing so, however, they still must uphold central legal principles: predictability, certainty, non-discrimination, finality, judicial review, transparency and accountability. Finding an appropriate balance between legal frameworks that are adaptable, flexible, and tailored to local contexts and the need for non-discriminatory approaches that provide predictability and certainty is a difficult task and a work in progress.[205] Further, the appropriate balance will depend on the specific legal, social and economic context; there is no one-size-fits all solution,[206] no simple checklist for legal design.

Being cognizant that arrangements will vary between countries, sectors or environmental problems, the literature review reveals distinct trends in the search for legal frameworks that focus on whole systems rather than individual elements. These trends reaffirm and supplement the specific legal features supportive of EAA outlined in Chapter 2. For analytical purposes, it is convenient to organize these trends under three dimensions of EA (that is, three ways to understand EA).[207] The first dimension emphasizes process. The second dimension emphasizes substantive outcomes. A third dimension, in turn, emphasizes adaptivity and flexibility.

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or private instruments (e.g. labels, voluntary self-regulation). These will not be addressed further, although I acknowledge that laws and policies also influence these non-state instruments.

[205] See, eg: David Langlet & Rosemary Rayfuse, "Challenges in Implementing the Ecosystem Approach: Lessons Learned" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance Perspectives from Europe and Beyond* (Leiden; Boston: Brill Nijhoff, 2019) 445 at 449-450; but see Ebbesson, *supra* note 67, at 415.

[206] Ebbesson, *supra* note 67, at 417.

[207] Platjouw describes the EA as requiring "both a holistic approach that focuses on the ecosystem as a whole, as well as an approach that integrates various objectives" (Platjouw, *supra* note 1, at 1). This corresponds to the process and outcome-oriented dimensions of EA explained below. She adds that the concept of the EA is very broad, involving many elements beside the holistic and integrationist nature, including adaptive management, decentralization, and humans as integral part of the ecosystems (*ibid*, at 4).

3.7.1. EA as a Social Process

EA can be understood as a social (consensus-building) process[208] that seeks to balance diverse societal goals and interests[209] through transparent, participatory and decentralized processes.[210] Therefore, a legal framework facilitating EA understood as a social process emphasizes decision-making structures, with a focus on scale (fit), coordination, transparency, and participation.[211]

Generally, decentralization of decision-making contributes to institutional fit and enables flexible responses that are tailored to the local context, including ecological features, social structures and local interests. However, decentralization also contributes to fragmentation in decision-making. It can create conflicts for the balancing of local, national and global interest. Further, and as the literature of SER emphasizes, the complexity of systems and the multiple scales at which it operates makes delineation of one relevant scale difficult, if not impossible.

It is important, therefore, that legal authorities and responsibilities are clearly delineated. Equally important is to establish effective institutional or procedural coordination mechanisms; procedures for transfer of information at all scales, including horizontally and vertically transfer; and internal conflict resolution mechanisms. Comprehensive environmental impact assessments are one legal tool that can facilitate coordination and information transfer at all levels.

Decentralization does not only consider the allocation of decision-making authority to sub-national government structures, or decision-making process that are tailored to particular ecosystems. It further considers stronger participation of local communities, including but not limited to co-management institutions. Legal provisions

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[208] CBD, Decision VII/11 on Ecosystem Approach adopted by the Seventh Ordinary Meeting of the Conference of the Parties held in Kuala Lumpur, Malaysia, 9 - 20 February 2004, Annex I, para A(3); Elisa Morgera, "The Ecosystem Approach and the Precautionary Principle" in Elisa Morgera & Jona Razzaque (ed), *Biodiversity and Nature Protection Law* 70 (Cheltenham, UK: Edward Elgar, 2017), at 73.

[209] Platjouw notes: "As such, the ecosystem approach requires both a holistic approach that focuses on the ecosystem as a whole, as well as an approach that integrates various objectives" See: Platjouw, *supra* note 1, at 1. It is the latter demand (the integration of various objectives) that is encapsulated in this first dimension of EAA.

[210] CBD, Decision VII/11, *supra* note 208. It further notes: *The objectives for managing land, water, and living resources is a matter of societal choice, determined through negotiations and trade-offs among stakeholders having different perceptions, interests, and intentions.*

[211] See also: Robin Kundis Craig, "Fostering adaptive marine aquaculture through procedural innovation in marine spatial planning" (2019) 110 Marine Policy 103555, at 4.

for EA should consider, therefore, clear consultation and participation rights, including co-allocation of decision-making responsibilities, as well as structures and processes to incorporate local knowledge into decision-making. Further, the law should ensure wide and timely access to information, in particular information resulting from monitoring results.

Public participation is generally considered necessary to adopt context-specific decisions that consider the interests of the local communities. Further, public participation (including access to "fair, independent and impartial courts or court-like bodies"[212]) has been understood as a mechanism to "keep the public administration within legal bounds, while acknowledging the need for openness and flexibility in environmental decision-making".[213] Thus, public participation also acts as a procedural safeguard for discretion and promotes legitimacy ("local buy-in") in decision-making.

This process-oriented dimension of EA is explicitly recognized in the literature on EAA. The FAO Technical Guidelines highlight that the EAA requires a trade-off between different societal objectives and between benefits and costs of aquaculture developments.[214] These trade-offs are further reflected in Principle 2, requiring the consideration of all benefits and costs associated to aquaculture, and in Principle 3, requiring the consideration of different uses of the marine space and resources. Fragmentation is explicitly considered a key obstacle for the integrated consideration and balancing of different societal objectives.[215]

The Technical Guidelines further emphasize the need for participatory approaches at the appropriate scale. As stated by Bermúdez, an EAA requires new institutional arrangements that reflect new ways of interaction between public institutions at different jurisdictional level (vertical and horizontal integration), and between public institutions and private organizations.[216]

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[212] Ebbesson, *supra* note 67, at 416.
[213] *Ibid*.
[214] FAO, *Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010)[hereinafter FAO, EAA Technical Guidelines].
[215] *Ibid*, at 25.
[216] Jorge Bermúdez, "Legal and policy components of the application of the ecosystem approach to aquaculture to site selection and carrying capacity" in LG Ross et al (eds), *Site selection and carrying capacities for inland and coastal aquaculture.* FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6–8 December 2010, Stirling, the United Kingdom of Great Britain and Northern Ireland. FAO

3.7.2. EA as a Substantive Concept

The process for decision-making needs to be complemented with a substantive, outcome-oriented and normative dimension: the overarching goal of maintaining ecosystems' structure and integrity. To this end, a legal framework supportive of EA needs to adopt a system (holistic) view that focuses on the full range of system interactions and anthropogenic pressures. EA as a substantive concept recognizes that there are ecological limits to the Earth's capacity to accommodate anthropogenic intervention.[217]

Substantive law limits public authorities' discretion. It provides a guidepost for decision-making and ensures consistent and coherent decision-making across jurisdictional and sectoral silos. Ultimately, substantive law ensures the protection of Nature's capacity for the continued provision of ecosystem services and for its own sake.

Practical tools to operationalize substantive outcome-oriented laws with a system view include ecological quality standards, ecological ceilings, ecological floors, or ecological triggers demanding managerial intervention to an activity that has exceeded the level of anthropocentric impact defined as acceptable. Such instruments also allow translating broad and integrative goals into sufficiently clear and detailed rules to allow decision-making, and to assess the performance of regulatory and policy interventions.

This dimension is explicitly recognized in the EAA Principle 1: *aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society*. The need for holistic and integrative approaches to assess and manage the impacts of aquaculture on the ecosystem is reflected directly in Principle 1 ("*full range of ecosystem functions and services*") but also in the emphasis on the need to address cumulative and watershed impacts. Indeed, the need to overcome the site-by-site regulation process was highlighted as an imperative for EAA implementation.[218]

Fisheries and Aquaculture Proceedings No 21 (Rome: FAO, 2013) 117 at 125 [hereinafter Bermúdez, Legal and policy components]. Participation is explicitly linked to acceptability and legitimacy (*ibid*).

[217] CBD, Decision VII/11, *supra* note 208, Annex, Principle 6: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach (principle 5). Ecosystems must be managed within the limits of their functioning.

[218] FAO, EAA Technical Guidelines, *supra* note 214; Bermúdez, Legal and policy components, *supra* note 216.

3.7.3. EA as Adaptive and Flexible Approach

The legal design for the management of complex and dynamic systems emphasizes legal process to ensure that regulations are flexible and responsive to change.[219] A legal design supportive of EA and EAA explicitly recognizes adaptive management or its key components. These include the mandatory collection of baseline information prior the beginning of a project or activity; the mandatory and transparent monitoring of relevant pre-selected performance indicators at appropriate scales during the project or activity; the definition of, or the process for defining, environmental thresholds that trigger mandatory and enforceable management responses (i.e. adjustments to the project or activity); and legal sunsets (mandatory windows for revision in light of new information) of regulatory instruments, policy goals or laws.[220]

Flexible and adaptive approaches apply at two levels. At the project level, it can be the result of regulations or conditions in licences or permits. At the policy and regulatory level, it requires the periodic revision of broader planning or zoning instruments, policies, and regulations themselves, to ensure that they continue to be aligned with the values, goals and factual situation that justified their enactment.

The need for flexible and adaptive regulatory approaches was recognized in the FAO Technical Guidelines on EAA[221] and has been further emphasized in more recent literature.[222]

3.7.4. Framework for Comparative Assessment

Untangling the complex concept of EA in three distinct, but interlinked, dimensions is a useful and practical framework to assess and compare salmon mariculture laws and policies. It allows to deconstruct the broad original research question (namely to identify key law and policy coordinates for operationalizing an EAA) into a subset of more

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[219] CBD, VII/11, *supra* note 208, Annex: Principle 9 Management must recognize that change is inevitable.
[220] Humby, *supra* note 4, at 109, citing Zellmar & Gunderson, *supra* note 26. This is particularly regarding laws regulating allocation of rights and entitlements. Humby concludes, however, that "the extent to which unsustainable, yet persistent natural resource decisions can be revisited, and existing rights and entitlements can be modified or taken away, was not a strong focus of the law and resilience literature under review" (*ibid*, at 110).
[221] FAO, EAA Technical Guidelines, *supra* note 214.
[222] Cecile Brugère et al, "The ecosystem approach to aquaculture 10 years on: A critical review and consideration of its future role in blue growth" (2019) 11 Rev in Aquaculture 493.

specific and concrete inquiries that reflect the different ways in which EA is understood (that is, that reflect the different dimensions of an EAA).

The salmon mariculture legal frameworks will be addressed and compared, therefore, through the following research questions:

- Do salmon mariculture laws and policies endorse EAA?
- Which legal structures or tools are in place to balance multiple ecological, social, and economic objectives?[223]
- How do legal instruments address "beyond the farm" impacts (i.e. ecosystem-level and cumulative interactions)?
- How do salmon mariculture legal frameworks support adaptive management?

The analytical framework for assessment and comparison of salmon mariculture legal frameworks and the more precise research questions identified above deserves a few further comments. First, it is important to acknowledge that the distinction between three dimensions of EAA (or three ways to understand EAA) is an analytical tool; in practice and legal design, it is expected that they will be intertwined. Second, knowledge-based decision-making and precautionary approach were not mentioned explicitly in this categorization despite the very important role they play in dealing with uncertainty and the recognized link between the ecosystem and precautionary approaches. Both knowledge-based decision-making and precautionary approach are implicit in all the dimensions of EA and are relevant to all the research questions. While the precautionary approach is not directly assessed in this Dissertation, examples of precautionary measures for salmon mariculture management will be included in Chapter 6 and 7.

[223] This particular research question will be further refined after the analysis of aquaculture legal frameworks in Chapter 6.

CHAPTER 4. AQUACULTURE AND THE LAW OF THE SEA: JURISDICTIONAL ASPECTS

The previous two chapters have clarified the concept of EAA and have identified three dimensions of EAA (EAA as a social process, as a substantive concept, and as flexible and adaptive approach), each associated to particular legal features for operationalization. The Dissertation turns now to addressing the international law applicable to salmon mariculture. The analysis of international law allows to identify the procedural and substantive international standards that States shall or should follow in regulating a sustainable industry. It also allows to assess to what extent the identified legal coordinates for EAA are reflected in those standards.

It was aptly noted elsewhere that international law has both "not much" and "lots" to do with aquaculture.[1] As an activity that generally takes place in areas under States' sovereignty,[2] there is no international agreement addressing marine aquaculture specifically. Nevertheless, international law (and in particular international law of the sea, international environmental law, and international trade law) is relevant for aquaculture in several ways. International law provides the overall rules according to which States can claim the jurisdiction to regulate, control and manage aquaculture activities. It also outlines responsibilities of States in exercising that jurisdiction. This chapter addresses the former: the jurisdiction to regulate, control and manage aquaculture activities under international law, as reflected in the 1982 *United Nations Convention on the Law of the Sea*[3] **(**hereinafter LOSC). Chapter 5, in turn, will address the LOSC provisions, as well as other international and regional instruments, outlining the responsibilities of States in the exercise of this jurisdiction.

The LOSC divides the ocean into multiple jurisdictional zones to assign and coordinate rights and obligations of coastal States and third States.[4] The zonal and

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[1] David L VanderZwaag, "The international law and policy seascape for aquaculture: navigating tangled currents" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016) 11.

[2] See below for more precisions.

[3] (10 December 1982) 1833 UNTS 397, entered into force 16 November 1994 [hereinafter LOSC]. All States studied in this Dissertation are parties to the LOSC. In any case, many of its provisions are considered to have reached the status of customary international law.

[4] Yoshifumi Tanaka, *The International Law of the Sea*, 2nd ed (Cambridge: Cambridge University Press, 21015) at 4.

sectoral approach of the LOSC, assigning rights and responsibilities to different categories of States and international organizations in different marine areas, has been considered a barrier for integrated and holistic ocean management. Despite a preambular recognition that the problems of ocean space are closely interrelated and need to be considered as a whole[5] and some provisions that reinforce a holistic view to oceans management,[6] the architecture of the law of the sea enshrined in the LOSC and furthered in other global and regional instruments is fragmented at the spatial and sectoral level.[7]

Traditional aquaculture installations require sheltered marine areas located close to the coast, in inland waters or (well within) the territorial sea. Nevertheless, technological advances have also allowed for the location of sites farther offshore.[8] Offshore aquaculture prototypes include multi-use offshore platforms,[9] open and semi-closed systems, floating and submersible options, and fixed and mobile systems.[10] Designs can consider living arrangements for staff but also full automation.[11] There is, therefore, at least a possibility that aquaculture may take place outside of internal waters and the territorial sea in the exclusive economic zone (EEZ) of the coastal State, and even

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[5] LOSC, *supra* note 3, Preamble, para 3.

[6] Eg, and as will be explained in Chapter 5 in more detail, the obligation to protect the marine environment (art 192), the duty not to transfer damage or hazards or transform one type of pollution into another (art 195), and some provisions regarding conservation of living resources and their dependent species (arts 61 and 119) have been interpreted as supporting (rather than mandating) a holistic or ecosystem approach to oceans management.

[7] See, generally: UN Secretary-General, *Gaps in international environmental law and environment-related instruments: towards a global pact for the environment*, A/73/419 (30 November 2018).

[8] FAO has adopted a broad classification system for marine aquaculture activities based on the marine area in which it is exercised. Relevant criteria include location/hydrography (distance from the coast, water column depth, and shelter), environment (significant wave height, wind, currents), access (landing accessibility), operation (manual vs. remote operations) and exposure. Based on a combination of these criteria, FAO classifies mariculture in: coastal mariculture, off the coast mariculture; and offshore mariculture. These categories are not based on the legal regime applicable to the respective marine area and, therefore, are of limited relevance for international law (although they may carry legal consequences at the domestic level). Offshore aquaculture generally is situated at more than 2km from the coast but well inside the territorial sea (See: A Lovatelli, J Aguilar-Manjarrez & D Soto (eds), *Expanding mariculture farther offshore: technical, environmental, spatial and governance challenges*. FAO Technical Workshop, 22–25 March 2010, Orbetello, Italy. FAO Fisheries and Aquaculture Proceedings No 24 (Rome: FAO. 2013)).

[9] See generally: Bela H Buck & Richard Langan (eds), *Aquaculture Perspective of Multi-Use Sites in the Open Ocean: The Untapped Potential for Marine Resources in the Anthropocene* (Cham, Switzerland: Springer, 2017).

[10] Gardner Pinfold Consultants Inc, "State of Salmon Aquaculture Technologies: Canada British Columbia" Report prepared for Fisheries and Oceans Canada, Ministry of Agriculture (Government of British Columbia) and Sustainable Development Technology Canada (2019), online: DFO <https://waves-vagues.dfo-mpo.gc.ca/Library/40864492.pdf>.

[11] *Ibid.*

outside areas under national jurisdiction.[12] Indeed, there are prototypes[13] of manned floating aquaculture vessels with the capability of operating in the open ocean, including the high seas. The legal regime applicable to these endeavours is therefore worth exploring, even though a more in-depth legal analysis will be dependent on the technology deployed. [14]

4.1. Aquaculture in Internal Waters and Territorial Sea

Traditionally, mariculture takes place in sheltered areas located either in internal waters[15] (e.g. fjords, lochs, protected bays) or in coastal areas well within the limits of the territorial sea.[16] Both internal waters and the territorial sea are areas subject to territorial sovereignty, and coastal States exercise comprehensive legislative and enforcement jurisdiction with the limitation that the coastal State has to respect the innocent passage of foreign ships in the territorial sea.[17]

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[12] See: David R Percy, Nathanael Hishamunda & Blaise Kuemlangan, "Governance in marine aquaculture: the legal dimension" in A Lovatelli, J Aguilar-Manjarrez & D Soto (eds), *Expanding mariculture farther offshore: technical, environmental, spatial and governance challenges* 245 at 246, FAO Technical Workshop, 22–25 March 2010, Orbetello, Italy. FAO Fisheries and Aquaculture Proceedings No 24 (Rome, FAO, 2013). According to economic models, offshore mariculture could be cost-effective up to a distance of 25nm from shore (JM Kapetsky, J Aguilar-Manjarrez & J Jenness, *A global assessment of potential for offshore mariculture development from a spatial perspective*. FAO Fisheries and Aquaculture Technical Paper No 549 (Rome: FAO, 2013) at 7, 23, citing D Jin, "Economic models of potential U.S. Offshore aquaculture operations", in *Offshore Aquaculture in the United States: Economic Considerations, Implications and Opportunities* (Silver Spring, Maryland, USA: NOAA Aquaculture Program, 2008). However, the majority of current open ocean operations, pilot projects and explorations are located within the territorial sea, between 1 and 10 nautical miles from the coast (California Environmental Associates, *Offshore Finfish Aquaculture: Global Reviews and US Prospects* (The David and Lucile Packard Foundation, 2018).

[13] One salmon farm ship is in trial period in China: Fish Farming Expert (eds), "China's salmon farm ship starts sea trials" (1 February 2022), online: Fish Farming Expert <https://www.fishfarmingexpert.com/china-fish-farm-ship-qingdao-conson-group/chinas-salmon-farm-ship-starts-sea-trials/1182518> (accessed 4 November 2022). A prototype, the Ocean Ark, considers operations in the exclusive economic zone and in the high seas. See: Daniela Balin, "Ark' fish farm designers seek investors to get on board" (8 June 2018), Fish Farming Expert: https://www.fishfarmingexpert.com/article/ark-fish-farm-designers-hoping-investors-will-get-on-board/.

[14] The LOSC recognizes other marine zones subject to a special regime. These include the contiguous zone, archipelagic waters, the international straits, and the Area. Since their relevance to salmon marine farming is limited, they will not be addressed further.

[15] LOSC, *supra* note 3, art 8(1): "(…) waters on the landward side of the baseline of the territorial sea form part of the internal waters of the State". The baselines are determined in accordance with the LOSC and can be normal (art 5) or straight (art 7) baselines.

[16] The territorial sea is the marine area seaward of the baselines determined in accordance with the LOSC, to a limit not exceeding 12 nautical miles (nm) (LOSC, *ibid*, arts 2, 3).

[17] LOSC, *ibid*, art 17.

Consequently, the coastal State[18] has the sovereign right to exploit their natural resources pursuant to its environmental policies[19] (subject to the responsibilities that will be analyzed in the next chapter), which include undertaking, or authorizing the undertaking, of aquaculture activities. It has the right to adopt laws and regulations, in conformity with the LOSC and other rules of international law, relating to innocent passage through the territorial sea for the safety of navigation and the regulation of maritime traffic and for the protection of facilities and installations.[20] This right may include the designation of sea lanes or traffic separation schemes.[21] It does not extend, however, to the design, construction, manning or equipment of foreign ships unless they are giving effect to generally accepted international rules or standards.[22] The coastal State has an obligation to give due publicity to all such laws and regulations[23] as well as any known danger to navigation in its territorial sea.[24]

In exercising its rights and responsibilities, the coastal State shall not hamper the innocent passage of foreign ships through the territorial sea.[25] It has been interpreted that this provision applies not only to prescriptive measures (laws and regulations) but also to the construction of devices and installations within the territorial sea.[26] Whether an installation can be considered an unreasonable interference with the right to innocent

[18] While the legal principle is simple, the jurisdictional issue can be controversial in cases of disputed maritime borders. Ireland and Northern Ireland (U.K.) offer a particularly interesting case of disputed boundaries in Lough Foyle and Lough Carlingford affecting the development of the aquaculture sector (W Flannery et al, "Evaluating conditions for transboundary marine spatial planning: Challenges and opportunities on the island of Ireland" (2015) 51 Marine Policy 86; see also Loughs Agency, online: https://www.loughs-agency.org/ (accessed 24 February 2021)).
[19] LOSC, *supra* note 3, art 193; United Nations General Assembly, Resolution 1803 (XVII) of 14 December 1962 on "Permanent sovereignty over natural resources"; United Nations General Assembly, Resolution 3201 (S-VI) "Declaration on the Establishment of a New International Economic Order" (1 May 1974); United Nations General Assembly Resolution 3281 (XXIX) "Charter of Economic Rights and Duties of States" (12 December 1974); UN, World Charter for Nature, Annex to Resolution of the United Nations General Assembly 37/7 (28 October 1982).
[20] LOSC, *supra* note 3, art 21(1)(a) and (b).
[21] *Ibid*, art 22.
[22] *Ibid*, art 21(2).
[23] *Ibid*, art 21(3).
[24] *Ibid*, art 24(2).
[25] *Ibid*, art 24(1).
[26] See: R Barnes, "Article 24" in A Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* 217 at 220 ((Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017); RR Churchill & AV Lowe, *The Law of the Sea*, 3d ed (Manchester: Manchester Univ Press: 1999) at 100.

passage would need to be addressed on a case-by-case basis, balancing the rights and interests of the coastal State with the right to innocent passage.[27]

4.2. Aquaculture in the EEZ

The EEZ is the area beyond and adjacent to the territorial sea which breadth shall not extend beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.[28] In the EEZ, the coastal State has exclusive jurisdiction for the purpose of exploring and exploiting, conserving and managing the living and non-living natural resources of the waters superjacent to the seabed, the seabed and its subsoil, and for the economic exploitation and exploration of the zone.[29]

The legal regime in the EEZ is characterized by the balancing of the rights and interests of coastal States with the rights, freedoms, and interests of other States[30] (and in particular the freedom of navigation). Thus, while the coastal State enjoys extended sovereign rights in this marine area, these sovereign rights are subject to limitations that do not have a parallel in the internal waters and territorial seas.

According to article 56(1)(b)(i), the coastal State has jurisdiction, as provided in the relevant provisions of the LOSC, with regard to the "establishment and use of artificial islands, installations and structures."[31] This jurisdiction is further outlined in article 60. According to this provision, in the EEZ the coastal State has the exclusive right to right to "construct and to authorize and regulate the construction, operation and use of: a) artificial islands; b) installations and structures for the purposes provided for in article 56 and other economic purposes; and c) installations and structures which may interfere with the exercise of the rights of the coastal State in the zone". The LOSC does not define the terms artificial island, installation, or structures. Some authors distinguish installations and structures from artificial islands in that "the latter are built from man-made or natural materials that are piled on the seabed to form an area of land".[32]

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[27] See: Barnes, "Article 24", *supra* note 26, at 220.
[28] LOSC, *supra* note 3, arts 55 and 57.
[29] *Ibid,* art 56.
[30] *Ibid*, arts 55, 56 and 58. See in particular articles 56(2), 58(3) and 59.
[31] *Ibid*, art 56(1)(b)(i).
[32] Alex G Oude Elferink, "Artificial islands, installations and structures" Max-Planck Encyclopedia of Public International Law (online) (updated September 2013), para 5.

Aquaculture offshore technologies fall within the category of "installations" or "structures".[33] Since aquaculture is a form of economic exploitation of the zone equivalent to economic activities explicitly mentioned in article 56 (e.g. production of energy from water, currents and winds), it is therefore uncontested that a coastal state has the right and exclusive jurisdiction to construct and authorize and regulate the construction, operation and use of aquaculture installations or structures within its EEZ under articles 56 and 60(1)(b).[34]

In exercising this exclusive right, however, the coastal State must have due regard to other rights and interests, and in particular the freedom of navigation. This due regard obligation includes the specific obligations listed in article 60. The coastal State has the obligation to give due notice of the construction of artificial islands, installations, and structures, and to maintain permanent warnings on their presence. The coastal State has the right to establish reasonable "safety zones" to ensure the safety of the structure and of navigation.[35] This right is subject to restrictions to ensure freedom of navigation. The breath of the safety zone is determined by the coastal State, but it has to be "reasonably related to the nature and function" of the structure, taking into account applicable international standards. Unless authorized by general standard or recommended by a competent international organization, it cannot exceed 500 metres around the structure.[36] A safety zone cannot be established where they would interfere with recognized sea lanes

[33] At least one author distinguishes between installation and structure, arguing that installations can be moved form one site to another without losings its identity (A Proelss, "Article 60", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 464 at 471, citing R Lagoni, "Künstliche Inseln und Anlagen im Meer" (1975) 18 Jahrbuch für Internationales Recht 241).

[34] VanderZwaag, *supra* note 1; Percy, Hishamunda & Kuemlangan, *supra* note 12; Jana Roderburg, "Marine Aquaculture: Impacts and International Regulation" (2011) 25 Australian & New Zealand Maritime LJ 161. In commenting on article 56 of the LOSC, Proelss discusses the scope of the expression "conserving and managing the natural resources" in the EEZ and concludes that this expression does not apply to non-natural (artificial or man-made) resources. Therefore, he concludes that offshore aquaculture (that is, aquaculture undertaken in the EEZ) "cannot be regarded as satisfying the element of conservation and management of natural living resources and exploration of the zone, but rather it ought to be seen as one of several 'other activities for the economic exploitation and exploration of the zone'". He also concludes that articles 61-67 (addressing conservation and management of living resources in the EEZ) are arguably not applicable to offshore aquaculture. (A Proelss, "Article 56" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 418 at 427).

[35] LOSC, *supra* note 3, art 60(4).

[36] *Ibid*, art 60(5).

essential to international navigation.[37] Further, coastal States do not have the right to establish navigation standards as ships are required to comply only with "generally accepted international standard regarding navigation" in the vicinity of the structure.[38]

Abandoned or disused installations or structures shall be removed to ensure safety of navigation, taking into account generally accepted international standards. Article 60(3) does not require that the installations or structures be removed in their entirety. Nevertheless, permanent removal is required in the non-binding Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone approved by the International Maritime Organization for installations or structures placed on or after 1 January 1998.[39]

In addition to sovereign rights for the economic exploitation, coastal States have both the jurisdiction[40] and the duty to protect and preserve the marine environment in the EEZ.[41] This jurisdiction must be exercised, however, "as provided for in the relevant provisions of this Convention."[42]

4.3. Aquaculture Installations on the Continental Shelf

The regime for the continental shelf is regulated in Part VI of the LOSC. The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200nm from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance.[43] In the continental shelf, the coastal State has sovereign rights for the purpose of exploring and exploiting the mineral

[37] *Ibid*, art 60(7).
[38] *Ibid*, art 60(6).
[39] International Maritime Organization (IMO), *Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone*, International Maritime Organisation, Resolution A.672(16) (19 October 1989) annex art 3.13.
[40] LOSC, *supra* note 3, art 56(1)(b)(iii).
[41] *Ibid*, art 192.
[42] *Ibid*, art 56(1) (b)(iii). The environmental responsibilities of coastal States will be addressed in chapter 5.
[43] *Ibid*, art 76(1).

and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species.[44]

While the exclusive rights to explore and exploit the natural resources of the seabed fall within the regimes for the EEZ and the continental shelf,[45] the independent analysis of the continental shelf regime is relevant for situations where the continental shelf of a coastal State extends beyond its EEZ.[46] This can occur because the coastal State has not claimed the full breadth of its EEZ, or because its continental shelf extends beyond the 200nm outer limit of the EEZ (i.e. the "outer" continental shelf).[47]

Article 80 addresses "artificial islands, installations and structures on the continental shelf". The scope of the provision is limited to artificial islands, installations and structures *on the continental shelf* (emphasis added), i.e. installations or structures that are attached to the seabed.[48] It simply states, however, that "[a]rticle 60 applies *mutatis mutandis* to artificial islands, installations and structures on the continental shelf" without specifying which modifications to article 60 are necessary in the context of the continental shelf regime.[49]

Article 60, as noted, states that in the EEZ, the coastal State has the exclusive right to construct, authorize and regulate the construction, operation and use of: (a) artificial islands (for all purposes); (b) installations and structures for the purposes provided for in article 56 and "other economic purposes"; and (c) installations and structures which may interfere with the exercise of the rights of the coastal State in the zone. Subparagraphs (b) and (c) are relevant for the aquaculture context. I address subparagraph (b) first.

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[44] *Ibid*, art 77(1) and (4). Sedentary species are "organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil" (*ibid*).
[45] *Ibid,* arts 56(1) and 77(1).
[46] AR Maggio, "Article 80", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 628 at 629.
[47] RR Churchill & AV Lowe, *The Law of the Sea*, 3d ed, (Manchester, UK: Manchester University Press, 1999) at 149; Elferink, *supra* note 32, para 16.
[48] Maggio, *supra* note 46, at 632.
[49] Todd Emerson Hutchins, "Crafting an International Legal Framework for Renewable Energy on the High Seas" (2021) 51:2 Env't L 485; Aldo Chircop & Peter L'Esperance, "Functional Interactions and Maritime Regulation: The Mutual Accommodation of Offshore Wind Farms and International Navigation and Shipping" (2016) 30 Ocean Yearbook 439.

While several interpretations can be construed from the reference to article 60 in article 80,[50] the scholarship generally agrees that the coastal State has the exclusive right to construct, authorize and regulate the construction, operation and use of installations for the purposes of exploring and exploiting its mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species.[51] This interpretation is consistent with the functional purpose of the continental shelf regime and with article 78, according to which the rights of the coastal State over the continental shelf do not affect the legal status of the superjacent waters, and the exercise of its rights as a coastal State over the continental shelf must not infringe or result in any unjustifiable interference with navigation *and other rights and freedoms* of other States (emphasis added). Finfish aquaculture is a surface activity that occupies the water column; it does not exploit the resources of the continental shelf. Therefore, it does not fall within the exclusive rights of the coastal State under subparagraph (b).[52]

The interpretation and implementation of subparagraph (c) is more difficult,[53] however. According to this subparagraph, a coastal State also has exclusive rights to construct, authorize and regulate the construction, operation and use of installations and structures which may *interfere* with the exercise of the rights of the coastal State. Establishing interference, or potential interference ("*may interfere*"), involves an analysis of facts and law. In the context of finfish aquaculture, two potential sources of interference can be considered: the laying of anchors or other infrastructure to attach the infrastructure to the seabed, and the deposition of emissions from the aquaculture operations.

The first question that needs to be addressed is if any installation that is attached to the seabed interferes with the rights of the coastal State on its continental shelf. If so, the construction, authorization, and regulation of such an installation would fall within the coastal State's exclusive jurisdiction under articles 80 and 60(1)(c). Some coastal States seem to adopt this interpretation. In the context of offshore surface renewable

[50] Chircop & L'Esperance, *supra* note 49, at 467, present three alternative interpretations of article 80 and article 60.
[51] LOSC, *supra* note 3, art 77(4). Chircop & L'Esperance, *supra* note 49, at 467, refer to this interpretation as providing a contextual dimension to the articles, with reference "to their position and relationship to the Convention as a whole, and in particular the freedoms in Article 87". But see Tanaka, *supra* note 4, a 148.
[52] See: Roderburg, *supra* note 34.
[53] Proelss, "Article 60", *supra* note 33.

energy installations, the U.S.A. has claimed the right to manage the development of such activities in the federally owned outer continental shelf based on the "attachment to the seabed" of anchors and power cables.[54] The Act has been criticized as an act of creeping jurisdiction inconsistent with article 78 of the LOSC.[55]

A different line of argumentation allows for the conclusion that not every activity attached to the seabed falls within the exclusive jurisdiction of the coastal State, but that nevertheless the coastal State can exercise limited rights in relation to the infrastructure attaching those installations to the seabed. Article 81 of the LOSC states that the "coastal State shall have the exclusive right to authorize and regulate drilling on the continental shelf for all purposes" (thus, not only for exploration and exploitation of non-living resources and sedentary resources).[56] A harmonious interpretation of articles 80, 60, 87 and 81 of the LOSC allows to conclude that while the coastal State does not have rights or jurisdiction over the *activity (*in this case, aquaculture activity) conducted in superjacent waters, it does have the *exclusive* right to authorize the drilling in the continental shelf for the purpose of installing the anchoring system (provided that drilling is necessary). Another provision of the LOSC confirms that the placement or any structures in the continental shelf (for purposes other than those in article 76) requires the authorization of, or at least consultation with, the coastal State. Article 79 addresses the right of all States to lay submarine cables and pipelines on the continental shelf. This is a freedom of all States, and coastal States may not impede its exercise.[57] However, the coastal State has the right to take reasonable measures to protect the (present or future) exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction, and control of pollution from pipelines. Furthermore, the delineation of the course of pipelines is subject to the consent of the coastal State.[58]

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[54] Hutchins, *supra* note 49, at 506.
[55] *Ibid*.
[56] See also: LOSC, *supra* note 3, art 246(5).
[57] *Ibid*, article 79(2).
[58] *Ibid*, article 79(2) and (3). Mossop further argues the coastal State has extended environmental responsibilities over the outer continental shelf based on the provisions of Part XII and the Convention on Biological Diversity (see: Joanna Mossop, "The relationship between the continental shelf regime and a new international instrument for protecting marine biodiversity in areas beyond national jurisdiction" (2017) ICES J of Maine Science doi:10.1093/icesjms/fsx111, at 3).

A second source of interference is the emissions from the farming operation. Such emissions may have negative impact on sedentary communities of the continental shelf and therefore interfere with the exploration and exploitation rights of the coastal State on such species. Arguably, the facts of such an interference would be difficult to establish considering the scale, extent, and duration of any potential impact in high-energy environments. The legal landscape is also not straightforward, as the regime in the continental shelf is not as detailed as the EEZ regime in balancing rights and obligations of the coastal and other States.[59] In particular, it is unclear whether the coastal State may be able to regulate the emissions from shipping or other structures in the superjacent water column to protect the resources and ecosystems under its jurisdiction on the extended continental shelf above and beyond any pollution standards under general international law.

4.4. Aquaculture on the High Seas

The high seas are all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State.[60] The high seas are open to all States, whether coastal or land-locked.[61] The freedoms of the high seas, which must be exercised under the conditions laid down by the Convention and by other rules of international law, include the freedom of navigation[62] (without qualification) and the freedom to construct artificial islands and installations permitted under international law.[63] Although not explicitly mentioned, fish farming uses the high seas for peaceful purposes[64] and is therefore, at least *prima facie*, permitted under international law. Consequently, any State has the right to engage in

[59] Mossop, *ibid*.
[60] LOSC, *supra* note 3, art 86.
[61] *Ibid*, art 87(1).
[62] *Ibid*, art 87(1)(a).
[63] *Ibid*, art 87(1)(d). Note that article 87 refers only to "installations" and not "installations and structures", the expressions used in article 56(1)(b)(i) and 60. Considering that the terms are not defined, it is unclear whether this different language entails any legal consequence.
[64] *Ibid*, art 88.

aquaculture in the high seas,[65] and to subject the aquaculture installation to its regulatory and enforcement rights and responsibilities.[66]

Nevertheless, the freedom to construct artificial islands and installations is subject to three limitations. First, it is a freedom "subject to Part VI" on the continental shelf. This expression can have two implications, depending on the interpretation adopted in relation to activities attached to the seabed in the continental shelf. If the provision of articles 80 and 60(1)(c) is interpreted as providing exclusive right to the coastal State to construct or authorize and regulate the construction, use and operation of installations attached to the seabed of the outer continental shelf, then "subject to Part VI" means that such an installation does not fall within the freedom of the high seas. If, in turn, the interpretation of articles 80 and 60(1)(c) is that the State must consult and seek authorization or consent of the coastal State to attach an installation to the outer continental shelf, then "subject to Part VI" refers to this authorization or consent as a condition for the exercise of the freedom of the high seas. It is worth reiterating that, in either case, the limitations resulting from Part VI apply to fixed structures attached to the seabed and not floating aquaculture infrastructure.

Second, the freedom to construct installations in the high seas must be exercised with due regard to the rights with respect to the activities in the Area. In turn, article 147(3) prescribes that other activities in the marine environment (i.e. activities other than those falling under the regime of the Area) shall be conducted with reasonable regard for activities in the Area. Neither the term *due regard* nor the term *reasonable regard* provides a precise duty or particularly clear standard. Generally, the freedom is limited "insofar as unnecessary or unreasonable interference with legitimate activities in the Area shall be avoided."[67]

Finally, in exercising the freedom of the high seas, States must have due regard to the interests of other states in their exercise of the freedoms of the high seas.[68] As in the

[65] See: VanderZwaag, *supra* note 1; Percy, Hishamunda & Kuemlangan, *supra* note 12; Roderburg, *supra* note 34. Hutchins, *supra* note 49, arrives at the same conclusion with respect to renewable energy installations.
[66] LOSC, *supra* note 3, art 94. About aquaculture structures as ships, see below.
[67] S Vöneky & F Beck, "Article 147", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1035 at 1045.
[68] LOSC, *supra* note 3, art 87(2).

previous situation, there is no clear standard to assess the content of the due regard obligation. A "balancing of interests in the use of the seas is required."[69]

Interesting interpretation questions have been put forward in the analysis of other new activities in the high seas, and in particular offshore wind farms, which would also apply to aquaculture. These include, for example, the extent to which (extensive) fixed structures in the high seas can be considered to conflict with article 89 of the LOSC prohibiting any State to subject part of the high seas to its sovereignty;[70] the extent to which (extensive) fixed structures in the high seas are compatible with the interests of other States in exercising their exercise of the freedom of the high seas and to the rights with respect to the activities in the Area.[71] In relation to environmental protection, the lack of environmental standards[72] and the legal gap regarding an obligation related to decommissioning of facilities no longer in use[73] have also been noted.[74]

4.5. Aquaculture Infrastructure as Ships

A further interpretation issue that is relevant for offshore aquaculture is whether an aquaculture farm can be considered a "vessel" or "ship" and therefore subject to the extensive legal regime applicable to vessels or ships in the LOSC and other international agreements.[75] The LOSC uses both concepts -- "ship" and "vessel" – interchangeably but

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[69] D Guilfoyle, "Article 87" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 678 at 681.
[70] Nicholas J Lund, "Renewable Energy as a Catalyst for Changes on the High Seas Regime" (2010) 15 Ocean & Coastal LJ 95 at 108-109; Hutchins, *supra* note 49.
[71] LOSC, *supra* note 3, art 87(2); Chatham Partners, "Offshore Wind in High Seas: Unlimited potential beyond national control?" (December 2019), online: <https://chatham.partners/site/assets/files/1031/chatham-partners-offshore-wind-farms-in-high-seas.pdf>; Hutchins, *supra* note 49.
[72] Hutchins, *supra* note 49.
[73] Paul Elsner & Suzette Suarez, "Renewable energy from the high seas: Geo-spatial modelling of resource potential and legal implications for developing offshore wind projects beyond the national jurisdiction of coastal States" (2019) 128 Energy Policy 919, at 926.
[74] The adoption and entry into force of an international agreement currently under negotiation, the Internationally Legally Binding Instrument for the Conservation of Marine Biodiversity in ABNJ, may affect the analysis of the legal regime applicable to aquaculture in the high seas. Obligations on environmental impact assessment and area-based conservation measures may be of particular relevance. See, eg: UN, Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction, online: UN <https://www.un.org/bbnj/> (accessed 4 November 2022). However, since the negotiation is not finalized and there is still significant disagreement on its text, the analysis of the implications of such agreement for aquaculture will not be addressed in this Dissertation.
[75] For a related discussion on the relationship between mariculture and Canadian maritime law, including whether mariculture installations can be considered ships under Canadian law, see: Aldo Chircop,

does not define either. The definition of ship and vessel has been extensively discussed in international law, and there is a broad understanding that these are terms which definition varies depending on the specific subject of regulation.[76] Generally, definitions provided in international agreements and endorsed by scholars are broad and encompass, in principle "any craft that could float and navigate at sea".[77] In these broad definitions, it is the function rather than the form which characterizes a "vessel". Further, a craft needs to be apt for "navigation" but not necessarily used for navigation. Some authors have argued that platforms should not be considered under the definition of vessels because they do have a special treatment in the LOSC, but others consider that some regulatory objectives of the LOSC apply to fixed platforms as well. Indeed, some agreements include fixed platform explicitly in their definition of ships.[78]

The question is then, can an offshore aquaculture installation be considered a ship under international law? Lowe, discussing the case of mobile offshore drilling crafts, argues that the structure is considered a ship while in navigation (from one site to another or to a shipyard, whether self-propelled or towed) but not when they are operating on location whether or not they are permanently fixed to the seabed.[79] By analogy, an aquaculture facility can be considered a ship and subject to the respective legal regime

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"Mariculture and Canadian maritime law: an unexplored relationship" in David L VanderZwaag & Gloria Chao, *Aquaculture Law and Policy: Towards principled access and operations* (Oxon; New York: Routledge, 2006) 207.

[76] Vaughan Lowe, "Ships" in Nerina Boschiero et al, (eds), *International Courts and the Development of International Law: Essays in Honour of Tullio Treves* (The Hague: Springer, 2013) 291 at 296-297. See also: Elferink, *supra* note 32.

[77] Lowe, *supra* note 76, at 293.

[78] Eg: the *International Convention for the Prevention of Pollution from Ships*, *1973*, as modified by the *Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973* (MARPOL73/78), 17 February 1978, 1340 UNTS 61 (entered into force 2 October 1983), defines "ship" in art 2.4 as "a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft and fixed and floating platforms". The same definition is included in the *Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992* (Helsinki Convention), 9 April 1992, 2099 UNTS 197 (entered into force 17 January 2000) (as amended), art 2.4. The Helsinki convention was originally adopted in 1974 and entered into force in 1980. It was updated in 1992. Some bilateral treaties also consider a broad definition inclusive of fixed platforms. Other multilateral treaties consider a broad definition of ships that include floating crafts or platforms not permanently moored (eg: *Convention on the International Maritime Satellite Organization* (INMARSAT), 3 September 1976, 1143 UNTS 105 (entered into force 16 July 1979), art 1; *Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation*, 10 March 1988, 1678 UNTS 221 (entered into force 1 March 1992) art 1). See also: Finnish Memorial, December 1991, Part III, Chapter II, www.icj-cij.org/docket/files/86/6885.pdf (accessed 27 January 2021).

[79] Lowe, *ibid*, discusses the opinion of the Finnish government in the *Great Belt* case submitted to the ICJ and which ended by agreement of the parties. See: Lowe, *ibid*; See also Finnish Memorial, *supra* note 78.

while in transit (whether self-propelled or in tow); once installed for operation (in the EEZ or high seas) it would be considered an installation subject to exclusive jurisdiction of the coastal or controlling State[80] (without prejudice of the application of particular legal regimes applicable to "vessels" where their definition explicitly includes fixed structures or platforms).

Further interpretation issues may arise from offshore farming technologies that operate without being fixed to the seabed. These technologies may be considered ships for most regulatory objectives of the International Maritime Organization.[81] As the ship is undertaking an economic activity that relies on the marine environment *while* navigating, within the EEZ it would be subject to the exclusive jurisdiction and control of the coastal State both for licensing and for environmental protection purposes.[82] A floating farm operating in the high seas may use transhipment vessels to access ports and markets or may need to access port itself. The latter case poses further interpretation questions as the conditions under which it may navigate through the exclusive economic zone of another State and whether its navigation in the territorial seas can be considered innocent passage.

4.6. Concluding Remarks

This chapter has analyzed the jurisdictional aspects of the LOSC, identifying the right to engage in aquaculture activities. While the trend in aquaculture practices is to move farther offshore to reduce environmental and social pressure on the coastal systems, the legal regime applicable to those activities, and in particularly activities in the high seas, remain far from clear. The issue is not exclusive to aquaculture installations or vessels, however; other offshore sectors are having, or will have, similar legal difficulties.

The right to install and operate, or authorize the installation and operation, of aquaculture facilities does look at one aspect of the international law relevant for aquaculture. The other aspect comprises the duties and responsibilities that the LOSC and

[80] Hutchins arrives at the same conclusion analyzing offshore renewable energy platforms. See: Hutchins, *supra* note 49.
[81] The Ocean Ark prototype has recently gained Approval in Principle from an international classification society (RINA) according to RINA rules and SOLAS, MARPOL and IMO regulations (RINA's approval of offshore farming vessel (30 November 2021): https://aquafeed.co.uk/entrada/rinas-approval-of-offshore-fish-farming-vessel-53759).
[82] The domestic legislation and standards applicable to such an initiative would raise further legal interpretation issues, as has been the case with floating renewable energy installations.

other international instruments imposes on coastal or controlling States in exercising their sovereignty, jurisdiction, or exclusive rights. I turn to this aspect in the next chapter.

CHAPTER 5. SALMON MARICULTURE AND INTERNATIONAL ENVIRONMENTAL LAW AND POLICY

The previous chapter addressed the rights of the coastal State to construct, or authorize and regulate the construction, operation, and use, of salmon mariculture installations in the different maritime zones recognized in the 1982 *United Nations Convention on the Law of the Sea* (LOSC).[1] The exercise of these rights, however, is subject to the responsibilities and duties of the holistic LOSC regime for marine environmental protection. It is also subject to other rules of international environmental law, as reflected in customary international law and in multilateral and regional agreements. International environmental law must be understood broadly to include not only provisions addressing environmental conservation and sustainable use of natural resources, but also obligations and standards guiding States' conduct and environmental decision-making *vis a vis* their citizens or population. The "social dimensions" of environmental law, at the intersect of human rights law and environmental law,[2] are consistent with the broader perspective of the EAA encompassing ecological and social sustainability.

International environmental law and policy relevant for aquaculture planning and management addresses, therefore, a wide variety of subject matters. These include, *inter alia*: the conservation of marine biodiversity; the conservation of particular species, habitats or ecosystems; transboundary environmental impacts; food safety; fish health; introduction of alien species; biotechnology; environmental democracy; and recognition of the rights of Indigenous Peoples. As a result, a vast, complex, and fragmented landscape of international law has bearing in the development, regulation, and management of aquaculture.[3]

Addressing this complex and fragmented landscape is relevant for the analysis in this Dissertation for several reasons. First, it provides the international legal framework

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[1] 10 December 1982, 1833 UNTS 397 (entered into force 16 November 1994) [hereinafter LOSC].
[2] Lavanya Rajamani & Jacqueline Peel, "International Environmental Law: Changing Context, Emerging Trends, and Expanding Frontiers", in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 1.
[3] Howarth notes that the issues covered in international institutes constitute a "checklist" of possible environment impacts that may arise from aquaculture and need to be addressed, cautioning however that the checklist needs to be read with caution due to diversity of aquaculture (William Howarth, "Global challenges in the regulation of aquaculture" in David L VanderZwaag & Gloria Chao (eds), *Aquaculture Law and Policy: Towards Principled Access and Operations* (London; New York: Routledge, 2006) 13 at 19.

setting out the obligations of States in planning and managing salmon mariculture under their jurisdiction or control. While international treaties generally need to be incorporated into legislation to have domestic effect,[4] States have a duty to carry out in good faith obligations arising from treaties and other sources of international law.[5] Second, it allows to assess the extent to which international law endorses and supports holistic and integrative approaches to management consistent with the EAA, focusing on the three dimensions of EAA identified in Chapter 3. And third, it also highlights the limits of international environmental law with respect to substantive protections to ecosystem integrity.

Two international agreements are addressed in detail in sections 5.1 and 5.2: the LOSC, and the *United Nations Convention on Biological Diversity*[6] (CBD). Section 5.3 further addresses key policy instruments developed by FAO that are influential for aquaculture planning and management, namely, the CCRF and various aquaculture guidelines.

The chapter also provides a broad overview of key multilateral agreements relevant for aquaculture planning and management in section 5.4. These include: the Convention on the Conservation of Migratory Species of Wild Animals, the Codex Alimentarium, the Aquatic Code adopted by the World Organisation for Animal Health (founded as OIE), the Cartagena Protocol, the Aarhus Convention, the Escazú

[4] This is the case for all the States included in this Dissertation. See: R St J MacDonald, "The Relationship between International Law and Domestic Law in Canada" in R St J MacDonald, Gerald L Morris & Douglas M Johnston (eds), *Canadian Perspectives on International Law and Organization* (Toronto; Buffalo: University of Toronto Press, 1974) 88, at 114-130; Constitución Política de la República de Chile, art 54(1) and Judith Schönsteiner, "Algunas Reflexiones Preliminares sobre la Incorporación del Derecho Internacional de los Derechos Humanos y Asuntos Económicos" in Ximena Gauché (ed), *X Coloquios de Derecho Internacional. Constitución Política y Derecho Internacional, Universidad de Concepción, 2021* (2021), online: Foro Constituyente Universidad de Concepción <https://foroconstituyente.udec.cl/storage/2021/08/2021_agosto31_Dossier_final_X_Coloquios_Derecho_Internacional.pdf>) 109 [Some Preliminary Reflections on Incorporating International Human Rights Law and Economic Issues]; Hans Christian Bugge, *Environmental Law in Norway*, 4th ed (Alphen aan den Rijn, Netherlands: Kluwer Law International, 2022) at 64; Patrick Butchard, "Principles of international law: A brief guide", House of Commons Library Briefing Paper 9010 (21 September 2020), online: House of Commons <https://researchbriefings.files.parliament.uk/documents/CBP-9010/CBP-9010.pdf> (accessed 14 March 2023). The relationship between international law and domestic law is more complex in all cases, as noted in the cited references. This is particularly the case with respect to customary international law and international law in the field of human rights. Further, international law can have an important role in the interpretation of domestic law (see eg Bugge, *ibid*).

[5] *Vienna Convention on Law of Treaties*, 23 May 1969, 1155 UNTS 331 (entered into force on 27 January 1980), art 26.

[6] *Convention on Biological Diversity*, 5 June 1992, 1760 UNTS 69 [hereinafter CBD].

Agreement, the International Labor Organization (ILO) Convention No 169 concerning Indigenous and Tribal Peoples in independent countries, and the U.N. General Assembly Declaration on the Rights of Indigenous Peoples (UNDRIP). Lastly, section 5.5 addresses developments under regional organizations of relevance for this Dissertation: the North Atlantic Salmon Conservation Organization (NASCO), the OSPAR Commission, and the International Council for the Exploration of the Seas (ICES).[7]

Consistent with the scope of the Dissertation, the chapter focuses on substantive and procedural obligations relevant for the grow-out phase of salmon mariculture.[8] Not all the international and regional instruments discussed in this Chapter have been ratified by all States considered in this Dissertation. The status of ratification is noted in the main text. Additionally, a summary is included in Table 3 at the end of this Chapter.

5.1. Protection and Preservation of the Marine Environment under the LOSC

The general framework for marine environmental protection is outlined in Part XII of the LOSC on "Protection and Preservation of the Marine Environment".[9] The Part is

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[7] The Dissertation addresses only the most relevant multilateral and regional instruments, considering in particular instruments that have specifically addressed impacts of aquaculture. There are other instruments that are of relevance, however. One example is the *Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere*, 12 October 1940, 161 UNTS 193 (entered into force 30 April 1942) (Washington Convention), signed with the objective of protecting and preserving superlative scenery and flora and fauna of national importance, recognizes different categories of protected areas, and prohibits commercial activities in national parks. This Convention is particularly relevant to Chile and its regulatory framework for aquaculture (Chapter 6).

[8] This Dissertation does not address post-production issues (including international trade), ancillary services to mariculture production, breeding facilities or freshwater farms. However, the Codex Alimentarium and the Aquatic Animal Health Code insofar they address fish health and welfare. For some of these issues, see generally Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016) and David L VanderZwaag & Gloria Chao, *Aquaculture Law and Policy: Towards principled access and operations* (Oxon; New York: Routledge, 2006). See in particular: Elizabeth Whitsitt & Nigel Bankes, "Aquaculture and Trade: trade law and trade-related multilateral environmental agreements" in Bankes, Dahl & VanderZwaag, *ibid*, 33; Ted L McDorman & Torsten Ström, "Aquaculture and the multilateral trade regime: issues of seafood safety, labeling and the environment" in VanderZwaag & Chao, *ibid*, 355.

[9] Some provisions of Part V (on EEZ) and Part VII (on high seas) are also relevant for marine environmental protection. According to article 61, the coastal State has an obligation to ensure that living resources in the EEZ are not endangered by over-exploitation. It further has an obligation to ensure that harvested species are maintained at levels which can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors, and that species associated with or dependent upon harvested species are maintained above levels at which their reproduction may become seriously threatened. Similar provisions apply to the high seas under article 116. Furthermore, article 66 contains a special regime for anadromous species (pertinent for this Dissertation as wild salmon is an anadromous

"characterized by an anti-pollution approach",[10] with many of its provisions addressing pollution by different sources. However, the scope of the Part XII (and particularly the environmental principles codified in Section 1) is broader as it also provides a framework for the conservation of species, stocks, habitats and ecosystems.[11]

Two broad features define Part XII. First, it adopts a decidedly preventative approach to marine protection and preservation.[12] Boyle argues that the "most striking achievement of the Convention in this regard is the creation of a legal regime whose primary focus is not on obligations of responsibility for damage, but on comprehensive regulation to prevent and control marine pollution."[13] Whether Part XII also recognizes the precautionary approach (or principle) is debated in the literature. Beyerlin and Marauhn argue that the preventative approach undoubtedly adopted by LOSC does not meet the specific requirements of the concept of precautionary action.[14] Other authors, in turn, consider that the structure and content of the obligations spelled out in Part XII reflect the precautionary approach or principle. This interpretation is based on the definition of pollution (including substances that are "likely" to result in harmful interactions) read together with the broad obligation to protect the marine environment and the obligation to undertake an environmental impact assessment when there is

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species) and article 65 refers to marine mammals. It seems questionable whether these provisions are relevant for aquaculture, as they clearly focus on conservation of anadromous species by regulating fisheries. Not only is their focus the living marine "resources" (rather than marine life generally), but their objective is to protect marine resources from over-exploitation rather than other anthropogenic threats. While it does address associated and dependent species, those are the species associated and dependent on fisheries resources and the protection extended is from the threat of fishing. Furthermore, these provisions reflect a limited ethos for marine conservation (i.e. avoid serious threats of depletion or extinction) that is inconsistent with modern policy and legal developments. See generally: Ulrich Beyerlin, "New Developments in the Protection of the Marine Environment: Potential Effects of the Rio Process" (1995) 55 ZaöRV 544.

[10] Detlef Czybulka, "Article 194", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1295 at 1309-1315; Alan E Boyle, "Marine Pollution under the Law of the Sea Convention" (1985) 79(2) Am J Int'l L 347, at 350.

[11] Robin Churchill, "The LOSC regime for protection of the marine environment: fit for the twenty-first century?" in Rosemary Rayfuse (ed), *Research Handbook on International Marine Environmental Law* (Edward Elgar, Elgaronline, 2017) 3 at 7; *Southern Bluefin Tuna (New Zealand v Japan; Australia v Japan)*, Provisional Measures, Order of 27 August 1999, ITLOS Reports 1999, p 280, para 70; *Chagos Marine Protected Area Arbitration (Mauritius v United Kingdom)*, Award of 18th March 2015, ICGJ 486 (PCA Case N° 2011-03), para 538 (Professor Ivan Shearer, Judge Sir Christopher Greenwood CMG QC, Judge Albert Hoffmann, Judge James Kateka, Judge Rüdiger Wolfrum).

[12] Beyerlin, *supra* note 9, at 554; Ulrich Beyerlin & Thilo Marauhn, *International Environmental Law* (Oxford, UK; Portland, USA: Hart/CH Beck/Nomos 2011) at 118.

[13] Boyle, *supra* note 10, at 357.

[14] Beyerlin & Marauhn, *supra* note 12, at 118; Beyerlin, *supra* note 9, at 554.

"reasonable" ground for believing that the activity may cause significant pollution.[15] In any case, international dispute settlement bodies have stressed that the precautionary principle is becoming part of customary international law, and also that it is integral to the general obligation of due diligence.[16]

Whether the LOSC also enshrines an ecosystem approach (EA) in the provisions regarding protection of the marine environment in Part XII is also debated. Some authors have argued that the LOSC mandates an EA to marine management on the basis of, *inter alia*, the broad obligation to protect the marine environment in article 192 and a preambular recognition that problems of the ocean space are closely interrelated and need to be considered as a whole.[17] While this interpretation is not shared by other authors, they generally conclude that the LOSC enables EA implementation and elaboration.[18] Yet, as has been pointed out, the fragmented architecture of the LOSC and its marked zonal and sectoral approach represent barriers to EA implementation.[19]

The second relevant feature is the pivotal role that the LOSC regime affords to cooperation. Indeed, the LOSC largely abstains from issuing substantive environmental rules. Rather, it contains a system which determine "who is competent for issuing substantive rule and who is to enforce those rules."[20] According to the LOSC,

> States shall cooperate on a global basis and, as appropriate, on a regional basis, directly or through competent international organizations, in formulating and

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[15] Alexander Proelss, "The Contribution of the ITLOS to Strengthening the Regime for the Protection of the Marine Environment" in Angela Del Vecchio & Roberto Virzo (eds), *Interpretations of the United Nations Convention on the Law of the Sea by International Courts and Tribunals* (Cham, Switzerland: Springer International, 2019) 93, at 95.

[16] *Responsibilities and obligations of States with respect to activities in the Area*, Advisory Opinion, 1 February 2011, ITLOS Reports 2011, p 10, paras 131, 135.

[17] LOSC, *supra* note 1, Preamble para 3. The argument is also substantiated in several provisions of Parts V and VII on the conservation and management of living resources. The arguments are discussed in Vito de Lucia, *The 'Ecosystem Approach' in International Environmental Law: a Biopolitical Critique* (PhD Thesis, Faculty of Law, UiT Arctic University of Norway, 2015)[unpublished] at 295-297, citing in particular Martin H Belski, "Using Legal Principles to Promote the Health of an Ecosystem" (1995) 3 Tulsa J Comp and Int'l L 183.

[18] Cecilia Engler, "Beyond rhetoric: navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management" (2015) 23 Envtl Rev 288, at 311, citing: J Morishita, "What is ecosystem approach for fisheries management?" (2008) 32 Marine Policy 19; Erik J Molenaar, "Ecosystem-based fisheries management, commercial fisheries, marine mammals and the 2001 Reykjavik Declaration in the context of international law" (2002) 17 Int'l J Marine & Coastal L 561; Daniela Diz Pereira Pinto, *Fisheries management in areas beyond national jurisdiction: the impact of ecosystem-based law-making* (Leiden; Boston: Martinus Nijhoff, 2003); Rüdiger Wolfrum & Nele Matz, *Conflicts in international environmental law* (Berlin: Springer, 2003).

[19] Engler, *supra* note 18, at 310.

[20] Beyerlin, *supra* note 9.

> elaborating international rules, standards and recommended practices and procedures consistent with this Convention, for the protection and preservation of the marine environment, taking into account characteristic regional features. [21]

5.1.1. Duty to Protect the Marine Environment

Article 192 imposes on States a broad duty to protect and preserve the marine environment.[22] This obligation applies to all marine areas, includes all forms of human intervention, and seeks to protect the "marine environment" generally. Although this term is not defined, from several provisions of the LOSC it has been concluded that it comprises the water column and the seabed from the coastline seawards, in areas both within and beyond the limits of national jurisdiction, encompassing both the physical estuarine and oceanic environment and its ecology, including individual biological components.[23]

The application of the LOSC to internal waters has been debated, a matter of importance since a significant part of salmon farming occurs in internal waters. Some authors argue that the LOSC "explicitly excluded internal waters" and that therefore, internal waters are "exclusively regulated by customary law".[24] Most authors conclude, however, that the spatial scope of article 192 includes internal waters, as the obligation to protect the marine environment does not depend on its legal status (i.e. under sovereignty or sovereign rights).[25] A broader interpretation of the spatial scope of article 192 is also

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[21] LOSC, *supra* note 1, art 197.
[22] *Ibid,* art 193.
[23] Tim Stephens "Article 197", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1328 at 1333. The International Tribunal for the Law of the Sea ruled that "the conservation of the living resources of the sea is an element in the protection and preservation of the marine environment" (*Southern Bluefin Tuna (New Zealand v Japan; Australia v Japan)*, Provisional Measures, Order of 27 August 1999, ITLOS Reports 1999, p 280, para 7).
[24] Kaare Bangert, "Internal Waters", Max-Planck Encyclopedia of Public International Law (last updated February 2018).
[25] Czybulka, "Article 192" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1277 at 1280; Myron H Nordquist et al, *United Nations Convention on the Law of the Sea: A Commentary*, Vol IV (Dodrecht; London; Boston: Martinus Nijhoff, 2002) at 43 (noting that some of the provisions of Part XII explicitly apply to internal waters, e.g. estuaries); *South China Sea Arbitration (Republic of the Philippines v the People's Republic of China)* Award of 12 July 2016 (PCA Case Nº 2013-19), para 940 (Arbitrators: Judge Thomas A Mensah, Judge Jean-Pierre Cot, Judge Stanislaw Pawlak, Professor Alfred H Soons, Judge Rüdiger Wolfrum). Kohen argues that several provisions of the LOSC lay down a legal regime for internal waters but does not include art 192 among those provisions (Marcelo G Kohen, "Is the Internal Waters

supported by the definition of pollution in article 1(1)(4) of the LOSC, which explicitly includes estuaries into the concept of marine environment.[26] The issue may have fewer practical implications if it is accepted that the duty to protect the marine environment is customary international law.[27]

Scholars have defined the primary duty in article 192 as an environmental "principle" in the LOSC[28] as it is too general and abstract to impose any meaningful obligation on States.[29] Furthermore, article 192 needs to be read together with article 193: "States have the sovereign right to exploit their natural resources pursuant to their environmental policies and in accordance with their duty to protect and preserve the marine environment." These articles reflect the traditional "antagonism" between, and the need to balance, competing interests (environmental protection and resource utilization).[30] Nevertheless, Part XII further specifies this general duty with substantive and procedural obligations. These are analyzed next.

5.1.2. Obligation to Protect Rare of Fragile Ecosystems and Habitats

Article 194(5) of the LOSC requires States to protect and preserve "rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life."[31] This obligation, although included in article 194 of the LOSC on

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Regime Excluded from the United Nations Convention on the Law of the Sea?" in Lilian del Castillo (ed), *Law of the Sea, From Grotius to the International Tribunal for the Law of the Sea: Liber Amicorum Judge Hugo Caminos* 110 (Leiden: Brill Nijhoff, 2015, eBook)).

[26] Nordquist et al, *ibid*. The definition will be addressed in *infra* note 36 and accompanying text.
[27] Czybulka, *supra* note 25, at 1284-1286; Doris König, "Marine Environment, International Protection" Max Planck Encyclopedia of Public International Law (online) (last updated February 2013), para 8.
[28] Proelss, *supra* note 15, at 95 (clarifying that the word "principles" is not used as to note "general principles of law recognized by civilized nations"). See also: James Harrison, *Saving the Oceans Through Law: The International legal Framework for the Protection of the Marine Environment* (Oxford: Oxford University Press, 2017) at 23.
[29] Churchill, *supra* note 11, at 18.
[30] Beyerlin, *supra* note 9, at 548. Rothwell and Stephens argue that the duty in art 192 is "elevated above the sovereign right of states to exploit their natural resources, as Article 193 provides that this right must be exercised by states 'in accordance with their duty to protect and preserve the marine environment'". (Donald R Rothwell and Tim Stephens, The International Law of the Sea, 2nd ed (Oxford; Portland, OR: Hart, 2016) at 370). Similarly, König argues that the "State's right to use marine areas and natural resources under its sovereignty or jurisdiction is broad but not unlimited" (König, *supra* note 27, para 8).
[31] LOSC, *supra* note 1, art 194(5); see also: CBD, *supra* note 6, arts 8(f), (k),9(c) and art 7(a)(b) and Annex I. To interpret which ecosystems are rare or fragile, and which species are depleted, threatened or endangered, can be interpreted by reference to other international instruments (Harrison, *supra* note 28, at 30). Some of these will be analyzed below.

"Measures to prevent, reduce and control pollution of the marine environment", applies to any form of human intervention as it refers to the measures taken in accordance with this "Part" (i.e. Part XII on Protection and Preservation of the Marine Environment) and not to measures taken in accordance "with this article".[32] Thus, under article 194(5), a State regulating aquaculture would need to consider the protection and preservation of rare or fragile ecosystems or marine habitats not only from pollution but also from interventions such as the construction or decommissioning of the facility or new and increased vessel traffic. The article is significant because it is one of the few provisions of the LOSC that impose a specific conservation obligation with respect to marine life generally, rather than marine "resources", and refers to non-living elements of the environment, as it extends protection to "ecosystems" and "habitats".[33] In so doing, it is consistent with the obligation to protect biological diversity under the CBD. Indeed, although the term "ecosystem" is not defined by the LOSC, it has been interpreted to have the meaning of "ecosystem" codified in the CBD, that is: "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit".[34]

It has been noted, however, that the article is by no means precautionary or anticipatory. Indeed, the obligation in article 194(5) is triggered only when species are already imperilled.[35]

5.1.3. Prevention, Reduction and Control of Pollution

Under article 194, States have an obligation ("*shall*") to "prevent, reduce and control pollution of the marine environment from any source using best practicable means at their disposal and in accordance with their capabilities." Pollution is defined broadly as the

[32] Churchill, *supra* note 11, at 18. Note that article 194 itself can be interpreted more broadly, as held in *Chagos Marine Protected Area Arbitration (Mauritius v United Kingdom), supra* note 11 and noted by Harrison, *supra* note 28, at 30.
[33] Czybulka, *supra* note 10, 1309-1314.
[34] CBD, *supra* note 6, art 2; *South China Sea Arbitration*, *supra* note 25, para 945; Czybulka, *supra* note 10, at 1311; Proelss, *supra* note 15, at 100.
[35] Beyerlin, *supra* note 9, at 551. This is without prejudice of the obligation to protect the living and non-living components of the marine environment (Harrison, *supra* note 28, at 31).

> introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.[36]

The definition is broad enough to include several polluting activities associated with intensive marine aquaculture, from the introduction of feed, metals, medicines and therapeutants (substances) to the introduction of artificial light or noise (energy). It is questionable, however, whether the definition of pollution is broad enough to also include escaped fish.[37] As discussed in Chapter 1, the introduction of non-native species, invasive alien species, genetically distinct populations, or genetically modified species, can have deleterious effects in the local living resources and marine life through competition, predation or interbreeding. Fish, however, do not fall clearly in the definition of pollution as they are not a "substance" or "energy".[38] The issue is at least partially addressed by article 196(1) of the LOSC (see below).

The broad obligation to prevent, reduce and control pollution in article 194 of the LOSC is qualified. States are only obliged to use "best means" that are "practical" and "at their disposal", and only according to their capabilities. More precise obligations are introduced in the following articles.

5.1.4. Use of Technologies and Introduction of Alien or New Species

Under article 196 of the LOSC, States are required to take

> all measures necessary to prevent, reduce and control the pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto.

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[36] LOSC, *supra* note 1, art 1.1(4).
[37] Tricia K Barry & David L VanderZwaag, "Preventing Salmon Escapes from Aquaculture in Canada and the USA: Limited International Coordinates, Divergent Regulatory Currents and Possible Future Courses" (2017) 16 RECIEL 58; D Czybulka, "Article 196" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1319 at 1324.
[38] Czybulka, *supra* note 37, at 1327-1328.

The provision is particularly relevant to aquaculture. Indeed, the history of article 196 negotiation is closely linked to the, at the time, incipient mariculture industry.[39]

The term "technology" is not defined in the LOSC. Nevertheless, and in accordance with its ordinary meaning, technology has been interpreted as including both hardware and software and include installations in the sense of articles 60 and 80 of the LOSC.[40] Aquaculture installations, therefore, are a "technology" in the sense of article 196, including known and future designs.[41] It also includes "biotechnology".[42]

The article also addresses the intentional and accidental introduction of alien and new species. Alien species is generally understood to refer to a species that "occur outside its past or present natural range of dispersal potential, being outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans."[43] The term "new species", in turn, is interpreted to include those that have been bred traditionally or through modern biotechnology.[44] The scope of the article is, thus, broad and would include common situations encountered in aquaculture activities: the cultivation of non-native species, and the cultivation of species that, through intensive interbreeding, have changed its genetic composition (therefore being a "new species"). It also covers the cultivation of genetically modified organisms, which at the time of writing is not a common commercial practice. It would include, therefore, the cultivation of domesticated Atlantic salmon used in marine aquaculture. The scope also likely covers non-target species, including alien viruses, bacteria and pathogens. It is questionable, however, whether the article is broad enough to cover the cultivation of a naturally occurring (but genetically distinct) population of an endemic species.

Scholars have debated whether the article of the LOSC covers pollution resulting from the introduction of alien species, or if the obligation included in the subsection refers to an obligation to prevent, reduce and control the introduction of alien species regardless of the mechanism through which it causes change to the marine environment.

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[39] *Ibid*, at 1321-1323.
[40] *Ibid*, at 1324.
[41] *Ibid*, at 1324.
[42] *Ibid*, at 1325.
[43] *Ibid*, at 1325, citing the IUCN, *Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species* (2000).
[44] Czybulka, *supra* note 37, at 1326.

The latter, broader interpretation has been favoured.[45] Indeed, the history of the negotiation of article 196 demonstrates that the objective of this article was to address emerging risky human activities that fell outside of the definition of pollution of the LOSC.[46]

The duty of conduct of article 196 ("take all measures necessary") has been understood to go beyond the obligation of article 194 in that it demands measures vis-à-vis unknown and uncertain risks.[47] The obligation to take all measures necessary must be understood as an obligation of conduct requiring due diligence. In practical terms, such measures relate to best available technology or best environmental practice.[48] The early assessment of these activities is required.[49] In any case, the changes induced by technologies and alien or new species must be significant and harmful.[50]

5.1.5. Transboundary Impacts

More precise obligations exist in the case of potential transboundary impacts. States have a specific obligation to ensure that activities under their jurisdiction or control do not cause damage by pollution to other States and their environment, and that pollution arising from activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with the Convention. [51] This obligation reflects the principle of "no harm" generally recognized as customary international law but limited to damage by "pollution".[52] The article also reflects a preventative approach to pollution in which the State is required to take "all necessary measures" to prevent pollution. It is, therefore, an obligation of conduct and the State has to comply with the standard of "due diligence". What is due diligence would need to be assessed on a case-by-case basis, but technical standards such as "best available technology" or "best environmental practice" can provide some benchmarks for the

[45] Churchill, *supra* note 11, at 18.
[46] Czybulka, *supra* note 37, at 1322; Nordquist et al, *supra* note 25, Vol IV, at 73-75.
[47] Czybulka, *supra* note 37, at 1323. According to Czybulka, this reflects the precautionary approach (*ibid*).
[48] *Ibid*, at 1324, with reference to the expression "best practicable means" in art 194(1).
[49] *Ibid*, at 1327.
[50] *Ibid*.
[51] LOSC, *supra* note 1, art 194(2).
[52] In doing so, the article is consistent with Principle 21 of the Stockholm Declaration. See: Czybulka, *supra* note 10, at 1306. Authors debate whether the obligation to not cause damage to global common areas is part of customary international law (*ibid*).

assessment.[53] Furthermore, the "no harm" rule also requires compliance with certain procedural obligations that can support the assessment of reasonableness. These include a requirement under general international law to undertake a transboundary environmental impact assessment (EIA),[54] a requirement that is also included in the Espoo Convention at the regional level.[55] As part of the no harm rule and the EIA, but also as independent obligations under international law, coastal States are also required to the exchange of information, early warning, and consultation.[56]

Considering the limited geographical scope of pollution resulting from current aquaculture practices, pollution to common areas (i.e. areas beyond national jurisdiction) is unlikely. Under some circumstances, however, marine finfish aquaculture near a State's maritime boundary may negatively impact the marine environment of a neighboring State. Although literature is scarce, transboundary impacts have been at least theorized for several regions, including in areas relevant for this Dissertation (namely both the Pacific and Atlantic coasts of Canada and the U.S.). Perhaps the primary concern is the negative impact that escaped fish can cause in the local wildlife at a regional

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[53] Beyerlin & Marauhn, *supra* note 12, at 42.

[54] *Pulp Mills on the River Uruguay (Argentina v Uruguay)* (Merits 20 April 2010) [2010] ICJ Rep 2010. See also: Beyerlin & Marauhn, *supra* note 12, at 233.

[55] *Convention on Environmental Impact Assessment in a Transboundary Context*, 1989 UNTS 309. Of relevance for this Dissertation, Norway, UK and Canada are parties to the Espoo Convention although the relevance for Canada is limited to transboundary areas with other Espoo Convention parties, namely France (Pierre et Miquelon) and Denmark (Greenland) (Environment and Climate Change Canada, Compendium of Canada's Engagement in International Environmental Agreements and Instruments: UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) (January 2020), online: https://www.canada.ca/content/dam/eccc/documents/pdf/international-affairs/compendium/2020/batch-2/convention-environmental-impact-assessment-transboundary-context-espoo-convention.pdf (accessed 25 February 2021).

[56] Beyerlin & Marauhn, *supra* note 12, at 45. The authors identify five procedural obligations associated to the "no harm" rule (to consult each other with the aim of preventing transboundary harm; to exchange in a timely fashion information regarding projects likely to cause transboundary harm; to notify of environmental emergency situations and give early warnings in case of imminent harm; to assess nationally the projects' potential transboundary environmental impacts; and to grant non-residents equal access to environmental information, equal participation in relevant decision-making processes, and equal access to justice in environmetnal matters). The conclude, however, that only three (mentioned in the main text) can be considered to have reached status of customary international law independently from the status of the "no harm" rule. In Birnie, Boyle and Redgwell's treatise on international law and the environment, the authors address the status of the obligations to notify and consult in less categoric terms ("even if notification and consultation in case of transboundary risk are not independent customary rules, non-compliance with them is likely to be evidence of a failure to act diligently in protecting other states from harm under Rio Principle 2" (Alan Boyle & Catherine Redgwell, *International Law and the Environment*, 4th ed (Oxford: Oxford University Press, 2021) at 202).

level.[57] As mentioned, it is doubtful that fish can fall within the definition of "pollution" under the LOSC. Nevertheless, transboundary impacts of escaped fish could be included under the "no harm" rule of international law. Three key considerations in the assessment of potential transboundary harm by escapes are the definition of "all measures necessary" that provide content to the obligation of conduct of the State of origin; the evidence of causal relationship between the event (escape) and damage to the environment; and the evidence regarding significance of the damage.

5.1.6. Implementation of Internationally Agreed Rules

As mentioned above, the LOSC does not contain substantive standards for pollution but addresses these substantive standards with a preference for internationally agreed rules.[58] Reflecting the balance of interests that permeates the structure and content of the LOSC, the Convention regards these internationally agreed rules either as a maximum standard of regulation (to prevent excessively onerous burdens for shipping) or a minimum standard of regulation (giving content to the duty to regulate)[59] depending on the source of pollution.

For aquaculture purposes, the relevant provision is article 208. Under its first paragraph, coastal States have an obligation to adopt[60] laws and regulations (or other necessary measures[61]) to "prevent, reduce and control pollution of the marine environment arising from or in connection with […] installations and structures under their jurisdiction, pursuant to articles 60 and 80". Such measures shall be "no less effective" than "international rules, standards and recommended practices and procedures".[62] A coastal State is entitled to adopt stricter measures than those in international rules, standards and recommended best practices and procedures, as well as different measures, if they are "no less effective". The LOSC also calls on States to harmonize their policies at the appropriate regional level and to work cooperatively to

[57] See, eg: Barry & VanderZwaag, *supra* note 37.
[58] Boyle, *supra* note 10, at 352.
[59] *Ibid*.
[60] LOSC, *supra* note 1, art 214, addresses enforcement of laws and regulations adopted according with article 208.
[61] *Ibid*, art 208(2).
[62] *Ibid*, art 208(3). See also art 208(5).

establish global and regional rules, standards and recommended best practices and procedures to prevent, reduce and control pollution of the marine environment.[63]

The provision makes a reference to installations and structures under their jurisdiction pursuant articles 60 and 80, that is, in their EEZ and continental shelf. A literal interpretation would exclude the application of article 208 to installations and structures situated in internal waters and the territorial sea, which in effect would mean that any international standard would not be binding to current aquaculture activities (without prejudice to the incentives to apply them). Some authors argue that installations and structures in internal waters and the territorial sea are *a fortiori* included in this provision.[64] This argument seems questionable, as States Parties to the LOSC may have agreed to binding minimum standards only for areas in which they do not exercise full sovereignty. However, the argument can also be made that article 208 implements the duty to protect the marine environment in article 192, which applies to territorial seas and, arguably, internal waters.

In any case, the substantive international rules, standards and recommended practices and procedures that apply, as a minimum, for installations and structures in the EEZ are "few and far between".[65] Thus, there are limited substantive rules outlining minimum responsibilities for the protection of the marine environment in the authorization and monitoring of such installations and structures. Aside from decommissioning guidelines, regional agreements have in some cases developed further rules.[66]

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[63] *Ibid*, art 208(4), (5).
[64] Frank Wacht, "Article 208", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1391 at 1396.
[65] Rothwell & Stephens, *supra* note 30, at 400. See also: König, *supra* note 27, para 25, noting that "no comprehensive international agreement exists" laying out international rules, standards and recommended practices and procedures, and that "international rules and regulations are scarce".
[66] Rothwell & Stephens, *supra* note 30, at 400-401. IMO's non-binding Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone were discussed in Chapter 4, note 39, and accompanying text.

5.1.7. Procedural Obligations

Part XII also outlines procedural obligations. The LOSC requires States to assess the potential effects of planned activities under their jurisdiction or control,[67] in a provision generally regarded as mandating environmental impact assessment (EIA). This is not limited to polluting activities and applies in all marine areas.[68] Further, the obligation is triggered even in the absence of transboundary effects.[69]

The obligation of article 206 is qualified in two main ways. First, it requires States to perform such assessment "as far as practicable". Second, it requires an assessment only when there is "reasonable ground" for believing they may cause "substantial" pollution of or "significant and harmful" changes to the marine environment, all terms left undefined. The provision therefore grants States with significant discretion to determine the thresholds that trigger an EIA, the content of such an assessment, or the role of its outcome in the final decision on the planned project.[70] This discretion is not unlimited. The International Court of Justice (ICJ) has stressed that an EIA needs to be commensurate: it must account for the nature and the magnitude of the project as well as its likelihood of causing adverse impact on the environment.[71] The non-binding UNEP Goals and Principles of Environmental Impact Assessment can assist States in these determinations.[72]

Article 204(2) of the LOSC also requires States to keep under surveillance (i.e. monitor) the effects of any activities which they permit or in which they engage in order to determine whether these activities are likely to pollute the marine environment.[73] It has

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[67] LOSC, *supra* note 1, art 206. See also: CBD, *supra* note 6, art 7(c) and Annex I.
[68] Eike Blitza "Article 204" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1356 at 1371.
[69] *Ibid*. See also *supra* note 55 and accompanying text.
[70] *Ibid*, at 1373-1374.
[71] *Ibid*, at 1376, citing Alan Boyle, "Developments in the International Law of Environmental Impact Assessments and Their Relation to the Espoo Convention" (2011) 20 RECIEL 227, at 228; *Pulp Mills on the River Uruguay (Argentina v Uruguay), supra* note 54.
[72] United Nations Environment Programme (UNEP), "Goals and Principles of Environmental Impact Assessment", decision 14/25 of the Governing Council of UNEP (17 June 1987), online: Environmental Law Alliance Worldwide <https://www.elaw.org/content/un-unep-goals-and-principles-environmental-impact-assessment> (accessed 8 January 2023).
[73] LOSC, *supra* note 1, art 204. See also CBD, *supra* note 6, art 7. Article 204 of the LOSC also contains a more general obligation to "endeavour, as far as practicable, directly or through the competent international organizations, to observe, measure, evaluate and analyse, by recognized scientific methods, the risks or effects of pollution of the marine environment". See Blitza, *supra* note 68.

been noted that this obligation complements the impact assessment undertaken prior to the authorization under article 206 and can be considered a "continuing environmental impact assessment".[74] Nevertheless, it is worth noting that it is an obligation that exists independently from the qualified obligation to undertake an impact assessment, as discussed above.

Article 204(1) contains a second, more general, obligation to "observe, measure, evaluate and analyse, by recognized scientific methods, the risks or effects of pollution of the marine environment". This obligation has a different object than article 204(2): while 204(2) focuses on *activities* under the jurisdiction or control of a State, 204(1) focuses on the marine environment as a whole.[75] It is also a qualified obligation, as States are only required to "endeavour, as far as practicable" to undertake such monitoring. The relevance that the LOSC affords to monitoring and scientific research are linked to the broad obligations to protect and preserve the marine environment.[76]

Reports of the results of EIAs[77] and monitoring shall be made available to other States,[78] thus contributing to cooperation in the protection of the marine environment. It has been argued that this obligation mainly applies to the results of the general monitoring obligation rather than the more specific obligation contained in article 204(2) that are not knowledge-generating in nature.[79]

5.2. Aquaculture and the Convention on Biological Diversity

The CBD was adopted in 1992 as one of the key outcomes of the Rio Conference on Environment and Development. It is one of the most widely ratified environmental agreements: 196 States are Parties to the CBD, including the four countries under analysis in this Dissertation.[80] The Convention has three interrelated objectives: a) the conservation of biological diversity; b) the sustainable use of its components; and c) the

[74] Blitza, *supra* note 68, at 1357.
[75] *Ibid*, at 1363.
[76] See, LOSC, *supra* note 1, Part XIII art 238ff.
[77] *Ibid*, art 206.
[78] *Ibid*, art 205.
[79] Blitza, *supra* note 68, at 1367.
[80] See: Convention on Biological Diversity, "List of Parties", online: CBD <https://www.cbd.int/information/parties.shtml> (accessed 13 March 2023). Canada deposited the ratification instrument on 4 December 1992; Norway on 9 July 1993; the United Kingdom of Great Britain and Northern Ireland on 3 June 1994; and Chile on 9 September 1994.

fair and equitable sharing of the benefits arising out of the utilization of genetic resources. While the latter objective is particularly relevant for international environmental law generally but also for aquaculture,[81] its relevance for this Dissertation is limited and therefore will not be addressed in detail.

Article 3 of the CBD reiterates a fundamental principle of international environmental law also stated in article 193 of the LOSC, namely: that States have the sovereign right to exploit their own resources pursuant to their own environmental policies, but the corresponding responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction. In exercising this sovereign right, however, the parties to the CBD recognize that the conservation of biological diversity is a common concern of humankind[82] and that, for this reason, they hold a responsibility to conserve it and to use its components sustainably.[83]

Biological diversity (or biodiversity) is defined as "the variability among living organisms from all sources […] and the ecological complexes of which they are part".[84] The definition explicitly recognizes three levels of biological diversity: genetic diversity ("diversity within species"), species diversity, and ecosystems diversity.[85] Ecosystems are defined as "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit".[86] The CBD, thus, acknowledges and protects environment in a broad sense, including genetically distinct populations, non-living components, and ecosystem processes and functions. It also encompasses terrestrial, marine and other aquatic ecosystems.[87]

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[81] See: Fran Humphries, "The rising tide of access and benefit sharing in aquaculture" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, USA: Edward Elgar, 2016) 63. The access and benefit sharing regime refers to the use of biological resources for its genetic material rather than for its attributes as a product. It is particularly important for aquaculture because, unlike agriculture, the domestication of fish is a recent phenomenon. Therefore, the sector requires access to aquatic genetic material to breed new varieties and to promote genetic diversity.
[82] CBD, *supra* note 6, Preamble, para 3.
[83] *Ibid*, para 5.
[84] *Ibid*, art 2.
[85] *Ibid*.
[86] *Ibid*.
[87] *Ibid*. Yoshifumi Tanaka, *The International Law of the Sea*, 2nd ed (Cambridge, UK: Cambridge University Press, 2015) at 345.

Another aspect of the CBD that is worth highlighting is its "holistic" goal. The CBD, inspired by the 1972 Stockholm Declaration,[88] represents a shift from the fragmented issue-by-issue approach of earlier international law focusing on specific problems or the protection of specific species or habitats.[89] Rather, the CBD addresses all biodiversity (genetic, species and ecosystem diversity) considering conservation and sustainable use.[90] Unlike earlier agreements focused on preservation of specific habitat or species, the CBD is not a preservationist convention but rather its objective is to conserve the benefits that human derive from biodiversity.[91] Biodiversity considerations must be integrated into all relevant sectoral or cross-sectoral plans, programmes and policies.[92] The human dimensions of ecosystems is recognized in the preamble and in the substantive text explicitly.[93]

These two elements of the CBD are particularly relevant for this Dissertation. In recognizing an obligation to protect and sustainably use all ecosystems, the CBD provided the legal basis for the normative development of an ecosystem approach.[94] The CoP recognized early on the need to address conservation and sustainable use of biological diversity and its components in a holistic manner and to take into account

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[88] Stockholm Declaration on the Human Environment, in *Report of the United Nations Conference on the Human Environment*, UN Doc A/CONF.48/14, at 2 and Corr.1 (1972).

[89] See: Bronwyn H Arthur, A Commentary on the Convention on Biological Diversity, LLM Research Paper, Law Faculty, Victoria University of Wellington (1993) available online https://core.ac.uk/download/pdf/82892004.pdf (accessed 3 March 2022). Note that there is an explicit reference to the CBD falling within "second generation" international environmental law (*ibid*, at 5, citing AO Adede "International Environmental Law from Stockholm to Rio: An Overview of Past Lessons and Future Challenges" (1992) 22 Envtl Pol'y & L 88).

[90] Indeed, the sustainable use of biodiversity in "production landscapes" (rather than protection landscapes) is particularly vital for the achievement of the CBD's objective, as exemplified in the "Satoyama Initiative" for the benefit of biodiversity and human well-being (CBD, "Sustainable use of biological diversity in socio-ecological production landscapes: Background to the 'Satoyama Initiative for the benefit of biodiversity and human well-being", CBD Technical Series Nr. 52 (2010)).

[91] de Lucia, *supra* note 17, at 336.

[92] CBD, *supra* note 6, arts 6 and 10. See also: Harrison, *supra* note 28, at 46.

[93] The preamble recognizes the vital role that women play in the conservation and sustainable use of biological diversity and affirming the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation. No specific mention is included in the substantive text. The preamble also recognizes the close and traditional dependence of many indigenous and local communities embodying traditional lifestyles on biological resources. The substantive text considers specific obligations in this respect (see below).

[94] Elisa Morgera, "The Ecosystem Approach and the Precautionary Principle" in Elisa Morgera & Jona Razzaque (ed), *Biodiversity and Nature Protection Law* (Cheltenham, UK: Edward Elgar, 2017) 70 at 71-72.

socio-economic and cultural factors.[95] It further recognized the EA a primary framework for action in the implementation of the Convention,[96] and adopted soft law principles and guidelines for its implementation.[97]

5.2.1. Obligations under the CBD

To define its scope of application, the CBD distinguishes between the components of biological diversity, and processes and activities (that may affect biological diversity).[98] In areas within the limits of a State's national jurisdiction (including internal waters, the territorial sea and the EEZ), both the components of biological diversity and processes and activities carried out by the coastal States fall within the scope of the CBD. In areas beyond the limits of national jurisdiction, the CBD applies to processes and activities (irrespective of where their effects occur). The exclusion of the direct protection of components of biological diversity outside areas of national jurisdiction reflects existing international law concerning the exercise of state jurisdiction.[99] Nevertheless, States have also a qualified obligation to cooperate, directly or through competent international

[95] CBD, "Decision II/8 Preliminary Consideration of Components of Biological Diversity Particularly under Threat and Action which Could Be Taken under the Convention", adopted by the Conference of the Parties during the Second Ordinary Meeting held in Jakarta, Indonesia, 6 - 17 November 1995, para 1.
[96] *Ibid*.
[97] CBD, Decision V/6 on Ecosystem Approach adopted by the Fifth Ordinary Meeting of the Conference of the Parties held in Nairobi, Kenya, 15 - 26 May 2000, and Decision VII/11 on Ecosystem Approach adopted by the Seventh Ordinary Meeting of the Conference of the Parties held in Kuala Lumpur, Malaysia, 9 - 20 February 2004, Annex I, paragraph A.1. See also Chapter 2. Also relevant in this context are the Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity (CBD Secretariat, *Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity* (Montreal: CBD Secretariat, 2004). The document contains 14 practical principles and associated operational guidelines to advise State Parties in their efforts to achieve sustainable use of biological diversity and is explicitly linked to the ecosystem approach adopted by the CoP by Decision V/6. It calls, for example, to practice adaptive management (Principle 4), to avoid or minimize adverse impacts on ecosystem services, structure and functions as well as other components of ecosystems (Principle 5), to consider spatial and temporal scales of management that are compatible with the ecological and socio-economic scales of the use and its impacts (Principle 7), and to apply an interdisciplinary and participatory approach at the appropriate levels of management and governance (Principle 9). It calls to enact supportive policies, laws and institutions at all levels of governance and with effective cooperation and coordination linkages among them (Principle 1).
[98] CBD, *supra* note 6, art 4.
[99] Rüdiger Wolfrum & Nele Matz, "The Interplay of the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity" in (2000) 4 *Max Planck Yearbook of United Nations Law* 445, at 462.

organizations, for the conservation and sustainable use of biological diversity in areas beyond national jurisdiction.[100]

The scope of the CBD is particularly relevant because it complements the rather limited provisions of the LOSC regarding conservation of the marine ecosystems in the internal waters and territorial sea. The complementary nature is recognized explicitly in the CBD: "Contracting Parties shall implement this Convention with respect to the marine environment consistently with the rights and obligations of States under the law of the sea".[101]

The CBD "specifies two broad types of substantive obligations relating to the *in situ* conservation and sustainable use of biological diversity."[102] First, it calls upon States to identify, monitor, regulate and manage important components of biological diversity which may need special protection in areas within national jurisdiction.[103] Annex I provides criteria for this identification addressing ecosystems and habitats, species and communities, and genomes and genes. The Convention further identifies a range of measures that may be taken by States in fulfilling this obligation, including adopting legislation to protect threatened species and populations, establishing protected areas, and promoting sustainable development in areas adjacent to protected areas.[104] Measures

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[100] CBD, *supra* note 6, art 5. The obligation is qualified by the terms "as far as possible and as appropriate". See also: Wolfrum & Matz, *supra* note 99, at 462. At the time of writing, an intergovernmental conference under the auspices of the United Nations is negotiating the text of an international legally binding instrument under the LOSC on the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction. This instrument seeks to fill gaps left by the LOSC and the CBD, addressing four main elements: marine genetic resources (including questions on the sharing of benefits), measures such as area-based management tools (including marine protected areas), environmental impact assessments, and capacity-building and the transfer of marine technology (UNGA, Resolution 69/292 on the Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (19 June 2015), Doc A/RES/69/292 (6 July 2015)). The lack of an adequate legal framework for aquaculture in the high seas was mentioned in early studies as one of the justifications for the new agreement (Kristina M Gjerde et al, *Regulatory and Governance Gaps in the International Regime for the Conservation and Sustainable Use of Marine Biodiversity in Areas beyond National Jurisdiction* (Gland, Switzerland: IUCN, 2008)). It is possible, then, that the regulatory framework will be strengthened with more detailed requirements for environmental impact assessment and compliance with area-based measures. However, there is a still significant uncertainty about the outcome of the negotiation process and the content of a new agreement. See: UN, Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction, online: UN <https://www.un.org/bbnj/> (accessed 4 November 2022).

[101] CBD, *supra* note 6, art 22(2). See also: Harrison, *supra* note 28, at 47.

[102] Harrison, *supra* note 28, at 46. The CBD also considers provisions for *ex situ* conservation of biodiversity (CBD, *supra* note 6, art 9). They will not be addressed here.

[103] Harrison, *supra* note 28, at 47.

[104] CBD, *supra* note 6, art 8(a), (e) and (k).

adopted to fulfill this obligations are relevant to the planning and management of salmon mariculture, as they may impose restrictions for salmon farming either by prohibiting the activity in a protected area of by raising the required diligence in preventing or mitigating harm.[105]

Second, the CBD calls to identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, to monitor their effects, and to regulate or manage the relevant process and categories of activities when significant adverse effects have been determined. Salmon farming is undoubtedly such a process or activity. Particularly relevant for aquaculture, the CBD calls upon States to regulate the risks associated with the use and release of living modified organisms, as well as prevent the introduction of those alien species which threaten the ecosystems, habitats or species[106] (i.e. invasive species).

States are called to introduce appropriate procedures for environmental impact assessment of their proposed projects that are "likely" to have "significant" adverse effects on biological diversity with a view to avoiding or minimizing such effects.[107] As in the case of the LOSC, this is a qualified obligation that provides States with discretion as to when the thresholds of likelihood and significance are met.

The CBD adds two components to the obligation to undertake EIA that are absent from the LOSC, however. First, it calls for public participation in such procedures "where appropriate".[108] Second, it also calls for states to introduce appropriate arrangements to "ensure that the environmental consequences of its programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account".[109] Thus, the CBD calls for strategic environmental assessment (SEA) rather than the traditional "project-by-project" assessment.[110] It is also worth noting that these

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[105] Harrison, *supra* note 28, at 47-48.
[106] CBD, *supra* note 6, art 8(g) and (h).
[107] *Ibid*, art 14(a).
[108] *Ibid*, art 14(a).
[109] *Ibid*, art 14(b). See also: Harrison, *supra* note 28, at 46.
[110] A Strategic Environmental Assessment is also called for in the *Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context*, 21 May 2003, 2685 UNTS 140 (entered into force 11 July 2010) (Kyiv Protocol). Norway and the EU are parties to the Protocol. Intensive fish farming is included in Annex II to the Protocol. Therefore, plans and programmes prepared for intensive fish farming require an SEA only if fish farming requires an EIA under

provisions of the CBD apply to processes and activities under the jurisdiction or control of a State Party, and thus apply also to activities carried out in areas beyond national jurisdiction.[111]

The provision on impact assessment also includes qualified procedural obligations for activities that are likely to significantly affect the biodiversity of other States or areas beyond national jurisdiction. The State has an obligation to "promote" notification, exchange of information and consultation on the basis of reciprocity and preferably through bilateral or regional arrangements.[112] States also have an obligation to notify immediately to affected States in cases of immediate or grave danger or damage.[113] These procedural obligations have arguably reached status of customary international law.[114]

Further important provisions of the CBD address certain obligations regarding indigenous and local communities that reflect their close and traditional dependence on biological resources.[115] Contracting Parties have a qualified obligation ("as far as possible and as appropriate" and "subject to its national legislation") to

> respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.[116]

5.2.2. Soft Law Developments under the CBD

The obligations of the CBD have been criticized, as "vague"[117] and leaving too much discretion to State Parties. Nevertheless, the content of these obligations has been further outlined and developed by decisions adopted by the CoP in fulfilling its responsibility to

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national legislation. SEA is further required for plans and programmes which are prepared for town and country planning or land use, which is also relevant for aquaculture purposes. The EU has transposed the protocol in *the Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30.

[111] CBD, *supra* note 6, art 4(b) and Harrison, *supra* note 28, at 46.

[112] CBD, *supra* note 6, art 14(d).

[113] *Ibid*, art 14(e)

[114] See *supra* note 56 and accompanying text.

[115] CBD, *supra* note 6, Preamble para 12.

[116] *Ibid*, art 8(j). See also: arts 17(2) and 18(4).

[117] Harrison, *supra* note 28, at 48.

undertake actions required for the achievement of the purposes of the Convention.[118] Two protocols to the CBD have been adopted: the Cartagena Protocol on Biosafety[119] (see section 5.4.3) and the Nagoya Protocol on Access and Benefit Sharing.[120] With the assistance of its subsidiary bodies, the CoP has also elaborated principles, guidelines, and tools to support countries in their efforts to conserve and sustainable use biological diversity and has promoted accountability in the form of national reports to be submitted to the CoP.[121] The work of the CBD is extensive and comprises seven thematic programmes of work corresponding to major biomes on the planet, as well as more than 25 cross-cutting themes. These include the work on the EA, as noted in Chapter 2 and above. Three other developments are worth mentioning in the context of salmon mariculture: high-level policy goals; aquaculture guidelines; and other relevant guidelines.

a) High-level Policy Goals: the Strategic Plan for Biodiversity and Aichi Biodiversity Targets

In 2010, the CoP adopted a Strategic Plan for Biodiversity 2011-2020 and Aichi Biodiversity Targets[122] as a 10-year framework of action for all countries and stakeholders. The Aichi Biodiversity Targets consider aquaculture in its target 7: by 2020, areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.[123] Several other Aichi targets are also relevant for marine

[118] CBD, *supra* note 6, art 23. As a modern multilateral environmental agreement (MEA), the CBD establishes an institutional structure consisting of the Conference of the Parties (CoP), responsible broadly for undertaking actions required for the achievement of the purposes of the Convention[118], a Secretariat, and a Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA). This institutional structure allows for the continuous development and oversight of the CBD implementation.
[119] *Cartagena Protocol on Biosafety to the Convention on Biological Diversity*, 29 January 2000, 2226 UNTS 208, 39 ILM 1027 (entered into force 11 September 2003).
[120] *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*, 29 October 2010, UNEP/CBD/COP/DEC/X/1 (entered into force 12 October 2014).
[121] CBD, *supra* note 6, art 26.
[122] CBD, Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets, Decision X/2 adopted by the Conference of the Parties to the Convention on Biological Diversity during their X meeting held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan. The Post-2020 Global Diversity Framework is in its final stage of negotiation by the CoP (see CBD, Processes and Meetings, online: CBD <https://www.cbd.int/process/> (accessed 4 November 2022).
[123] The post-2020 Kumming-Montreal Global biodiversity framework adopted in December 2022 reiterates but reinforces this target. Parties commit to: "Ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, in particular through the sustainable use of biodiversity, including

aquaculture, particularly in the context of an EAA. These include targets on reducing marine pollution, including from excess nutrients (Aichi Target 8); on the identification, prioritization, management, control and eradication of invasive species (Aichi Target 9); on minimization of anthropogenic pressures on vulnerable ecosystems, including coral reefs (Aichi Target 10); on maintenance of genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives (Aichi Target 13); in respect to traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity and their customary use of biological resources (Aichi Target 18); restoration of ecosystem that provide essential services (Aichi Target 14); and enhanced ecosystem resilience (Aichi Target 15).

b) CBD and Mariculture Programme of Work

The potential adverse effects of mariculture on marine biodiversity were on the radar of the CBD early on.[124] In 1998, the CBD adopted a first programme of work for the conservation and sustainable use of marine and coastal biological diversity,[125] including mariculture as one of its six programme elements.[126] The programme of work was revised

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through a substantial increase of the application of biodiversity friendly practices, such as sustainable intensification, agroecological and other innovative approaches contributing to the resilience and long-term efficiency and productivity of these production systems and to food security, conserving and restoring biodiversity and maintaining nature's contributions to people, including ecosystem functions and services" (CBD, Kummings-Montreal Global biodiversity framework, Annex to Resolution adopted by the Conference of the Parties during the Fifteenth Meeting (Part II) held in Montreal, December 2022, CBD/COP/15/L.25 (18 December 2022), Target 11). The Post-2020 Global biodiversity framework was adopted only shortly before this Dissertation was submitted. An extensive analysis of its implications for biodiversity conservation obligations and requirements for States in managing salmon mariculture was not undertaken.

[124] See: SBSTTA, Recommendation I/8 on Scientific, technical and technological aspects of the conservation and sustainable use of coastal and marine biological diversity adopted during the First Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, 4 - 8 September 1995, Paris, France; CBD, Decision II/10 on Conservation and sustainable use of marine and coastal biological diversity, adopted during the Second Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, 6 - 17 November 1995, Jakarta, Indonesia (also known as Jakarta Mandate).

[125] CBD, Decision IV/5 on Conservation and sustainable development of marine and coastal biological diversity, including a programme of work, adopted during the Fourth Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, 4-15 May 1998, Bratislava, Slovakia.

[126] Other elements included the implementation of integrated marine and coastal area management, marine and coastal living resources, marine and coastal protected areas, alien species and genotypes, and a general cross-cutting theme. The mariculture program had the overall objective of assessing the consequences of mariculture for marine and coastal biological diversity and promote techniques which minimize adverse impact, a task that comprised three associated activities. Associated activities included: to provide guidance on criteria, methods and techniques which avoid the adverse effects of mariculture and also subsequent

in 2004, including on the basis of a report produced by an ad hoc technical expert group under the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA).[127]

The elaborated programme of work on marine and coastal biodiversity[128] seeks to halt the loss of marine and coastal biological diversity nationally, regionally and globally and secure its capacity to provide goods and services. The programme recognizes the central role of the ecosystem approach in the implementation of the Programme.[129] It is specifically mentioned in relation to the implementation of integrated coastal and marine management and the conservation and sustainable use of marine and coastal living resources.[130] The precautionary approach and evidenced-based decision making that includes scientific research as well as science, technical and technological knowledge of local and indigenous communities are also highlighted.[131]

The programme outlines goals, objectives and activities for six programme elements including mariculture. The mariculture programme elements have only one associated goal: to prevent or minimize the negative impacts of mariculture on marine and coastal biodiversity and to enhance any positive effects of mariculture using native species. It also has one associated operational objective: to promote use of techniques, which minimize adverse impact of mariculture on marine and coastal biological diversity.[132] Several methods, techniques and practices that support this goal were identified in the decision, including *inter alia*:

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stock enhancement on marine and coastal biological diversity and enhance the positive effects of mariculture on marine and coastal productivity; to collect and disseminate information, data, literature and bibliography relevant to the operational objective and best practice of successful sustainable mariculture, including the use of local species where appropriate; and to evaluate the current state of scientific and technological knowledge on the effects of mariculture on marine and coastal biological diversity.

[127] CBD, *Solutions for Sustainable Mariculture: Avoiding the Adverse Effects of Mariculture on Biological Diversity* (CBD Technical Series Nr. 12 (2004). The report evaluated the state of scientific and technical knowledge on the effects of mariculture on marine and coastal biodiversity, and provided guidance on criteria, methods, techniques and best practices to avoid adverse effects and to enhance the positive effects of mariculture.

[128] CBD, Decision VII/5 on Marine and coastal biological diversity adopted during the Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, 9-20 February 2004, Kuala Lumpur, Malaysia.

[129] *Ibid*, Section II on Basic Principles at 10.

[130] *Ibid*, Section III, paras 1.1(d), 2.1, 2.1(c).

[131] *Ibid*, Section II on Basic Principles at 10.

[132] Under the five associated activities, State Parties are encouraged to adopt the use of relevant methods, techniques and practices; to adopt best-management practices and legal and institutional arrangements for sustainable mariculture; and to undertake regional and international collaboration to address transboundary

- The application of environmental impact assessment or similar assessment and monitoring procedures that address the likely immediate, intermediate and long-term impacts on all levels of biodiversity;[133]
- Effective site-selection methods, in the framework of integrated marine and coastal area management;
- Effective methods for effluent and waste control;
- Use of native species and subspecies in mariculture;
- Effective measures to prevent the inadvertent release of mariculture species and fertile polyploids, including living modified organisms (LMOs);
- Proper methods of breeding to protect genetic diversity;
- Minimizing the use of antibiotics through better husbandry techniques;
- Ensuring that fish stocks used for fish meal and fish oil are managed in such a way as to be sustainable and to maintain the trophic web;
- Considering traditional knowledge, where applicable as a source to develop sustainable mariculture techniques.[134]

c) CBD and Other Relevant Guidelines

Other guidelines and support tools adopted by the CoP address specific issues relevant for aquaculture management. Guidelines address, inter alia: biodiversity-inclusive environmental impact assessments;[135] marine spatial planning;[136] integrated coastal and

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impacts of mariculture on biodiversity. All stakeholders are encouraged to facilitate the implementation of identified research and monitoring priorities. The Secretariat is further required to take a lead role in undertaking a comprehensive review of documents on best practices relevant to mariculture, and to disseminate the results.

[133] The programme of work calls to take into account the guidelines on the integration of biodiversity considerations in environmental impact assessment legislation and/or processes and in strategic impact assessment, as well as the recommendations on the conduct of cultural, environmental and social impact assessments regarding developments proposed to take place on, or which are likely to impact on, sacred sites and on lands and waters traditionally occupied or used by indigenous and local communities (see below).

[134] Decision VII/5, *supra* note 128, Appendix 5, acknowledges that "at the present time there is insufficient information available about the effects of mariculture on biodiversity and its mitigation." It outlines general research needs as well as research needs related to impacts of mariculture on species and ecosystem diversity; socio-economics, culture, policy and legislation; and monitoring programmes.

[135] CBD, Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment, Annex to Decision VIII/28 adopted by the Conference of the Parties at its Eighth Meeting held in Curitiba, Brazil, 20-31 March 2006, UNEP/CBD/COP/DEC/VIII/28 (15 June 2006), online: CBD <https://www.cbd.int/meetings/COP-08> (access 3 March 2022). See also: CBD, *Marine and Coastal Biodiversity: Revised Voluntary Guidelines for the Consideration of Biodiversity in Environmental Impact Assessments and Strategic Environmental*

marine management;[137] and preventing the introduction and mitigating impacts of alien species.[138] Parties are urged to implement the ICES Code of Practice on the Introduction and Transfers of Marine Organisms and the CCRF (see below).[139] Further guidance have been issued for compliance with article 8(j) of the CBD, including guidelines on access to indigenous and local communities knowledge, innovations and practices and for fair and equitable sharing of benefits arising from their use[140] and on assessment of developments taking place on, or likely to impact, sacred sites or land and waters traditionally occupied or used by indigenous and local communities.[141]

5.3. FAO Instruments for Aquaculture Development

As discussed in Chapters 1 and 2, the work of FAO's Fisheries and Aquaculture Department is pivotal in promoting aquaculture sustainability. The *Code of Conduct for Responsible Fisheries and Aquaculture Development* (CCRF) is a key instrument to guide sustainable practices and guides the EAA. The contents of the CCRF have been complemented and further developed in a series of technical guidelines.

Assessments in Marine and Coastal Areas (Note by the Executive Secretary, 21 August 2012), UNEP/CBD/COP/11/23.

[136] CBD, Decision X/29 on marine and coastal biodiversity adopted during the Tenth Meeting of the Conference of the Parties held in Nagoya, Japan, October 2010, paras 15, 78.

[137] Secretariat of the CBD, Integrated Coastal Management for the Achievement of the Aichi Biodiversity Targets: Practical Guidance for Implementation Based on Experience and Lessons Learned from Coastal and Ocean Governance in the Seas of East Asia, Technical Series No 76 (Montreal: CBD, 2015).

[138] CBD, "Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species", Annex to Decision VI/23 adopted during the Sixth Meeting of the Conference of the Parties to the CBD held in the Hague, Netherlands, April 2002.

[139] CBD, Decision VIII/27 on Alien Species That Threaten Ecosystems, Habitats Or Species (Article 8 (H)): Further Consideration of Gaps and Inconsistencies in the International Regulatory Framework, adopted by the Conference of the Parties to the Convention on Biological Diversity at its Eighth Meeting held in Curitiba, Brazil, 20-31 March 2006, UNEP/CBD/COP/DEC/VIII/27 (15 June 2006), online: CBD <https://www.cbd.int/meetings/COP-08> (access 3 March 2022).

[140] Mo'otz Kuxtal Voluntary Guidelines. Annex to Decision XIII/18 adopted during the Thirteenth Meeting of the Conference of the Parties to the CBD held in Cancun, Mexico, December 2016.

[141] CBD, Akwé: Kon Voluntary Guidelines for the Conduct of Cultural, Environmental and Social Impact Assessments regarding Developments Proposed to Take Place on, or which are Likely to Impact on, Sacred Sites and on Lands and Waters Traditionally Occupied or used by Indigenous and Local Communities, Annex to Decision VII/16 adopted during the Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, Kuala Lumpur, February 2004.

5.3.1. FAO Code of Conduct for Responsible Fisheries and Aquaculture Development

The CCRF was drafted in the early 1990s and adopted by the FAO Conference by Resolution 4/95 on 31 October 1995. The Code sets out principles and international standards for responsible fisheries and aquaculture practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity.[142] Although non-binding in nature, certain parts of it are based on relevant rules of international law, including the LOSC and the CBD.[143] Furthermore, the Code has an aspiration to guide national, regional and international bodies in the development of legislation and policy.[144] The scope of the Code is global and includes both governmental and private organizations.

Aquaculture is addressed in the CCRF mainly in article 9 on "Aquaculture development". The article addresses responsible development of aquaculture in areas under national jurisdiction; responsible development of aquaculture within transboundary aquatic ecosystems; use of aquatic genetic resources for aquaculture; and responsible aquaculture at the production level. Some provisions in article 6 on "General Principles" are also relevant, notwithstanding its heavy fisheries focus. Also key are several provisions in Article 10 on "Integration of fisheries into coastal area management".[145]

The CCRF does not call for the application of an ecosystem approach. While it does not call for the application of the precautionary approach explicitly in article 9,[146] its general principles (Article 6) call on States to apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment.[147] It further defines the precautionary approach in line with the definition of the Rio Declaration: "the absence of adequate scientific information should not be used as a reason for postponing or failing to take

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[142] FAO, *Code of Conduct for Responsible Fisheries and Aquaculture Development*, Doc 95/20/Rev1 (October 31, 1995)[hereinafter CCRF], Introduction.
[143] *Ibid*, 1.1.
[144] *Ibid*, art 2(b)-(d).
[145] *Ibid*, art 11 on "Post-harvest practices and trade" and art 12 on "Fisheries research" are also relevant for aquaculture but, considering the scope of the Dissertation, they are not addressed here.
[146] For contrast, see *ibid*, article 7.5 under the Article on fisheries management.
[147] *Ibid*, art 6.5.

measures to conserve target species, associated or dependent species and non-target species and their environment."[148]

Despite not calling for EAA, the CCRF identifies governance, procedural, and substantive standards for sustainable aquaculture planning and management that are consistent with the law and policy coordinates for EA implementation identified in Chapters 2 and 3. The consistency should not be surprising, as the Technical Guidelines on EAA explicitly describe the strategy as implementing the CCRF. Substantively, the CCRF recognizes ecological, social, and economic objectives that need to be taken into account in decision-making, while at the same time highlighting the need to conserve biodiversity.[149] The CCRF also identifies governance and procedural tools, addressing integration, cooperation and collaboration, participatory decision-making, and knowledge-based decision making including environmental impact assessment. Specific obligations for aquaculture in transboundary coastal environments are also outlined.

The CCRF calls for States to establish appropriate legal and administrative frameworks for the development of responsible aquaculture.[150] These should include the production and regular update of aquaculture development strategies and plans.[151] Further, Article 10 calls for States to adopt legal, policy and institutional frameworks that achieve sustainable and integrated management of the coastal areas. These frameworks should consider mechanisms for cooperation and coordination among national authorities involved in planning, development, conservation and management of coastal areas.[152]

The CCRF also calls on States to ensure that aquaculture is ecologically sustainable.[153] This is also reinforced in Article 6 on "General Principles", calling on both

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[148] Risks and uncertainties are also addressed in the article on integrated coastal zone management which calls for States to take due account of the risks and uncertainties involved when setting policies for the management of coastal areas.

[149] The dual objective of EA, described by Platjouw as requiring "both a holistic approach that focuses on the ecosystem as a whole, as well as an approach that integrates various objectives" manifests in two of the dimensions of EAA identified in Chapter 3: EAA as a social process, and EAA as substantive norm (Froukje Maria Platjouw, *Environmental Law and the Ecosystem Approach: Maintaining ecological integrity through consistency in law* (Oxon; New York: Routledge, 2016) at 1.

[150] FAO, CCRF, *supra* note 142, art 9.1.1.

[151] *Ibid*, art 9.1.3.

[152] *Ibid*, art 10.4.1.

[153] *Ibid*, art 9(1.3). This is consistent with the objective of the Code, "ensuring the effective conservation, management and development of living aquatic resources, *with due respect for the ecosystem and biodiversity*" (*ibid*, Introduction (emphasis added)).

States and users of living aquatic resources to conserve aquatic ecosystems.[154] It is further reinforced in Article 10, recognizing that management of coastal resources must take into account all human activities and stressors, the needs of the coastal communities, the fragility of coastal ecosystems, and the finite nature of their natural resources.[155] Emphasis on the integrative assessment of different stressors and the recognition of environmental limits is consistent with the EAA in its substantive dimension.

The general obligation to develop ecologically sustainable aquaculture is further developed through more specific requirements.[156] For this purpose, the CCRF calls for:

- minimizing harmful effects of introducing non-native species or genetically altered stocks, especially when there is a potential for the spread into waters under the jurisdiction of other States or State of origin,[157] including through the elaboration of international codes of practices and procedures for introductions and transfers of aquatic organisms;
- minimizing adverse genetic, disease and other effects of escaped farm fish on wild stocks;[158]
- using appropriate procedures for the selection of broodstock and the production of eggs, larvae and fry,[159] developing national codes of practice and procedures to this end;
- protecting and rehabilitating, as far as possible and when necessary, all critical fisheries habitats in marine and freshwater ecosystems, such as wetlands, mangroves, reefs, lagoons, nursery and spawning areas;[160]
- managing waste and effluents (including feeds, feeds additives and fertilizers;[161] use of chemicals;[162] and disposal of waste such as offal, sludge, dead or diseased fish;[163]
- enhancing fish health management practices, including vaccination, effective and minimal use of therapeutants, hormones and drugs, antibiotics and other disease control chemicals;[164] and
- ensuring food safety to maintain product quality.[165]

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[154] *Ibid*, art 6(1).
[155] *Ibid*, art 10.1.1.
[156] *Ibid*, art 9.3.1.
[157] *Ibid*, art 9.3.1.
[158] *Ibid*, art 9.3.1.
[159] *Ibid*, art 9.3.4
[160] *Ibid*, art 6.8.
[161] *Ibid*, art 9.4.3.
[162] *Ibid*, art 9.4.5.
[163] *Ibid*, art 9.4.6.
[164] *Ibid*, art 9.4.4.

The CCRF does establish principles for responsible management not only in a biological and ecological context, but also considering technological, economic, social, and commercial aspects.[166] Social objectives, in particular the role of aquaculture to promote diversification of income and diet,[167] are explicitly promoted. It also calls for conservation and management decisions to be based not only on environmental and ecological considerations but also economic and social factors.[168] In establishing principles for aquaculture management, it calls to ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments.[169] It further calls on States to promote responsible aquaculture practices in support of rural communities, producer organizations and fish farmers. Furthermore, the Code also calls to protect the rights and fishers and fishworkers to a secure and just livelihood;[170] the rights to preferential access, where appropriate, to traditional fishing grounds and resource;[171] and to ensure that facilities and equipment as well as activities allow for safe, healthy, and fair working and living conditions.[172]

The CCRF encourages generally a participatory approach to decision-making processes, encouraging transparent processes that facilitate consultation and effective participation of industry, fishworkers, environmental and other interested organizations.[173] Specific references are also made in the context of aquaculture development and integrated coastal zone management. Article 9 calls for the active participation of fishfarmers and their communities in the development of responsible aquaculture management practices.[174] Article 10, in turn, highlights the need to create public awareness of the need for the protection and management of coastal resources, as well as participation in the (integrated coastal) management process by those affected,[175]

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[165] *Ibid*, art 9.4.7.
[166] *Ibid*, art 2(a).
[167] *Ibid* art 6.19. See also art 2(f).
[168] *Ibid*, art 6.4.
[169] See also *ibid*, art 6.19.
[170] *Ibid*, art 6.18.
[171] *Ibid*, art 6.18.
[172] *Ibid*, art 6.17.
[173] *Ibid*, art 6. 13.
[174] *Ibid*, art 9.4.2.
[175] *Ibid*, art 10.2.1.

with particular reference to the need to consult with, and involve, representatives of the fisheries sector and fishing communities.[176]

Decision making should be based on best available scientific information,[177] also taking into account traditional knowledge of the resources and their habitat, as well as relevant environmental, economic and social factors.[178] EIA is specifically required for aquaculture. Legal frameworks should include the establishment of effective procedures specific to aquaculture to undertake appropriate environmental assessment and monitoring with the aim of minimizing adverse ecological, economic and social consequences of aquaculture activities.[179] In the context of coastal management, it calls for States to promote the assessment of the value of different coastal resources, taking into account economic, social and cultural aspects, in order to assist decision-making on their allocation.[180] Adaptive management is not addressed explicitly. Nevertheless, the Code calls for "timely solutions to urgent matters",[181] as well as to initiate scientific research as soon as possible when scientific information is absent.[182]

A special article of the CCRF provides guidelines on aquaculture development in transboundary waters, in the view to seek complementary and collaborative measures among relevant jurisdictions. The CCRF calls for States to protect transboundary aquatic ecosystems by ensuring responsible choice of species, siting and management of aquaculture activities.[183] It further calls on States to cooperate in the promotion of sustainable aquaculture practices. States are required to consult with their neighbouring states before introducing non-indigenous species into transboundary aquatic ecosystems. They are also required to establish mechanisms to monitor the impacts of inputs used in aquaculture, and to establish appropriate mechanisms to collect, share and disseminate

[176] *Ibid*, art 10.1.2.
[177] *Ibid*, art 9.1.2 and article 6.1.4.
[178] *Ibid,* art 6.1.4 (General Principles).
[179] *Ibid* art 9.1.5. An advance evaluation of the effects of aquaculture developments on genetic diversity and ecosystem integrity is called for in article 9.1.2. Art 9.1.5. calls for ongoing monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities. While addressing integrated coastal zone management, it also calls for states to establish or promote the establishment of systems to monitor the coastal environment as part of the coastal management process using physical, chemical, biological, economic, and social parameters (art. 10.2.4).
[180] *Ibid*, art 10.2.2.
[181] *Ibid*, art 6.13.
[182] *Ibid*, art 12.3.2.
[183] *Ibid*, art 9.2.1 and 9.2.2.

data to facilitate cooperation on planning for aquaculture development at the national, sub-regional, regional and global level.[184]

More broadly, the CCRF also addresses substantive and procedural obligations for transboundary management of the coastal area. It calls for bilateral, sub-regional or regional cooperation to facilitate the sustainable use of coastal resources and the conservation of the environment.[185] Particular guidelines are provided in the case of activities that may have an adverse transboundary environmental effect in coastal waters, including notification and consultation obligations.[186]

5.3.2. FAO Technical Guidelines for Aquaculture

FAO has developed several technical guidelines to support States' efforts to develop sustainable aquaculture consistent with the recommendations of the CCRF. These include the FAO Technical Guideline for Responsible Fisheries No. 5 on Aquaculture Development,[187] as well as 9 supplementary guidelines addressing mostly technical or biological issues. These are:

- Good Aquaculture Feed Manufacturing Practice;[188]
- Health Management for Responsible Movement of Live Aquatic Animals;[189]
- Genetic Resource Management;[190]
- Ecosystem Approach to Aquaculture;[191]

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[184] *Ibid*, art 9.2.1, 9.2.3.-9.2.5.
[185] *Ibid*, art 10.3.
[186] *Ibid*, art 10.3.2.
[187] FAO, *Aquaculture development*. FAO Technical Guidelines for Responsible Fisheries No 5 (Rome: FAO, 1997).
[188] FAO, *Good aquaculture feed manufacturing practice*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 1 (Rome: FAO, 2001). The Guideline is directed to feed manufacturers and the production, handling and storage of feed at the manufacturers' site. It does not apply to feed handling and storage at the farm.
[189] FAO, *Health management for responsible movement of live aquatic animals*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 2 (Rome: FAO, 2007). The guideline deals mostly with the safe transboundary movement of fish between States but includes measures at the farm and farm cluster level to the extent that farms are involved in the spread of transboundary aquatic animal diseases.
[190] FAO, *Genetic resource management*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 3 (Rome: FAO, 2008). The document provides guidance on responsible broodstock management and domestication, genetic improvement programmes, and dissemination programmes for genetically improved fish (considering dissemination between countries and within a country but recognizing that the watershed is the most important biological unit), considering economic and ecological risks and in the context of the precautionary approach.

- Use of Wild Fish as Feed in Aquaculture;[192]
- Use of Wild Fishery Resources for Capture-based Aquaculture;[193]
- Aquaculture governance and sector development;[194]
- Prudent and Responsible Use of Veterinary Medicines in Aquaculture;[195]
- Development of aquatic genetic resources: A framework of essential criteria.[196]

Aside from the FAO Technical Guidelines for Responsible Fisheries series, FAO has also produced other documents with the aim to support States' efforts to develop ecologically, socially and economically sustainable aquaculture. These include:

- Technical Guidelines on Aquaculture Certification.[197]
- Handbook on aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture.[198]
- Understanding and applying risk analysis in aquaculture.[199]

Further, and as noted in Chapter 1, Guidelines on Sustainable Aquaculture are expected to be released in 2023.[200]

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[191] FAO, *Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010). See also chapter 2.
[192] FAO, *Use of wild fish as feed in aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 5 (Rome: FAO, 2011). The guide develops ten principles for the use of wild fish as feed, which seek to ensure: ecological and socially sustainably exploitation of wild fisheries, including the access to sufficient data for these purposes; promote use of alternative feeds; ensure feed does not compromise the food safety or quality of farmed fish. The use of private certification schemes is encouraged.
[193] FAO, *Use of wild fishery resources for capture-based aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 6 (Rome: FAO, 2011).
[194] FAO, *Aquaculture governance and sector development*. FAO Technical Guidelines for Responsible Fisheries No 5 Suppl 7 (Rome: FAO, 2017). The guidelines recognize principles for the good aquaculture governance (effectiveness and efficiency, equity, accountability and predictability of the law). It further provides recommendations for the aquaculture sector in relation to administration, legal and regulatory frameworks, license policies and non-state participation in decision-making.
[195] FAO, *Recommendations for prudent and responsible use of veterinary medicines in aquaculture.* FAO Technical Guidelines for Responsible Fisheries No 5 Suppl 8 (Rome: FAO, 2019). Provides recommendations for government, private sector and animal health professionals for the safe and responsible use of veterinary medicines with the objective of reducing concerns for fish health, human health and the environment, including antimicrobial resistance.
[196] FAO, *Development of aquatic genetic resources: A framework of essential criteria*. FAO Technical Guidelines for Responsible Fisheries No 5 Suppl 9 (Rome: FAO, 2018).
[197] FAO, *Technical guidelines on aquaculture certification* (Rome: FAO, 2011).
[198] José Aguilar-Manjarrez, Doris Soto & Randall Brummett, *Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture. A handbook*. Report ACS18071 (Rome, FAO; Washington, World Bank Group: 2017).
[199] MG Bondad-Reantaso, JR Arthur & RP Subasinghe (eds), *Understanding and applying risk analysis in aquaculture*. FAO Fisheries and Aquaculture Technical Paper No 519 (Rome: FAO, 2008).

5.4.Other International Agreements Relevant to Finfish Aquaculture

The LOSC, CBD and FAO provide the general and global legal and policy framework outlining the jurisdiction, rights, and responsibilities of States in regulating aquaculture. Other multilateral agreements complement the policy and legal framework by outlining specific obligations and responsibilities of States vis-à-vis particular areas of international concern. This section provides a broad overview of instruments relevant to finfish aquaculture regulation and management.

5.4.1. Multilateral Agreements Addressing Species and Habitat Protection

Various global agreements address the conservation needs of specific species or habitats. Contracting Parties to these agreements may be bound by stricter or more precise obligations for the protection of these species and habitats, which in turn may have direct or indirect relevance for the assessment and authorization of salmon mariculture. Three of such agreements are particularly relevant for aquaculture: the *Convention on the Conservation of Migratory Species of Wild Animals* (CMS Convention);[201] the *Convention Concerning the Protection of the World Cultural and Natural Heritage* (World Heritage Convention);[202] and the *Convention on Wetlands of International Importance especially as Waterfowl Habitat* (RAMSAR Convention).[203] This section focuses on the CMS Convention. The RAMSAR Convention is generally of limited relevance to salmon mariculture, as a wetland is not a suitable salmon environment.[204]

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[200] FAO, "Guidelines for Sustainable Aquaculture", online: FAO <https://www.fao.org/in-action/gsa/background/fr/> (accessed 30 December 2022).

[201] 23 June 1979, 1651 UNTS 333 (entered into force 1 November 1983) (also known as the Bonn Convention). Note that Canada is not a Party to this Convention.

[202] 16 November 1972, 1037 UNTS 151 (entered into force 17 December 1975).

[203] 2 February 1971, 996 UNTS 245 (entered into force 21 December 1975).

[204] According to art 1.1 of the RAMSAR Convention, *ibid*, wetlands are "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Art 2 allows to designate coastal and riparian water adjacent to a wetland and deeper than six metres as a There are instances in which a RAMSAR site may interact with an existing or proposed salmon mariculture site, however. Indeed, art 2 allows to designate coastal or riverine zone adjacent to a wetland and deeper than six metres as part of a RAMSAR site, especially where these have importance as waterfowl habitat. Further, a salmon mariculture could be located in the vicinity of a designated RAMSAR site, which would impose particular assessment obligations to the coastal State. It should also be mentioned that a RAMSAR site may be relevant for the earlier stages of salmon aquaculture. RAMSAR has been ratified by 171 States, including the four States studied in this Dissertation (see online: UNESCO < https://en.unesco.org/about-

The World Heritage Convention, in turn, may be relevant to developments in or near listed cultural[205] or natural[206] heritage sites.[207] Aquaculture was identified in the standard list of factors affecting the outstanding universal value of World Heritage Sites.[208] It has also been identified as a particular threat for a small number of properties.[209] Nevertheless, aquaculture has only been addressed in a limited and site-specific manner and therefore the Convention will not be analyzed further.

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us/legal-affairs/convention-wetlands-international-importance-especially-waterfowl-habitat> (accessed 13 March 2023).

[205] 194 States are parties to the World Heritage Convention, including the four States studied in this Dissertation (see online: UNESCO <https://whc.unesco.org/> (accessed 13 March 2023). Cultural sites are human creations, buildings or group of buildings that have an outstanding universal value from the history, art or science, as well as the work of man or the combined work of nature and man with an outstanding universal value from a historical, aesthetic, ethnological or anthropological point of view. To date, more than 800 cultural heritage sites have been identified, inscribed, and protected under the provisions of the Convention. Budj Bim is an interesting case in that its identification and inscription in the World Heritage Site was precisely because its three serial components contain one of the world's most extensive and oldest aquaculture system (see: UNESCO, nd, online: https://whc.unesco.org/en/list/1577/ (accessed 16 December 2020)).

[206] Natural sites, generally, are physical, biological or physiographical formations and precisely delineated natural areas of outstanding universal value from a scientific, conservation or aesthetic point of view. To date, more than 200 natural heritage sites have been identified, inscribed, and protected under the provisions of the Convention.

[207] The World Heritage Convention recognizes the primary responsibility of States for the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage situated on its territory. Considering, however, that the disappearance of any item of cultural or natural heritage is a harmful impoverishment of the heritage of all nations in the world, it puts in place a mechanism for international assistance and co-operation in the form of financial, artistic, scientific and technical resources. A committee composed of 21 State Parties elected by the General Assembly makes decision on whether a site should be inscribed in the World Heritage lists, examines the reports of the state of conservation of inscribed sites, and makes requests states to take action when properties are not being properly managed.

[208] The Committee adopted a standard list of 14 primary factors affecting the outstanding universal value of World Heritage Sites adopted by the Committee. Marine and freshwater aquaculture was listed under the primary factor "biological resource use/modification" (UNESCO, nd, online: WHC <https://whc.unesco.org/en/factors/> (accessed 16 December 2020)).

[209] These include Ha Long Bay (Vietnam), Shark Bay (Western Australia), Vegaøyan (the Vega Archipelago) (Norway), Budj Bim Cultural Landscape (Australia), Lagoons of New Caledonia (France), the Wadden Sea (Germany/Netherlands), and Rock Islands Southern Lagoon (Palau). Most of these properties are natural heritage sites, with one being a mixed (natural and cultural) heritage site and two being cultural sites (the Vega Archipelago and Budj Bim Cultural Landscape). In these cases, the Committee has requested relevant State Parties to take, or continue to take, action. For example, it called on States to: maintain restrictions on developments, including aquaculture, in the property and in the vicinity of property boundaries; enhance surveillance and monitoring; implement monitoring programs to control invasive species associated to aquaculture; address the interface between conservation and development in respect of aquaculture; or ensure ecologically sustainable aquaculture. Through the report and review process of the World Heritage Convention, aquaculture management in particular locations (in or near world heritage sites) can therefore be under particular international scrutiny. Requirements are, however, site-specific.

The CMS Convention was adopted in 1979 to elicit international cooperation for the conservation of species that migrate across or outside areas under national jurisdiction.[210] Chile, Norway, and the UK are among 133 State parties to the Convention. Canada is neither a party nor a signatory.[211] Its objective is to promote favourable conservation status of such migratory species.[212] The Convention distinguishes between two categories of species for listing purposes: Appendix I includes migratory species that have been assessed as being in danger of extinction throughout all or a significant portion of their range; Appendix II includes migratory species that have an unfavourable conservation status and that require international agreements for their conservation and management, or that have a conservation status which would significantly benefit from the international cooperation that could be achieved by an international agreement.

Stronger obligations are considered for Annex I species. Parties are required to prohibit the taking of animals belonging to Annex I species, with limited exceptions.[213] Further, they have a weaker obligation to "endeavour" to: a) conserve and restore habitats; b) prevent or minimize adverse effects of activities seriously impeding migration of species; c) control introduction of exotic species.[214] For species listed in Appendix II, the agreement requires parties to "endeavour to conclude agreements" covering conservation and management. Several CMS-instruments have been signed by parties to the CMS to protect these Annex II species.[215] A further "soft" obligation calls

[210] CMS Convention, *supra* note 201, art I(1)(a) defines migratory species as "the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries".
[211] See online: CMS <https://www.cms.int/en/parties-range-states> (accessed 13 March 2023).
[212] CMS Convention, *supra* note 201, art V and art I(1)(b)-(d).
[213] *Ibid*, art III(5). Taking is defined in art I(1)(i) and includes harassing of animals belonging to Annex I species.
[214] *Ibid*, art III(4). See Harrison, *supra* note 28, at 52.
[215] Several CMS subsidiary agreements or memoranda of understanding have been signed for the conservation of certain migratory species in regions that are relevant for this Dissertation. They include the Agreement on the Conservation of African-Eurasian Migratory Waterbirds; the Memorandum of Understanding (MoU) on Pacific Islands Cetaceans, the Agreement on the Conservation of Albatrosses and Petrels; and the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS). From these, only the Agreement on the Conservation of African-Eurasian Migratory Waterbirds has addressed aquaculture as a concern (David L VanderZwaag, "The international law and policy seascape for aquaculture: navigating tangled currents" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016) 11) albeit in a very limited manner.

on parties to promote, cooperate in and support scientific research regarding migratory species.[216]

The CMS Convention could be relevant for the regulation of the impacts of aquaculture on listed wild species, and particularly marine mammals and seabirds. Aquaculture can have both positive and negative interactions with marine mammals or seabirds, but positive impacts are harder to quantify. Negative effects can occur from competition for space (habitat modification or exclusion), potential for entanglement with nets and structures, underwater noise disturbance, attraction to artificial lighting, and possible effects due to alterations in trophic pathways.[217] While these stressors may have an impact only at the individual level in most cases, it can be a significant impact for endangered populations or populations with unfavourable status listed under CMS. The main mitigation measure to prevent negative impact is siting, i.e., locating farms outside of migratory routes or important habitats of listed species.

CMS has not addressed aquaculture impacts in its work, suggesting that reported impacts on CMS listed species (in particular Annex I species) are low and it is not considered a research priority. The CMS has, however, called on parties to implement EIA and SEA that considers, as completely as possible, impediments to migration, transboundary effects on migratory species, and impacts on migratory patterns or ranges.[218] It further developed CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-Generating Activities,[219] and Light Pollution Guidelines for Wildlife.[220] Noise and light generated by aquaculture activities has not been

[216] CMS Convention, *supra* note 201, article II(3)(a).
[217] Ministry for Primary Industries (New Zealand), *Literature Review of Ecological Effects of Aquaculture* (Cawthron Institute; NIWA: August 2013), Chapter 4 on Marine Mammals.
[218] CMS, Resolution 7.2 "Impact Assessment and Migratory Species", adopted by the Conference of the Parties at its Seventh Meeting (Bonn, 18-24 September 2002).
[219] CMS, Resolution 12.14 "Adverse Impacts of Anthropogenic Noise on Cetaceans and Other Migratory Species" adopted by the Conference of the Parties at its 12th Meeting, Manila, October 2017, para.7. The guidelines rely on the use of best available techniques and best environmental practices, as well as consideration of noise impacts on migratory species in the environmental and strategic environmental impact assessments. While not mentioning aquaculture, the guidelines offer best practices for the assessment and mitigation of noise resulting from coastal and offshore construction works, offshore platforms, pingers or acoustic deterrent devices, new technologies, and other noise-generating activities.
[220] CMS, Resolution 13.5 "Light Pollution Guidelines for Wildlife" adopted by the Conference of the Parties at its 13th Meeting, Gandhinagar, February 2020. The resolution endorses the Australian "National Light Pollution Guidelines for Wildlife, including marine turtles, seabirds and migratory shorebirds" (January 2020) (para 63 and Annex to Resolution 13.5) and urges the parties to use them "to adopt appropriate measures and processes designed to assess if a lighting project is likely to negatively affect

considered a significant stressor, but some effects have been reported.[221] Evolving knowledge may put more focus on negative impacts of aquaculture noise-generating activities or other impacts on endangered or threatened species.

5.4.2. Multilateral Agreements Addressing Fish Health and Food Safety

With seafood products being an internationally traded commodity, trade agreements are particularly relevant for the seafood industry. The World Trade Organization's agreements[222] set the legal framework for international trade of goods and services, as well as intellectual property and investments. Regional or bilateral trade agreements or unilateral trade measures also address seafood trade and can consequently impact seafood production and management.

While international trade law is not the focus of this Dissertation,[223] they provide the basis for international standards embodied in two relevant instruments: the FAO and World Health Organization's Codex Alimentarius; and the World Organization for Animal Health (OIE) Aquatic Animal Health Code (or Aquatic Code) and Manual of Diagnostics Tests for Aquatic Animals. The Codex Alimentarium is a collection of international food standards (and related texts) adopted to protect consumers' health and to ensure fair practices in the food trade. The OIE Aquatic Code, in turn, is a collection of standards adopted by the OIE to improve aquatic animal health worldwide, to improve welfare of farmed fish, and to control use of antimicrobial agents in aquatic animals. They are used by importing and exporting countries for the prevention, early detection, reporting and control of pathogenic agents in aquatic animals and prevent spread from international trade.

What these instruments have in common is that they seek to balance legitimate national and international interests: consumer safety or fish health, on one hand, and free and fair

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wildlife and identify management tools to minimise and mitigate that impact" (para 6). It also requests the Secretariat to promote the guidelines to the CMS Family (subsidiary instruments and memoranda of understanding) and more broadly to other marine environmental agreements.

[221] Ministry for Primary Industries, *supra* note 217.

[222] Agreement establishing the World Trade Organization (1994); General Agreement on Tariffs and Trade (GATT) 1994; Marrakesh Protocol to the GATT 1994; General Agreement on Trade in Services, and other multilateral agreements to implement the GATT 1994 (see WTO, "Legal texts", online: WTO <https://www.wto.org/english/docs_e/legal_e/legal_e.htm>). All States included in this Dissertation are members of the World Trade Organization.

[223] See generally: Whitsitt & Bankes, *supra* note 8.

trade, on the other. All countries are entitled to protect human, animal or plant life or health, and those protections may include restrictions to trade in the form of sanitary or phytosanitary measures.[224] Under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), these trade restrictions need to comply with certain requirements aimed at preventing unfair (protectionist or discriminatory) international trade practices. Restrictive trade measures need to be based on science; be applied only to the extent necessary to protect human, animal or plant life or health; and should not arbitrarily or unjustifiably discriminate between members where identical or similar conditions prevail.[225]

To harmonize sanitary and phytosanitary measures on as wide a basis as possible, WTO members shall base their sanitary or phytosanitary measures on international standards, guidelines or recommendations, where they exist. Sanitary or phytosanitary measures which conform to international standards, guidelines or recommendations shall be deemed to be necessary to protect human, animal or plant life or health, and presumed to be consistent with the relevant provisions of the Agreement and of GATT 1994. The Codex Alimentarius and the standards adopted by the International Office of Epizootic (now World Animal Health Organization) are explicitly included as international standards, guidelines and recommendations.[226]

The importing country is allowed to adopt measures that result in higher level of sanitary or phytosanitary protection. These measures need to be based on a risk assessment, cannot be more trade-restrictive than required to achieve their appropriate level of sanitary or phytosanitary protection, taking into account technical and economic feasibility, and must not arbitrarily or unjustifiably discriminate against any member.[227] In turn, the exporting country is not under an obligation to adopt the international standards, but not implementing them may result in barriers to international trade.

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[224] Agreement on the Application of Sanitary and Phytosanitary Measures, 15 April 1994, 1867 UNTS 493 (entered into force 1 January 1995) (SPS Agreement), art 2.1.
[225] *Ibid*, art 2.2 and 2.3.
[226] *Ibid*, Annex A on Definitions, sections 3(a) and (b). See also: Preamble, para. 6, art 3.4, and art 12(3).
[227] *Ibid*, art 5. See also: Whitsitt & Bankes, *supra* note 8, at 41.

a) The Codex Alimentarius

The Codex[228] is an extensive set of standards, guidelines, and codes of practices for the production of food for human consumption, and includes aspects such as labelling, food additives, import/export certifications, exchange of information in case of food safety emergency situations, and maximum allowed residue of particular substances in food. The Code of Practice for Fish and Shellfish is particularly relevant for aquaculture and includes a specific section on aquaculture production that addresses the feeding, growing, harvesting and transportation stages of aquaculture production (while handling and processing of fish are covered in other sections of the Code). The measures included are directed to ensure food safety for human consumption and as such are only indirectly relevant for this Dissertation. Some provisions of the Code are worth mentioning, nevertheless:

- It highlights that aquaculture establishments should operate responsibly, in compliance with the recommendations of the FAO Code of Practice.
- Site selection (including setting, design and construction of fish farms) should follow principles of good aquaculture practice appropriate to species. In particular, it calls for fish farms to be located in areas where the risk of contamination by chemical, physical or microbiological hazards is minimal and where sources of pollution can be controlled.
- It highlights that fish farms should operate effective fish health management practices. Diseased fish should be quarantined. Fish farm should have a management plan that includes, among other, defined fallowing periods, appropriate use of agrochemicals, verification procedures and systematic records.
- The Code requires all aquaculture facilities to implement a food safety management system based on Hazard Analysis Critical Control Point (HACCP) principles.
- Water quality must be suitable for the production of products that are safe for human consumption. Water quality should be monitored regularly.
- Farming density must be appropriate to the cultured technique, fish species, size and age, carrying capacity of the fish farm, anticipated survival and desired size at harvesting.
- Feed supply needs to comply with the Code of Practice on Good Animal Feeding. Feed products should be registered with the relevant national authority. Feed ingredients must not contain unsafe levels of pesticides, herbicides, chemical

[228] Joint FAO/WHO Codex Alimentarius Commission. *Codex Alimentarius: International Food Standards*, (World Health Organization; FAO, 2007) online: FAO < https://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/de/> (accessed 9 December 2022).

contaminants, microbial toxins, mycotoxins, pathogens, other contaminants or adulterating substances. Feed can only include approved colours of the correct concentration.

- Veterinary drugs need to comply with the Guidelines for the Design and Implementation of National Regulatory Food Safety Assurance Programmes associated with the Use of Veterinary Drugs in Food Producing Animals. Veterinary products should be registered with the appropriate national authority and prescribed or distributed by personnel authorized under national regulations.

b) The Aquatic Code

The Aquatic Code[229] addresses animal health, animal welfare and use of antimicrobial agents in aquatic animals. Its purpose is the prevention, early detection, reporting and control of pathogenic agents in aquatic animals and to prevent spread from international trade. Fish health (including the health of farmed fish and the transmission of disease between farmed and wild fish) is one of the most pressing problems for aquaculture production worldwide, and thus its guidelines are of paramount importance for aquaculture management, including the grow-out phase of salmon in the marine environment.

The Aquatic Code has seven general sections addressing: notification, diseases listed by the OIE and surveillance for aquatic animals; risk analysis; quality of aquatic animal health services; disease prevention and control; trade measures, importation/exportation procedures and health certification; antimicrobial use in aquatic animals; and welfare of farmed fish. It also contains measures for specific diseases of amphibian, finfish, crustacean and molluscs in four additional sections. The animal health provisions of the Code rely on several structural pillars:

a) Aquaculture zoning and compartmentalization[230]. While a disease may be absent in the whole country, in some cases it is present in some areas. Countries are encouraged to designate zones or compartments with distinct health status for the purpose of disease control and international trade.[231] Measures should be taken to

[229] World Organisation for Animal Health, Aquatic Code, online: WOAH <https://www.woah.org/en/what-we-do/standards/codes-and-manuals/aquatic-code-online-access/> (accessed 9 December 2022).
[230] Zones and compartments define subpopulations of distinct aquatic animal health status for the purposes of disease control and international trade. Compartments refer to subpopulations where the management practices related to biosecurity are the defining factor in the health status. Zoning applies to subpopulations where the distinctive health status has a geographical basis.
[231] A country, zone or compartment may be declared diseased free if: there is no susceptible species in the respective unit; if the country, zone or compartment has been historically free (provided that for the last ten

prevent the introduction of diseases to a disease-free zone or compartment (for example by limiting the exchange of fish or equipment between zones or compartments with different health status).

b) Fish health surveillance. Countries should establish fish health surveillance programs with different purposes: demonstrating the absence of disease, identifying events requiring notification (listed or emerging diseases), and determining occurrence or distribution of endemic diseases, including changes in their incidence or prevalence. Surveillance may be targeted or non-targeted, pathogen-specific or general; and based on surveys or non-random data sources.

c) Early reporting. The first occurrence or reoccurrence of a listed[232] or emerging[233] disease in the country, a zone or a compartment needs to be notified to the OIE. Voluntary reporting of other aquatic animal health information is encouraged.

d) Risk analysis. The international trade of aquatic animals and products[234] must be based on a transparent, objective and defensible risk analysis (including hazard identification, risk assessment, risk management and risk communication).

e) Contingency planning. In case a disease outbreak occurs, the Code requires countries to have a legal framework that allows them to adopt necessary measures as well as an institutional setting that facilitates prompt and coordinated action.[235]

f) Responsible and prudent use of antimicrobial agents. The Code spells out the responsibilities of countries, the veterinary pharmaceutical industry, wholesale and retail distributors, veterinarians and other animal health professionals, and aquatic animal producers, for a rational and prudent use of antimicrobial agents, considering in particular the risk of transfer of resistant microorganisms and resistance determinants from aquatic animals to humans and terrestrial animals.

g) Quality of Aquatic Animal Health Services. The quality of aquatic animal health services is a necessary requirement for the trust that will facilitate international trade. The Code addresses a number of principles for professional quality,

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years there have been basic biosecurity conditions in place, no vaccination has been carried out and the disease is not known to be established in wild aquatic animals in the respective unit); or when the disease has been eradicated within the last 10 years or the health status is unknown and a pathogen-specific surveillance programme is in place.

[232] Listed OIE disease for finfish include: Aphanomycesinvadans (epizootic ulcerative syndrome); epizootic haematopoietic necrosis virus; Gyrodactylus salaris; HPR-deleted or HPRO infectious salmon anaemia virus; infectious haematopoietic necrosis virus; koi herpesvirus; red sea bream iridovirus; salmonid alphavirus; spring viraemia of carp virus; viral haemorrhagic septicaemia virus (Aquatic Code, *supra* note 229, art. 1.3.1).

[233] Emerging diseases means diseases, other than a listed disease, which has a significant impact on aquatic animal or public health resulting from: a) a change of known pathogenic agent or its spread to a new geographic area or species; or b) a newly recognized or suspected pathogenic agent.

[234] These include aquatic animal genetic material, feedstuffs, biological products and pathological material.

[235] A contingency plan should include instructions to address diagnostic procedures, handling and disposal of dead aquatic animals, establishment of quarantine areas and surveillance zones, control of movement of aquatic animals between established zones, sanitary slaughtering, disease control at the local level, disinfection (also encouraged as a routine biosecurity practice), fallowing (also recognized as a biosecurity measure), surveillance, reporting, restocking, compensation, and public awareness.

including an enabling legislative and regulatory environment, independence, impartiality, integrity, objectivity, procedures and standards, documentation, self-evaluation, communication, and information, complaints and appeal.

The Code includes a special section on welfare of farmed fish,[236] which is justified in ethical, economic, and productivity considerations. Indeed, the Code recognizes, as a guiding principle, that the use of fish carries with it an ethical responsibility to ensure the welfare of such animals to the greatest extent practicable.[237] It further links fish welfare with fish health and notes that improved fish welfare leads to improved productivity and economic benefits.[238] The basic requirements of the Code is that handling methods are appropriate to the biological characteristics of the fish and a suitable environment to fulfil their needs. Due to diversity of species requirements, it only includes general recommendations addressing welfare of farmed fish during transport, slaughter and destruction for disease control purposes.[239]

5.4.3. Multilateral Agreements Addressing Genetically Modified Organisms

Some multilateral agreements focus on activities with potentially harmful ecological impact on the marine environment, rather than specific species or habitats. One activity with potential harmful ecological impacts relevant for aquaculture is the use of genetically modified organisms (GMOs) resulting from modern biotechnology. As noted, article 196 of the LOSC and article 8(g) of the CBD address biotechnology. The latter calls for States to "establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health". Article 19(3) also calls for States to consider the need for a protocol setting out appropriate procedures in the field of the safe transfer, handling and use of living modified organisms that may have adverse effects on the conservation and sustainable use of biological diversity. The *Cartagena Protocol on Biosafety to the*

[236] Aquatic Code, *supra* note 229, section 7.
[237] *Ibid*, section 7.1.1.
[238] *Ibid*.
[239] *Ibid*, sections 7.2-7.4.

Convention on Biological Diversity[240] was adopted in 2000 in response to that mandate. From the States included in this Dissertation, only Norway and UK have ratified the Protocol.[241]

According to article 1 of the Protocol, its objective is "to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements". The objective set out in article 1 deserves a few comments. First, the Cartagena Protocol explicitly invokes the precautionary approach as a fundamental principle guiding the need for this agreement and its provisions. A reference to Principle 15 of the Rio Declaration is included in the Preamble and in article 1. The precautionary approach is also implicit in other provisions of the Protocol.[242] Second, the scope of the Protocol in article 1 (together with article 4) exceeds the mandate of article 19 of the CBD by considering not only risks to biodiversity but also "taking into account" risks to human health. This was a controversial topic during the negotiation, and there are different interpretations on the extent to which human health risks may be considered under the Protocol.[243] Third, the Protocol also restricts the scope of the CBD by addressing living organisms that posses a novel combination of genetic material *obtained through the use of modern biotechnology*[244] (or genetically modified organisms). It excludes, therefore, living modified organisms obtained through traditional genetic manipulation such as selective breeding.[245]

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[240] 29 January 2000, 2226 UNTS 208 (entered into force 11 September 2003).
[241] CBD, "Parties to the Cartagena Protocol and its Supplementary Protocol on Liability and Redress", online: CBD <https://bch.cbd.int/protocol/parties/> (accessed 13 March 2023).
[242] See, eg: *ibid*, arts 10(6) and 11(8), and Annex III(4). See also: Ruth Mackenzie et al, *An Explanatory Guide to the Cartagena Protocol on Biosafety* (Gland, Switzerland; Cambridge, UK: IUCN, 2003) at 13-14.
[243] Mackenzie et al, *supra* note 242.
[244] Cartagena Protocol, *supra* note 240, art 3. Modern biotechnology is defined as the application of: a) In vitro nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles, or b) Fusion of cells beyond the taxonomic family, that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection (*ibid*).
[245] *Ibid*. See also: Mackenzie et al, *supra* note 242, at 46.

The main material object of the Protocol is transboundary movement of living modified organisms (LMOs).[246] The protocol considers rules for intentional, unintentional[247] and illegal[248] transboundary movements. Intentional movement is subject to two different procedures, depending on whether the movement is for the purpose of an intentional introduction to the environment,[249] or for use as food or feed or for processing.[250]

The first intentional transboundary movement for intentional introduction to the environment requires a prior advanced informed agreement procedure.[251] Decisions on transboundary movement should be based on a risk analysis (including risk assessment and management), which may include socio-economic considerations, in particular with regard to the value of biological diversity to indigenous and local communities. The Protocol establishes a Biosafety Clearing House to facilitate the exchange of scientific, technical, environmental and legal information on, and experience with, living modified organisms and to assist Parties to implement the Protocol.[252] Public awareness and participation in decision-making is also mandated "in accordance with (…) laws and regulations" of the contracting Parties.[253]

Despite the relevance of biotechnology for aquaculture, the applicability of the Cartagena Protocol for salmon aquaculture is limited. With most provisions applying to transboundary movement of *living* modified organisms,[254] its scope excludes most international trade with the exception of eggs, fry, smolt or broodstock.[255] Further, the advanced informed agreement procedure of article 7 does not apply to transboundary

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[246] The Protocol, *supra* note 240, also applies to the "handling and use" of LMOs (art 1 and 4). In particular, the provisions on risk assessment (art 15(2)), risk management (art 16), capacity building (art 22) and public awareness and participation (art 23). See also: Mackenzie et al, *supra* note 242, at 33-34.
[247] Cartagena Protocol, *supra* note 240, art 17.
[248] *Ibid*, art 25.
[249] *Ibid*, arts 7-10.
[250] *Ibid*, art 11.
[251] *Ibid*, arts 7 to 10 and 12.
[252] *Ibid*, art 20.
[253] *Ibid*, art 23.
[254] A living organism is a "biological entity capable of transferring or replicating genetic material, including sterile organisms, viruses and viroid" (*ibid*, art 3).
[255] The international trade of genetically modified food is subject to the Codex Alimentarius, see above (Mackenzie et al, *supra* note 242). See also: Douglas Moodie, "Transgenic Fish: Some Canadian Regulatory Issues" in David L VanderZwaag & Gloria Chao (eds), *Aquaculture Law and Policy: Towards principled access and operations* 421 (London: Routledge, 2006) at 429.

movement of LMOs destined for contained use undertaken in accordance with the standards of the Party of import.[256]

To date, there is only one genetically modified salmon in commercial production.[257] AquAdvantage Salmon is produced in Canada (Prince Edward Island) in land-based recirculating aquaculture systems. Salmon eggs are also exported to USA (Indiana) for grow-out in contained facilities. In an early stage, eggs were exported to Panama. USA and Canada have authorized the commercial sale of AquAdvantage salmon for food.[258] Only Panama is a Party to the Cartagena Protocol, but the import of AquAdvantage eggs for grow-out in enclosed facilities does not require an advanced informed agreement procedure under articles 7-10.[259]

5.4.4. Multilateral Agreements Addressing Social Aspects of Environmental Protection

While the previous paragraphs addressed several international instruments that focused on the protection of the marine environment, this section addresses instruments that address different social aspects that are increasingly part of international environmental law. What the subjects under this section have in common is that they are considered at the crossroad between environmental law and human rights law. While they do not address the environment directly, the compliance with, and enforcement of, these general duties by States strengthen environmental governance. Four aspects can be considered falling into this category: public participation (also called environmental democracy or access rights), rights of Indigenous peoples, gender considerations, and fair labour

[256] *Cartagena Protocol*, *supra* note 240, art 6.
[257] Biosafety Clearing-House, online: https://bch.cbd.int/en/about/ (accessed 22 December 2021).
[258] See: Kara M Van Slyck, "Salmon with a Side of Genetic Modification: The FDA's Approval of AquAdvantage Salmon and Why the Precautionary Principle Is Essential for Biotechnology Regulation" (2017) 41 Seattle UL Rev 311, at 329.
[259] Cartagena Protocol, *supra* note 240, art 5. This is without prejudice of procedures and requirements established in domestic legislation, which may include risk assessments. The USA Federal Drug Agency under the *Food, Drug and Cosmetic Act*, Environment and Climate Change Canada under the *Canadian Environmental Protection Act, 1999*, SC 1999, c 33 and the *New Substances Notification Regulations (Organisms)*, SOR/2005-248, and Health Canada under the *Food and Drug Regulations*, all made determinations (on manufacturing, grow-out or access to market of transgenic salmon) based on risk assessments. The risk assessments were criticized by the literature (see: Van Slyck, *supra* note 258) and subject to judicial review both in the USA (*Inst for Fisheries Res v Hahn*, 424 F Supp 3d 740, 2019 WL 6907079; and 499 F Supp 3d 657, 2020 WL 6495656, partially accepting the plaintiff's claim of inadequate risk analysis) and in Canada (*Ecology Action Centre v Canada (Minister of the Environment)*, [2015] FCJ No 1534, 2015 FC 1412 and its appeal *Ecology Action Centre v Canada (Minister of the Environment)*, [2016] FCJ No 1162, 2016 FCA 258).

conditions. This section addresses international instruments addressing the first two aspects.

a) Public Participation

Modern environmental law emphasizes public participation (also known as environmental democracy, participatory democracy[260] or access rights[261]) as a necessary component of governance for sustainable development and as a reflection of the complex relationship between environmental law and human rights law.[262] The right to access information, to participate in decision-making and to access justice in environmental matters provide means to achieve substantive ends. They are also an end in themselves, as they raise awareness and autonomy, fostering empowerment, and contributing to the legitimacy of governmental action.[263] The importance of access rights, "the peoples' right to participate in decisions that affect them", was highlighted in the Brundtland Report[264] and recognized as a principle of environmental law in the Rio Declaration on Environment and Development. Principle 10 states:

> Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

The elements of environmental democracy have been further endorsed by several high-level policy documents, including Sustainable Development Goal 16 on Peace,

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[260] Pierre-Marie Dupuy & Jorge E Viñuales, *International Environmental Law*, 2ed (Cambridge; New York, NY: Cambridge University Press, 2018).
[261] Marcos Orellana, "Governance and the Sustainable Development Goals: The increasing importance of access rights in Principle 10 of the Rio Declaration" (2016) 25 RECIEL 50 at 51.
[262] James R May, "Constitutional Directions in Procedural Environmental Rights" (2013) 28 J Envtl L & Litig 27, at 29-30.
[263] *Ibid*, at 30; Orellana, *supra* note 261, at 51. Ebbesson provides three justifications for public participation: straightforward environmental arguments, the adaptation and furtherance of human rights law, and the enhancement of legitimacy of decision-making (Jonas Ebbesson, "Principle 10: Public Participation" in Jorge E Viñuales (ed), *The Rio Declaration on Environment and Development* (Oxford: Oxford University Press, 2015) 287 at 289.
[264] World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1987), para 82.

Justice and Strong Institutions.[265] They have also been endorsed in modern multilateral environmental agreements and human rights jurisprudence, albeit with marked regional character and little geographic symmetry.[266] Considering the lack of global recognition of access rights (that is, the lack of consistent and general State practice), their status as customary international law is questionable.[267] Nevertheless, the recognition of public participation rights in different binding and non-biding international instruments and in international jurisprudence has led several authors to conclude that participation and consultation are at least emerging duties under general international law.[268]

Two international agreements guaranty access rights in environmental matters: the Aarhus Convention,[269] and the Escazú Agreement[270]. The Aarhus Convention was adopted under the auspices of the U.N. Economic Commission for Europe (UNECE).[271]

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[265] Sustainable Development Goal 16 Target 10 calls to ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements. Target 7 calls to ensure responsive, inclusive, participatory and representative decision-making at all levels. Target 3 calls to promote the rule of law at the national and international levels and ensure equal access to justice for all.

[266] UN Secretary-General, *Gaps in international environmental law and environment-related instruments: towards a global pact for the environment*, A/73/419 (30 November 2018), para 14-15 at 8-9; Ebbesson, *supra* note 263; Jonas Ebbesson, "Public Participation" in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 351, especially at 355 and 361.

[267] See: Dupuy & Viñuales, *supra* note 260, at 86-87, concluding that the question of the customary nature of the principle of public participation is still debated but highlighting that some treaties as well as the jurisprudence of the human rights regime have given it a firmer basis in positive international law. In turn, Duvic-Paoli concludes that "the right is consolidating in international law and that there are hints of its potential customary nature" (Leslie-Anne Duvic-Paoli, "The Status of the Right to Public Participation in International Environmental Law: An Analysis of the Jurisprudence" (2012) 23 YB Int'l Env L 80, at 105). Her analysis is limited to the first two rights in Principle 10 of the Rio Declaration, however (namely access to information and right to participate in environmental decision-making).

[268] Ebbesson, *supra* note 266, at 355. Duvic-Paoli, *supra* note 267, in turn, highlights that the jurisprudence has recognized the right to indigenous participation in environmental decisions as a general principle of law. It is worth noting that shortly after the Rio Declaration was signed, authors included public participation firmly within the group of the Rio Principles considered "policy guidelines" rather than reflecting existing international law (Alexandre Kiss, "The Rio Declaration on Environment and Development" in Luigi Campiglio et al, *The Environment After Rio: International Law and Economics* (London; Norwell, MA: Graham & Trotman/Martinus Nijhoff, 1994) 55, at 62-62). This reinforces the evolution of public participation in international law and provides further arguments for its consideration as, at least, an emerging general principle of law or customary international law.

[269] *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*, 25 June 1998, 2161 UNTS 447 (entered into force 30 October 2001) (Aarhus Convention).

[270] *Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement),* 4 March 2018, UNTS I-56654 (entered into force 22 April 2021).

[271] The Aarhus Convention, *supra* note 269, opened for signature to members of the UNECE, States having consultative status with the UNECE, and by regional economic integration organizations constituted by

The importance of the Aarhus Convention is not merely regional, however, in two main ways. First, the Convention is open to accession by other States with the prior approval of the meeting of the Parties. Second, the Convention requires State parties to promote the application of the principles of the convention in international environmental decision-making processes and within the framework of international organizations in matters relating to the environment.[272] To date, ratifications remain limited; from the States assessed in this Dissertation, only Norway and the UK have ratified the Aarhus Convention.[273] The Escazú Agreement, in turn, is a regional agreement on access to information, public participation and justice in environmental matters in Latin America and the Caribbean. Chile adhered to the agreement in June 2022 and enacted it as domestic law on 25 October 2022.[274] Despite its regional scope, it will be addressed together with the Aarhus Convention.

The Aarhus Convention operationalizes the three pillars of Principle 10 by recognizing a right to access information, a right to participate in decision-making, and a right to access justice in environmental matters. The right to access information is broad, does not require statement of interests, and can only be restricted under certain exceptions that need to be interpreted in a restrictive manner.[275] The Convention also guarantees the right of public participation in relation to three categories of decisions or procedures: legally binding normative instruments that may have a significant effect on the environment;[276] plans, programmes, and policies relating to the environment,[277] and

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State members to the UNECE to which their member States have transferred competence over matters governed by the Convention.

[272] *Ibid*, art 3(7).

[273] See: United Nations Treaty Series, Chapter XXVII Section 13, *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters*, online: UNTS <https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-13&chapter=27&clang=_en#1> (accessed 9 September 2022).

[274] Promulga el Acuerdo Regional sobre el Acceso a la Información, la Participación Pública y el Acceso a la Justicia en Asuntos Ambientales en América Latina y el Caribe y su Anexo 1, DS N° 209 de 2022 del Ministerio de Relaciones Exteriores [Promulgates the Regional Agreement on Access to Information, Public Participation and Access to Justice in Environmental Matters in Latin America and the Caribbean and its Annex 1].

[275] Aarhus Convention, *supra* note 269, art 4(4).

[276] *Ibid*, art 8.

[277] *Ibid*, art 7.

decisions for specific activities designated in Annex 1.[278] Annex 1 does not mention aquaculture explicitly. However, the Convention applies where public participation is provided for under an environmental impact assessment procedure in accordance with national legislation, which may be the case for aquaculture. Parties can also extend the obligations of the Aarhus Convention to projects not explicitly designated but that may have a significant effect on the environment.[279]

The Aarhus Convention also requires States to ensure access to a review procedure before a court of law or another independent and impartial body in cases where the right of access to information has been ignored or wrongfully refused, or to challenge the substantive or procedural legality of any environmental decision or the acts and omissions by private persons and public authorities which contravene provisions of its national law relating to the environment.[280] The procedures must provide adequate and effective remedies, including injunctive relief as appropriate, and be fair, equitable, timely and not prohibitively expensive.[281]

The Escazú Agreement similarly operationalizes the three pillars of Principle 10 in a manner similar to the Aarhus Convention, although reflecting regional circumstances.[282] Its text has been criticized as having less prescriptive language and leaving greater discretion to State Parties in its interpretation and implementation.[283]

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[278] *Ibid*, art 6. The most detailed standards for public participation apply to permit procedures, while the less strict standards apply to regulations and generally applicable normative instruments (Ebbesson, *supra* note 263, at 289.

[279] Aarhus Convention, *supra* note 269, art 6(1)(b).

[280] *Ibid*, art 9. The right to challenge environmental decisions is restricted to members of the public that have a sufficient interest or that maintain impairment of a right.

[281] *Ibid.*

[282] For example, the Escazú Agreement, *supra* note 270, considers special rights for "vulnerable persons", and establishes the obligation to protect environmental activists. It does also enshrine principles for the interpretation and implementation of the Agreement, including the principle of non-regression. See also: Stephen Stec & Jerzy Jendrośka, "The Escazú Agreement and the Regional Approach to Rio Principle 10: Process, Innovation, and Shortcomings" (2019) 31 J Envtl L 533; Gastón Médici Colombo, "El Acuerdo Escazú: La Implementación del Principio 10 de Río en América Latina y el Caribe" (2018) IX Revista Catalana de Dret Ambiental 1.

[283] Some identified shortcomings include: the vague definition of "environmental information"; the exceptions to the right to access environmental information are not defined in the Agreement and will be determined in domestic legislation, albeit subject to the principle of maximum disclosure (article 3 of the Agreement) and subject to American Convention on Human Rights as defined by the Inter-American Court of Human Rights (see Médici Colombo, *supra* note 282, at 35); the definition of "public" does only include persons that are nationals or that are subject to the national jurisdiction of the State Party (Escazú Agreement, *supra* note 270, art 2(d)). See also: Médici Colombo, *ibid,* and Stec & Jendrośka, *supra* note 282.

b) Rights of Indigenous Peoples

Another dimension of the connection between human rights law and environmental law is the consideration of rights and interests of Indigenous Peoples. Key international instruments include the binding Indigenous and Tribal Peoples Convention[284] adopted in 1989 (ratified by Chile and Norway) and the non-binding U.N. Declaration on the Rights of Indigenous Peoples (UNDRIP) adopted in 2007.[285] Norway, U.K. and Chile voted to adopt the Declaration; Canada endorsed it in 2016 and passed it into law in 2021.[286] While the Declaration itself is non-binding, its moral and policy influence cannot be underestimated. Its explicit objective is to recognize the minimum standards for the survival, dignity and well-being of the indigenous peoples of the world.[287] At least some of the rights enshrined in the declaration may have achieved status of customary international law.[288]

Both documents address several aspects of the relationship between States and Indigenous Peoples, including: individual and collective rights to fundamental freedoms and human rights; the right to be free from discrimination; the right to self-determination; the right to redress for the taking of physical property such as land and also cultural, intellectual, religious or spiritual property; the right to autonomy and self-government in internal and local affairs; and cultural rights in political, social and economic areas. States are obliged to respect treaties and agreements, and to consult and cooperate in good faith with the Indigenous Peoples in order to obtain their free, prior and informed consent before implementing legislation or administrative measures that may affect them.

Particularly important for aquaculture development is the recognition of the fundamental relationship between Indigenous Peoples, their culture, and their

[284] International Labor Organization (ILO) *Convention No 169 concerning Indigenous and Tribal Peoples in independent countrie*s, 27 June 1989, 1650 UNTS 383 (entered into force 5 September 1991) [ILO 169]. The ILO 169 Convention only has 24 ratifications. These include Chile and Norway.

[285] *United Nations Declaration on the Rights of Indigenous People*, Annex to Resolution 61/295 adopted by the United Nations General Assembly on 13 September 2007, A/RES/61/295 (2 October 2007) [hereinafter UNDRIP].

[286] In June 2021, UNDRIP received Royal Assent and came into force (SC 2021, c 14).

[287] UNDRIP, *supra* note 285, art 43.

[288] Russel Lawrence Barsh, "Indigenous Peoples", in Daniel Bodansky, Jutta Brunnée & Ellen Hey, *The Oxford Handbook of International Environmental Law* (New York: Oxford University Press, 2017) 829 at 841. Barsh refers in particular to recognition of land rights, protection from environmental degradation, and the right of Indigenous Peoples to participate in decisions that affect them. With respect to participatory rights, see also: Duvic-Paoli, *supra* note 267, citing in particular the jurisprudence of the Inter-American Commission of Human Rights.

environment.[289] This relationship is the basis for the recognition of several interconnected Indigenous People's rights: to the land, territories and resources that they have traditionally owned, occupied or otherwise used or acquired;[290] to the conservation and protection of the environment and productive capacity of their land or territories and resources; [291] to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures;[292] and to determine and develop priorities and strategies for the development or use of their lands or territories and other resources.[293] Consequently,

> States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources.[294]

Article 32 further requires States to provide effective mechanisms for just and fair redress for any such activities, and appropriate measures shall be taken to mitigate adverse environmental, economic, social, cultural, or spiritual impact.

5.5. Regional Agreements

Together with global multilateral agreements, several regional agreements either directly address aquaculture or, more frequently, address subject-matters relevant for aquaculture planning and management. Generally, these agreements take the form of regional networks for aquaculture development,[295] regional fishery bodies,[296] or regional

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[289] UNDRIP, *supra* note 285, art 25; ILO 169, *supra* note 284, art 13; Barsh, *supra* note 288, at 834.
[290] UNDRIP, *supra* note 285, art 26; ILO 169, *supra* note 284, art 14.
[291] UNDRIP, *supra* note 285, art 29; see also: ILO 169, *supra* note 284, art 15.
[292] UNDRIP, *supra* note 285, art 31; ILO 169, *supra* note 284, eg art 27.
[293] UNDRIP, *supra* note 285; ILO 169, *supra* note 284, art 7.
[294] UNDRIP, *supra* note 285, art 32(2). Article 19 adds a general consultation obligation: States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them. See also: ILO 169, *supra* note 284, art 6.
[295] Five network organizations have been established to promote sustainable development of aquaculture. These include: the Network of Aquaculture Centres in Asia (NACA); the Aquaculture Network of the Americas (RAA); the Micronesian Association for Sustainable Aquaculture (MASA); the Aquaculture Network for Africa (ANAF); and the Network of Aquaculture Centres in Central and Eastern Europe (FAO, *The 2030 Agenda and the Sustainable Development Goals: The challenge for aquaculture development and management*, by John Hambrey, FAO Fisheries and Aquaculture Circular No 1141

agreements for the protection of the marine environment. Considering their relevance for this Dissertation, the developments under three regional organizations will be addressed here. These are: the North Atlantic Salmon Conservation Organization (NASCO); the OSPAR Commission; and the International Council for the Exploration of the Sea (ICES).

5.5.1. The North Atlantic Salmon Conservation Organization

The North Atlantic Salmon Conservation Organization (NASCO) was established in 1984 with the objective of contributing "through consultation and co-operation to the conservation, restoration, enhancement and rational management of salmon stocks subject to [the] Convention, taking into account the best scientific evidence available to it."[297] The organization consists of a Council, three regional Commissions (North American Commission, West Greenland Commission and North-East Atlantic Commission), and a Secretariat. Seven States are Contracting Parties to NASCO, including Canada, Norway, U.K. and the European Union.

While the original scope of NASCO's activity focused on cooperation for the rational management of wild anadromous salmonids according to article 66 of the LOSC, the State Parties recognized that the status of Atlantic salmon was also affected by other

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(Rome: FAO, 2017); Pedro Bueno et al, "Micronesian Association for Sustainable Aquaculture established" FAO Aquaculture Newsletter 54 (March 2016) 24-25). NACA was the first and remains the most active of the regional networks. With FAO, it has developed important policy instruments for aquaculture, including codes of practice, policy declarations and guidelines, certification guidelines, and technical and policy briefs. The only network that has the potential of being relevant for this Dissertation is the Aquaculture Network of the Americas, established by the *Convención para el Establecimiento de la Red de Acuicultura de las Américas*, signed on 18 April 2012, online: UNEP <https://leap.unep.org/sites/default/files/legislation/mul-129193.pdf> (accessed 27 December 2021) which Chile as one participating member. However, the Network has not been active in recent years (Comisión de Pesca Continental y Acuicultura para América Latina y el Caribe, XV reunión, Ciudad de Panamá, Panamá, 22-24 enero 2018, FAORLC COPESCAALC-XV-4, online: FAO <https://www.fao.org/3/I8415ES/i8415es.pdf> (accessed 27 December 2021)).

[296] Regional fishery bodies are multilateral bodies through which States cooperate in the management of fisheries in a defined region encompassing (shared) inland waters, territorial seas, exclusive economic zones, or areas beyond national jurisdiction. Some regional fishery bodies have a mandate to adopt binding management measures, while others have only an advisory and coordinating role. Some of these agreements, mostly advisory bodies address aquaculture to some extent (Terje Løbach et al, *Regional fisheries management organizations and advisory bodies. Activities and developments, 2000–2017*. FAO Fisheries and Aquaculture Technical Paper No 651 (Rome: FAO, 2020, online: FAO <https://doi.org/10.4060/ ca7843en>).

[297] *Convention on the Conservation of Salmon in the North Atlantic Ocean,* 2 March 1982, 1338 UNTS 33 (entered into force 1 October 1983) [hereinafter NASCO Convention], art 3(2).

human activities, including aquaculture. With this premise and based on the broad interpretation of the objective of the convention (conservation, restoration and enhancement of wild salmon stocks),[298] NASCO has broadened its scope of action to include a wide range of issues affecting Atlantic salmon conservation, including the harmful biological and genetic interactions between farmed and wild salmon.[299]

A key policy outcome of this work is the Williamsburg Resolution adopted in 2003 and amended in 2004 and 2006. The resolution provides a framework for the parties to NASCO to cooperate to "minimise impacts from aquaculture, introductions and transfers, and transgenics on the wild salmon stocks".[300] It includes, as annexes, previous guidelines adopted by NASCO on Containment of Farmed Salmon, on Stocking Atlantic Salmon, and on Action on Transgenic Salmonids. In 2009, NASCO adopted a "Guidance on Best Management Practices to address impacts of sea lice and escaped farmed salmon on wild salmon stocks",[301] which further supplements the Williamsburg Resolution.

The Williamsburg resolution makes an explicit reference to the precautionary approach for the management of aquaculture activities.[302] The precautionary approach is explicitly linked to the reversal of burden of proof: the applicant of an aquaculture activity should provide all information necessary to prove that the activity will not have a significant adverse impact on wild salmon stocks or lead to irreversible change.[303] It is

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[298] Irene Dahl, "Regional approaches to aquaculture and a case study of the North Atlantic Salmon Conservation Organization" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016) 103 at 118.

[299] The work was facilitated by consultation with the salmon industry, later formalized in a Liaison Group formed in 2000. Additionally, NASCO requests scientific advice from ICES. It is important to note that aquaculture activities only fall within the mandate of NASCO insofar they negatively affect the conservation and restoration of wild salmon stocks. Other interactions between aquaculture and the environment or social systems are not addressed by NASCO.

[300] NASCO, "Resolution by the Parties to the Convention for the Conservation of Salmon in the North Atlantic Ocean to Minimise Impacts from Aquaculture, Introductions and Transfers, and Transgenics on the Wild Salmon Stocks" (the Williamsburg Resolution), adopted at the Twentieth Annual Meeting of NASCO in June 2003 and amended at the Twenty-First Annual Meeting of NASCO in June 2004 and at the Twenty-Third Annual Meeting of NASCO in June 2006, CNL(06) 48.

[301] NASCO, "Guidance on Best Management Practices to address impacts of sea lice and escaped farmed salmon on wild salmon stocks" (adopted in June 2009 and revised in June 2010), SLG(09)5. See also: NASCO, "Explanations of Terms Used in the Guidance on Best Management Practices to Address Impacts of Sea Lice and Escaped Farmed Salmon on Wild Salmon Stocks" (adopted in June 2010), SLG(10)9.

[302] Williamsburg Resolution, *supra* note 300, preamble, para 3, arts 3 and 4. This is consistent with NASCO commitment to implementing the precautionary approach in their work (NASCO, "Agreement on Adoption of a Precautionary Approach" (CNL(98)46)).

[303] Williamsburg Resolution, *supra* note 300, art 3.

also linked to the development and application of appropriate risk assessment methodologies in considering the measures to be taken in accordance with the Resolution.[304]

The Williamsburg Resolution and the 2009 Guidance provide a framework of measures for marine aquaculture management,[305] specific international goals, and detailed monitoring requirements. Key action areas include the following:

a) River classification and zoning system for Atlantic salmon rivers.[306] Contracting Parties should classify their Atlantic salmon rivers according to the degree of human impact, for the purpose of undertaking risk assessments and developing management measures concerning aquaculture and introductions and transfers. They may also group neighbouring or biologically (or otherwise) similar river systems into complementary management zones, where appropriate.[307]

b) Siting of aquaculture activities. Aquaculture facilities should only be located where hydrographical, epidemiological, biological and ecological standards can be met. Risk-based site selection should consider in particular the risks of escapes and sea lice on wild salmon populations.[308]

c) Wild salmon protection areas. Parties should consider establishing wild salmon protection areas where salmon aquaculture is restricted or prohibited.

d) Aquaculture regions. Parties could consider establishing aquaculture regions, with coordination production and separated from similar regions by areas without aquaculture.

e) Species selection. The resolution considers a prohibition to introduce reproductively viable non-indigenous anadromous salmonids or their gametes in any Commission area. Movements of Atlantic salmon or their gametes originating from outside a Commission area should be prohibited. The North American Commission Protocols for the Introduction and Transfer of Salmonids specifies that reproductively viable strains of Atlantic salmon of European, including Icelandic, origin are not to be used in aquaculture in the North American Commission Area.

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[304] *Ibid*, art 4. Risk assessment is considered as "integral to the implementation of the Precautionary Approach" (*ibid*). The article further specified that the risk assessment should include identification of options and mitigation measures.
[305] The resolution also includes measures regarding stock enhancement programs.
[306] Williamsburg Resolution, *supra* note 300, art 8 and Annex 6.
[307] North America Commission, "Protocols for the Introduction and Transfer of Salmonids Summary of Protocols by Zone", NAC(94)14 Protocol, Appendix I to the Williamsburg Resolution. The Protocol establishes three Zones in North America, from less (Northern Areas) to more (Southern areas) intervened by humans. Rivers are classified as Class 1, 2 and 3. Although generally the Class corresponds to the Zone (i.e. Zone 1 has class 1 rivers), there are some exceptions that provide some operational flexibility. Zone-specific measures are considered in the protocol regarding aquaculture, stocking, commercial ranching, rehabilitation, and introduction and transfer of non-native species.
[308] NASCO, "Guidance on Best Management Practices", *supra* note 301.

f) Carrying capacity. Aquaculture production should be adapted to the holding capacity of an individual site and should not exceed density levels based on science and good husbandry practices.

g) Fish health management practices. Parties should adopt fish health protection practices in all steps in the aquaculture production process. If possible, different generations of salmon should be reared in separate facilities. Fallowing regime should be practised as a means of minimising outbreaks of disease and parasites.

h) Fish health surveillance. Procedures for early identification, detection of, and rapid response to outbreak of any new disease or parasitic infection should be established.

i) Epidemiological zones. Parties should designate epidemiological zones for serious diseases and parasites (including at least for viral haemorrhagic septicaemia, Infectious Haematopoietic Necrosis, Infectious Salmon Anaemia and the parasite *Gyrodratylus salaris*) and restrictions of movement of live salmonid and their eggs from infested zones to a zone free of that disease.

j) Sea lice management. Parties should adopt the following best management practices: area management, risk-based, integrated pest management programmes that meet jurisdictional targets for lice loads at the most vulnerable life-history stage of wild salmonids; single-year class stocking; fallowing; trigger levels appropriate for sea lice control; strategic timing, methods and levels of treatment to achieve the international goal and avoid lice resistance to treatment; lice control management programmes appropriate to the number of fish in the management area.[309]

k) Escapes. The Guidelines on Containment of Farm Salmon address, *inter alia:* site selection; equipment marking; cage, net and structures design, construction, and deployment; predator deterrence methods; regular preventative maintenance; appropriate farm management procedures; training; storm preparation; security; contingency plans; and report of escapes. Tagging, marking or inventory tracking systems coupled with river monitoring and recapture systems will be adopted "depending on local regulations and protocols".

l) Transgenic salmonids. NASCO has adopted a strong presumption against the use of transgenic salmonids. Parties should apply the Guidelines for Action on Transgenic Salmon, advise the NASCO Council of any proposal to permit the rearing of transgenic salmonids, and take all possible actions to ensure that the use of transgenic salmonids, in any part of the NASCO Convention Area, is confined to secure, self-contained, land-based facilities.[310]

Contracting Parties have committed to work towards specific international goals on containment and sea lice in the 2009 Guidance on Best Management Practices. These goals are: for 100% of farms to have effective sea lice management such that there is no

[309] *Ibid.*
[310] NASCO, "Guidelines for Action on Transgenic Salmonids", CNL(04)41, in Williamsburg Resolution, *supra* note 300, Annex 5.

increase in sea lice loads or lice-induced mortality of wild salmonids attributable to the farms, and for 100% farmed fish to be retained in all production facilities.[311]

An aspect that deserves consideration is the legal status of the resolutions adopted by NASCO addressing aquaculture and its interactions with wild salmon. Considering the shortcomings of the Convention noted elsewhere,[312] the answer to this question is not straightforward. The decision-making authority of NASCO (including the Council and its Commissions) is not clearly laid out in the Convention.[313] It is clear that the Council, at the request of a Commission, can make recommendations on regulatory measures referred to in articles 7(1)(b) and (c) and article 8(b) and that these regulatory measures are binding to the members of that Commission, subject to an objection procedure.[314] The regulatory measures addressed in the cited articles refer to fishing in the area of fisheries jurisdiction of a member of salmon originating in the rivers of other Parties. In the case of other decisions, the Council can make "recommendations"[315] but the legal status of this recommendations is not clear in the text.[316] Considering that these recommendations were explicitly not included under the objection procedure of art 13, it must be concluded that these are non-binding.[317] This soft law nature is also reflected in the language of the relevant decisions, which contain broad and qualified obligations.

This interpretation is not shared by all scholars. Dahl, in analyzing the legal status of the Williamsburg Resolution, argues that the resolution can be considered an authoritative interpretation of the articles of the Convention and therefore, at least parts of it may be binding.[318] She considers, in particular, the language of the Williamsburg resolution and its use of binding legal expressions such as "shall" in some, but not all, of its provisions. The Resolution explicitly states that its content must be considered a

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[311] NASCO, "Guidance on Best Management Practices", *supra* note 301.
[312] NASCO, "External Performance Review", CNL(12)11, online: NASCO <https://nasco.int/wp-content/uploads/2020/02/cnl_12_11.pdf> (accessed 10 December 2022).
[313] *Ibid*, at 38.
[314] NASCO Convention, *supra* note 297, arts 4, 7, 8, and 13.
[315] In practice, they are termed resolutions, recommendations, agreements or guidelines. See, for example: Williamsburg Resolution, *supra* note 300, Annex II-IV. See also NASCO, External Review, *supra* note 312, at 38, and Dahl, *supra* note 298, at 127.
[316] NASCO, External Review, *supra* note 312, at 51
[317] *Ibid*. Additionally, since aquaculture is a subject matter under national sovereignty, the mandate and process for an international organization to adopt binding decisions should be clearly established in the constituent agreement. That is not the case for NASCO.
[318] Dahl, *supra* note 298, at 129-130.

minimum standard for contracting parties;[319] and includes an obligation for parties to submit annual reports with the measures adopted and actions taken under specific provisions of the resolution.[320]

Even though NASCO recommendations on aquaculture are non-binding, it is clear that they represent strong international commitments subject to review and accountability mechanisms akin to managerial and reputational models for compliance with international obligations.[321] While it is "up for the Parties and jurisdictions to identify and implement appropriate measures",[322] NASCO requires demonstrable (and quantitative) progress towards those goals. Parties must submit implementation plans and annual reports detailing the measures taken.[323] Implementation plans and annual reports are subject to a critical review by a Review Group appointed by the Council.[324]

Despite these efforts to provide the NASCO recommendations with some teeth, the record of implementation is unsatisfactory. Parties (including States assessed in this Dissertation) have not achieved the international commitments nor have they develop action plans that will move them towards achieving their commitments.[325] In light of the failures of the Parties to demonstrate progress and the deteriorating condition of wild Atlantic salmon, in their last meeting in 2022 the Council adopted a statement urging: the development of innovative salmon farming technologies both at sea and on land; the use of such technologies, or the use of equally effective alternative approaches, where they provide additional environmental protections; and prioritize this approach initially in

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[319] Williamsburg Resolution, *supra* note 300, art 10.
[320] *Ibid*, with reference to articles 5 (measures to minimise impacts of aquaculture and introductions and transfers), 6 (non-indigenous fish), 7 (transgenic salmonids) and 9 (mitigation and corrective measures).
[321] See: Andrew T Guzman, "A Compliance-Based Theory of International Law" (2002) 90 Cal L Rev 1823.
[322] See, eg: NASCO, "Report on Progress in Implementing the 'Action Plan for taking forward the recommendations of the External Performance Review and the review of the 'Next Steps' for NASCO", CNL(13)38, CNL(19)17, section 2.8 at 33.
[323] NASCO, "Implementation Plans and Annual Progress Reports", online: NASCO <https://nasco.int/conservation/implementation-plans-and-reporting/> (accessed 28 December 2021).
[324] NASCO, "Guidelines for the Preparation and Evaluation of NASCO Implementation Plans and for Reporting on Progress", CNL(12)44, para 2.2-2.7.
[325] John Campbell et al, "Minimising Impacts of Salmon Farming on Wild Atlantic Salmon: Supporting Meaningful and More Rapid Progress Towards Achievement of the International Goals for Sea Lice and Containment", A Report of a Theme-based Special Session of the Council of NASCO (27 May 2021), online: NASCO <https://nasco.int/conservation/theme-based-special-sessions/> (accessed 8 December 2022).

sensitive areas, estuaries of pristine rivers, and along salmon migratory routes.[326] Balancing the interests of salmon farming, the statement recognizes the importance of wild and farmed Atlantic salmon in coastal and rural areas and of the careful continuance and development of farming practices.[327]

5.5.2. The OSPAR Commission

The *Convention for the Protection of the Marine Environment of the North-East Atlantic* (the "OSPAR Convention") has its origin in the 1972 Oslo Convention on Dumping and in the 1974 Paris Convention addressing land-based and offshore industry pollution. In 1992, both Conventions were unified, updated and expanded in the OSPAR Convention. In 1998, the Commission adopted an Annex to the Convention that broadened its mandate to address the protection of marine biodiversity and ecosystems from non-polluting human activities. The Convention has been ratified by 15 contracting Parties (including U.K. and Norway) and the EU.

Marine aquaculture is one human activity with potential to impact the marine environment, and therefore it has been "on the radar" of the OSPAR Commission. OSPAR has produced some reports on aquaculture impacts, with the most comprehensive released in 2009.[328] The Assessment called for continued exchange of information and review of a number of far field impacts: the introduction of alien species; impacts of sea lice; ecological and genetic impacts of escaped fish; and increased demand for industrial fisheries products. The Assessment concluded, however, that there was no need for additional programmes and measures at the OSPAR level. This conclusion was based on the site-specific impacts of aquaculture that commands a case-by-case approach to regulation and control, and the substantial amount of general guidance already available to support those decisions.

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[326] NASCO, "Statement on Salmon Farming from the Council of the North Atlantic Salmon Conservation Organization", CNL(22)49, online: NASCO <https://nasco.int/annual-meeting/thirty-ninth-annual-meeting-2022/#annual-reports-of-the-council-of-nasco> (accessed 9 December 2022). Pristine estuaries (Class I rivers) are generally located in the Northern range of distribution (see Williamsburg Resolution, *supra* note 300).

[327] *Ibid.*

[328] OSPAR Commission, "Assessment of Impacts of Mariculture", Biodiversity Series (2009), online: OSPAR <https://qsr2010.ospar.org/media/assessments/p00442_Impacts_of_Mariculture.pdf>.

Aquaculture has been addressed by OSPAR in the context of the Quality Status Reports, including the Quality Status Reports of 2010[329] and the 2021 Feeder Report on Aquaculture[330] prepared for the Quality Status Report scheduled for 2023. The Reports highlight the wider impacts of aquaculture on OSPAR eco-regions, including spread of non-indigenous species, transfer of parasites and diseases (in particular sea lice), genetic interaction between farmed fish and wild stocks, and dependence on industrial catches of wild fish for feed. They also mention concerns on eutrophication, competitions between escapees and wild stocks, release of chemicals, displacement of fauna, and litter.[331]

The Reports consider that site-specific decisions on location and management of aquaculture are the primary measures for addressing the environmental impacts of aquaculture.[332] Noting the advances in scientific knowledge in the last decades, the Feeding Report calls for OSPAR to increase its understanding in some key areas, in particular in light of the growth ambition of the sector in the OSPAR area (mainly Norway). These key areas include spatial planning, the risk of spread of non-indigenous species or parasites, and contamination of water with hazardous substances, pharmaceuticals, or nutrients. It also recommends that consideration be given to new or expanded forms of aquaculture, including offshore aquaculture, recirculating aquaculture systems and new species.[333]

Few aquaculture-specific guidelines or recommendations have been issued by OSPAR. The organization oversees the PARCOM Recommendation 94/6 on Best Environmental Practice (BEP) for the Reduction of Inputs of Potentially Toxic Chemicals from Aquaculture Use.[334] It has further adopted Guidelines for reporting of nitrogen and phosphorus discharges/losses from aquaculture plants.[335] Several non-sectoral plans and

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[329] OSPAR, *Quality Status Report 2010* (London: OSPAR Commission, 2010), online: OSPAR https://qsr2010.ospar.org/en/index.html> (accessed 3 March 2023).
[330] OSPAR, "Feeder Report 2021: Aquaculture", online: OSPAR <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/other-assessments/> (accessed 3 March 2023).
[331] See: OSPAR, Quality Status Report 2010, *supra* note 329, in particular 87-88, 116, 118-119; OSPAR, Feeder Report 2021, *supra* note 330, para 5.1.
[332] OSPAR, Feeder Report 2021, *supra* note 330.
[333] *Ibid*, para 7.1.
[334] Reporting under the PARCOM Recommendation was suspended between 2006 and 2020.
[335] OSPAR, "Guidelines for Harmonised Quantification and Reporting Procedures for Nutrients" (HARP-NUT). Guideline 2: Quantification and Reporting of Nitrogen and Phosphorus Discharges/losses from Aquaculture Plants (2004, revised in 2018), online: NASCO <https://www.ospar.org/convention/agreements?q=aquaculture&t=&a=&s=> (accessed 3 March 2023).

guidelines may be relevant for aquaculture development and management. Examples include: Agreement 2008-6 including Atlantic salmon in the OSPAR List of Threatened and/or Declining Species and Habitats; Recommendation 2016/03 on furthering the protection and conservation of the Atlantic salmon (*Salmo salar*) in Regions I, II, III and IV of the OSPAR Maritime Area; and the 2014 Regional Action Plan on Marine Litter.[336]

5.5.3. International Council for the Exploration of the Seas

The International Council for the Exploration of the Seas (ICES) is an intergovernmental marine science organization established in 1902 by an exchange of letters and later formalized in the 1964 *Convention for the International Council for the Exploration of the Sea*. Its purpose is to promote, encourage and draw up programmes for the study of the Atlantic Ocean and adjacent seas, with a primary concern for the North Atlantic.[337] Today, it comprises 20 member States (including Norway, U.K. and Canada) and, through strategic partnerships, has extended its work to the Arctic, the Mediterranean Sea, the Black Sea, and the North Pacific Ocean.[338]

ICES has been involved in aquaculture research for several years. Aquaculture is included under four of the seven priorities of the current science plan: seafood production, impacts of human activities, conservation and management science, and sea and society.[339] Specific research tasks include, among others: assess aquaculture production potential and carrying capacity; development of scenarios; methods of risk and benefit assessments; assessment of interactions between aquaculture and the environment; development of aquaculture overviews; and the wider role of seafood production in society. These and other tasks are addressed by several working groups or expert groups under an aquaculture steering group.[340]

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[336] OSPAR, Feeder Report, *supra* note 330, paras 6.4-6.5.
[337] *Convention for the International Council for the Exploration of the Sea*, 12 September 1964, 652 UNTS 237, 7 ILM 302 (entered into force 22 July 1968), arts 1, 2.
[338] Online: ICES <https://www.ices.dk/about-ICES/who-we-are/Pages/Who-we-are.aspx/>.
[339] ICES, "Science Plan" (Copenhagen: ICES, 2009), online: ICES <http://doi.org/10.17895/ices.pub.5469>. Other priorities are also indirectly relevant: ecosystem science, observation and exploration, and emerging techniques and technologies.
[340] These are the existing working groups: Application of Genetics in Fisheries and Aquaculture; Ecological Carrying Capacity in Aquaculture; Open Ocean Aquaculture; Risk Assessment of Environmental Interactions of Aquaculture; Scenario Planning in Aquaculture; Pathology and Diseases of Marine Organisms; Social and Economic Dimensions of Aquaculture.

Although the role of ICES is to provide scientific advice at the request of Members, it has also engaged in the development of standards for aquaculture. In 1973, it adopted (in collaboration with FAO) the first version of an internationally recognized code of practice for the introduction and transfers of marine organisms. The first version was modified several times with a last version adopted in 2005.[341] Although the Code was initially designed for ICES member countries, all countries are encouraged to implement it.[342]

The Code follows the precautionary approach, consistent with the FAO Guidelines on Precautionary Approach to Capture Fisheries and Species Introductions.[343] The main provisions require early notification of introduction of transfers of species to the ICES Council for comments or recommendations; a risk assessment before introduction (including expected ecological, genetic and disease impacts and economic assessments); inspection of health status of the marine organisms; and monitoring programs. The Code also contains specific requirements for species that are not part of current commercial practice. In this case, a pilot phase with limited scale introduction into open waters is required in order to assess ecological interactions with native species and to test the risk assessment assumptions.

Stricter measures are recommended for GMOs and polyploid species. These include experiments in simulated natural environments to assess phenotypic traits, behaviour, competitive advantages/disadvantages, reproductive potential, performance and success, and relative fitness of juveniles resulting from crosses. In the case of polyploids, the evaluation of the sterility of the organisms and population is recommended generally and for non-native species in particular.

5.6.Concluding Remarks

This chapter has addressed international obligations, responsibilities and associated guidelines relevant for aquaculture planning and management. The purpose of this last section is to make some general remarks about its content, to draw linkages with previous

[341] ICES, "Code of Practice on the Introductions and Transfers of Marine Organisms 2005", online: ICES <https://www.nobanis.org/globalassets/ices-code-of-practice.pdf>.
[342] See also: *supra* note 139 and accompanying text.
[343] FAO, *Precautionary Approach to Fisheries. Part I: Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions*. FAO Fisheries Technical Paper 350 (Rome: FAO, 1995).

chapters, and to lay out its contribution towards the comparative analysis of aquaculture regulatory frameworks.

5.6.1. The Fragmentation of International Law and Policy

As noted in Chapter 4, no international binding agreement addresses marine aquaculture. Rather, a fragmented array of multilateral and regional non-sectoral agreements lay out substantive or procedural obligations that need to be considered during environmental (and aquaculture) planning and management. Fragmentation results not only from the different subject-matters bearing on aquaculture management, but also the geographical scope of some agreements and the status of their ratification. Thus, while some obligations are global and universal (e.g. the obligations for marine environmental protection under the LOSC; the obligation to not cause transboundary harm in customary international law), others bind only a limited number of ratifying States (e.g. the Cartagena Protocol; the Aarhus Convention) or apply only within a specific geographical region (e.g. NASCO). Fragmentation of international environmental law is not unique to aquaculture, though, and has been considered a key challenge for effective and comprehensive environmental protection.[344] It also mirrors the challenges of environmental fragmentation at the domestic level discussed in Chapter 3. Fragmentation of international law, as fragmentation of domestic law, represents a barrier for the implementation of an EAA.

Although the EA is mostly not recognized explicitly in internationally binding instruments, there is a discernable trend towards holistic (or integrative) approaches to marine environmental protection and natural resources management. These approaches recognize ecosystems, encompassing all their living and non-living components, including humans, and their interrelationships, as an object of legal concern.

Holistic approaches are included in the LOSC, although to a limited extent as the Convention follows a sectoral and zonal approach to ocean management. In its Preamble, the Convention recognizes "that the problems of ocean space are closely interrelated and need to be considered as a whole". Article 192, in turn, enshrines a broad duty to protect

[344] UN, *Gaps in international environmental law and environment-related instruments: towards a global pact for the environment*, Report of the Secretary-General, A/73/419 (30 November 2018).

the marine environment, encompassing living and non-living components of the marine system. Part XII provides a comprehensive set of rules for the protection and preservation of the marine environment. Despite the integrative nature of these obligations, other international and regional instruments complement these broad obligations with rules and standards applicable to specific activities or regions, contributing to fragmentation.[345]

The clearest shift towards an integrated or holistic approach to environmental protection and natural resources management is the CBD. The CBD recognizes all ecosystems (and its components) as a subject of international law. It also seeks to balance conservation and sustainable use of biological resources, therefore departing from the dual perspective of traditional environmental management that views nature either for preservation in its natural state, or for exploitation of valuable resources (as discussed in Chapter 3). Further, the CBD and other international instruments focus on the social component of the social-ecological systems.

It is still an open question whether international law recognizes EA as a general principle of international law or customary international law. Arguably, part of the uncertainty derives from the complexity and multi-dimensional nature of the EA. Yet it seems unquestionable that international law has increasingly endorsed integrative approaches and ecosystem perspectives to management.[346] Further, some of the elements of EA (including some of the law and policy coordinates identified in Chapters 2 and 3) are more precisely recognized in international instruments. I turn to the content of these obligations next.

5.6.2. The Content of International Law and Policy for Aquaculture

The analysis in this chapter allows a conclusion that the international framework for aquaculture comprises two elements. The first element is broad, often qualified substantive and procedural duties that leave coastal States with a wide margin of discretion for their implementation. The second is voluntary guidelines (soft law)

[345] *Ibid*, para 107 at 44.
[346] See, eg Alexander Gillespie, "Ethical Considerations" in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 217, at 229-231.

delineating more specific best management practices or approaches.[347] These substantive and procedural obligations or recommendations enshrined in international binding and non-binding instruments reflect some of the law and policy coordinates enabling an EA identified in Chapters 2 and 3.

Relevant substantive obligations addressing ecological concerns include: (a) the protection of the marine environment; (b) the conservation and sustainable use of marine biodiversity; (c) the protection of rare or fragile ecosystems and habitats of depleted, threatened, or endangered species and other forms of marine life; (d) the prevention, reduction and control of pollution from all sources; (e) the prevention, reduction, and control of the intentional or accidental introduction of alien or new species; and (e) the prevention of transboundary impacts of aquaculture. These obligations are broad and generally qualified, and therefore a weak definition of the substantive or "hard" rules required to protect ecosystem integrity. More specific obligations have been agreed in a regional setting. In particular, the international commitments for sea lice and escape management under NASCO are specific, detailed, and outcome-oriented (Chapter 3) yet non-binding.

Procedural obligations, although more precise in their content, are also generally qualified. The obligation to undertake environmental impact assessment and the continuing monitoring of the effects of activities that are likely to impact the marine environment or biodiversity are qualified obligations under the LOSC and CBD. The CBD also contains a qualified obligation for the assessment of environmental consequences of programs and policies that are likely to have significant adverse impacts on biological diversity (SEA). These procedural obligations support the comprehensive and holistic assessment of the impacts of proposed activities within the wider social and ecological system, consistent with the EA. They also support the continuous and adaptive management of harmful impacts in the context of uncertainty and change (Chapters 2 and 3).

[347] In the context of the preparatory work for the development of Sustainable Aquaculture Guidelines, FAO and an expert consultation prepared a document with a list of FAO guidelines and documents as well as additional resources (FAO, *Draft Report of the Expert Consultation on the Development of Sustainable Aquaculture Guidelines* (Rome, Italy, 17-20 June 2019), Appendix 6: List of Thematic Modules and Guidelines, COFI:AQ/X/2019/Inf.8).

Access to information, public participation in environmental decision-making, and access to justice are obligations under regional agreements, as well as principles of international environmental law recognized in the Rio Declaration. Specific obligations for consultation with Indigenous Peoples, and to obtain their free and informed consent prior to the approval of any project affecting their lands, territories or resources, are laid out in international agreements and declarations. These procedural rights are an integral component of the EA understood as a "social process": a transparent, participatory and decentralized process for balancing diverse societal objectives at the ecosystem level (Chapter 3).

In addition to binding obligations, international law and policy also recognize environmental principles that provide flexible guidance for discretionary decision-making. Principles include: prevention, precaution, evidence-based decision-making, and public participation.

Finally, voluntary guidelines analyzed in this chapter provide more detailed best management practices to specific management problems (including fish health management, the introduction and transfer of fish, and genetic resource management) or at the regional level (e.g. NASCO). Specific regulatory and management tools are identified, including: zoning, spatial planning and site selection; carrying capacity assessments; and risk analysis. These are consistent with tools for implementing EAA identified in Chapter 2.

5.6.3. The Need for an International Agreement for Aquaculture

While the previous sections noted that the international legal framework for aquaculture is fragmented and consisting of broad environmental duties coupled with voluntary (soft law) guidelines, the question that follows is whether the structure and content of the international framework addressing aquaculture should be strengthened with an international binding agreement on aquaculture.

A starting point to this discussion is the acknowledgement that current aquaculture, including salmon farming, is conducted in areas under States' sovereignty. While sovereignty is subject to limitations under international law concerning the protection of the environment, this law focuses on concerns with an international

dimension: transboundary damage, exploitation of resources that are shared between two or more States, the use and protection of areas beyond national jurisdiction, as well as managing environmental problems of global relevance.[348] Whether an issue is of "global relevance" will need to be decided by consensus of the community of States.[349] Further, international law is appropriate only when the problem "can only be solved efficiently on an international rather than national level."[350] In commenting on the content of international law, Wiersema notes that "the broader in scope a treaty is, the softer its obligations are likely to be, and the more a treaty focuses on internal land use, the more deference it will give to national sovereignty."[351]

Considering these principles to assess the need for, and the feasibility of, an international agreement, the scope for the negotiation of an agreement addressing aquaculture appear rather limited. First, the effects of aquaculture are mostly local or regional, rather than international. Second, the diversity of aquaculture activities in terms of species, system, and scale likely implies that an international agreement could only include broad rules, adding little to the current framework.[352] Additionally, a new international agreement on aquaculture undertaken in areas under national jurisdiction will likely face little support from States.[353]

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[348] Rüdiger Wolfrum, "Purposes and Principles of International Environmental Law" (1990) 33 German YB Int'l L 308 at 308-309.
[349] *Ibid*, at 328.
[350] *Ibid*, at 308.
[351] Annecoos Wiersema, "Wildlife" in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 554, at 567.
[352] In answering this same question, the panelist of the Second Hamburg International Environmental Law Conference held in Hamburg in 2013 were reluctant to accept the need for international agreement on aquaculture (Proceedings published in Hans-Joachim Koch et al, *Legal Regimes for Environmental Protection: Governance for Climate Change and Ocean Resources* (Brill Nijhoff, 2015). See in particular chapter 16, Arndt Schmehl, "Discussion Summary Working Group: Mariculture", *ibid*, 270). Percy et al argue that inshore aquaculture (in internal waters and the territorial sea) "was always seen as a matter entirely within the national jurisdiction of the coastal state and posed few questions in international law" and argued that "it is unlikely that inshore mariculture will often have sufficient international dimensions to conflict with international obligations of this nature" (David R Percy, Nathanael Hishamunda & Blaise Kuemlangan, "Governance in marine aquaculture: the legal dimension" in A Lovatelli, J Aguilar-Manjarrez and D Soto (eds), *Expanding mariculture farther offshore: technical, environmental, spatial and governance challenges*. FAO Technical Workshop, 22–25 March 2010, Orbetello, Italy. FAO Fisheries and Aquaculture Proceedings No 24, 245 (Rome: FAO, 2013) at 246-247). See also: Irene Dahl, "Adaptation of Aquaculture to Climate Change: The Relevance of Temporal International Framework from a Norwegian Perspective" in Elise Johansen, Signe Veierud Busch & Ingvild Ulrikke Jakobsen, *The Law of the Sea and Climate Change: Solutions and Constraints* 289 (Cambridge: Cambridge University Press, 2021) at 289.
[353] Percy, Hishamunda & Kuemlangan, *supra* note 352, at 259.

A few aquaculture issues that have a global dimension have been highlighted as in potential need of international rules. These include: food safety, sustainable sourcing of fish meal and fish oil,[354] adaptation to climate change,[355] and a more general appeal to "minimise competition by a 'race to the bottom' of environmental standards and that will also provide a fair distribution of the use of environmental resources for mariculture purposes".[356]

It can be argued, however, that all those aspects have already been addressed by international law, although to the extent to which the international community is prepared to bound States' sovereignty. For example, food safety is addressed through the Codex Alimentarius, which has a strong enforcement mechanism in international trade law. The legal framework for adaptation to climate change has been set, most recently and comprehensively, in the Paris Agreement[357] through flexible mechanisms deemed more appropriate to achieve global goals. For some of the other issues raised, practical and flexible instruments to achieve environmental outcomes may be preferred, including mechanisms that involve the private companies directly (e.g. sustainability certification).

The above comments deserve some qualifications. First, while an international agreement on aquaculture may be inefficient and impractical, there is space for regional or bilateral agreements to address issues of common concern. One of these concerns is the protection of threatened wild Atlantic salmon. Second, specific issues of global concern are more likely to be considered for a binding agreement. For example, States could agree on a prohibition to cultivate genetically modified organisms in open waters (a measure that is already enshrined in voluntary guidelines). Third, if aquaculture operations prove technically and economically viable in the high seas, these activities are

[354] Schmehl, *supra* note 352.
[355] Dahl, *supra* note 352, at 308, based on the international interest in an adaptive aquaculture.
[356] Schmehl, *supra* note 352, at 272. Bermúdez appears to favor an international approach to regulation by stating that "there is no international binding regulation that addresses the problems and challenges of mariculture in an appropriate manner. The incorporation of an international perspective on mariculture regulations is essential to assure the sustainable development activity" (Jorge Bermúdez, "Mariculture and Environmental Protection: Problems and Regulatory Strategies" in Koch et al, *supra* note 352, 144 at 151).
[357] 12 December 2015, UN Doc FCCC/CP/2015/L.9/Rev/1 (Dec. 12, 2015), (entered into force 4 November 2016).

likely to require the development of international rules that address conflicts of use (e.g. navigation) and environmental protection (including decommissioning of structures).[358]

[358] See: Percy, Hishamunda & Kuemlangan, *supra* note 352, at 259. Percy et al identify three potential solutions to fill the regulatory gap for aquaculture in the high seas: the extension of States' regimes (which in their opinion provides only a partial solution to the problem); a new treaty (which they consider the best solution but also unrealistic), and the extension of competences of existing bodies, and in particular regional fishery management organizations. The latter solution seems questionable, considering the limited mandate of most of these organizations.

Table 3. **International Agreements: Ratification Status**

International Agreement	Abbreviation	Date of ratification/accession/acceptance[1]			
		Canada	Chile	Norway	UK
1982 *United Nations Convention on the Law of the Sea*	LOSC	7 Nov 2003	25 Aug 1997	24 Jun 1996	25 Jul 1997
Convention on Biological Diversity	CBD	4 Dec 1992	9 Sept 1994	9 Jul 1993	3 Jun 1994
Convention on the Conservation of Migratory Species of Wild Animals	CMS Convention		15 Sep 1981	30 May1985	23 Jul 1985
WTO *Agreement on Sanitary and Phytosanitary Measures*	SPS Agreement	30 Dec 1994	28 Dec 1994	7 Dec 1994	30 Dec 1994
Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters	Aarhus Convention			2 May 2003	23 Feb 2005
Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean	Escazú Agreement		13 Jun 2022		
Convention (No. 169) concerning indigenous and tribal peoples in independent countries	ILO 169		15 Sep 2008	19 Jun 1990	
Convention for the Conservation of Salmon in the North Atlantic Ocean	NASCO Convention	30 Sep 1983		20 May 1983	27 Nov 2020[2]
Convention for the Protection of the Marine Environment of the North-East Atlantic	OSPAR Convention			8 Sep 1995	15 Jul 1997
Convention for the International Council for the Exploration of the Sea	ICES Convention	22 Jul 1968		26 May 1965	4 May 1965
Cartagena Protocol on Biosafety to the Convention on Biological Diversity	Cartagena Protocol			10 May 2001	19 Nov 2003
Convention on Environmental Impact Assessment in a Transboundary Context	Espoo Convention	13 May1998		23 Jun 1993	10 Oct 1997
Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context	Kyiv Protocol			11 Oct 2007	

[1] The date of entry into force of the international agreements is included in the individual references in the main text and in the list of references.
[2] The NASCO Convention applied to United Kingdom by virtue of its membership to the European Union until on 31 January 2020.

CHAPTER 6. STATE PRACTICE: AQUACULTURE LEGAL FRAMEWORKS IN FOUR SALMON MARICULTURE JURISDICTIONS

The four sections in this chapter provide an overview of the legal frameworks for salmon mariculture in Nova Scotia (NS), Chile, Scotland, and Norway, respectively. Each section provides a general overview of the salmon industry and a general description of the legal, policy and institutional framework for salmon mariculture. This description includes the legal tools, processes, and criteria supporting decisions on where salmon farming can take place and how much salmon farming is allowed at a site and ecosystem level (if applicable), including through adaptive management processes. Further information is provided on three of the most important ecosystem impacts: escapes, sea lice, and emissions. The chapter also includes information about reported shortcomings of aquaculture legal frameworks and regulatory reform initiatives. As much as possible, each overview assesses the legal frameworks in a systematic manner to allow for easy comparison. However, due to legal and regulatory differences in each jurisdiction and for the sake of clarity, a strict template was not followed.

The chapter does not address all regulatory matters relevant for salmon mariculture licencing and management. Several technical elements of the salmon mariculture operations are subject to detailed regulations or guidelines, but have rather limited bearing on the main focus of the Dissertation. Elements excluded from the description include, *inter alia*: permit requirements for feed or medicinal products (including import requirements); fish health surveillance, therapeutic treatment, or biosecurity measures in case of a disease outbreak;[1] measures to assess and mitigate impacts on landscape;[2] or measures to minimize plastic debris or other waste.[3] Fees

[1] See, however, the international standards for fish health management described in Section 5.4.2 in Chapter 5.

[2] See eg: NatureScot (formerly Scottish Natural Heritage), "Guidance on Landscape/Seascape Capacity for Aquaculture" (2008); NatureScot, "The siting and design of aquaculture in the landscape: visual and landscape considerations" (2011); and NatureScot, "Visualisations for Aquaculture: Guidance Note" (February 2018), all documents online: Nature Scot <https://www.nature.scot/professional-advice/planning-and-development/planning-and-development-advice/marine-aquaculture> (accessed 11 March 2023).

[3] See, eg: Crown Estate Scotland, "Root and Branch Review of Aquaculture Leasing Complete" (25 January 2022) online: CES <https://www.crownestatescotland.com/news/root-and-branch-review-of-aquaculture-leasing-complete> (accessed 13 December 2022). Crown Estate Scotland will include, as a

associated to different permits or leases are, as a general rule, not considered either.[4] Further, while the content in this Chapter supports the comparative analysis in Chapter 7, some of the detailed discussion of key provisions will be addressed in that context. As will be explained, the legal frameworks for aquaculture are dynamic and evolving. The information provided in this chapter attempts to be accurate as of 31 October 2022.

6.1. Aquaculture Legal Framework in Nova Scotia

Marine aquaculture has a long history in the province dating back to 1867.[5] In 1875, a federal hatchery program was established to enhance wild salmon stocks for recreational fisheries. In 1969, the first commercial finfish farming site was authorized in Bras d'Ors Lake, Cape Breton, for the cultivation of trout. The first commercial harvest of farmed salmon occurred in 1984.

In 2021, NS produced 8,968 tonnes of Atlantic salmon and trout for a value of ca. 71 million dollars.[6] This represents 81% (in volume) and 86% (in value) of NS's aquaculture production.[7] The industry directly employed 181 full time workers and a total of 254 workers in 2021.[8] NS currently has 36 marine finfish licenses in 11 counties located mostly around Cape Breton Island[9] and in the Southern Shore.[10] There are two

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condition of leases and starting in January 2023, the obligation to submit a report with the measures adopted to manage plastic waste.

[4] The allocation of part of aquaculture fees to regional and local authorities in Chile and Norway is mentioned as an example of benefit sharing.

[5] See: Paul Kraly, "Evolution of Aquaculture in Nova Scotia", prepared for Aquaculture Association of Nova Scotia (31 May 2019), online: Seafarmers <https://seafarmers.ca/about-us/history-of-aquaculture-in-nova-scotia/> (accessed 14 March 2022).

[6] DFO, "Aquaculture Production and Value: Canadian Aquaculture Production 2021", online: DFO <https://www.dfo-mpo.gc.ca/stats/aqua/aqua-prod-eng.htm> (accessed 15 March 2023); NS, "Aquaculture Statistics", online: Nova Scotia Government <https://novascotia.ca/fish/aquaculture/economic-impact/> (accessed 8 January 2023). Salmon production includes mostly Atlantic salmon and a low percentage of Trout. Salmon production in 2020 was somewhat higher (11,710 tonnes and ca. 80 million dollar value).

[7] DFO, *supra* note 6; NS, *supra* note 6. Shellfish production includes mostly Blue mussels, and a smaller volume of American oysters, Bay Quahog, and Giant sea scallops.

[8] NSDFA, Aquaculture Statistics: Employment Statistics (online: NSDFA <https://novascotia.ca/fish/aquaculture/economic-impact/> (accessed 25 May 2022).

[9] Two Indigenous organizations (Waycobah First Nations Band Council and We'koqma'q First Nation) have 9 leases in Cape Breton Island.

[10] Counties with most sites include: Shelburne (7 sites), Digby (6 sites), Inverness (5 sites) and Yarmouth (5 sites). The most important operating companies are Kelly Cove Salmon Ltd. (a division of Cooke Aquaculture Inc., with 15 leases) and Ocean Trout Farms Inc (5 leases).

land-based salmon farms that grow salmon to market size.[11] Several new marine finfish sites are in different stages of the application process.[12]

The small scale of salmon farming in NS is explained in part by the relative scarcity of suitable sites in the province's marine waters[13] and in part by lack of social license.[14] Opposition to salmon farming has been clear and consistent over the years, with key environmental concerns being the impacts of open-net salmon farming on the threatened wild Atlantic salmon populations and impacts of the operations on the valuable lobster fishery.[15] Further, there is a wide-spread perception that the sector is not adequately regulated.[16] Key concerns include the fragmentation and lack of coordination and integration of aquaculture regulation, including vertical (federal/provincial) and horizontal (multi-sectoral) fragmentation; the lack of an appropriate legislative framework at the federal level; the broad discretion of decision-makers; and lack of transparency.

In 2013, the Government of NS introduced a moratorium for marine-based aquaculture and commissioned a review of the legal and regulatory framework for the

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[11] Sustainable Blue Inc has a land-based farm for its salmon product in Hants county (online: Sustainable Blue <https://www.sustainableblue.com/> (accessed 15 March 2022); Cape D'Or Sustainable Seafoods Inc has a land-based recirculating aquaculture system located in Cumberland county, see: Cape D'Or <http://capedor.co/> (accessed 29 July 2022).

[12] Canadian Salmon Limited (a division of the Norwegian company Haugland Gruppen) would be an important new operator with 4 new sites if the applications are granted. Information on current leases, licenses and applications under review was extracted from Department of Fisheries and Aquaculture (NS), online NS Government <https://novascotia.ca/fish/aquaculture/public-information/> (accessed 18 May 2022).

[13] John Phyne, "Along the Coast and in the State: Aquaculture and Politics in Nova Scotia and New Brunswick" in Conner Bailey, Svein Jentoft & Peter Sinclair (eds), *Aquacultural Development: Social Dimensions of an Emerging Industry* (New York: Routledge, 1996) 69 at 72.

[14] See: Meinhard Doelle & William Lahey, *A New Regulatory Framework for Low-Impact/High-Value Aquaculture in Nova Scotia*. The Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia [hereinafter NS, Independent Aquaculture Review] (2014), at 15, online: NSDFA <https://novascotia.ca/fish/aquaculture/reference-material/> (accessed 24 May 2022).

[15] *Ibid*, especially at 11-13, 27-28; Nathan Young et al, "Limitations to growth: Social-ecological challenges to aquaculture development in five wealthy nations" (2019) 104 Marine Policy 216, at 218. Three populations of Atlantic salmon with at least partial distribution in the province of NS have been assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), only one has been listed under the federal *Species at Risk Act,* SC 2002, c 29 (as amended): Eastern Cape Breton (endangered), NS Southern Upland (endangered), Inner Bay of Fundy (endangered and listed in Schedule I of the *Species at Risk Act*). The Gaspe-Southern Gulf of St. Lawrence population, also partially distributed in NS, has been assessed as a special concern population. See: Species at Risk Public Registry, online: <https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html> (accessed 15 March 2023).

[16] NS, Independent Aquaculture Review, *supra* note 14, at 14.

sector.[17] In December 2014, after 18 months of work, the Panel released its report. The Report recommended an overhaul of the regulatory framework, which should be

> … guided by the idea that aquaculture that integrates economic prosperity, social well-being and environmental sustainability is one that is low impact and high value. By this we mean aquaculture that combines two fundamental attributes: it has a low level of adverse environmental and social impact which decreases over time and it produces a positive economic and social value from the use of coastal resources which is high and increases over time.[18]

Based on the recommendations of the Independent Aquaculture Review,[19] the province amended the *Fisheries and Coastal Resources Act*[20] in May 2015 and introduced new regulations in October 2015. In 2016, the government started accepting applications for the farming of marine plants, suspended shellfish, and trout;[21] a year later it started accepting new applications for salmon farms.[22]

Although it has been seven years since the new framework is in place, some provisions of the Act have not yet been implemented. A review of the new framework has been recently commissioned by the Government, as recommended in the Independent Aquaculture Review and mandated in legislation.[23] The review has not been released at the time of writing.

Further to these regulatory initiatives, the provincial government has strengthened its capacity to support aquaculture growth and manage marine aquaculture within a science-based sustainability framework. It has established two advisory committees

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[17] *Ibid*.
[18] *Ibid*, at v, 3.
[19] The assessment of the extent to which the Government followed the recommendations of the Doelle-Lahey Panel in drafting the Act and regulations are mixed. See, for example, the written submissions to the Law Amendments Committee in the discussion of Bill No 95, *Fisheries and Coastal Resources Act* (amended), online: NS Legislature <https://nslegislature.ca/legislative-business/committees/standing/law-amendments/submissions/assembly-62-session-2/95> (accessed 29 July 2022).
[20] 1996, c 25, as amended [hereinafter FCRA].
[21] NS Legislature, Committee on Economic Development, 13 September 2016, online: NS Legislature <https://nslegislature.ca/legislative-business/committees/standing/economic-development/archive/economic-development/index.htm> (accessed 29 July 2022).
[22] Legislature, Committee of the Whole House on Supply, Supply Subcommittee, 29 September 2017, online: NS Legislature <https://nslegislature.ca/legislative-business/committees/whole-house/subcommittee-whole-house-supply/archive/supply-subcommittee> (accessed 29 July 2022)
[23] NS, Independent Aquaculture Review, *supra* note 14, at 130-131; FCRA, *supra* note 20, s 123; NS Department of Fisheries and Aquaculture (NSDFA), "https://novascotia.ca/fish/aquaculture/laws-regs/aquaculture-regulatory-review.asp" (nd), online: NS Government <https://novascotia.ca/fish/aquaculture/laws-regs/aquaculture-regulatory-review.asp> (accessed 13 July 2022).

comprising stakeholders: the Regulatory Advisory Committee and the Science Advisory Committee.[24] It has further established an independent Centre for Marine Applied Research to lead and support "science research projects in collaboration with industry, government, communities, and other marine user groups, to support the sustainable development of coastal resources in Nova Scotia".[25]

6.1.1. Jurisdictional Issues

One distinctive feature of the NS legal framework for aquaculture is the complexity and uncertainty of the jurisdiction over the regulation of aquaculture, a matter embroiled in common law and the constitutional division of jurisdictions between the national or federal government and the provinces of Canada under the Canadian *Constitution Act, 1867*.[26] According to common law applicable to tidal waters,[27] proprietary rights in the foreshore and the seabed of the territorial sea are vested in the Crown. Within the territory of a province (with the exception of federal lands in the province),[28] the Crown in right of the Province has the authority to grant property rights over the bed of tidal

[24] See online: NSDFA <https://novascotia.ca/fish/aquaculture/laws-regs/> (accessed 2 August 2022). The committees were created under the authority of the FCRA, *supra* note 20, s 7.
[25] Online: CMAR <https://cmar.ca/> (accessed 29 July 2022). CMAR was created within the provincial development agency Perennia Food and Agriculture Inc. Budget for a CMAR was first established in the 2017 budget (Legislature, Committee of the Whole House on Supply, Supply Subcommittee, 29 September 2017, online: NS Legislature <https://nslegislature.ca/legislative-business/committees/whole-house/subcommittee-whole-house-supply/archive/supply-subcommittee> (accessed 29 July 2022)). CMAR's coastal monitoring program collects data on essential ocean variables (temperature, dissolved oxygen and intermittent salinity measurements) through sensors at various depth (CMAR, <https://cmar.ca/coastal-monitoring-program/> (accessed 15 July 2022). Information is available on NS's Open Data Portal and the Canadian Integrated Ocean Observation System (CIOOS) Atlantic. In partnership with NSDFA, CMAR also measure current speed and location at several locations in NS. CMAR has also produced a map of land's infrastructure and service support. Other research outputs include studies on climate change vulnerability assessments for fisheries and aquaculture, exposure models, economic impact of aquaculture, offshore aquaculture, aquaculture and eelgrass interactions.
[26] *Constitution Act, 1867*, 30 & 31 Victoria, c 3 (UK).
[27] Since this paper focuses on marine finfish aquaculture sites, the analysis is focused only on tidal waters. The legal analysis is different for navigable non-tidal waters, where no public right of fishing exists, and for non-navigable non-tidal waters, where no public rights of fishing or navigation exist.
[28] See: Phillip M Saunders & Richard Finn, "Property Rights in Canadian Aquaculture: A Principled Approach" in David L VanderZwaag & Gloria Chao, *Aquaculture Law and Policy: Towards Principled Access and Operations* (Abingdon, New York: Routledge, 2006) 115 at 133. Federal land inside a province includes, for example, areas within national parks or federally-regulated ports (see Meinhard Doelle & Phillip Saunders, "Aquaculture governance in Canada: A patchwork of approaches" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA: Edward Elgar, 2016) 183, at 186.

waters and the waters above the bed, with or without legislative authority.[29] The property rights held or granted by the province are, however, subject to federal regulatory powers over federal subject-matters. These include seacoast and inland fisheries (including the management and protection of fisheries and fish habitat),[30] navigation and shipping,[31] extraprovincial trade and commerce,[32] and Aboriginal rights.[33] The federal regulatory powers could, potentially, restrict to a great extent the property rights held or granted by the province.[34]

At the same time, aspects of the aquaculture industry fall under provincial responsibility under several headings of the *Constitution Act, 1867*, s 92. These include local works and undertakings, matters of property and civil rights, and matters of a merely local or private nature.[35] Further, and depending on the scope and interpretation of the term "agriculture", section 95 of the *Constitution Act, 1867* may also be relevant as it allows the province to make laws in relation to agriculture in the province.[36]

The complex co-existence of proprietary rights, public right of navigation, public right of fishing, aboriginal entitlements, and federal regulatory powers results in the need for action by both levels of government for an effective grant of private rights in tidal waters within a province. The approach adopted by the federal and provincial governments was to negotiate a memorandum of understanding (MoU) to coordinate their respective roles and responsibilities.[37] The federal Department of Fisheries and Oceans (DFO) and the provincial Department of Agriculture and Fisheries (now Department of Fisheries and Aquaculture - NSDFA) signed a MoU in 1986, which was

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[29] See: Saunders & Finn, *supra* note 28, at 134 and 139-140; *Re Provincial Fisheries* (1895) 26 SCR 444; *AG British Columbia v AG Canada* (1913) 15 DLR 308 (PC) [*Re BC Fisheries*].
[30] *Constitution Act, 1867*, *supra* note 26, s 91(12). Doelle & Saunders, *supra* note 28, at 186.
[31] *Constitution Act, 1867*, *supra* note 26, s 91(10). This includes the protection of navigable waterways form works which obstruct navigation (Doelle & Saunders, *supra* note 28, at 186).
[32] *Constitution Act, 1867*, *supra* note 26, s 91(2).
[33] *Ibid*, s 91(24) ("Indians, and Lands reserved for the Indians"). See also: the *Constitution Act, 1982, Schedule B to the Canada Act 1982 (UK), 1982*, c 11, s 35.
[34] Canadian constitutional law distinguishes between jurisdiction over property rights and jurisdiction to legislate respecting an activity. See: Saunders & Finn, *supra* note 28, at 130-132.
[35] *Constitution Act, 1867*, *supra* note 26, s 92(10), (13) and (16).
[36] See: Doelle & Saunders, *supra* note 28.
[37] On the potential insufficiency of a system of delegated responsibilities where no explicit federal legislative provision authorizes the restriction of public right to fish from aquaculture leases granted by the provinces, as well as a system that does not address the limitations of the territorial jurisdiction of the province to grant property rights to aquaculture leases, see Saunders & Finn, *supra* note 28, in particular at 142-153.

re-negotiated in 1995[38] and 2002.[39] NS assumed the leading role in aquaculture development, management and regulation, including responsibility for issuing leases and licences for aquaculture operations and for ensuring compliance with federal legislation.[40] The federal government retains, however, a significant role in aquacultures site selection and management under several pieces of legislation administered by different federal agencies.

Three sources of uncertainty add to the already complex jurisdictional landscape. First, as noted in Chapter 1, the 2009 *Morton v. British Columbia (Agriculture and Lands)* decision,[41] impugned provincial regulation of aquaculture. While the effects of the *Morton* decision are limited to British Columbia (BC), the judicial precedent introduces an element of uncertainty to the legal and regulatory framework developed by the federal and provincial governments in other provinces.[42]

Second, there is significant uncertainty on the jurisdiction to regulate aquaculture offshore. Outside the boundaries of the province, the regulation of aquaculture is a federal subject-matter in its entirety.[43] Although the legal principle may be clear, the factual element of identifying the boundary of the territory of the province is not.[44] The status of a particular area of water and submerged land (and thus the territorial

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[38] *Memorandum of Understanding on Aquaculture Development between Minister of Fisheries and Oceans (Canada) one the First Part and Minister of Fisheries (Nova Scotia) on the Second Part* (on file with author).

[39] *Memorandum of Understanding on Aquaculture Development between Minister of Fisheries and Oceans (Canada) and Minister of Agriculture and Fisheries (Nova Scotia) (2002)* (in file with author) [hereinafter NS MoU 2002].

[40] David L VanderZwaag, Gloria Chao & Mark Covan, "Canadian Aquaculture and the Principles of Sustainable Development" in David L VanderZwaag & Gloria Chao, *Aquaculture Law and Policy: Towards Principled Access and Operations* (Abingdon, New York: Routledge, 2006) 49 at 56.

[41] *Morton v British Columbia (Minister of Agriculture and Lands)* [2009] BCJ No 193, 2009 BCSC 136. Alexander Ross Clarkson, *The Jurisdiction to Regulate Aquaculture in Canada* (LLM Thesis, UBC, 2014)[unpublished]. Clarkson criticizes the conclusion that aquaculture is a fishery. He also argues that even if it is a fishery, that does not preclude all provincial jurisdiction. Examining the pith and substance of the impugned legislation and regulation, he concludes that the regulations addressing escapes are probably *ultra vires* but the provincial seafloor pollution regulations are *intra vires*. Analyzing the legislation and regulations in the Atlantic coast, he concludes that property rights laws (property right over escaped farmed fish within the lease and within 100m of the lease) are likely *ultra vires*, but disease regulations are likely *intra vires*.

[42] In an appeal to a NS Minister of Fisheries and Aquaculture to issue finfish farming leases, the appellant similarly argued that aquaculture regulation and management falls under the exclusive jurisdiction of Parliament under the *Constitution Act, 1867*. The case was not pursued further by the appellants. *St Mary's Bay Coastal Alliance Society v Nova Scotia (Minister of Fisheries and Aquaculture)*, [2013] NSJ No 148, 2013 NSSC 105.

[43] Saunders & Finn, *supra* note 28, at 137.

[44] *Ibid.*

jurisdiction) can only be ascertained on a case-by-case basis considering both geographical configuration and legal history.[45] In particular in the Bay of Fundy, the historical titles of the former colony have led scholars to conclude that NS and New Brunswick have a strong case to argue that the Bay of Fundy is provincial territory.[46] Nevertheless, this has been historically a contentious issue[47] that has not been referred to in a judicial decision.[48] A new federal Aquaculture Act may clarify the regulatory regime applicable to offshore aquaculture.[49]

A third area of uncertainty is the unsettled issue of Aboriginal title to submerged land and marine areas. The Indigenous People of NS (Mi'kmaq) claim Aboriginal title to the lands and waters of the province and adjacent areas of the offshore.[50] Negotiations between the province and Mi'kmaq are ongoing.

6.1.2. General Legal, Institutional and Policy Frameworks

The main regulatory authority for salmon farming in NS is the provincial government (and particularly the Minister of Fisheries and Aquaculture and the NSDFA) under the

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[45] *Ibid*, at 138; Leigh Michael Howarth, Gregor Reid & Leah Lewis-McCrea, *Supporting the Development of Offshore Aquaculture in Nova Scotia* (Dartmouth, NS: Centre for Marine Applied Research, 2022), online: CMAR <http://cmar.online/publicationlist/> (accessed 27 July 2022). The general principle is that the territorial extent of the province includes all the areas that it brought into Confederation. As a general rule, this territory ended at low-water mark (in the absence of legislative enactment to the contrary but subject to certain exceptions (Saunders & Finn, *supra* note 28, at 138). The exceptions include the "*waters inter fauces terrae*", a term not defined which would include bays, estuaries, and probably straits, but subject to certain exceptions.

[46] In the case of NS, scholars have suggested that the province holds an historical and legal claim to the Bay of Fundy as part of its territory (together with New Brunswick) (Meinhard Doelle *et al*, "The Regulation of Tidal Energy Development Off Nova Scotia: Navigating Foggy Waters" (2006) 55UNBLJ 27, at 40). Scholars also suggested that Atlantic Provinces and Quebec can claim a three mile territorial sea, and even a continental shelf, based on pre-Confederation statutes and other historical documents. The arguments supporting these opinions appear to have been dismissed in the *Hibernia Reference* and the *Ace-Atlantic Container Express Case* (*ibid* at 39). There has been, however, no judicial decision with respect to provincial claims to marine waters in Nova Scotia (*ibid* at 36, 41). See also: Howarth, Reid & Lewis-McCrea, *supra* note 45.

[47] Esteban Salcedo, "Marine Renewable Energy Law and Policy in the Bay of Fundy: The Impact of Ambiguous Domestic Boundaries in Canada on Nova Scotia's Regulatory Framework" (2019) 24 Ocean & Coastal LJ 1.

[48] *Ibid*.

[49] DFO, "A Discussion Paper: A Canadian Aquaculture Act" (2020), online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/act-loi/discussion-eng.html> (accessed 25 May 2022). See also Federal Aquaculture Act, online: DFO https://www.dfo-mpo.gc.ca/aquaculture/act-loi/index-eng.html (accessed 25 May 2022).

[50] NS Office of L'Nu Affairs, Negotiations, online: NS <https://novascotia.ca/abor/office/what-we-do/negotiations/> (accessed 27 March 2022).

Fisheries and Coastal Resources Act (FCRA)[51] and two accompanying regulations: the *Aquaculture Licence and Lease Regulations*[52] and the *Aquaculture Management Regulations*.[53]

DFO, in turn, is the lead federal agency for aquaculture.[54] DFO exercises its responsibilities under the authority of the *Fisheries Act*, the *Species at Risk Act*, and the *Oceans Act*,[55] as well as accompanying regulations.[56] Under these legal and regulatory instruments, DFO has the authority and the responsibility to ensure that aquaculture activities do not have a harmful environmental impact on the marine environment. In particular, DFO has the following responsibilities: to protect and conserve fish and fish habitat;[57] to prevent and control the deposit, into water where fish are found, of substances deleterious or harmful to fish;[58] to prevent the killing, harming, harassing, capturing or taking of an individual of a listed species at risk, and to mitigate risk of harm to, or destruction of, the residence or feeding grounds of a listed species;[59] to license the release or transfer of fish into fish habitat or rearing facilities;[60] to protect marine mammals;[61] and to authorize the recapture of fish.[62] Further, it may have further responsibilities associated to strategies for the integrated management of coastal and marine areas and marine protected areas.[63]

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[51] *Supra* note 20.
[52] NS Reg 347/2015 (as amended).
[53] NS Reg 348/201 (as amended).
[54] DFO was appointed as lead federal agency in the 1995 Federal Aquaculture Development Strategy. See: DFO, "Aquaculture Policy Framework" (2002), online: DFO <https://waves-vagues.dfo-mpo.gc.ca/Library/263241eng.pdf> (accessed 14 July 2022), at 1.
[55] *Fisheries Act*, RSC, 1985, c F-14 (as amended); *Species at Risk Act,* SC 2002, c 29 (as amended); and *Oceans Act*, SC 1996 c31 (as amended).
[56] Particularly relevant are the *Aquaculture Activities Regulations*, SOR/2015-177 and the *Marine Mammals Regulation,* SOR/93-56 (as amended).
[57] *Fisheries Act*, *supra* note 55, ss 34, 34.1, 34.4, 35.
[58] Under the *Fisheries Act*, *supra* note 55, s 36(3) prohibits the deposit of a deleterious substance in water frequented by fish unless authorized by regulations. The *Aquaculture Activities Regulations*, *supra* note 56, specifies what are deleterious substances deposited during normal aquaculture operations (biochemical oxygen demanding matter, medicines, and pesticides) and the circumstances under which their deposit does not infringe s 36(3).
[59] *Species at Risk Act*, *supra* note 55, s 32.
[60] *Fishery (General) Regulations*, SOR/93-53, s 56. This is a shared responsibility exercised through federal-provincial introductions and transfers committees.
[61] *Marine Mammals Regulations*, *supra* note 56.
[62] *Fisheries Act*, *supra* note 55; *Atlantic Fishery Regulations, 1985*, SOR/86-21; *Maritime Provinces Fishery Regulations, 1985*, SOR/93-55.
[63] *Oceans Act*, *supra* note 55.

Noteworthy, the federal government does not have an Act specifically addressing aquaculture. Following several reports recommending a unified legal framework and an agreement adopted in the Council of Ministers for Fisheries and Aquaculture in 2018,[64] the Minister of Fisheries, Oceans and the Canadian Coast Guard received a mandate to develop the first federal Aquaculture Act.[65] A consultation processes has taken place, but to date there is no further legislative development.[66]

Several other federal and provincial agencies have issue-specific responsibilities over aquaculture and related activities under several pieces of legislation.[67] The vertical and horizontal fragmentation of responsibilities over aquaculture and related coordination problems have long been noted.[68] There is evidence that some regulatory issues "fall within the cracks" of jurisdictional or sectoral boundaries, which has contributed to the perception of inadequate, insufficient, or insufficiently enforced regulations for the sector. The streamlining of regulations has been on the agenda of federal and provincial governments for many years.[69]

Further to the legal and regulatory fragmentation, policy or strategies at the federal and provincial level have been lagging. The province has not updated its Aquaculture Strategy since 2012.[70] Nevertheless, several recent developments evidence the support of the Government to aquaculture. These include the mandate letter of the

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[64] DFO, Federal Aquaculture Act: How We Got Here, online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/act-loi/how-comment-eng.html> (accessed 1 August 2022).
[65] Office of the Prime Minister, "Minister of Fisheries, Oceans and the Canadian Coast Guard Mandate Letter" (13 December 2019), online: Office of the Prime Minister <https://pm.gc.ca/en/all-archived-mandate-letters> (accessed 31 December 2022).
[66] A member motion to require closed containment aquaculture in the marine waters off the Pacific coast is currently under discussion in Parliament (Bill C-258, *An Act to amend the Fisheries Act (closed containment aquaculture)*, 1st Sess, 44th Parl, 2022).
[67] Key federal agencies with competence over some aspects of aquaculture management include the Canadian Food Inspection Agency, Health Canada, Pest Management Regulatory Agency, and Transport Canada. For a list of applicable laws and regulations, see References, National Documents.
[68] See, eg: Commissioner of the Environment and Sustainable Development, "Salmon Farming" 2018 Fall Report, online: Office of the Auditor General <https://www.oag-bvg.gc.ca/internet/English/parl_lp_e_901.html> (accessed 7 December 2022), especially paras 1.29, 1.44, 1.46.
[69] See, eg: Canadian Council of Fisheries and Aquaculture Ministers (CCFAM), "National Aquaculture Strategic Action Plan (NASAPI)", online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/nasapi-inpasa-eng.html> (Archived) (accessed 1 August 2022).
[70] Government of Nova Scotia, *Aquaculture Strategy Creating Sustainable Wealth in Rural and Coastal Nova Scotia* (2012), online: Nova Scotia <https://novascotia.ca/fish/NS-Aquaculture-Policy.pdf> (accessed 14 July 2022). The Strategy predates the 2014 regulatory review and mostly addresses particular needs through time-bound activities, rather than broad principles and goals guiding aquaculture development.

Minister of Fisheries and Aquaculture,[71] the renewed Memorandum of Understanding of the Atlantic Provinces,[72] and the Report of the Nova Scotia Commission on Building Our New Economy.[73] This support is also explicit in the recently passed *Environment Goals and Climate Change Reduction Act,* which commits to "support low-impact sustainable aquaculture through a licensing process that weighs environmental considerations and includes provincial regulation for potential environmental impacts, animal welfare and fish health".[74]

The position of the federal government is harder to ascertain. The stated vision for aquaculture within DFO's mandate and role is "to benefit Canadians, now and in the future, through the culture of aquatic organisms, while upholding the ecological and socio-economic values associated with Canada's oceans and inland waters."[75] The vision is not backed by recent, clear, and public policy developments.[76] Current DFO's policy

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[71] The mandate letter includes three priorities: support low-impact, sustainable aquaculture by implementing a proper licensing process that places much weight on environmental considerations (…); create a classification system under which coastal areas would be rated as Green, Yellow or Red based on their suitability for fin-fish aquaculture (…); and engage with key stakeholders regarding the open pen aquaculture licensing process (Mandate Letter to the Honourable Steve Craig, Minister of Fisheries and Aquaculture (14 September 2021), online: Government of NS <https://novascotia.ca/exec_council/letters-2021/ministerial-mandate-letter-2021-FA.pdf> (accessed 19 May 2022). See also online: NSDFA <https://novascotia.ca/fish/about/> (accessed 18 March 2022).

[72] Memorandum of Understanding for the Development and Management of the Aquaculture Industry between de Governments of New Brunswick, Prince Edward Island, Newfoundland and Labrador, and Nova Scotia (2021). The MoU replaced the previous "Atlantic Provinces' Memorandum of Understanding for the Development of the Aquaculture Sector" (2008).

[73] *One Nova Scotia, Now or Never: An Urgent Call for Action for Nova Scotians*. The Report of the Nova Scotia Commission on Building Our New Economy (February 2014) [Ivany Report]. It is noteworthy that this report includes the only quantifiable goal for aquaculture growth. According to the report, the province should aim to double the value of exports from the fisheries (including aquaculture) and the agricultural sectors on a sustainable basis.

[74] *Environment Goals and Climate Change Reduction Act*, 2021 c 20, s 14 on aquaculture and food goals.

[75] Online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/management-gestion/vision-eng.htm> (accessed 1 August 2022).

[76] A number of past plans, strategies and programs provide a broader perspective on the policy framework, but these documents either have lapsed and have not been renewed or are dated. Under a 2002 federal Aquaculture Policy Framework, DFO committed to "creating policy conditions that increase both the public's confidence that aquaculture is being developed in a sustainable manner and the aquaculture industry's competitiveness in global markets" (DFO, "Aquaculture Policy Framework", *supra* note 54, at 3). The Aquaculture Policy Framework was the department's response to the Federal Aquaculture Development Strategy adopted by the Cabinet in 1995. The policy framework has not been renewed or revised. A Sustainable Aquaculture Program 2008-2013 was renewed for 5 years (DFO, "Canada's Sustainable Aquaculture Program", online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/programs-programmes/sustainable-durable/index-eng.htm> (accessed 14 July 2022)). A federal-provincial-territorial initiative, the National Aquaculture Strategic Action Plan, guided federal-provincial coordination between 2011-2015 and set out a strategic vision for the future sustainability of the aquaculture sector based on the

initiatives are mostly related to BC, a province in which it has primary licensing responsibility. The Government's policy for the West Coast is to transition open cage farming out of the waters of the Pacific coast, although details on how to achieve that are still uncertain.[77] Further, DFO is developing a framework to implement area-based aquaculture management in BC as an initiative where "Federal, Provincial and Indigenous Governments, stakeholders, and industry work together to plan, manage, monitor and continue to improve aquaculture activities".[78] One pilot area to implement such measure was recently announced.[79]

At the national level, DFO's focus is the preparation of a federal Aquaculture Act as well as General Aquaculture Regulation.[80] More comprehensively, the federal government is also working on a Blue Economy Strategy for Canada, which could clarify the federal vision for the aquaculture sector.[81]

6.1.3. Spatial Planning

As noted, NS is responsible for issuing marine finfish aquaculture leases and licenses in provincial waters. The approach taken by the province is largely reactive, in the sense that it does not actively plan how aquaculture develops in the province but rather oversees and responds to the developments proposed by the private sector. NS has not developed zoning and area management to any significant extent. Neither does NS have

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principles of environmental protection, social well-being, and economic prosperity. This initiative was followed by an Aquaculture Development Strategy 2016-2019.

[77] DFO, "The future of salmon aquaculture in British Columbia – Toward an open-net pen transition plan: A framework for discussion" (29 July 2022), online: DFO <https://www.pac.dfo-mpo.gc.ca/consultation/aquaculture/bc-transition-cb/cadre-discussion-framework-eng.html> (accessed 1 August 2022).

[78] DFO, "Area-based Aquaculture Management in British Columbia", online: DFO <https://www.pac.dfo-mpo.gc.ca/aquaculture/abam-gaz-eng.html> (accessed 29 October 2022). See also: DFO, "Proposal from the Area-based Management Technical Working Group to the Indigenous and Multi-stakeholder Advisory Body" (22 May 2020), online: <https://www.dfo-mpo.gc.ca/aquaculture/publications/amb-twg-eng.html> (accessed 1 August 2022).

[79] On 28 October 2022, DFO and K'omoks First Nation in Baynes Sound and Lambert Channel announced a 2-year partnership for a pilot area-based aquaculture management initiative focused on shellfish (DFO, *supra* note 78).

[80] See: *supra* note 49; DFO, "Forward Regulatory Plan 2022-2024", online: DFO <https://www.dfo-mpo.gc.ca/acts-lois/initiatives/rule-reglement-eng.htm#reg10> (accessed 14 July 2022).

[81] DFO, "Blue Economy Strategy", online: <https://www.dfo-mpo.gc.ca/campaign-campagne/bes-seb/index-eng.html> (accessed 1 August 2022).

an integrated coastal zone plan or marine spatial planning (MSP).[82] MSP and integrated ocean management at the federal level is also largely considered an unfulfilled promise.[83]

The lack of strategic spatial planning in the province has been attributed to several reasons, including inadequate legal frameworks. One important challenge is the uncertain federal-provincial boundaries and consequent jurisdictional uncertainty.[84] Both levels of governments have "agreed to disagree", opting instead for fragmented and sectoral approaches to legislating and planning[85] that leave jurisdictional issues ambiguous and lacking vertical integration.[86]

Further, the integrated management mandate of the *Oceans Act* has been criticized. Key weaknesses include: the lack of timelines for the completion of integrated management plans or marine protected areas; the lack of an accountability framework against which to measure outcomes; lack of specific provision and/or regulations to give

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[82] At the provincial level, a Coastal Management Framework was released in 2008. The province also prepared a draft Coastal Strategy that was, however, never finalized. In 2019, it passed a *Coastal Protection Act* (2019 SNS c 3) that will take effect when the accompanying regulations are adopted. Draft regulations have been subject to a consultation process but are yet to be finalized (Nova Scotia, Coast, online: NS <https://novascotia.ca/coast/> (accessed 29 March 2022)). The Act addresses, however, the "coast" defined as the "maritime shoreline of the Province wherever the land meets a body of salt water and includes the shoreline of an estuary and a maritime island" (*ibid*, s 3(c)). Its relevance for marine farming is therefore limited.

[83] The *Oceans Act*, *supra* note 55, s 31, states: "The Minister, in collaboration with other ministers, boards and agencies of the Government of Canada, with provincial and territorial governments and with affected aboriginal organizations, coastal communities and other persons and bodies, including those bodies established under land claims agreements, shall lead and facilitate the development and implementation of plans for the integrated management of all activities or measures in or affecting estuaries, coastal waters and marine waters that form part of Canada or in which Canada has sovereign rights under international law." The Act was introduced with the promise to end the piecemeal, fragmented and scattered policies for actual management of our oceans areas (Linda Nowlan, "Brave New Wave: Marine Spatial Planning and Ocean Regulation on Canada's Pacific" (2016) 29 JELP 151, at 166). Efforts to develop integrated management plans or spatial planning in Canada, as mandated by the *Oceans Act,* have been slow and even hectic with several initiatives effectively abandoned (see, eg: Salcedo, *supra* note 47). More recently, the federal government has demonstrated renewed support to marine spatial planning initiatives (eg: Charlevoix Blueprint for Healthy Oceans, Seas and Resilient Coastal Communities, adopted by the leaders of the G7 in Charlevoix, Quebec, 9 June 2018, para 6; DFO, "Blue Economy Strategy", *supra* note 81). A key component of the spatial planning initiative is the development of the Canadian Marine Spatial Planning Atlas (East and West) with information on: (1) Ecosystem and Ocean Knowledge; (2) Local, Socio-cultural and Traditional Knowledge; (3) Boundaries and Management Areas; (4) Human Use; (5) Synthesis Areas; and (6) Impacts and Threats Assessments (*ibid*). The federal government has committed to develop marine spatial plans for five areas, including the Bay of Fundy/Scotian Shelf (DFO, Department Plan 2022-2023, online: DFO <https://www.dfo-mpo.gc.ca/rpp/2022-23/dp-eng.html> (accessed 29 March 2022)). A first generation plan is expected for 2024.

[84] See *supra* note 43 and accompanying text.

[85] Salcedo, *supra* note 47; Sondra L Eger & Simon C Courtenay, "Integrated coastal and marine management: Insights from lived experiences in the Bay of Fundy, Atlantic Canada" (2021) 204 Ocean & Coastal Management 105457.

[86] Eger & Courtenay, *ibid.*

integrated management plans legal force; and the absence of requirements for other federal departments to comply with or implement the *Oceans Act*.[87] Further identified problems include inconsistent commitment from legal authorities and inadequate capacity to sustain initiatives, inadequate stakeholder engagement, and unsupported informal structures for horizontal integration.[88]

The above statements need to be tempered, however, by legal provisions that can potentially enhance spatial planning of the sector. They are discussed in turn.

a) Zoning in the Fisheries and Coastal Resources Act

Section 56(1)(a) of the FCRA gives the Minister of Fisheries and Aquaculture, with the approval of the Governor in Council, the authority to designate subaquatic lands under marine or brackish waters and their water columns as an aquaculture development area, or as a closed area unsuitable for aquaculture. The designation of an aquaculture development area (but not the closure of an area) requires consultation with other provincial and federal agencies, as "may be required by legislation".[89] Additionally, it requires consultation with "any person, group of persons or organization that the Minister considers necessary or advisable in the circumstances".[90] The designation of the aquaculture development area can be coupled with conditions or restrictions on the conduct of aquaculture or of other activities in the area.

It is noteworthy that the Act provides very limited guidance regarding the process that the Minister needs to follow to designate development areas. It does not require a strategic impact assessment under the *Environment Act*[91] or any equivalent study. Further, the Minister has significant discretion to determine whether and how to provide

[87] Sabine Jessen, "A Review of Canada's Implementation of the Oceans Act since 1997—From Leader to Follower?" (2011) 39 Coastal Management 20, at 25; David L VanderZwaag et al, "Canada's international and national commitments to sustain marine biodiversity" (2012) 20 Environmental Reviews 312.
[88] Eger & Courtenay, *supra* note 85. See also: Jessen, *supra* note 87; Nowlan, *supra* note 83, at 167-168.
[89] FCRA, *supra* note 20, s 56(2)(a).
[90] *Ibid,* s 56(2)(b).
[91] *Environment Act*, SNS 1994-95, c 1, Part IV. While the environmental assessment process of the Act applies to scheduled "undertakings", the Minister of the Environment may apply a (strategic) impact assessment to policies, plans, and programs (*Environmental Assessment Regulations*, NS Reg 26/1995 (as amended), ss 11(3)).

opportunities for public engagement.[92] From a substantive perspective, it does not spell out the considerations that need to be taken into account while designating an aquaculture development area, although it must be understood that the general objectives of the Act apply and, considering the effects of a designation, likely the criteria for decision-making spelled out in the *Aquaculture Licence and Lease Regulations*.

The designation of aquaculture development areas has an important procedural effect: aquaculture leases and licenses applications inside a designated area are decided in a simplified process (administrative decision) rather than an adjudicative review. The simplified process does not require an option to lease or a scoping session, further limiting opportunities for public engagement.[93]

To date, article 56(1) of the FCRA has not been operationalized and there are no designated aquaculture development areas (or aquaculture closed areas) in NS. Nevertheless, the province and the Municipality of Argyle are exploring the potential of a development area for shellfish and marine plant aquaculture.[94] The direct involvement of a municipality in this initiative is a noteworthy development, as it provides the local government with an active role in aquaculture planning to meet local development priorities.

b) Other Spatial Planning Provisions

Although short of providing comprehensive planning, another provision of the FCRA addresses conflicting uses of marine space, in particular renewable energy and aquaculture. According to section 122(A) of the Act, no lease may be entered into and no licence, permit or other authorization may be issued under the FCRA in respect of any part of a marine renewable-electricity area as defined by the *Marine Renewable-energy*

[92] FCRA, *supra* note 20, s 56(2)(b). This contrasts with the provisions in the previous version of the Act, which made public hearing and consultation mandatory for the designation of an aquaculture development area (s 56(2)(b),(3) and (4) of the earlier version of the FCRA).
[93] Lisa Mitchell & Aaron Ward, *Aquaculture Regulation in the Post Doelle-Lahey Era: An Analysis of Nova Scotia's New Regulatory Framework* (Halifax: ECELAW, 2015) at 9.
[94] Despite the lack of guidance in the Act (*supra* notes 91 and 92 and accompanying text), the preparatory work for the first aquaculture development area has been defined as a "science-based collaborative review process" in which "[e]cological, economic, and social data are being collected and analyzed to identify areas suitable for aquaculture" (Center for Marine Applied Research (CMAR), "Research: Aquaculture", online: CMAR <https://cmar.ca/aquaculture-development-area/> (accessed 14 July 2022)). Further, the Municipality leads local stakeholder engagement, including an open house on 10 October 2022. See online: Argyle's Business Park on the Sea <https://www.aquacultureargyle.com/> (accessed 17 December 2022).

Act. Further, the Minister may not designate any sub-aquatic lands situated within a marine renewable-electricity area as an aquaculture development area.

6.1.4. Site Permitting Process

To carry out marine salmon farming in NS, a proponent needs an aquaculture licence and an aquaculture lease, both issued under the FCRA, and a federal approval (Transport Canada) to install work in navigable waters.[95] It may further require a federal approval (DFO) under the fish and fish habitat provisions of the *Fisheries Act* or under the *Species at Risk Act*. To stock the site, it must meet further requirements: a farm management plan approved by the NSDFA; a federal-provincial-territorial authorization for the introduction and transfer of aquatic species under the National Code on Introductions and Transfers of Aquatic Organisms;[96] and a federal (DFO) and provincial (NSDFA) authorization to stock the site under the *Fisheries Act* (*Aquaculture Activities Regulations*[97]) and the FCRA (*Aquaculture Management Regulations*).

The key administrative instruments outlining the terms and conditions of the farming operations are the aquaculture licence and lease and the Farm Management Plan. The aquaculture lease grants the operator an exclusive right to the possession of the water column and sub-aquatic land described in the lease, with the purpose of developing aquaculture.[98] Leases and licenses are time-bound: licences are issued for up to 10 years

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[95] *Canadian Navigable Waters Act,* RSC, 1985, c N-22, ss 5ff.
[96] Government of Canada, *National Code on Introductions and Transfers of Aquatic Organisms* (28 June 2017), online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/management-gestion/it-code-eng.htm> (accessed 26 May 2022). The Code was elaborated under several pieces of federal and provincial legislation and regulations. Federal legislation include: the *Health of Animals Act*, the *Fisheries Act*, *Species at Risk Act*, *Wild Animal & Plant Protection and Regulation of International & Interprovincial Trade Act* (WAPPRIITA), *Canadian Environmental Protection Act* and *Nunavut Land Claims Agreement Act*. Provincial (NS) legislation includes the FCRA and its regulations, including the Live Fish Possessions Regulations. An Introduction and Transfers Committee (ITC) is established in each province or territory, and comprises representatives of DFO, the Canadian Food Inspection Agency, and provincial/territorial governments, as specified in each Committee's terms of reference. The ITC undertakes a risk assessment and presents its conclusions to the decision-making authority (DFO under s 56 of the *Fisheries Act*; the Canadian Food Inspection Agency under the *Health of Animals Act* and the National Aquatic Animal Health Program; a provincial authority).
[97] *Supra* note 56.
[98] FCRA, *supra* note 20, ss 44(3).

and leases for up to 20 years, both renewable.[99] The license and lease are transferable (assigned[100]) but cannot be sublicensed or subleased.[101]

Marine licenses and leases specify the surface of the water column and seabed that can be occupied for aquaculture purposes, the species that can be farmed, and the duration of the lease and license.[102] The maximum amount of aquacultural produce allowed on the site may be specified in the license or lease,[103] but this designation is not mandatory nor current practice.[104]

Aquaculture licences and leases can be varied or revoked.[105] For this purpose, the regulatory framework requires a performance review of the site at specific times,[106] which will provide the basis for the administrative decision. It is noteworthy, though, that while a license may be varied based on concerns raised on the performance review, it can only be revoked "in accordance with section 59A of the Act".[107] Section 59A of the Act, in turn, specifies four grounds for such revocation: a request for revocation; breach of the Act, its regulations or license; judicial conviction for violation of any other provincial law or of federal laws; and detriment or interference with previously licensed or leased aquaculture sites. Environmental concerns and other use conflicts do not authorize the revocation of a license and lease; those concerns may be considered at the time of renewal, however.

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[99] See *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 52(1)(2).
[100] *Ibid*, s 38(1)(e). The assignment of an aquaculture licence or lease requires an approval by the Administrator in a simplified process.
[101] *Ibid*, s 59.
[102] *Ibid*, s 54(1).
[103] *Ibid*, s 54(2).
[104] See: NS, "Licensed Aquaculture Sites in Nova Scotia", online: NSDAF <ttps://novascotia.ca/fish/aquaculture/public-information/> (accessed 24 May 2022).
[105] FCRA, *supra* note 20, ss 59, 59A; *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 73. It is also noteworthy that the decision-making authority is the Administrator, even in cases where the original lease and license was decided by the NSARB.
[106] At a minimum, the Administrator must conduct a performance review after the first production cycle, upon receiving an application to assign or renew an aquaculture lease and licence, upon receiving an application to amend an aquaculture lease and licence that is under the jurisdiction of the Administrator, and before entering the information regarding the site into the Aquaculture Registry. The Minister has discretion to request a performance review at any time he considers it necessary (*Aquaculture Licence and Lease Regulations*, *supra* note 52, s 72).
[107] *Ibid*, ss 73(2)(b).

6.1.5. Process for Issuing of a License and Lease

In the absence of comprehensive spatial planning or sectoral zoning, the main instrument to assess an aquaculture development is the individual lease and license application process. This process has been significantly strengthened during the 2015 legal and regulatory reform in at least three ways. First, in an effort to de-politicize decisions, the decision-making authority resides not in the Minister but in an independent body or an Aquaculture Administrator. Second, the Act lists the criteria that need to be taken into account in making the decision and the decision-making authorities are required to provide written reasons for its decision. Third, some of the applications require an early engagement with local communities. These key elements will be analyzed below.

It is worth noting that as a general rule and current practice, the issuing of a lease or license does not require an environmental impact assessment under federal or provincial legislation.[108] The Doelle-Lahey Panel pondered the need for an EIA under the *Environment Act* but instead recommended that the licensing process be understood as a specialized EIA.[109]

a) Decision-Making Authority

The process and the authority responsible for decision-making depend on the type of application, with the general principle that applications with potentially significant environmental and social impact (or where the environmental and social impacts have not been previously assessed) are subject to a more rigorous process.[110] It can be an adjudicative hearing before the independent NS Aquaculture Review Board (NSARB), a

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[108] According to the *Impact Assessment Act* (SC 2019, c 28, s 1) and the Schedule to the *Physical Activities Regulations* (SOR/2019-285), the construction, operation, decommissioning and abandonment of a new aquaculture facility in a *wildlife area* (s 2 of the *Wildlife Area Regulations* (CRC, c 1609)) a *migratory bird sanctuary* (ss 1 of the *Migratory Bird Sanctuary Regulations* (CRC, c 1036)*)* or a protected marine area established under ss 4.1(1) of the *Canada Wildlife Act* (RSC, 1985, c W-9), is a designated physical activity that requires a federal impact assessment. In other cases, the Minister of the Environment may require a federal impact assessment for an aquaculture facility if she considers that it may cause adverse effects within federal jurisdiction or adverse direct or incidental effects, or public concerns related to those effects warrant the designation (*Impact Assessment Act*, ss 9(1)). Similarly, aquaculture is not a designated undertaking under the *Environment Act*, *supra* note 91, and *Environmental Assessment Regulations*, NS Reg 26/1995 (as amended).

[109] NS, Independent Aquaculture Review, *supra* note 14, at 74-75.

[110] The respective procedures are required under the FCRA, *supra* note 20, ss 49, 54(1), 55, 55A and 58 and under the *Aquaculture Licence and Lease Regulations*, *supra* note 52.

simplified process before the Aquaculture Administrator, or a routine amendment decided by the Administrator without further procedural requirements.[111]

The NSARB is responsible for deciding applications on new marine farms outside areas designated for aquaculture, and amendments to add finfish or to increase the area of an existing license and lease outside of an aquaculture development area. The NSARB is an independent body comprising 10 members appointed by the Minister. An application can be decided by a panel comprising at least 3 members of the NSARB.

The Aquaculture Administrator is an employee of NSDFA appointed by the Minister. She is responsible for making decisions on new marine farms within aquaculture development areas, non-adjudicative amendments, and renewals of marine farms.[112]

b) Adjudicative Process

Since no ADA has been designated in the province, new marine sites are subject to an adjudicatory hearing process before the NSARB. The process starts with the issuing of an option to lease a tract of Crown land, either as a result of the Minister's call for proposals or as unsolicited proposal.[113] The Minister has discretion to issue an option to lease, to set the conditions of such an option, and to decide on competing applications.[114] Thus, the Minister exercises control, at this stage, to align aquaculture proposals with provincial policy priorities.[115]

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[111] Applications to correct an error or to address a revised policy or a regulatory change of the Government of NS or of the Government of Canada; Renewal of a special experimental licence or lease; Request for corresponding expiry dates (the holder of an aquaculture licence or aquaculture lease may request to the Administrator to amend the expiry date of the licence or lease so that it corresponds with the expiry date of another aquaculture licence or aquaculture lease granted to the same holder, but only if this does not result in the granting or renewal of a term longer than that permitted); amalgamation of sites.

[112] The Administrator is also responsible making decisions on new land-based aquaculture sites; assignment of an aquaculture licence or lease; reallocation of an aquaculture site (i.e. the issuance of an aquaculture licence or aquaculture lease for the aquaculture site after the revocation of its previous aquaculture licence or aquaculture lease); amalgamation of two or more aquaculture licences or aquaculture leases and their associated aquaculture sites; institutional licence or lease in a designated ADA; special experimental licence or lease.

[113] FCRA, *supra* note 20, s 44a; *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 5.

[114] FCRA, *supra* note 20, ss44A(4),(5),(6); *Aquaculture Licence and Lease Regulations*, *supra* note 52, ss 6(2).

[115] See: NS Legislature, Committee on Economic Development, 13 September 2016, online: NS Legislature <https://nslegislature.ca/legislative-business/committees/standing/economic-development/archive/economic-development/index.htm\> (accessed 1 August 2022).

The option to lease provides its holder with the exclusive right, for the duration of the option (up to 6 months renewable for another 6 months), to apply for an aquaculture lease for one or more sites within the area.[116] During this time, the holder is required to undertake the studies to prepare and submit its application, including a scoping process with early engagement with the local community.[117]

Before the expiration of the option to lease, the applicant must submit the application to the NSDFA, including a report on the scoping process and a development plan. NSDFA organizes a provincial and federal "network review" of the application and, if the Minister considers necessary or advisable in the circumstance, a consultation with any person, group of persons or organization.[118] The file and the reports of the network review and the outcomes of the consultations, if applicable, are then referred to the NSARB for adjudicative hearing.

Persons directly and substantially affected by a decision can act as intervenors (including full access to information, right to present witnesses, cross-examine witnesses, and appeal from the decision). The general public can submit written or oral statements during the hearing.[119]

Although the NSARB was established in 2015, to date only two applications have been decided by the Board, only one pertaining salmon farming, and none for new sites. There is, therefore, limited information about the interpretation and implementation of the aquaculture legal framework by the newly established body.

c) Simplified Process Before the Administrator

Decisions made by the Administrator follow a simplified procedure consisting of three stages: a pre-application phase (where the applicant is required to have an information session with NSDFA); a review phase (network review); and a 30 day public consultation in which members of the public are invited to submit written comments on the

[116] FCRA, *supra* note 20; *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 8.
[117] FCRA, *supra* note 20, s 46; *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 10.
[118] FCRA, *supra* note 20, ss 47(2).
[119] *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 41. A party to an application may appeal a Review Board decision to the Supreme Court of Nova Scotia, upon any question as to the jurisdiction of the Review Board or upon any question of law (FCRA, *supra* note 20, s 50).

application.[120] After the consultation period is closed, the Administrator must issue a reasoned written decision and publish it in the NSDFA's website.[121]

d) Network Review

Both the adjudicative hearing and the simplified administrative process require a network review, that is, a consultation with federal and provincial agencies with responsibilities on matters that may be relevant for the aquaculture application. In most cases, the agencies submit an opinion on a narrow subject-matter to be considered by the decision-making authority. The role of DFO in the process deserves some further comments.

Under its statutory responsibilities, DFO has more comprehensive oversight over the environmental interactions of the aquaculture operations. The statutory responsibilities are discharged through its opinion and recommendations to NSDFA and, if applicable, the conditions set in the letter of approval issued under ss 35 and 36 of the *Fisheries Act*. DFO performs an assessment and applies risk management strategies[122] in the licensing process, with the objective of avoiding or mitigating unacceptable impact on fish and fish habitat, including aquatic species at risk.[123] Unacceptable harm is defined with a broad narrative threshold: "any aquaculture activity that is anticipated to have population-level detrimental effects on wild fish".[124] Quantitative standards have been identified for the release of organic matter.[125] In both cases, a precautionary approach requires avoidance or mitigation of impacts well below thresholds.[126]

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[120] Comments received from the public that comply with all submission requirements will be posted on the Department's website when the Administrator's decision concerning that application is made and communicated.
[121] *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 42.
[122] The risk assessment follows a Pathways of Effect Framework. The Framework considers potential stressors on fish, fish habitat, aquatic species at risk, and their critical habitat. Stressors considered in the framework include: physical alteration of habitat structure, alteration in light, noise, release of nutrients and organic material, release of chemicals, release of farmed fish, and release of pathogens and sea lice. The risk assessment is supported by deposition models. Models for the spread of drugs are being developed. See: DFO, "Pathways of Effects for Finfish and Shellfish Aquaculture", Canadian Science Advisory Secretariat (CSAS) Science Advisory Report 2009/071, online: CSAS <https://waves-vagues.dfo-mpo.gc.ca/Library/339745.pdf> (accessed 14 July 2022).
[123] ICES, *Working Group on Environmental Interactions of Aquaculture (WGEIA)*. ICES Scientific Reports 2:112 (2020), online: ICES <http://doi.org/10.17895/ices.pub.7619> (accessed 14 July 2022) at 115.
[124] DFO, "Framework for Aquaculture Risk Management" (Draft) (March 2021), at 8 (in file with author). Stricter thresholds apply in case of species at risk according to the *Species at Risk Act*, *supra* note 55.
[125] *Aquaculture Activities Regulations*, *supra* note 56; ICES, *supra* note 123, at 116-117.
[126] DFO, "Framework for Aquaculture Risk Management", *supra* note 124.

e) Factors to be Considered in Decision-Making

The *Aquaculture Licence and Lease Regulations* lists the factors that must be taken into consideration by the decision-maker, stressing that all factors need to be considered. Thus, ecological, social, and economic considerations must be taken into account. The listed factors include:

- the optimum use of marine resources;
- the contribution of the proposed operation to community and Provincial economic development;
- fishery activities in the public waters surrounding the proposed aquacultural operation;
- the oceanographic and biophysical characteristics of the public waters surrounding the proposed aquacultural operation;
- the other users of the public waters surrounding the proposed aquacultural operation;
- the public right of navigation;
- the sustainability of wild salmon;
- the number and productivity of other aquaculture sites in the public waters surrounding the proposed aquacultural operation.[127]

The criteria are broad, and the decision-maker only has an obligation to consider each of these factors but not to give them any particular weight. The procedural requirements that the decision-makers considers all these factors and that it issues a reasoned decision that is publicly available contributes to an informed and transparent decision balancing multiple objectives. This is particularly evident in the semi-judicial setting of a Board. Whether this tool will be effectively use by decision-makers to strengthen public confidence in the system remains to be seen.

6.1.6. Operational and Monitoring Requirements

Once the license and lease are granted, the marine farm is subject to the conditions in its licence. Most operational requirements are, however, contained in a Farm Management Plan that the applicant must prepare and submit to the Minister for approval before the initial stocking of the site. The Farm Management Plan is the core document outlining

[127] *Aquaculture Licence and Lease Regulations*, *supra* note 52, s 3.

farming practices, monitoring, and reporting obligations in relation to fish health management,[128] environmental monitoring,[129] containment management,[130] and farm operations.[131] It is in the farming plan that the lease holder specifies, *inter alia*, the number of fish to be stocked, the farming density, and the fallowing period.

The Farm Management Plan is a living document: it can be amended during the duration of the license and lease with the approval of the Minister, and the Minister has the authority to require amendments to the Plan. The health section of the Plan must be updated once a year. The regulations do not consider any procedural obligations for the approval of this document or its amendments. Further, the Plan is not a public document. While the Minister "may" establish policies for the routine release of aquaculture related information held by the Department,[132] as a general rule this information does not include veterinary medical records.[133]

The regulations require that the operator identifies, for each procedure in the Farm Management Plan, as applicable, the critical control points, critical control limits, monitoring procedures, and corrective actions to be taken.[134] The regulations and guidelines developed by NSDFA identify specific content that must be included but few

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[128] For a holder of an aquaculture licence for salmon or trout, the fish health section of the Farm Management Plan must include: finfish husbandry and welfare, veterinary care and disease surveillance practices, biosecurity measures, and general emergency measures, including culling or mass stock depopulation practices; and procedures for managing sea lice.

[129] For holders of an aquaculture licence for finfish, the environmental section of the Farm Management Plan must include: processes for measuring oxic conditions within the boundaries of the site and at any other locations determined by the Minister; the monitoring schedule and associated process for reporting results; sampling locations for each monitoring event; processes for assessing and reporting on the stocking levels associated with monitoring events; a mitigation plan.

[130]For this section, the license holder must consider operating procedures that limit the risk of a breach; processes for installing and maintaining infrastructure in place to limit the risk of a breach; responses to breaches; areas of potential impact if a breach occurs; management of the site if unusual events or severe weather occurs; schedules for reporting the initial farm stocking and inventory levels during production; and proof of a professional engineer's approval of the design of the structures in place for containment management.

[131] The license holders must include in this section procedures consistent with industry best practices regarding: storing and disposing of feed, fuel, lubricants and chemicals; removing and disposing of accumulated refuse and decommissioned farm supplies and equipment; retrieving any gear or debris from the aquacultural operation that has broken loose; interactions with wildlife; maintaining the site in good order; and noise.

[132] *Aquaculture Management Regulations*, *supra* note 53, s 4.

[133] FCRA, *supra* note 20, ss 8(4)(5).

[134] *Aquaculture Management Regulations*, *supra* note 53, s 6(2).

explicit substantive requirements.[135] Critically, there are very few publicly available environmental standards. Some substantive requirements include: a mandatory year-class stocking (maximum of two year-class stockings for Rainbow trout); a maximum period of continuous stocking (36 months); a mandatory but undefined fallowing period; a mandatory removal of nets from the water after each production cycle for cleaning, disinfection, and testing.

Another key component of the Plan is the obligation to keep records, and in some cases to submit records to the authorities. Monitoring and reporting obligations are also set out in provincial or federal regulations. This monitoring information allows the NSDFA to determine whether the farmer is in compliance with its license. It also provides supporting information to make decisions regarding the approval of an amendment to the Plan, license variations, and license renewals. Only a subset of monitored concerns are publicly available (e.g. drugs and pesticide use,[136] escapes,[137] benthic monitoring results,[138] and infection with federally reportable disease[139]). Information is aggregated for the province and some public registers do not reflect the latest data.

a) Escapes

The holder of an aquaculture licence for finfish in a marine aquaculture site must conduct their aquacultural operation in a manner that is designed to prevent breaches.[140] The design of the structures in place for containment management must be approved by a professional engineer. The Farm Management Plan must identify, *inter alia*: the operating procedures that limit the risk of breach, including regular inspections and maintenance of structures; measures to be adopted in case of breach, including mandatory

[135] NSDFA, "Marine Finfish Farm Management Plan Minimum Compliance Requirements", online: NSDFA <https://novascotia.ca/fish/aquaculture/aquaculture-management/> (accessed 31 December 2022).
[136] Online: DFO <https://open.canada.ca/data/en/dataset/288b6dc4-16dc-43cc-80a4-2a45b1f93383> (accessed 25 May 2022).
[137] Online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/protect-protege/escape-prevention-evasions-eng.html#annual> (accessed 25 May 2022).
[138] Online: NS Open Data Portal <https://data.novascotia.ca/browse> (accessed 25 May 2022).
[139] Online: Canadian Food Inspection Agency (CFIA), "Federally reportable aquatic animal diseases in Canada", online: CFIA <https://inspection.canada.ca/animal-health/aquatic-animals/eng/1299155892122/1320536294234> (accessed 31 December 2022).
[140] *Aquaculture Management Regulations*, *supra* note 53, s 33.

notification to competent authorities; area of potential impact if a breach occurs; and a finfish marking plan.[141] Recapture of escaped salmon requires a federal licence.[142]

The containment section of the Farm Management Plan must be audited by a third party before initial stocking. It must also be audited after a report of breach of containment of more than 50 fish, and when one or more cultured salmonids are identified in a water body. In this latter case, the audit applies to all the aquaculture licence holders who have identified the respective water body as potentially affected by a breach, unless the licence holder has an approved marking plan that verifies that the fish are not part of its operations.[143]

b) Environmental Monitoring

Environmental monitoring must be undertaken under a provincial (*Aquaculture Management Regulations)* and federal (*Aquaculture Activities Regulations)* environmental monitoring program. Although the provincial and federal governments have made efforts to harmonize these two programs, they are not entirely coordinated.[144]

A holder of an aquaculture licence for finfish in a marine aquaculture site must conduct their aquacultural operation in a manner that maintains oxic conditions indicating that indicate that sufficient oxygen is present within the boundaries of the site.[145] Environmental monitoring focuses on sediment conditions under the cages. The sites can be classified in one of four conditions, based on measures of free sulphide (soft bottom) or presence of *Beggiatoa* or other similar species (hard bottom). The lease holder is required to adjust its mitigation plan if hypoxic conditions are detected. In case of

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[141] *Ibid*, s 15.
[142] *Fisheries Act*, *supra* note 55; *Atlantic Fishery Regulations, 1985*, SOR/86-21; *Maritime Provinces Fishery Regulations, 1985*, SOR/93-55. See also: NASCO, "Aquaculture Management in Canada: Advancing NASCO's International Goals", Doc CNL(16)44 (2016), online: NASCO <https://nasco.int/annual-meetings/> (accessed 31 December 2022).
[143] *Aquaculture Management Regulations*, *supra* note 53, s 33.
[144] Key differences include: the frequency of monitoring (the federal approach relies on one monitoring event per production cycle, NS requires annual monitoring at a minimum); the recognition of mixed bottoms (according to the *Aquaculture Activities Regulations*, *supra* note 56, if grab sampling fails in one sampling station, the whole site is classified as hard bottom, while NS considers a mixed bottom category); and the classification of a site's condition (the federal approach classifies the site as above or below acceptability threshold, while NS has adopted a tiered classification system for soft bottom sites that allows the province to adopt a risk-based response to increased impacts).
[145] *Aquaculture Management Regulations*, *supra* note 53, ss 32(1).

unacceptable hypoxic conditions, the site must be fallowed until the sediment recovers.[146] The Minister may require additional measures, including limiting approved stocking levels and adjusting the site layout.[147]

c) Sea lice

The lease holder is required to submit weekly sea lice counts from April 1 to January 15th of each year.[148] There is no public critical threshold and no public information on sea lice numbers either by site or aggregated. Based on reported information on sea lice chemical treatment, it has been considered that farmed salmon in NS is not significantly affected by sea lice loads.[149]

6.1.7. Area-based Management

The *Aquaculture Management Regulations* allow (but do not require) the Minister to establish aquaculture management areas, that is, an area with multiple sites for the purpose of managing fish health.[150] If such an area is established, the operators of sites within the area are required to agree, in writing, on coordinated management, including coordinated disease treatments and fallowing periods. If agreement cannot be reached, the Minister must determine the management requirements for the AMA.[151] To date, no AMAs have been established in the province. During the Doelle-Lahey review process, it was argued that the industry is "currently not sufficiently concentrated to warrant a large-scale application of bay management."[152]

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[146] *Aquaculture Activities Regulations*, *supra* note 56.
[147] *Aquaculture Management Regulations, supra* note 53, ss 32(3).
[148] See: NSDFA, Marine Finfish Farm Management Plan Minimum Compliance Requirements, online: NSDFA <https://novascotia.ca/fish/aquaculture/aquaculture-management/> (accessed 2 August 2022). For requirement of professional engineer's approval of the design of the structures in place for containment management, see *Aquaculture Management Regulations*, *supra* note 53, ss 15(g).
[149] See *supra* note 136 and Monterrey Bay Aquarium Seafood Watch, "Atlantic North America USA (Maine) and Atlantic Canada (New Brunswick, Newfoundland, Nova Scotia) Marine Net Pens" (6 December 2021), online: Seafood Watch <https://www.seafoodwatch.org/> (accessed 31 December 2022).
[150] *Aquaculture Management Regulations*, *supra* note 53, s 16.
[151] *Ibid*, s 17.
[152] NS, Independent Aquaculture Review, *supra* note 14, at 48. Individual companies with several sites in close proximity may voluntarily adopt coordinated management and treatment within their Farm Management Plan to minimize the risk of disease outbreaks.

6.2. Aquaculture Legal Framework in Chile[153]

Chile is the second largest producer of salmonids (Atlantic salmon, Coho salmon, and Rainbow trout)[154] after Norway and the leading producer of Coho salmon. It has also a significant production of bivalves (Chilean mussel)[155] and a small but increasing seaweed aquaculture.[156] The industry is heavily concentrated in the three southern regions of the country, which offer few alternative economic opportunities.[157] Thus, the industry is a significant contributor to Chilean economy generally[158] and particularly to rural economic growth, employment, and poverty reduction.[159]

Salmonids are non-native species in the country. Attempts to introduce salmonids in Southern rivers (focused on ranching and establishment of recreational fisheries) date back to the 19th and early 20th century. A commercial salmon farm was established in the late 1970s. By 1985, 36 farms produced 1,200 tonnes of salmonids. Production grew significantly during the 1980s and 1990s, favored by ideal oceanographic conditions in the Southern fjords, counter-seasonal advantages compared to other producers in the Northern hemisphere, supportive macro-economic policies, strong government support,

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[153] The information in this section is an updated summary of a legal report prepared by the author as a consultant to the FIPA Project 2017-17 "Propuesta de Política Nacional de Acuicultura de Chile para las Siguientes dos Décadas" (Cecilia Engler, "Marco Jurídico de la Acuicultura en Chile y Políticas Nacionales Relevantes para el Manejo del Sector Acuícola. Informe Final" (Junio 2019), Annex A to the Final Report of the Project Legal Framework and Relevant National Policies for Aquaculture in Chile, online: SUBPESCA <https://www.subpesca.cl/fipa/613/articles-96205_informe_final.pdf> (accessed 1 June 2022). See also: Jessica Fuentes Olmos & Cecilia Engler, "Three pillars for sustainable marine aquaculture: the evolving regulatory framework in Chile" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA: Edward Elgar, 2016) 213.

[154] Finfish production reached 978,328 tonnes in 2021 and 1,043,174 tonnes in 2020. Almost all finfish produced in Chile is salmonids (Subsecretaria de Pesca y Acuicultura (SUBPESCA), "Informe sectorial de Pesca y Acuicultura Consolidado (2020-2021)" [Consolidated Fisheries and Aquaculture Report (2020-2021)], online: SUBPESCA <https://www.subpesca.cl/portal/618/w3-article-114306.html> (accessed 26 May 2022).

[155] Bivalve production reached 431,297 tonnes in 2021 and 406,383 tonnes in 2020 (*ibid*).

[156] *Ibid.*

[157] *Ibid.*

[158] Seafood exports accounted for ca 7.5% of all product exports in 2021 and first trimester of 2022. 88% of these are salmon exports (Banco Central de Chile, "Indicadores de Comercio Exterior: Primer Trimestre 2022" [Trade Indicators: First Quarter 2022], online: Banco Central de Chile <https://us02web.zoom.us/jd9220537264?pwd=L1prYzRZVm92RCtkcFRmYXVXQ1Fidz09> (accessed 26 May 2022).

[159] Adams Ceballos, Jorge David Dresdner-Cid & Miguel Angel Quiroga-Suazo, "Does the location of salmon farms contribute to the reduction of poverty in remote coastal areas? An impact assessment using a Chilean case study" (2018) 75 Food Policy 68.

and few environmental regulations.[160] By 1992, Chile was the second largest producer of salmonids in the world. At the time of writing, there are 1358 salmon farms,[161] located in the internal waters of the Southern fjords. Around 500 are operating in any year,[162] producing close to 1 million tonnes.[163]

Environmental and social problems were evident in the 2000s and diagnosed in the 2003 National Aquaculture Policy, which however triggered little change.[164] In 2007, the industry was affected by a infectious salmon anemia outbreak that expanded quickly to most salmon farming areas, affecting all companies, and generating massive fish mortality and economic losses.[165] It also became clear that the industry was not supported by some sectors of the Chilean society.[166] These events triggered an overhaul of the regulatory framework, including by legal amendments in 2010, 2012, and 2013.[167] Two key regulatory innovations triggered by these reforms are worth mentioning at the outset. First, the legal reforms introduced a moratorium for new salmon farms in the South of Chile (Regions X, XI and XII) that is still in place.[168] While no new sites can be granted,

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[160] Jonathan R Barton & Arnd Fløysand, "The political ecology of Chilean salmon aquaculture, 1982–2010: A trajectory from economic development to global sustainability" (2010) 20 Global Environmental Change 739; Fuentes & Engler, *supra* note 153.

[161] The current number of salmon farms is contained in the list of salmon farm clusters (November 2021) published online: SUBPESCA <https://www.subpesca.cl/portal/619/w3-article-103129.html> (accessed 1 June 2022). Silva & Soto list 1357 salmon farms (Hugo Silva & Raimundo Soto, *Externalidades y Regulación de la Industria del Salmón en Chile y el resto del mundo*. Informe Preparado para le Consejo del Salmon (July 2022) [Externalities and Regulations of the Salmon Industry in Chile and the World][translation by author], online: Consejo del Salmon <https://www.consejodelsalmon.cl/wp-content/uploads/2022/07/Estudio-PUC-Informe-Final-Julio-2022.pdf> (accessed 9 August 2022), p 59). The total number of aquaculture leases in the country (for all species) is 3,263 (April 2022), information available online: SUBPESCA <https://www.subpesca.cl/portal/619/w3-article-92935.html> (accessed 2 June 2022).

[162] Silva & Soto, *supra* note 161.

[163] SERNAPESCA, "Anuario Estadístico de Pesca y Acuicultura 2021" [Statistical Yearbook for Fisheries and Aquaculture 2021], online: SERNAPESCA <http://www.sernapesca.cl/informacion-utilidad/anuarios-estadisticos-de-pesca-y-acuicultura> (accessed 3 June 2022).

[164] Fuentes & Engler, *supra* note 153; Beatriz Eugenia Cid Aquayo & José Barriga Parra, "Gobernanzas e Invisibilidades: Intereses y Racionalidades en la Regulación Socioambiental de la Salmonicultura en Chile" (2017) XX Ambiente & Sociedade 107.

[165] Frank Asche et al, "The Salmon Disease Crisis in Chile" (2009) 24 Marine Resource Economics 405; Fuentes & Engler, *supra* note 153.

[166] Fuentes & Engler, *supra* note 153, at 227ff.

[167] Key amendments were introduced after the fish health crisis in 2007 by Acts 20,434 of 2010, 20,583 and 20,597, both of 2012. Relevant amendments were also introduced through Act 20,657 of 2013, which focused on fisheries but modernized institutional structure and capacity and introduced legal principles for management.

[168] The initial moratoria were established by legislation (Acts 20,434 and 20,597). Currently, the SUBPESCA declared the AAA of the X, XI and XII Region as unavailable for aquaculture and suspended

relocation of existing sites and amendments of technical plans are allowed. Second, the reform introduced an area-based management measure, the salmon farm clusters or "neighborhoods" ("barrios"). Salmon farm clusters are groups of sites located within an area with geographical, oceanographic, and epidemiological characteristics that justify coordinated management.

Despite the regulatory amendments, controversy over the sustainability of salmon aquaculture continues.[169] Particularly contentious is the intensification of the industry in the pristine (and often protected) waters of the XII Region of Magallanes, which is opposed by environmental non-governmental organizations and Indigenous communities.[170]

Policy directions have been outlined in the 2003 National Aquaculture Policy,[171] which has not been revised. Further policy guidelines relevant to the sector are contained in the National Ocean Policy,[172] the National Biodiversity Strategy,[173] and the climate

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the reception of applications for new sites with the exception of relocations (SUBPESCA Orders N° 975 of 2012, N° 3264 of 2016, and N° 902 of 2020). The declaration was made under the authority of art 76 of the General Fisheries and Aquaculture Act (Ley General de Pesca y Acuicultura, DS N° 430 de 1991, del Ministerio de Economía, Fomento y Turismo, online: BCN <https://www.bcn.cl/leychile/navegar?idNorma=13315> (accessed 10 August 2022) [hereinafter LGPA]).

[169] A sign of that controversy is the number of Bills introduced in the Chilean Congress to address aquaculture generally, and in particular salmon farming. Bills include: Bills 12605-21 and 12758-21 on environmental regulations and climate change adaptation; Bill 13402-21 establishing a moratorium on new salmon farms; Bills 14712-21, 14758 -21 and 14811-21, all addressing salmon farms within protected areas (online: Senado, <https://www.senado.cl/> (accessed 17 December 2022).

[170] Claudio Carocca et al, *Incompatibilidad de la salmonicultura con la Reserva Nacional Kawésqar: Antecedentes y contribuciones para el proceso de elaboración del plan de manejo de la Reserva Nacional Kawésqar* [Incompatibility of salmon farming with the Kawésqar National Reserve: Background and contributions to the process of elaborating the management plan for the Kawésqar National Reserve](Greenpeace: 2021), online: Greenpeace <http://greenpeace.cl/pdf/2021/04/informe-kaweskar%20%281%29.pdf> (accessed 3 June 2021); Victoria Dannemann, "Patagonia chilena: ambientalistas exigen que salmoneras salgan de áreas protegidas" (6 October 2021) ["Chilean Patagonia: environmentalists demand that salmon farms leave protected areas"], online: Deutsche Welle <https://www.dw.com/es/patagonia-chilena-ambientalistas-exigen-que-salmoneras-salgan-de-%C3%A1reas-protegidas/a-59429202> (accessed 3 June 2022).

[171] Gobierno de Chile, "Política Nacional de Acuicultura" (2003) [National Aquaculture Policy], online: SUBPESCA <https://www.subpesca.cl/portal/616/w3-article-60019.html> (accessed 16 December 2022).

[172] Gobierno de Chile, "Política Oceánica Nacional de Chile", DS N° 74 of 2018, issued by the Ministry of Foreign Affairs [National Ocean Policy], online: BCN <https://www.bcn.cl/leychile/navegar?idNorma=1118403> (accessed 16 December 2022).

[173] Gobierno de Chile, "Estrategia Nacional de Biodiversidad 2017-2030" [National Biodiversity Strategy], online: Ministerio del Medio Ambiente <https://biodiversidad.mma.gob.cl/> (accessed 16 December 2022).

change adaptation plan for fisheries and aquaculture (in revision).[174] Most recently, the Undersecretary for Fisheries and Aquaculture has announced the government's intention to prepare a new aquaculture act[175] but no information has been provided on its goals or potential content.

6.2.1. General Legal and Institutional Framework

Aquaculture planning and management is regulated primarily under the 1992 General Fisheries and Aquaculture Act (as amended)[176] (hereinafter LGPA for its Spanish acronym). The LGPA's overall objective is the conservation and sustainable use of aquatic resources through the implementation of the precautionary approach, an ecosystem approach to fisheries regulations and the safeguard of the marine ecosystems in which these resources exist.[177] In implementing and interpreting the provisions of the Act and adopting management measures, authorities must consider several principles including: establishing long-term objectives for the conservation and management of fisheries and its ecosystems; the periodic assessment of the efficacy of measures adopted; the adoption of a precautionary approach; the adoption of an ecosystem approach; manage resources in a transparent, responsible and inclusive manner; collect and publicly share information on the aquatic resources and its ecosystems; and ensure adequate enforcement.

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[174] Gobierno de Chile, "Plan de Adaptación al Cambio Climático para Pesca y Acuicultura" (2015) [Climate Change Adaptation Plan for Fisheries and Aquaculture], online: Ministerio del Medio Ambiente <https://mma.gob.cl/cambio-climatico/> (accessed 16 December 2022).

[175] Aqua, "Julio Salas en Puerto Montt anuncio una nueva Ley General de Acuicultura" [In Puerto Montt, Julio Salas announces a new Act on Aquaculture] (10 November 2022), online: Aqua <https://www.aqua.cl/2022/11/10/julio-salas-en-aquaforum-puerto-montt-anuncio-una-nueva-ley-general-de-acuicultura/#> (accessed 16 November 2022).

[176] LGPA, *supra* note 168. The LGPA was first enacted in 1989 (Act 18,892) just before the transition to a democratic government in March 1990. As adopted, it never came into effect. It was modified by the newly elected Congress (Acts 18,899; 18,977; 19,009; 19,043; 19,066; 19079 and 19080) and its consolidated text, contained in DS N° 430 of 1991, of the Ministry of Economy, came into effect in 1992. Since then, it has been modified about 60 times (including significant amendments to the fisheries and management system and referential amendments).

[177] LGPA, *ibid*, art 1B, original text reads: "El objetivo de esta ley es la conservación y el uso sustentable de los recursos hidrobiológicos, mediante la aplicación del enfoque precautorio, de un enfoque ecosistémico en la regulación pesquera y la salvaguarda de los ecosistemas marinos en que existan esos recursos". This provision was incorporated in the LGPA only in 2013.

Several regulations under the Act govern aquaculture activities. Key regulations include the Aquaculture Lease Regulations,[178] the Aquaculture Environmental Regulations,[179] and the Fish Health Regulations for Aquaculture.[180] Each of them has been modified several times, in particular after 2007.

There are several other pieces of legislation relevant for salmon mariculture. In particular, institutional and legislative frameworks addressing nature protection and coastal zone use have evolved from their rather modest beginnings in the 1990s to complex legal regimes, with significant influence for salmon farming licensing, management, and enforcement. These frameworks include the Framework Environmental Act,[181] the Regulation on Environmental Impact Assessment adopted under it,[182] the Act establishing an Environmental Superintendence,[183] the Act creating Environmental Tribunals,[184] the Framework Act on Climate Change,[185] the National Policy on the Use of the Coastal Zone,[186] and the Act recognizing customary Indigenous use of marine and coastal space.[187] Several other pieces of legislation address specific aspects of the rearing process.

With Chile being a unitary country, the authorities responsible for implementing the relevant legislation are central authorities of the executive branch. These include: the Undersecretariat for Fisheries and Aquaculture (SUBPESCA for its acronym in Spanish) and the National Fisheries and Aquaculture Service (SERNAPESCA for its acronym in Spanish), both under the Ministry of Economy and Tourism; the Undersecretary of the Armed Forces under the Minister of Defense; the Environmental Assessment Service;

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[178] DS N° 290 of 1993 as modified by DS N° 50 of 2005, 202 of 2010 and 171 of 2014, all issued by the Ministry of Economy.
[179] DS N° 320 of 2001, issued by the Ministry of Economy, as amended.
[180] DS N° 319 of 2001, issued by the Minister of Economy, as amended.
[181] Act 19,300 of 1994, Ley sobre Bases Generales del Medio Ambiente (as amended) [hereinafter Framework Environmental Act].
[182] Reglamento del Sistema de Evaluación de Impacto Ambiental, DS N° 40 of 2012, of the Ministry of the Environment, as amended, [hereinafter Regulations on EIA].
[183] Act 20,417 of 2010, Ley Orgánica de la Superintendencia del Medio Ambiente [hereinafter Act on Environmental Superintendency]
[184] Act 20,600 of 2012, que crea los Tribuales Ambientales [establishing Environmental Tribunals].
[185] Act 21,455 of 2022, Ley Marco de Cambio Climático [Framework Act on Climate Change].
[186] Establece Política Nacional de Uso del Borde Costero del Litoral de la República, y establece Comisión que indica, DS N° 475 of 1994, of the Ministry of Defense [National Policy for the Use of the Coastal Zone, and establishes the commission].
[187] Act 20,249 of 2008 que Crea el Espacio Costero Marino de los Pueblos Originarios (Ley Lafquenche) [hereinafter Act creating the Coastal and Marine Space of Indigenous Peoples].

and the Environmental Superintendency. The Ministry of the Environment and Climate Change has broad responsibility over environmental matters and leads policy initiatives such as the National Aquaculture Policy or the sector's adaptation plan to climate change. Further, a high-level inter-ministerial body, the Council of Ministers for Sustainability and Climate Change, is responsible for approving legal, regulatory, and policy initiatives with environmental content and for submission to the consideration of the President.[188] Other central agencies have issue-specific authority over some aquaculture activities.

Despite the historically centralized form of government and administration, recent constitutional and legal amendments have strengthened decentralization.[189] Of relevance for the aquaculture sector, the zoning of the coastal zone under the National Policy on the Use of the Coastal Zone and the environmental assessment system consider decentralized decision-making processes. They will be addressed in more detail below.

The legal framework enshrines public-private cooperation and coordination in its institutional structure. The 2013 amendment to the LGPA established scientific advisory bodies (the aquaculture scientific and technical committees) integrated by experts appointed by the Minister in a public and competitive process.[190] It further created the National Aquaculture Commission as an advisory body in the elaboration and evaluation of actions, measures and programs required to implement the National Aquaculture Policy.[191] The Commission comprises representatives of different public agencies with competence over aquaculture as well as the private sector (aquaculture industry, ancillary services industry, and workers in the industry). The regional commissions on the use of the coastal zone are also integrated by representatives of different public agencies and of selected stakeholders.

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[188] Framework Environmental Act, *supra* note 181, art 71.
[189] Eg Acts 20,390 (2005) and 20990 (2017) amending the Chilean Constitution in the areas of regional government and administration.
[190] LGPA, *supra* note 168, arts 154-155. Three committees address, respectively, environmental issues, fish health issues, and marine planning.
[191] *Ibid*, arts 90A-90H.

6.2.2. Aquaculture Leases: General Framework

The installation and operation of a salmon fish farm in Chile requires a permit: an aquaculture lease that must be registered in the Aquaculture Registry.[192] In the original LGPA, aquaculture leases were issued for an indefinite period of time (subject to termination under specific grounds).[193] The 2010 legal amendment introduced a 25-year time limit, which can be renewed if some minimum environmental performance indicators are met.[194] Older leases were grandfathered, however. Thus, the majority of leases currently operating for salmon farming are not time limited.

The lease does not grant the owner property rights over the seabed or water column,[195] yet it grants property rights over the lease. Therefore, leases can be transferred, leased, mortgaged, and transmitted.[196] Leases are subject to an annual fee; part of these fees directly benefit the region and municipality in which the lease is located.[197]

The issuing of aquaculture leases is subject to strict spatial restrictions and a rigid application process. These will be analyzed in more detail below. As noted, there is currently a moratorium for new salmon farms in the South of Chile (Regions X, XI and XII).[198] Thus, at the time of writing the legal regime described below applies to lease relocations and amendments.

6.2.3. Spatial Planning

In the Chilean system, the approval of a site is subject to strict and binding spatial restrictions that need to be addressed first. For analytical purposes, they can be grouped into two categories: spatial planning instruments, and incompatibilities and minimum distances.

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[192] *Ibid*, art 67. It should be noted that some forms of aquaculture can also be undertaken in marine areas assigned to artisanal fishers for the exploitation of benthic resources (DS N°314 of 2004, issued by Ministry of Economy), to artisanal fishing communities (coves) (Act 21,027), or to Indigenous communities under the Act 20,249. They are unlikely to be relevant for salmon farming, however.
[193] LGPA, *supra* note 168, (original text of 1992) art 2(13) and art 142.
[194] *Ibid*, art 2(12) and 69 para 2, both introduced by Act 20434.
[195] *Ibid*, art 67bis.
[196] *Ibid*, arts 69 para 3 and 81, 81bis, 81ter, and 82.
[197] Fees for salmon farms are 20 UTM (unidad tributaria mensual), a standard monetary unit) per hectare per year (about US$1,380 as of 7 June 2022). Half of the fee is allocated to the municipality in which the site is located and to the regional development fund (*ibid*, art 84).
[198] See *supra* note 168 and accompanying text.

a) Spatial Planning Instruments

Two separate (and thinly harmonized) spatial planning instruments have a bearing on aquaculture siting. First, a sectoral planning instrument was incorporated in the 1992 LGPA: the appropriate areas for aquaculture (or AAA). Second, the National Policy on the Use of the Coastal Zone supports coastal zone planning instruments developed at a regional level.

The AAA is a public coastal or marine area[199] officially designated as suitable for the development of aquaculture activities (or for aquaculture over one or more species or group of species) by the Minister of Defense. Aquaculture activities in the marine environment must be located within AAA (but being within an AAA does not guarantee a site approval). To establish an AAA, the SUBPESCA must prepare a technical report that considers alternative uses of the marine areas (including fisheries, military uses, navigation, tourism) and the protection of the marine environment, including protected areas. Other public authorities participate as consultees. A proposed AAA must be subject to public consultation and, since 2009, a consultation with Indigenous Peoples if appropriate.[200]

The first AAAs were established in the mid-1990s on a regional basis, to allow for the development of the industry.[201] Generally, they comprise interior waters (bays and fjords) and coastal areas up to a distance of 1 nautical mile measured from normal or straight baselines. In most cases, they were designated by excluding areas with other uses and with limited environmental suitability studies. Very few new AAA have been established since.[202]

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[199] Public property for the common use of the Nation includes the beaches, the seabed and water column of the ocean. The land adjacent to the beach and up to a distance of 80m is also public land (except for historical private property titles). The management of these areas is assigned to the Minister of Defense.

[200] The *Indigenous and Tribal Peoples Convention*, 1989 (ILO Nr 169) was ratified by Chilean Congress and promulgated by DS N° 236 of 2008, issued by the Minister of Foreign Affairs. It entered into force on 15 September 2009. The regulations on the consultation process with Indigenous Peoples is contained in DS N° 66 of 2014, issued by the Minister of Social Development.

[201] Online: SUBPESCA <https://www.subpesca.cl/portal/616/w3-article-80985.html> (accessed 1 June 2022). The first AAA were established in 1993 and 1994, for the regions with most aquaculture activity and interest (*ibid)*.

[202] Significant new AAAs have been established only in the XII Region (DS N° 286 of 2018, issued by the Ministry of Defence). In other regions, AAAs have been amended for technical reasons or to eliminate AAAs.

In 1994, the government adopted the National Policy for the Use of the Coastal Zone.[203] The National Policy called for the adoption of integrated and multi-sectoral coastal zone plans (consisting of macro and microplanning) developed by public-private regional commissions[204] and approved by a National Commission.[205] The first region to undertake such a task was the XI Region, in large part as a response to what was perceived as a reckless expansion of the salmon farming industry into the region.[206] The final regional coastal zone plan was approved in 2004.[207] A second phase, the development of "microzoning" at the municipal level, has not been finalized.[208] Aside from the XI Region, only the IV Region has an approved coastal zone plan.[209] Other regions have initiated but not finalized the process.[210]

The co-existence of two zoning processes (the sectoral AAAs under the LGPA, and the integrated coastal zone plans under a national policy without direct legal authority) gave rise to several legal problems in the site application processes. This was eventually resolved through a 2010 amendment to the LGPA that grants legal recognition to the coastal plans, harmonizes both spatial planning instruments, and further requires the SUBPESCA to consult with the regional commission on coastal zone use before submitting a proposed AAAs to the approval of the Ministry of Defence.[211] The coastal planning instrument received further legal recognition through an amendment to the

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[203] National Policy for the Use of the Coastal Zone, *supra* note 186. "Borde costero" (here translated as coastal zone) is defined in the Policy as the area comprising fiscal beach land, beaches, bays, gulfs, straits, and interior channels, and the territorial sea of the Republic.
[204] Reglamento Interno de Funcionamiento de la Comisión Regional de Uso del Borde Costero de la República, Oficio Gabinete Presidencial N° 1 de 2005, [Internal Regulations for the Regional Commissions] online: Undersecretariat for the Armed Forces <https://www.ssffaa.cl/asuntos-maritimos/cnubc/cnubc-comision-nacional-de-uso-del-borde-costero-del-litoral/> (accessed 23 September 2022).
[205] *Supra* note 186.
[206] Fuentes & Engler, *supra* note 153.
[207] DS Nº 153 of 2004, issued by Ministry of Defense, Zonificación de Aysén. The Regional Commission on the Use of the Coastal Zone has initiated the process to amend the zoning plan. The amendments were submitted to a Strategic Environmental Assessment in June 2019 (see online: Ministry of the Environment <https://eae.mma.gob.cl/> (accessed 1 June 2022).
[208] The municipality of Dalcahue submitted a municipal microzoning for Strategic Environmental Assessment in 2014 but the process has not been finalized.
[209] Zonificación de Coquimbo, DS Nº 518 of 2005, issued by the Ministry of Defense.
[210] Regions VIII (Bio-Bio), XV (Arica y Parinacota), I (Tarapacá), II (Antofagasta), V (Valparaíso), VI (O'Higgins) and VII (Maule) have initiated the process but final coastal zoning plans are yet to be approved. See: Secretaria de Fuerzas Armadas, online <http://www.ssffaa.cl/index.php/zonificacion-del-borde-costero/> (accessed 1 January 2023)).
[211] LGPA, *supra* note 168, as amended by Act 20,434 of 2010.

Framework Environmental Act introducing strategic environmental assessment (SEA) to the Chilean legal framework. The amended Act requires a SEA for territorial planning instruments including the coastal zone plans.[212] The SEA is not required for the AAA, however.

While integrated coastal zone planning in Chile has been lagging, the procedural requirement to consult with the regional commission on coastal use prior to the establishment of AAAs can be considered an improvement towards planning that is decentralized, participatory, and integrated. Despite their consultative nature, the regional commissions have significant bearing on decisions on the use of the coastal zone. Nevertheless, the planning potential of AAAs is limited by further fragmentation of the legal framework on the use of the coastal zone, as explained below.

b) Incompatibilities and Minimum Distances

Even if a proposed site is located within an AAA and in areas compatible with aquaculture development under a coastal zone plan (if applicable), there are further spatial restrictions identified in law and regulations. A farm cannot be located on banks of hydrobiological resources, including algae.[213] Aquaculture cannot take place in marine and coastal areas requested by, or assigned to, Indigenous Peoples with the objective to safeguard customary uses of the coastal and marine space, including use of natural resources.[214]

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[212] See Framework Environmental Act, *supra* note 181, as amended, art 7 bis, ter and quáter. See also: Regulations on Strategic Environmental Assessment, DS N° 32 of 2015 issued by the Ministry of the Environment. The process of a strategic environmental assessment requires the participation of all relevant public authorities (as a minimum, the Ministries that comprise the Inter-ministerial Council for Sustainability and Climate Change) and a public consultation period. Through an integrated and participatory strategic environmental assessment process, the Act seeks to ensures that plans and policies consider and include environmental considerations in the context of sustainable development and include monitoring and assessment plans. While several coastal zone plans (macro and micro zoning) in elaboration have started an SEA, none of them has been finalized (see online: Minister of the Environment <https://eae.mma.gob.cl/> (accessed 23 September 2022)).

[213] LGPA, *supra* note 168, art 67 para 6.

[214] Act creating the Coastal and Marine Space of Indigenous Peoples, *supra* note 187. The Act allows for Indigenous communities to request the administration of delimited marine areas that have been customary used. It does not affect marine spaces already legally assigned at the time of the request, however, including previously issued aquaculture leases.

Further, aquaculture cannot take place in marine protected areas belonging to the national system of wildlife protection areas.[215] This prohibition does not apply to national or forest reserves, however, provided that the activity is compatible with the conservation objectives and management plan of such reserve.[216] This exception is highly contested, both on substantive[217] and procedural[218] grounds. The interpretation and implementation problems arise in part from the inconsistent and fragmented legislation addressing the protection of wildlife and habitats in terrestrial and marine spaces, pending the creation of a Service on Biodiversity and Protected Areas.[219]

Salmon farms must also respect minimum distances, defined in law or regulations, to marine protected areas[220] and to other leases for intensive or extensive farming.[221] Further, they cannot be located in "farm free corridors" between salmon farm neighborhoods and between macrozones.[222]

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[215] The designation of marine parks in the XII Region has forced the relocation of salmon farms previously granted inside the protected areas. Considering the rigidity of the aquaculture leasing system, the relocation process itself required special legislative authority (Act 20825 of 2015).

[216] LGPA, *supra* note 168, art 158.

[217] Carocca et al, *supra* note 170, argue that a coherent interpretation of art 158 of the LGPA (authorizing aquaculture activities within National Reserves) and art 67 para 7 of the LGPA (requiring a minimum distance of 1.5nm between a marine park or marine reserve and an aquaculture lease for intensive farming or extensive farming of non-native species) forces to conclude that the aquaculture activities that can be authorized within a national reserve exclude salmon farming. They argue that the protection of national reserves must be understood as equivalent, if not higher, than the protection provided in proximity of a marine reserve. The argument has been dismissed by the Auditor General, however, in decisions N° 83,278 (16 November 2016) and E121877 (2021), which are binding for the public agencies.

[218] An environmental decision approving a salmon farm assessed through an environmental impact statement was challenged on the grounds that, according to the Framework Environmental Act, *supra* note 181, the development should have been assessed on the basis of a study. Two grounds justified the claim: its proximity to a protected area (art 11(d)); and its proximity to Indigenous communities (art 11(c)). Further, it was argued that the proximity to Indigenous communities should have triggered an Indigenous consultation (Regulations on EIA, *supra* note 182, art 86). The challenge was successful but decided on substantive grounds (insufficient environmental information to assess impacts on the quantity and quality of renewable resources) rather than procedural objections to the approval (see: Comunidad Indígena ATAP y otros con Comisión de Evaluación Ambiental de la Region de Magallanes, Rol 20-2019 Tercer Tribunal Ambiental, decision 27 January 2021, confirmed by Supreme Court, Rol 14075-2021, Decision 14 of July 2021).

[219] The creation of the Service was mandated by the Framework Environmental Act, *supra* note 181, art 34. A Bill has been in discussion for 10 years but has not been approved (Bill 9404-12).

[220] LGPA, *supra* note 168, art 67 para 7 and 8. Intensive farming must be located at a minimum of 1,5nm from marine parks and marine reserves. Further, it needs to respect minimum distances defined in the coastal zoning plan with respect to terrestrial protected areas adjacent to marine areas.

[221] A salmon farm must be located at least 1,5nm (2 778m) from other intensive farms, and 400m from other intensive farms that use exclusively macroalgae as feed or extensive farms (Aquaculture Environmental Regulations, *supra* note 179, art 13). Farms that keep broodstock must be located at least 2,5nm apart, and at least 7nm from grow-out farms (Fish Health Regulations, *supra* note 180, art 23A). It should be mentioned that, due to an exception to the original distance requirement, in practice the salmon

The combined effect of aquaculture being excluded from Indigenous coastal and marine spaces and marine areas within national parks, has had a paralyzing effect in the approval of new AAAs. In turn, lack of AAAs has been a barrier for the reorganization of the industry and implementation of the new fish health provisions, ultimately affecting the industry's growth potential.

6.2.4. Site Permitting Process

A salmon farm (site) requires four distinct administrative decisions issued in sequence: the approval of an environmental impact assessment (by the regional evaluation commission);[223] the approval of a technical plan (by SUBPESCA); a lease that authorizes the use of a public marine area (issued by the Ministry of Defense); and the incorporation of the lease in a National Register for Aquaculture (by SERNAPESCA). Chile has implemented a single-window process for marine aquaculture applications. The application file is assessed sequentially by the different government agencies that verify compliance with regulatory requirements, in a process that has been refined over the years to promote efficiency. Importantly, applications are subject to a strict processing order based on the date of the application.

For the most part, the responsibilities of the authorities intervening in the process are well defined and their sectoral assessments are technical, regulated, and prescriptive,

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farms are often much closer together (Alejandro H Buschmann et al, "Salmon aquaculture and coastal ecosystem health in Chile: Analysis of regulations, environmental impacts and bioremediation systems" (2009) 52 Ocean & Coastal Management 243, at 244). The SUBPESCA projects that relocation of farms under the LGPA amendments will result in bigger farms located farther apart (Salmon Expert, "El Plan de Subpesca para relocalizar 500 concesiones de salmon da primer paso" [SUBPESCA plan to relocate 500 leases](24 December 2021), online: SalmonExpert <https://www.salmonexpert.cl/article/el-plan-de-subpesca-para-relocalizar-500-concesiones-de-salmon-da-primer-paso/> (accessed 7 June 2022).

[222] Fish Health Regulations, *supra* note 180, art 58G requires a minimum distance of 3nm between salmon farm clusters (neighborhoods), although exception may be allowed on technical grounds. Art 58L requires a minimum distance of 5nm between macrozones (the cluster of 2 or more neighborhoods). It should be noted that the "lease free areas" between neighborhoods and macrozones was only required after the ISA outbreak. Granted leases were grandfathered. Relocation has been difficult due to lack of available space within established AAA and difficulties in establishing new AAAs.

[223] Framework Environmental Act, *supra* note 181, art 10n), identifying projects that require an EIA, considers farming of aquatic resources. According to regulations, salmon farms with production of 35 tonnes or less are exempted from EIA (Reglamento del Sistema de Evaluación de Impacto Ambiental [Regulations on EIA], DS N° 40 of 2012 issued by the Ministry of the Environment, as amended, art 3(n.3)).

without much room for administrative discretion.[224] The most comprehensive assessment of the site's interaction with the marine environment takes place under the EIA, a process through which the authorities assess whether the impact of the project complies with all environmental regulations[225] and whether it has a significant negative impact on public health, renewable natural resources, living systems and customs of human groups, protected areas or species, scenic or tourist value, or cultural heritage.[226]

The project of a proposed farm must be submitted to the evaluation commission of the region in which the site will be located, [227] either through an environmental impact statement or an environmental impact study.[228] In most cases, salmon farms are submitted as a statement. The regional evaluation commission requests opinions from sectoral authorities with competence to issue sectoral environmental permits and agencies with general environmental responsibilities. The SUBPESCA participates in the process as a sectoral agency with competence to assess regulatory compliance with the LGPA and the Aquaculture Environmental Regulations. The responsibility to make a decision on the environmental assessment falls in most cases in the regional assessment commission. [229] The EIA decision identifies the details of the authorized activity, including the area, the species, the number and size of the cages, and the total authorized production, as well as conditions under applicable regulations.[230] The environmental assessment decision is binding on other authorities. If the project is approved, all authorities with environmental responsibilities must issue their respective environmental permits; if it is rejected, these cannot be issued.

Three features of the EIA process that applies to environmental impact statements are worth noting. First, the process only considers a public consultation period in

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[224] Eg verifying distance requirements, presence of natural fishing banks, or efficient use of leased space.
[225] Framework Environmental Act, *supra* note 181, art 2(j).
[226] *Ibid*, art 11.
[227] *Ibid*, arts 9 and 86.
[228] *Ibid*, art 11.
[229] The evaluation commission comprises the regional representative of the President and regional representatives of relevant ministers (Framework Environmental Act, *supra* note 181, art 86; Auditor General, Opinion 118757 of 2 July 2021, online: CGR <https://www.contraloria.cl/web/cgr/dictamenes-y-pronunciamientos-juridicos>.)
[230] The resolutions include the tonnes that can be produced in each production cycle.

exceptional circumstances and if members of the public request it.[231] This has not happened often.[232] Second, an environmental decision approving a project assessed through a statement does not consider a monitoring and follow-up program.[233] The third difference follows from the second one. The Act allows to review and amend an environmental decision in the case that the monitoring program or follow-up reveals significant differences with respect to the projected impacts at the time of the assessment.[234] Since projects assessed under an environmental impact statement do not have a follow-up program, the environmental decision cannot be revised.[235]

Until 2008, the terms of the environmental assessment decision and the approval of the technical project by SUBPESCA were the instruments defining the production capacity of each site. Considering the rigidity of the licensing process and the EIA decision, the government had limited options to alter them. Amendments to the Aquaculture Environmental Regulations and the Fish Health Regulations to address the infectious salmon anaemia crisis of 2007 introduced new management tools that enable adaptive adjustment of production capacity at farm and area level. They are described below.

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[231] Framework Environmental Act, *supra* note 181, arts 26, 30 and 30bis. The project must have an "environmental load" on local communities, that is, projects that have social benefits and environmental externalities. Public consultation is mandatory in the case of environmental impact studies.

[232] In a recent case, however, the Supreme Court ruled against the decision of the Environmental Assessment Agency to decline a public consultation process on the grounds that there were no human communities near the salmon farm. The Court considered potential far-field environmental externalities to be sufficient to trigger the obligation to open a public consultation (Comunidad Indígena ATAP y otros con Director Ejecutivo del Servicio de Evaluación de Impacto Ambiental, Corte Suprema, Sentencia causa Rol 60548 (31 January 2022), online: Corte Suprema <https://www.pjud.cl/tribunales/corte-suprema> (accessed 1 January 2023)).

[233] Such programs are only required from environmental impact studies (*ibid,* art 12). This is without prejudice of voluntary commitments included in the environmental impact statement and that become binding for the proponent (*ibid*, art 18).

[234] *Ibid*, art 25quinquies.

[235] Auditor General, Opinion 34811, 26 September 2017 and opinion 3727 of 5 February 2019. It is worth noting that the opinion cites the legislative history of the amendment that introduced art 25quinquies, in which the following was stated: "la revisión de oficio de las RCA [resolución de calificación ambiental] debiese ser regulada como un mecanismo excepcionalísimo, reconociendo que, en términos generales, modificar el contenido de una RCA atenta contra los procedimientos reglados y la certeza jurídica que debe emanar de actos administrativos en virtud del principio de juricidad" [the ex officio review of environmetnal assessment decisions should be regulated as a highly exceptional mechanism, recognizing that, in general terms, modifying the content of a decision violates regulated procedures and the legal certainty that should emanate from administrative acts by virtue of the principle of legality][Deepl Translate]. This paragraph highlights the tension between adaptive management and legal certainty addressed in Chapter 3.

6.2.5. Production Capacity Adjustments at the Site Level

The site approval (technical plan approved by SUBPESCA and EIA decision) specifies the maximum production allowed in a site, which is generally determined on the basis of existing oxic conditions in the leased area[236] and projected impact on natural resources within the area of influence of the project.[237] The operator cannot exceed this production limit. Additionally, the farm must comply with the maximum allowed farming density defined by Order of SUBPESCA.[238]

Once in operation, the allowed production capacity of the site may be further limited. A first limit may arise from the results of benthic impact monitoring protocols that ensure operations compatible with the carrying capacity of the site.[239] If critical thresholds are exceeded, the operator is required to fallow the site until the sediment recovers.[240] While the Aquaculture Environmental Regulations do not directly require a reduction of production in future production cycles, the regulatory framework provides incentives for the operator to keep the operation within the site's carrying capacity. Indeed, if an extended fallowing period is required, the farmer can miss the coordinated stocking window for the neighborhood and be forced to leave the site vacant for a full production cycle.[241] Additionally, poor performance may lead to the non-renewal of a lease (if applicable).[242]

A second adjustment of the maximum production of the site may result from its fish health performance, as reflected in the loss of fish during a production cycle. Low levels of fish loss (up to 10%) allow the farm to maintain the production authorized in the

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[236] The proposed site must demonstrate acceptable water quality and benthic conditions as measured through prescriptive baseline information and acceptability thresholds (Aquaculture Environmental Regulations, *supra* note 179, and accompanying Order under the Aquaculture Environmental Regulations, Order 3612 of 2009 issued by SUBPESCA, as amended).

[237] This broader assessment is undertaken by the regional evaluation commission based on the Framework Environmental Act, *supra* note 181, art 10, in order to verify that the project will not have a "significant negative impact on renewable natural resources". To this end, the applicant is required to submit depositional models (mostly DEPOMOD or newDEPOMOD).

[238] SUBPESCA, Order 1449 of 2009 as amended. The maximum allowed farming density is 17kg/m3 for Atlantic salmon, and 12kg/m3 for Coho and Rainbow Trout.

[239] LGPA, *supra* note 168, art 87; Aquaculture Environmental Regulations, *supra* note 179, and Order under the Aquaculture Environmental Regulations, *supra* note 236.

[240] Critical levels are defined in the Order under the Aquaculture Environmental Regulations, *supra* note 236.

[241] Fish Health Regulations, *supra* note 180.

[242] LGPA, *supra* note 168, art 69. Renewal process does not apply to grandfathered leases, which do not expire.

technical plan and EIA decision. If fish loss percentages are higher, however, the operator must reduce the production by 10% to 60%, depending on percentage of fish loss.[243]

6.2.6. "Neighborhoods" or Salmon Farm Clusters

The quick spread of the infectious salmon anaemia virus was attributed to the high density of farms and the high fish farming density. It became evident, therefore, that production needed to be managed and reduced at the area level to avoid recurrent sanitary crises. The amended legal framework introduced nested spatial units – the neighborhoods or salmon farm clusters (barrios, in Spanish) and the macrozones. The neighborhoods are defined areas that, due to epidemiological, oceanographic, operational, or geographic considerations, require coordinated fish health management.[244] The existing salmon farms in the three Southern regions have been grouped in 82 clusters or neighborhoods.[245] These 82 neighborhoods are further grouped in macro-zones, a management unit that becomes relevant in case of outbreak of diseases.[246] As noted earlier, the regulations require a fire-wall (lease-free corridors) between neighborhoods and between macrozones. Leases already granted within those firewalls are required to relocate, but relocation has been hindered by an increasingly difficult and slow process to establish new AAAs.

The area-based measure of neighborhood triggers two main regulatory effects. First, neighborhoods are subject to mandatory coordinated fish health management, including coordinated stocking, coordinated fallowing, coordinated treatment, as well as contingency measures in case of disease outbreak. Further measures at the neighborhood level can be adopted by voluntary agreement of the companies operating in the area.

Second, the regulations have introduced adaptive production capacity controls that apply at the neighborhood level and based on a performance score assigned to the

[243] Order 1503 of 2003, as amended, issued by the SUBPESCA. 60% reduction is required if fish loss in the site is greater than 25%.
[244] LGPA, *supra* note 168, art 2(52).
[245] Order N° 2782 of 2021 issued by SUBPESCA defining salmon farm groups (clusters) in the X, XI and XII Regions.
[246] Orders N° 1548 and N° 1549 (as amended), both of 2012, and N° 2247 of 2014, all issued by SUBPESCA establishing Macrozones in the X, XI and XII Regions.

area.[247] The performance score of each neighborhood considers the information of all the farms in the area regarding three criteria: fish health (loss of fish), production (proposed stocking for the next cycle), and environment protection (results of environmental benthic monitoring).[248] The farms within a neighborhoods with high biosecurity score may farm at the maximum farming density established by regulation.[249] The allowed farming density is increasingly reduced with lower biosecurity scores.[250]

The farming density controls have certain exceptions, as these operations are less efficient and can be economically unfeasible.[251] One exception mechanism allows individual sites with outstanding biosecurity performance to operate with higher farming densities than those allowed in its neighborhood.[252]

The second mechanism allows a company to implement a voluntary "stocking reduction program" for all its farms operating in the same production cycle, whether or not in the same neighborhood. The stocking program must reduce the number of fish to be stocked in the sites included in the program, compared to the previous production cycle. Regulations establish minimum required reduction levels based on fish health performance. The first time that a company opts for this mechanism (that is, for its first stocking plan), the stocking reduction is calculated based on two indicators of the previous production cycle: loss of fish, and percentage of cages that required treatment

[247] Fish Health Regulations, *supra* note 180, art 58H and 58M and ff, and Order 1503 of 2013, as amended, issued by SUBPESCA.
[248] Resolution N° 1503 of 2013, as amended, issued by SUBPESCA. The farming density is calculated twice a year: on 31 January for the neighborhoods that have mandatory fallowing between April and September of the same year; and on 31 July for the neighborhoods that have mandatory fallowing between October of that year and March of the following year. The calculation of the score may involve predicted, rather than actual, fish losses if the site is still in operation by the time of density calculations and proposals.
[249] *Supra* note 238.
[250] Order N° 3224 of 2018 issued by SUBPESCA. For Atlantic salmon, 15, 13, 11, 8 or 4kg/m3 depending on the score. In the case of Coho and trout, 11, 10, 8, 6 or 3 kg/m3.
[251] See: Fiscalía Nacional Económica, Oficio del Jefe de División Antimonopolios la Fiscal Nacional Económico de fecha 13 de abril de 2022, en Investigación en contra de SUBPESCA por posibles restricciones a la libre competencia en la industria salmonera, Rol N° 2529-19, online: FNE <https://www.fne.gob.cl/wp-content/uploads/2022/04/inpu_004_2022-Rol-2529-19.pdf> (accessed 2 June 2022).
[252] Fish loss of less than 5% in the production cycle. The site may maintain a farming density applicable to a neighborhood that has a biosecurity score in the immediately upper category. This incentive only applies if the neighborhood has a medium or good biosecurity score.

for sea lice.[253] For subsequent stocking plans, the required stocking reduction is calculated based on these two indicators and the amount of antibiotics used by the company in the sites included in the program. In this case, the operator may be able to increase the number of fish stocked (in relation to the previous cycle) if these three indicators show good performance.[254]

The stocking reduction program has been the preferred mechanism by the industry and is used for the majority of sites.[255] Unlike the farming density controls applied at the neighborhood level, the voluntary program directly controls production and, in many cases, will require a reduction in production. However, there are several incentives for its use. First, the operator has relative freedom to distribute its fish stocking among the sites included in the program. Second, the operator may stock sites at the maximum allowed farming density, even within barrios with poor biosecurity performance. Third, the sites included in the voluntary stocking reduction program are exempt from site-specific production adjustments.

6.2.7. Operational and Monitoring Requirements

As in other jurisdictions, Chilean farmers are subject to strict regulations addressing prevention and management of fish health and disease outbreaks,[256] containment, and

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[253] See: Order N° 904 of 2020 issued by SUBPESCA. The required reduction can fall in one of 10 categories depending on the number of cages that were treated for sea lice (more or less than 50% of cages) and fish loss (up to 10%, 10.1 to 14%, 14,1 to 20%, 20,1 to 25%, or more than 25%). Required stocking reduction varies between 3 and 21% of the fish stocked in the previous cycle.

[254] See: *ibid*. The reduction or increase of stocking numbers can fall in one of 30 categories. The criteria identified in *ibid* apply. Additionally, the sites are classified based on use of antibiotics per metric tonnes of production (between 0 and 150 gr per tonne; between 150,1 and 300 gr per tonne, between 300,1 and 600 gr per tonne). If more than 600gr of antibiotics were used per tonne of production, this indicator does not apply. A farmer can increase stocking only if fish loss is 14% or lower. Increases vary between 1 to 9%; reductions between 1 and 16%.

[255] Silva & Soto, *supra* note 161, at 68.

[256] The Chilean aquaculture legal framework considers lists of reportable diseases (List1 (diseases not occurring in the national territory); List 2 (disease present in the national territory, with high prevalence or distribution or high mortality or morbidity); and List 3 (present in part of the national territory with variable mortality and/or incomplete epidemiological description)). It considers mandatory reporting of suspected or known outbreaks of diseases; official investigation of a disease; zoning of areas infected, under surveillance or free of diseases; emergency measures adopted in case of outbreaks, including restrictions on use of equipment at the macrozone level. Further, the operator must comply with the requirements included in general or specific fish health programs (protocols) issued by the SERNAPESCA to address either routine activities in the salmon farms (e.g. general fish health protocol on vaccination, on active surveillance of high risk (List 1) diseases, on feed management, on mortality management, etc) or a specific disease in the

waste management.[257] These obligations are contained in regulations or orders of general application issued under the LGPA, Aquaculture Environmental Regulations, and Fish Health Regulations.

Operators must submit contingency plans for approval by SERNAPESCA for each site and also for two or more farms (which may be the neighborhood) to address circumstances that affect more than one site. The plan must consider at least extreme weather events, earthquakes, massive mortality, marine mammal interactions,[258] collision of vessels with infrastructure, harmful algal blooms, and escapes.

The industry is also subject to extensive reporting obligations, including information to operationalize the production controls at the site and neighborhood level as well as to comply with general or specific sanitary programs. Some of that information is publicly available,[259] although in some cases the information is aggregated and not always up to date.[260] Specific regulatory measures for environmental monitoring, escapes and sea lice are included below.

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area identified in the program (e.g. specific fish health programs for ISA, specific fish health program for sea lice).

[257] A recent Act has made it mandatory for operators to prevent and reduce the deposit of inorganic and organic material on the lease's sediment (Act 21410 of 2022, entering into force in January 2024). The Act will require recovery plans and research plans that promote the development of physical, chemical, or biological methods that improve sediment condition and accelerates the assimilation of organic material. Steep sanctions for the failure to clean the inorganic waste from the site are also considered.

[258] The Aquaculture Environmental Regulations, *supra* note 179, were amended to introduce additional measures to protect marine mammals, including enhanced reporting, as a response to the United States Import Provisions that require that marine mammal bycatch associated to international commercial fishing operations to have in place marine mammals protections that are equivalent to U.S. standards in effectiveness.

[259] These include, for example, specific information on containment structures, stocking plans, fish mortality, environmental results, and fish health information. Despite extensive reporting obligations, there have been doubts on the compliance level of the industry and its effects on the efficacy of the regulatory controls. Some companies have been charged with submitting false information on mortality levels. The company was sanctioned with the highest possible fine and suspension of operations for one productive cycle. See: Fundación Terram, "Corte de Apelaciones aumenta sanción a Nova Austral y suspende operación de uno de sus centros de cultivo" (30 December 2020), online: Fundación Terram <https://www.terram.cl/2020/12/corte-de-apelaciones-aumenta-sancion-a-nova-austral-y-suspende-operacion-de-uno-de-sus-centros-de-cultivo/? (accessed 7 June 2022). For problems with compliance and enforcement more generally, see: Buschman et al, *supra* note 221.

[260] Bill 11571-21 currently discussed in the Chilean Congress considers mandatory publication of mortalities, harvest, use of antibiotics and sea lice chemical treatment at the end of the production cycle.

a) Environmental Monitoring

Monitoring requirements for salmon farming companies have been generally limited. The Aquaculture Environmental Regulations requires monitoring the condition of the sediment under the cages with highest biomass shortly before harvest. Acceptability thresholds are defined in regulations with a dual (pass/fail) classification. The consequence of an unacceptable impact is the need to fallow until the sediment recovers.[261]

A new monitoring measure for water quality has been introduced through two different regulatory paths: a 2010 amendment to the LGPA implemented in 2022,[262] and an order issued by the Environmental Superintendency under its general environmental responsibilities.[263] Salmon farms operators are required to install a monitoring system that records and transmits, in real time, defined oceanographic and meteorological information.[264] The management of the records is entrusted to the national fisheries and aquaculture research institute (IFOP) and the Superintendency, respectively. What is noteworthy about the monitoring system under the LGPA is that the regulations authorize the operators of salmon farms that belong to one neighborhood to submit an integrated monitoring plan, reinforcing management at this spatial level.[265] The monitoring program is currently not linked to thresholds or action rules.

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[261] See: Aquaculture Environmental Regulations, *supra* note 179, and Order under the Aquaculture Environmental Regulations, *supra* note 236. Acceptability thresholds have been identified for organic matter, pH and Redox, and dissolved oxygen.

[262] The obligation is included in LGPA, *supra* note 168, art 87ter (introduced by Act 20434), regulated by DS N° 1 of 2020, issued by the Ministry of Economy and published in the Official Gazette in January 2021. Technical requirements were specified by Order N°3408 of 2021 issued by SUBPESCA (published December 2021), as required by art 9 of the Regulations. In 2022, the obligation applies to one neighborhood in each of the salmon producing regions (Order N° 3454 of 2021 issued by SUBPESCA).

[263] Currently in Order N° 2662 of 2021, as amended by Order N° 1488 of 2022, both issued by the Environmental Superintendency. The two monitoring systems are thinly coordinated (see clause 7(b)).

[264] Oceanographic variables include: temperature, conductivity/salinity, pressure, currents, turbidity, dissolved oxygen, and pH. Meteorological variables include: temperature, atmospheric pressure, wind, precipitation, and solar radiation. The Superintendency only requires dissolved oxygen in the water column, salinity and temperature.

[265] DS N° 1 of 2020, issued by the Ministry of Economy, art 10; Order N° 2662 of 2021, as amended by Order N° 1488 of 2022, both issued by the Environmental Superintendency.

b) Escapes

The measures to prevent and manage escapes and to mitigate the potential impacts of escapes are established in the LGPA and the Aquaculture Environmental Regulations.[266] According to the Regulations, cages and structures must be suitable for the geographic and oceanographic conditions of the leased area, as verified by an engineering study. Structures must be regularly inspected and maintained, and their safety must be certified once a year.[267] Further, the containment structures must include nets that reduce interaction with marine mammals.[268]

The farm management plan must consider contingency measures to address escapes. If an escape occurs, the lease holder must report the escape to the authorities and recapture escaped fish for a period of 30 days, which can be extended by SERNAPESCA.[269] The LGPA included a presumption of environmental damage if the lease holder does not capture at least 10% of the escaped fish.[270] In one mass escape event in the XII Region, the Superintendency relied on the presumption of environmental harm to sanction the responsible company with a steep fine, which is currently under judicial review. Further, the State sued the company to obtain reparation of environmental damage. The company successfully requested the Constitutional Tribunal to declare the legal presumption of environmental damage unconstitutional and inapplicable in both judicial proceedings.[271] A decision on the substance in both cases is still pending.[272]

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[266] Bill 11571-21 currently discussed in the Chilean Congress considers strengthening the legal framework to prevent and mitigate escapes, including by establishing stronger sanctions for escapes, and the obligation to carry out a monitoring program in the wider area for 2 years after an escape event.
[267] Order N° 1821 of 2020, SUBPESCA, "Establece Metodología para el Levantamiento de Información, Procesamiento y Cálculos del Estudio de Ingeniería, y Especificaciones Técnicas de las Estructuras de Cultivo a la que se Refiere el Artículo 4° Letra E) del D.S. 320 de 2001", [Methodology for Baseline Information, Processing, and Calculations of the Engineering Study, and Technical Standard for the Farming Structures under the Aquaculture Environmental Regulations].
[268] Aquaculture Environmental Regulations, *supra* note 179, art 4(e).
[269] *Ibid*, art 6 para 2.
[270] LGPA, *supra* note 168, art 118 quáter.
[271] Tribunal Constitucional de Chile, Sentencias en Causas Rol 10.109-21-INA (31 March 2022) y Rol 10.576-21-INA, Requerimientos de Inaplicabilidad Respecto del Artículo 118 Quáter de la Ley N° 18.892, General de Pesca y Acuicultura, online: Tribunal Constitucional <https://www2.tribunalconstitucional.cl/> (accessed 16 December 2022).
[272] Tercer Tribunal Ambiental, Causas Rol R-27-2020, R-31-2020 and D-5-2020, online: Tercer Tribunal Administrativo <https://causas.3ta.cl/> (accessed 16 December 2022).

c) Sea Lice

Lease holder must comply with the specific fish health program for *Caligus rogercressegi* issued by the SERNAPESCA.[273] The program considers coordinated treatment for sea lice at the neighborhood level, in the opportunities determined by the SERNAPESCA.[274] It requires weekly monitoring of salmon farms subject to high surveillance, and monthly monitoring for other salmon farms,[275] as well as monitoring the sensitivity of sea lice to chemical treatments.[276] If thresholds levels are reached, the site is required to adopt more stringent measures. Repeated breaching of threshold levels has a mandatory early harvest of 25 to 50% of the biomass in site.[277] While the program is very prescriptive, the lease holders in a neighborhood have the option to adopt, by agreement, a voluntary program for the management of sea lice establishing their own coordinated treatment strategies.[278]

6.3. Aquaculture Legal Framework in Scotland

Scotland is one of the pioneers in salmon farming. While hatcheries to support recreational fisheries were established in the 19th century, the first marine fish farm was established at Loch Ailort in Inverness-shire in 1965. The first commercial harvest was reported in 1971.[279] The industry expanded in the following years. While in 1986, the production of salmon farming was a modest 10,500 tonnes, it increased to ca. 130,000 tonnes in 2000, and ca. 180,000 tonnes in 2014.[280] In 2021, production exceeded 200,000

[273] Resolución N° 60 de 2022, que aprueba programa sanitario especifico de vigilancia y control de caligidosis [Specific fish health programme for the surveillance and control of sea lice], online: SERNAPESCA <http://www.sernapesca.cl/area-trabajo/acuicultura> (accessed 17 December 2022).
[274] *Ibid*, at 8 (in particular 8.2.6.).
[275] Almost all farms for salmon and trout farms are high surveillance farms; farms with coho and chinook are low surveillance farms (*ibid*, para 5.1 and 5.2). High surveillance farms are considered "high dissemination" farms when the monitoring results after coordinated treatment against sea lice show an average of 3 or more adult female lice per fish.
[276] *Ibid,* para 7. The monitoring is required for at least one site of the license holder in each of the neighborhoods.
[277] *Ibid*, para 8.4.
[278] *Ibid*, para 8.7.
[279] Salmon Scotland, "The history of Scottish salmon farming" (n/d), online: <https://www.salmonscotland.co.uk/facts/innovation/the-history-of-scottish-salmon-farming> (accessed 15 March 2023).
[280] Chris Berry & Alistair Davison, *Bitter Harvest A call for reform in Scottish aquaculture* (Perthshire, WWF Scotland, 2001) at 7; Tim Ellis et al, "Trends during development of Scottish salmon farming: An example of sustainable intensification?" (2016) 458 Aquaculture 82, at 88.

tonnes, the highest level of production recorded in Scotland,[281] with a reported value of more than one billion U.S. dollars.[282] While Scotland also produces other finfish (e.g. Rainbow trout, cod, and halibut) and shellfish (e.g. mussels, scallops, and oysters), Atlantic salmon is the predominant species representing more than 90% of total fish and shellfish production.[283] Further, Scotland is the main aquaculture producer in the United Kingdom (UK).

Currently, 11 companies are active across approximately 230 seawater cage sites (not all active at the same time)[284] distributed off the islands and in the lochs of the west coast of Scotland and within and around the northern islands of Orkney and Shetland.[285] There is a presumption against finfish farming development in the north and east coasts to safeguard migratory fish species.[286]

The industry has the ambition to double the economic contribution of the sector by 2030,[287] an ambition that is generally supported by the Scottish Government.[288]

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[281] Marine Scotland Science, "Scottish Fish Farm Production Survey 2021", online: Scottish Government <https://www.gov.scot/publications/scottish-fish-farm-production-survey-2021/documents/> (accessed 13 March 2023) [hereinafter Fish Farm Survey].
[282] Or 1,065,989,670 pound sterling (*ibid*).
[283] *Ibid*; Marine Scotland Science, "Scottish Shellfish Farm Production Survey 2021", online: Scottish Government <https://www.gov.scot/collections/scottish-shellfish-farm-production-surveys/> (accessed 15 August 2022).
[284] Scottish Government, "A Review of the Aquaculture Regulatory Process in Scotland", Report by Russel Griggs (February 2022), online: Scottish Government <https://www.gov.scot/publications/review-aquaculture-regulatory-process-scotland/> (accessed 6 May 2022) [hereinafter Griggs Report], at 26; Marine Scotland Science, Fish Farm Survey, *supra* note 281; Avison Young, Webster Rae & Powis Hughes, "A Review of Rent and Lease Terms for Marine Aquaculture in Scotland" (January 2021), Report prepared from Crown Estate Scotland, online: CES <https://www.crownestatescotland.com/resources/documents/aquaculture-review-report-jan-2021> (accessed 13 August 2022) at 23.
[285] Anne-Michelle Slater, "Aquaculture and the law: United Kingdom and Scotland" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Edward Elgar 2016) 412 at 412; Caitriona Carter, "Actor intentions implementing 'ecosystem Europe': The contested case of aquaculture" (2021) 124 Environmental Science and Policy 305, at 307.
[286] Scottish Government, *Scotland's National Marine Plan: A Single Framework for Managing Our Seas* (Edinburgh: The Scottish Government, 2015), at 50. The Government has reiterated the policy, with stronger language ("will not be supported") in the Draft National Planning Framework 4. See: Scottish Government, "Scotland 2045: Our Fourth National Planning Framework", Revised Draft, laid before the Scottish Parliament on 8 November 2022, Policy 32(a) at 91, online: Scottish Government <https://www.gov.scot/publications/scotland-2045-fourth-national-planning-framework-draft/> (accessed 13 December 2022) [hereinafter Scottish Government, Revised Draft NPF 4].
[287] Scotland Food and Drink, *Aquaculture Growth to 2030: A Strategic Plan for Farming Scotland's Seas* (2016), online: <https://www.salmonscotland.co.uk/sites/default/files/2021-06/Aquaculture_Growth_2030.pdf> (accessed 9 June 2022). The strategy states that "sustainably achievable projections for 2030 could be in the range of 300,000 to 400,000 tonnes per annum for finfish production."

Nevertheless, there is broad agreement that in order to achieve that ambition, the industry has to improve sustainability. In 2020, the salmon producers' association released a sustainability charter with five pledges, focusing on fish health and welfare, environment, traceability, opportunities, and local communities.[289]

One of the identified barriers for sustainable growth is the regulatory framework, which is perceived at "unfit for purpose".[290] The legal framework for aquaculture has been criticized as fragmented ("complex, confusing and disjointed"[291]) and focused on individual developments without a strategic approach.[292] And while some sectors consider it to be a highly regulated industry, others consider that the government provides a "'light touch' regulation and enforcement".[293] A 2017-2018 Parliamentary inquiry on salmon farming in Scotland concluded that "maintaining the status quo in terms of the regulatory regime in Scotland is not an option,"[294] and made 65 recommendations to improve different aspects of the regulatory process. The Scottish Government accepted the recommendations and initiated a number of initiatives to reform the regulatory framework,[295] but arguably without driving significant changes.[296]

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[288] Slater, *supra* note 285, at 416.
[289] Salmon Scotland (formerly Scottish Salmon Producers' Organisation or SSPO), *Scottish Salmon: A Better Future for Us All* (November 2020), online: <https://www.salmonscotland.co.uk/betterfuture> (accessed 16 June 2022).
[290] Clara McGhee, Lynne Falconer & Trevor Telfer, "What does 'beyond compliance' look like for the Scottish salmon aquaculture industry?" (2019) 109 Marine Policy 103668, at 3,4,5 and 8; Griggs Report, *supra* note 284.
[291] The Scottish Parliament, Rural Economy and Connectivity Committee, "Salmon Farming in Scotland" SP Paper 432, 9th Report (Session 5) (27 November 2018), at 109 [hereinafter Scottish Parliament, Salmon Farming in Scotland].
[292] *Ibid*, at 92.
[293] *Ibid*, at 111. Some participants in the review process were not in agreement with this statement, claiming that the regulatory standards in Scotland are very highly regarded internationally, which is why Scottish salmon prices have a premium price (*ibid* at 37).
[294] *Ibid*, Recommendation 60 at 16.
[295] These include, for example: the requirement to include an Environmental Management Program in planning permissions; the strengthening of SEPA's regulatory framework; the Farmed Fish Health Framework published in 2018 and updated in 2020; an Independent Review of Aquaculture Consenting (published in 2016); a Salmon Interactions Working Group and its Report with 40 recommendations; and a consultation on a new adaptive spatially-based risk assessment framework for sea lice emissions.
[296] Scottish Parliament, Rural Economy and Connectivity Committee, Session 5 Legacy Report, SP Paper 1018, 5th Report (Session 5) (23 March 2021), online: <https://sp-bpr-en-prod-cdnep.azureedge.net/published/REC/2021/3/23/1254bf5f-3247-4a40-83f3-d7d97073fc66-1/RECS052020R5.pdf> (accessed 15 August 2022), para 72 and 73 at 21.

The 2021 Scottish Government and Scottish Green Party Shared Policy Programme reiterated the acceptance of the recommendations of the Parliamentary review, and committed to specific actions:

- undertake an independent regulatory review leading to reform of regulatory and planning framework;
- develop a vision and strategy for sustainable aquaculture, focusing on environmental protection and community benefit (not released at the time of writing);
- begin an immediate programme of work to better protect wildlife and the environment focused on three areas: interactions with wild salmon; sea lice (including wrasse); and fish escapes; and
- explore options to ensure contributions to communities and other local activities, innovation, and support services.[297]

In fulfilling its first commitment, the Scottish Government commissioned an independent review of the regulatory framework. The final report, released in February 2022, once again concluded that the aquaculture regulatory framework is "not fit for purpose" and recommended a package of measures to deliver a unified consenting framework.[298] The Government has accepted its recommendations and announced measures for its implementation.[299] Considering this commitment and several concurrent initiatives to enhance the regulatory framework and address research needs, the Scottish regulatory system is particularly dynamic at the time of writing.

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[297] Scottish Government and Scottish Green Party, "Shared Policy Programme: Working Together to Build A Greener, Fairer, Independent Scotland" (1 September 2021), a component of the Cooperation Agreement between the Scottish Government and the Scottish Green Party Parliamentary Group (1 September 2021), online: Scottish Government < https://www.gov.scot/publications/cooperation-agreement-between-scottish-government-scottish-green-party-parliamentary-group/documents/> (accessed 16 June 2022).
[298] Griggs Report, *supra* note 284. The Report suggest a 12 month timeline to deliver these measures.
[299] In May 2022, the Scottish Government committed to the establishment of a Ministerial Aquaculture Strategy Forum to deliver the recommendations of the independent regulatory review, including assisting in the elaboration of the Government's Vision for the sector, to be released later in 2022. It also committed to a small consenting task force to make rapid changes to streamline the consenting process. It further requested to the Scottish Science Advisory Council to give consideration to the science recommendations in the Report. See: Scottish Parliament, Question ref. S6W-08393 answered by Mairi Gougeon on 3 May 2022, online: <https://www.parliament.scot/chamber-and-committees/written-questions-and-answers/question?ref=S6W-08393> (accessed 16 June 2022); Scottish Government, "First stage of aquaculture review complete" (11 February 2022), online: Scottish Government <https://www.gov.scot/news/first-stage-of-aquaculture-review-complete/> (accessed 10 June 2022).

6.3.1. General Legal and Institutional Framework

Since 1999, Scotland and the United Kingdom both have responsibility over the seas adjacent to Scotland through a mix of reserved, devolved and executively devolved powers. In the internal waters and territorial sea, the Scottish Ministers have devolved responsibility with the exception of reserved issues such as oil and gas and shipping. In the EEZ, the Scottish Ministers have devolved responsibility over fisheries and executively devolved responsibilities over aquaculture, nature conservation, marine planning, and renewable energy.[300] Considering the current distribution of finfish farming in Scotland, the main legislation addressing the activity is therefore Scottish law. Nevertheless, in some areas Scottish law must be consistent with UK law. Further, Scotland applies retained European Union law (e.g. the Water Framework Directive,[301] Habitats Directives,[302] and environmental impact assessment directives[303]).[304]

Scottish legislation for aquaculture is fragmented, with many different primary and secondary legislation administered by several different agencies addressing some aspects of it. While Scotland has enacted the *Aquaculture and Fisheries (Scotland) Act*

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[300] *Scotland Act 1998* (UK), 1998, c 46; Scottish Government, *Scotland's Marine Atlas: Information for The National Marine Plan* (16 March 2011), Chapter 1, online: <https://www.gov.scot/publications/scotlands-marine-atlas-information-national-marine-plan/pages/5/> (accessed 13 June 2022).

[301] *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*, [2000] OJL 327 [hereinafter Water Framework Directive].

[302] *Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7 and *Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds*, [2009] OJ L 20/7 [collectively, Habitat Directives].

[303] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30 [Strategic Environmental Assessment Directive]; *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment* [2012] OJ L 26/1, as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 [2014] OJ L 124/1 [Environmental Assessment Directive].

[304] Following Brexit, the EU legislation applicable to the United Kingdom on 31 December 2020 is now part of UK's domestic legislation ("retained EU legislation") and under control of the UK's Parliament and Assemblies (*European Union (Withdrawal Agreement) Act 2020* (UK), 2020, c1, ss 2, 3, in relation to ss 1, 39). While there is no legal obligation to continue to comply with EU law, the Scottish Government has signalled that, "'where appropriate', they would like to see Scots law continue to align with EU law" (Iain McIver, Alignment with EU law and the Continuity Act, Scottish Parliament Information Center (SPICe) Briefing, SB 21-75 (29 October 2021), online: <https://sp-bpr-en-prod-cdnep.azureedge.net/published/2021/10/29/4f46ce9c-c87e-4f5e-9ccf-d28df6a8ca2e/SB%2021-75.pdf> (accessed 13 June 2022). The *UK Withdrawal from the European Union (Continuity) (Scotland) Act 2021,* 2021 asp 4, provide "keeping pace powers" (power conferred to Scottish Ministers to allow them to make regulations to the effect of continuing to keep Scots law aligned with EU law in some areas of devolved policy) in relation to environmental protection and animal health and welfare (*ibid*)).

2007 and the *Aquaculture and Fisheries (Scotland) Act 2013*, these pieces of legislation do not address the activity comprehensively and in particular do not address consenting or planning considerations.[305] These aspects are governed by other pieces of legislation: the *Town and Country Planning (Scotland) Act 1997*, the *Water Environment and Water Services (Scotland) Act 2003*, the *Scottish Crown Estate Act 2019, Marine (Scotland) Act 2010*, and the *Animal Health and Welfare (Scotland) Act*, *2006*. Further, all public bodies have a duty to further the conservation of biodiversity under the *Nature Conservation (Scotland) Act 2004*.

Key agencies with competence over one or more aspects of finfish farming include Crown Estate Scotland, the Scottish Environmental Protection Agency (SEPA), and Marine Scotland (including the following divisions: Marine Scotland Science, Marine Scotland Licensing Operations Team, and Marine Scotland Science Fish Health Inspectorate). Further, the local governments (local councils) have important consenting authorities. Other authorities intervene in several processes as statutory consultees (e.g. NatureScot, formerly Scottish Natural Heritage).

The legal and institutional fragmentation has created problems of coordination, complexity, and duplicity, but perhaps more importantly has on occasion been a barrier for some regulatory concerns to be properly addressed. For example, while sea lice were addressed by one agency (the local authority), medicines for sea lice were addressed by another (SEPA).[306] There was unclear direction on the authority responsible for farmed fish interaction with wild salmon, which was only recently addressed by assigning responsibility to SEPA.[307] SEPA has also been transferred responsibility for discharges of wellboats previously overseen by Marine Scotland.[308]

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[305] Key aquaculture aspects considered in these Acts are: containment (including the power to adopt regulations to prescribe technical requirements for equipment to be used for or in connection with fish farming, reporting obligations, and inspection and enforcement powers); sea lice (including reporting obligations, inspection and enforcement powers); and operation of wellboats.
[306] Scottish Parliament, "Salmon Farming in Scotland", *supra* note 291, at 109.
[307] Marine Scotland, "Salmon Interactions Working Group Report: Scottish Government Response" (October 2021), online: Scottish Government <https://www.gov.scot/publications/salmon-interactions-working-group-report-scottish-government-response/> (accessed 20 June 2022).
[308] *Ibid.*

Several aspects of aquaculture are addressed by industry self-regulation in the form of Salmon Scotland's *A Code of Good Practice for Scottish Finfish Aquaculture*[309] (CoGP). The CoGP is mandatory for the members of the Organization, compliance is independently audited, and non-compliance with its binding provisions can result in the suspension or expulsion of its member. More importantly for the purposes of this Dissertation, some aspects of the CoGP have been included by reference in the *Aquaculture and Fisheries (Scotland) Act 2013*.

6.3.2. Consenting Process

The consenting process for aquaculture is largely a site-by-site process. A marine finfish farm requires a number of permits and assessments to operate. These include:

> a) Crown Lease issued by the Crown Estate Scotland under the *Scottish Crown Estate Act 2019*;
>
> b) Planning Permit issued by the competent local authority under the *Town and Country Planning (Scotland) Act 1997* (as amended in 2007). In processing a planning permit, it is the local authorities' responsibility to determine whether the application requires an Environmental Impact Assessment (EIA) under the *Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017*;[310] and an 'Appropriate Assessment' under the *Conservation (Natural Habitats, etc.) Regulations 1994* (as amended) [the Habitats Regulations];
>
> e) Discharge consent under the *Water Environment (Controlled Activities) (Scotland) Regulations 2011* (CAR permit), issued by SEPA;
>
> f) Marine licence issued by Marine Scotland Licensing Operations Team under the *Marine (Scotland) Act 2010*. The Licensing Operations Team has responsibility for possible hazards to navigation and considering applications for European Protected Species licences covering disturbance to cetaceans, if acoustic deterrent devices are used;[311]

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[309] Salmon Scotland, *A Code of Good Practice for Scottish Finfish Aquaculture* (2010 Edition), available online: Salmon Scotland <https://www.salmonscotland.co.uk/facts/sustainability/the-code-of-good-practice-explained> (accessed 13 June 2022) [hereinafter CoGP]. The Code was first introduced in 2006 but is an evolving document, regularly reviewed to incorporate elements of change in legislation and emerging priorities in environmental management.

[310] EIA is required for marine finfish aquaculture carried out in a sensitive area, designed to hold a biomass of 100 tonnes or greater, or extending to 0.1 hectare or more of the surface area of the marine waters, including any proposed structures or excavations.

[311] European Protected Species licences are issued under the provisions of the *Conservation (Natural Habitats, etc) Regulations 1994* (as amended) and the *Conservation of Offshore Marine Habitats and Species Regulations* 2017 (as amended) (Young, Rae & Hughes, *supra* note 284, at 40, 41; Slater, *supra*

g) An Authorization of Aquaculture Business, issued under the *Aquatic Animal Health (Scotland) Regulations 2009* and issued by Marine Scotland Science Fish Health Inspectorate for the purpose of adopting measures and controlling management of diseases.[312]

There is no single-window application process for these consents, nor is there a defined sequence of applications. Further, many of the applications (e.g. SEPA's CAR permit, local authorities' planning consent) consider a public consultation period, but this consultation cannot always be aligned. Licensing authorities, in turn, are statutory and non-statutory consultees in other consenting processes, reinforcing duplication and increasing processing timeframes.

The lack of coordination has been sharply criticized.[313] Several efforts to streamline the process have been undertaken.[314] Most recently, the independent aquaculture regulatory review recommended a new consenting system that, beyond coordination of relevant agencies, would aim at integration of decision-making through a single consenting document (which would include a "social contract"). This single

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note 285, at 423). Marine Scotland Licensing Operations Team was also responsible for issuing a separate licence for 'discharge of treatment agents' from a wellboat. Authorisation and regulation of discharge treatment solutions from wellboats were transferred from Marine Scotland to SEPA in November 2020.

[312] Authorisation, subject to conditions, is granted where the operation of the business will not lead to an unacceptable risk of spreading disease. Conditions attached to an APBs include: establishing, maintaining and complying with a Biosecurity Measures Plan (BMP); participating in a risk-based surveillance scheme; submitting information on fish movement and mortality records; notifying breaches in containment; and reporting sea lice numbers. Disease management is a considerable concern in Scotland, as farmed fish mortality is considered high and not improving (Scottish Parliament, "Salmon Farming in Scotland", *supra* note 291, Recommendations 9-14 at 43; Scottish Parliament, Rural Economy and Connectivity Committee, Official Report of Session 5, 30th Meeting on Wednesday 18 November 2020, "Salmon farming inquiry update", online: Scottish Government <https://archive2021.parliament.scot/parliamentarybusiness/CurrentCommittees/116919.aspx> (accessed 15 August 2022)).

[313] Griggs Report, *supra* note 284, at 16 states: "That means that each part is licenced or approved separately and while all permissions are needed to reach a final outcome there is no real coordinated approach".

[314] The Government issued recommendations as to what permit to request first. SEPA, "Water Environment (Controlled Activities) (Scotland) Regulations 2011: Licence Applicant Guidance, Form C: Point Source Fish Farm Discharges to the Water Environment" (2011), online: SEPA http://www.sepa.org.uk/water/water_regulation/regimes/aquaculture/marine_aquaculture/fish_farm_manual.aspx [Fish Farm Manual]). It also commissioned a Report on the subject matter (F Nimmo et al, *Independent Review of the Consenting Regime for Scottish Aquaculture* (2016), online Scottish Government <https://www.gov.scot/publications/independent-review-scottish-aquaculture-consenting/> (accessed 14 June 2022)).

consenting document would outline the requirements for all parties (the applicant, regulators, the community, and other statutory consultees) involved in the application.[315]

Within the complexity of the current consenting process, two instruments are key in deciding where a farm can be installed and how much salmon can be farmed: the planning system and permit; and the CAR discharge permit. They will be addressed in more detail below.

6.3.3. Aquaculture Planning

Pre-devolution, the development of salmon farming was guided mainly by the Crown Estate as owner of UK's developmental rights to the seabed.[316] Following devolution, the local authorities (local councils) were provided significant role in the allocation of fish farming.[317] Through an amendment to the *Town and Country Planning (Scotland) Act 1997* in 2007,[318] the definition of "development" was extended to include marine fish farming in continental and internal waters and the territorial sea.[319] This extension means that the local councils[320] have responsibility for including marine finfish aquaculture in their local development plans and to issue planning consents to individual projects. Thus, the amendment provided an extension of terrestrial planning system to the marine environment, for aquaculture purposes only.

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[315] Griggs Report, *supra* note 284, at 22. Professor Griggs adds two elements to this single consenting document. First, that the system will need a knowledgeable, local and independent person or body to be appointed as the process manager (at 23). Second, the system is supported by a new single licencing payment which covers the costs of all bodies involved in the process and addresses community benefit (at 29-30).

[316] D Peel & MG Lloyd, "Governance and planning policy in the marine environment: regulating aquaculture in Scotland" (2008) 174 The Geographical Journal 361, at 366; Slater, *supra* note 285, at 418; Carter, *supra* note 285, at 307.

[317] See: Carter, *supra* note 285, at 308. Note that algae farming does not fall within the controls of the local authorities.

[318] The amendments were introduced by the *Planning etc. (Scotland) Act 2006,* 2006 asp 17.

[319] In practice, the role of relevant planning authorities is currently extended to those areas designated in the Schedule to the *Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007*, that is, out to 3nm. It was considered that, due to the current technical nature of the fish farming industry, it is highly unlikely that applications for planning permission between 3nm and 12nm will be lodged in the near future. The Executive was to monitor the situation to determine the need to extend the planning authority designated areas out to 12nm. See also: Slater, *supra* note 285, at 419.

[320] The Schedule to the *Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007* divides marine waters into 23 marine planning zones. It further designates the local authorities responsible for planning and issuing consents.

The decision to provide these planning responsibilities to local authorities had different purposes: to provide for a single Scotland-wide regime to offer consistency of approach across Scottish waters; to overcome criticisms to the consenting system relating to lack of transparency and democratic accountability; to empower local authorities to deal with and enforce any breaches of planning control; and to overcome perceived conflicts of interest arising from the Crown Estate acting as a regulator (through conditions in the leases) while supporting the industry (as a landlord).[321] The result did not fulfil at least some of these objectives, however. It has been argued that the system did not provide for a consistent approach but rather added one more consent (the planning consent) to the existing requirements.[322]

The system has also created fragmentation in the management of marine space after the introduction of the *Marine (Scotland) Act 2010*.[323] The Act creates a new system of marine planning, mandating the adoption of a Scottish Government, "Scotland's National Marine Plan" and, if so decided, the designation of marine regions and the elaboration of regional marine plans. National and regional plans state the Scottish Ministers' policies for and in connection with the sustainable development of the respective marine area. The Act also lays down a simplified marine licensing system[324] under the responsibility of Marine Scotland, a new Directorate of the Scottish Government.

Despite the explicit objective of introducing a simplified and integrated planning and licensing process for marine activities, aquaculture was excluded from the scope of the Act.[325] However, the marine planning instruments are still relevant for aquaculture in two ways. First, it is expected that marine and terrestrial planning instruments will

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[321] Executive Note to the *Town And Country Planning (Marine Fish Farming) (Scotland) Order 2007*, SSI/2007/268, online: UK Legislation <https://www.legislation.gov.uk/ssi/2007/268/contents/made> (accessed 31 October 2022); Peel & Lloyd, *supra* note 316; Carter, *supra* note 285, at 308.
[322] Peel & Lloyd, *supra* note 316; Carter, *supra* note 285, at 308.
[323] Sigrid Eskeland Schütz & Ann-Michelle Slater, "From strategic marine planning to project licences: Striking a balance between predictability and adaptability in the management of aquaculture and offshore wind farms" (2019) 110 Marine Policy 103556, at 7.
[324] UK Legislation, Explanatory Note: *Marine (Scotland) Act 2010*, online: UK Legislation <https://www.legislation.gov.uk/asp/2010/5/contents> (accessed 14 December 2022).
[325] It should be noted that the industry opposed to the Act maintaining planning control for fish farm development whilst all other marine activities were to be licensed under a new system managed centrally by Marine Scotland. Efforts were made by the industry to amend this proposal but were narrowly defeated in parliamentary debate.

gradually be coordinated.[326] Second, under s 63 of the *Marine (Scotland) Act 2010*, the Scottish Minister, with the agreement of the planning authority, may provide that marine fish farm in an area is not "development" for the purposes of the statutory planning. Through this provision, the local authorities would be effectively giving up their planning rights to the Scottish Government in respect of aquaculture. The local authorities reportedly have different views on this possibility.[327]

a) Aquaculture and Local Development Plans

A first responsibility for local authorities under the amended *Town and Country Planning (Scotland) Act 1997* is to include marine aquaculture in their local development plans (often in supplementary aquaculture frameworks). The purpose of planning is to manage the development and use of land in the long term public interest.[328] The process to elaborate a local development plan is collaborative and with opportunities for public participation and engagement.[329] Further, the process is usually supported by a SEA under the *Environmental Assessment (Scotland) Act 2005*. The central aim of the SEA is to "help ensure that the environment is given the same level of consideration as social and economic factors within the plan."[330]

In drawing their local development plans, local authorities must have due regard to Scottish Planning Policy, other national guidelines (e.g. Scottish Marine Plan), and regional plans.[331] The Scottish Planning Policy generally supports the growth of the aquaculture sector and requires local development plans to make "positive provision for

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[326] Slater, *supra* note 285, at 424ff; Scottish Government, "The relationship between the Statutory Land Use Planning System and Maine Planning and Licensing", Planning Circular 1/2015 (June 2015), online: Scottish Government <https://www.gov.scot/collections/planning-circulars/> (accessed 15 December 2022).
[327] Griggs Report, *supra* note 284, at 23.
[328] *Town and Country Planning (Scotland) Act 1997,* s 3ZA.
[329] *Ibid*, ss 16ff.
[330] Scottish Government, "Planning Advice Note PAN 1/2010: Strategic Environmental Assessment of Development Plans" (March 2010), online: Scottish Government <https://www.gov.scot/policies/environmental-assessment/strategic-environmental-assessment-sea/> (accessed 2 January 2023>. It does so by "promoting: integration of environmental information into the plan preparation and adoption process; early dialogue with consultees, particularly those with environmental expertise, but also the wider public; full and objective consideration of alternatives to ensure that the best environmental options are identified and taken on board as far as possible; and transparency of decision-making, through the publication of the postadoption SEA statement." (*ibid*).
[331] For example, integrated coastal zone plans developed by non-statutory local coastal partnerships.

aquaculture development".[332] Nevertheless, it reiterates a presumption against salmon farming along the East and North Coast of Scotland to safeguard migratory fish species.[333]

The Policy further requires local development plans to set out the issues that will be considered when assessing specific proposals and enunciates relevant criteria to be considered by the local authority.[334] Thus, the local development plans for aquaculture are generally criteria-based (policy documents) rather than spatial plans,[335] although they also have some spatial components.

One particular instrument that the local authorities must take into account are Marine Scotland's locational guidelines, a predictive model to estimate environmental sensitivity based on estimate nutrient enhancement and benthic impact in sea lochs or similar water bodies supporting aquaculture.[336] The locational guidelines classify sea lochs in one of three categories, with category 1 areas being most environmentally sensitive to further fish farming development due to high predicted levels of nutrient

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[332] Scottish Government, "Scottish Planning Policy" (2014), online: Scottish Government <https://www.gov.scot/publications/scottish-planning-policy/documents/> (accessed 2 January 2023), para 250 at 56; Scottish Government, "Ambition, Opportunity, Place: Scotland's Third National Planning Framework" (2014) at 67, both online: Scottish Government <https://www.gov.scot/policies/planning-architecture/> (accessed 15 December 2022). These two documents will be replaced by the fourth National Planning Framework, laid before the Parliament in November 2022 (Scottish Government, Revised Draft NPF 4, *supra* note 286). The revised draft supports aquaculture in the following terms: "Planning should support an aquaculture industry that is sustainable, diverse, competitive, economically viable and which contributes to food security, whilst operating with social licence, within environmental limits and which ensures there is a thriving marine ecosystem for future generations" (*ibid* at 91).

[333] Scottish Government, "Scottish Planning Policy", *supra* note 332. Murray & Gubbins note that a few older salmon farms exist in Loch Eriboll on the north coast (Alexander G Murray & Matthew Gubbins, "Spatial management measures for disease mitigation as practiced in Scottish aquaculture" (2016) 70 Marine Policy 93).

[334] Scottish Government, "Scottish Planning Policy", *supra* note 332, para 251 at 56. These include: impacts on, and benefits for, local communities; economic benefits of the sustainable development of the aquaculture industry; landscape, seascape and visual impact; biological carrying capacity; effects on coastal and marine species (including wild salmonids) and habitats; impacts on the historic environment and the sea or loch bed; interaction with other users of the marine environment; and cumulative effects on all of the above factors.

[335] Some local development plans include some spatial elements, such as restrictions to develop aquaculture in certain areas. In other cases, the local councils have developed non-statutory integrated coastal and marine management plans or marine regional plans that have stronger spatial components.

[336] PA Gillibrand et al, "Scottish Executive Locational Guidelines for Fish Farming: Predicted Levels of Nutrient Enhancement and Benthic Impact", Scottish Fisheries Research Report Number 63/2002 (Fisheries Research Services, Marine Laboratory, Aberdeen, 2002); Marine Scotland, "Aquaculture: Guidance on the location of marine fish farms" (April 2022), online: Marine Scotland <http://marine.gov.scot/maps/530> (accessed 17 June 2022). It should be noted that the industry is increasingly applying for sites in more exposed areas that do not fall within the geographical scope of locational guidelines.

enhancement or benthic impact. Thus, category 1 sea lochs are likely going to be considered "sensitive areas" in local developments. While these do not prohibit further development, an application in this area would be subject to particular scrutiny to ensure that the applicant demonstrate adequate mitigation of impacts.

b) Planning Permission

The local authorities also have the responsibility of making decisions regarding planning permissions for new marine farm developments or amendments to existing developments. As part of the planning permission process, the local planning authority must determine whether the proposed development require an environmental impact assessment and an appropriate assessment. In any case, the process for a planning permission considers consultation with statutory consultees and with the public.[337]

The planning permission must be issued in accordance with the local development plan unless material considerations indicate otherwise.[338] Thus, development plans "do not have to be 'slavishly adhered' to".[339]

The local authority can grant a planning permission unconditionally or subject to such conditions as they think fit.[340] They are granted in perpetuity.[341] In recent years the planning permissions have included, as a condition, the obligation for the applicant to submit a site-specific Environmental Management Plan (EMP) for monitoring and managing the interactions between the operation of the farm and the wild fish environment. The EMP must be approved by the Planning Authority, in consultation with Marine Scotland Science.[342] This particular regulatory concern has been now transferred to SEPA.

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[337] Statutory consultees include Marine Scotland, SEPA, NatureScot, and the respective District Salmon Fishery Board.
[338] *Town and Country Planning (Scotland) Act 1997*, s 25.
[339] Slater, *supra* note 285, at 421.
[340] *Town and Country Planning (Scotland) Act 1997,* s 37(1).
[341] Schütz & Slater, *supra* note 323, at 7. See also *Town and Country Planning (Scotland) Act 1997,* s 41(1)(b) and Scottish Government, "Planning Circular 1/2007: Planning controls for marine fish farming" (2007), Annex C, para 33, online: Scottish Government <https://www.gov.scot/collections/planning-circulars/> (accessed 15 December 2022).
[342] See: NatureScot (then Scottish Natural Heritage), "Submission to Rural Economy and Connectivity Committee in Inquiry over Salmon Farming In Scotland" (May 2018), online: <https://archive2021.parliament.scot/S5_Rural/Scottish_Natural_Heritage.pdf > (accessed 17 June 2022). In 2019, and as an interim measure, the Scottish Government advised that Environmental Management

6.3.4. The CAR permit

Under the *Water Environment (Controlled Activities) (Scotland) Regulations 2011*, a finfish marine site needs a discharge permit (CAR permit), issued by SEPA.[343] In issuing the permit, SEPA ensures that the organic matter and chemicals released by the finfish farm will be sufficiently diluted as they disperse and mix in the sea to avoid levels that would harm sea life.[344] To this end, the CAR permit places limits on the amount of fish that can be held in the cages and the type and amount of medicines and chemicals that can be used on a particular site. [345] The site-specific biomass limits and medicine limits are published in the Scottish aquaculture website.[346]

The determination of maximum site biomass is assessed through depositional models and environmental quality standards.[347] In the past, each site's biomass was also subject to a precautionary limit of 2,500 tonnes. In 2019, SEPA released a strengthened regulatory framework to assess sites' carrying capacity. Key elements of the new framework include a stronger pre-application process, better depositional models (NewDepomod), stricter environmental standards, limits to the area that can be impacted

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Plans (EMPs) should be standard for any new consents for marine aquaculture where there is potential for sea lice interaction with wild fish.

[343] Schedule I of the CAR regulations contain an indicative list of main pollutants which includes "substances which have an unfavourable influence on the oxygen balance and can be measured using parameters such as biochemical oxygen demand (BOD), and chemical oxygen demand (COD) etc." See also: SEPA, "Protection of the Marine Environment: Discharge from Marine Net Pen Fish Farms. A Strengthened Regulatory Framework" (2019), online: SEPA <https://www.sepa.org.uk/media/433439/finfish-aquaculture-annex-2019_31052019.pdf> (accessed 15 December 2022) [hereinafter SEPA, Strengthened Framework]. The strengthened framework was in place in June 2019 with transitional provisions and came fully into effect in January 2020.

[344] See also: Young, Rae & Hughes, *supra* note 284.

[345] SEPA regulates discharge of medicines in two ways. Substances or products that pose no or low environmental risk and which require no site-specific risk assessment are added to the Permitted Substances List (eg vaccines, anaesthetics, and antibiotics). Substances or products that do not meet the no or low environmental risk threshold will be added to the permit with conditions controlling use to ensure that environmental standards are met. These include, for example, Emamectin Benzoate and Teflubenzuron (in feed medicines), and Azamethiphos, Cypermethrin and Deltamethrin (administered in baths). The quality standard for emamectin benzoate is being discussed at UK level; SEPA is operating under an interim position statement (SEPA, "Interim Position Statement for Protecting the Water Environment until such Time as a Direction Is Issued on an EQS in Relation to Emamectin Benzoate in Finfish Farm Regulation" WAT-PS-17-03).

[346] Scottish Government, "Scotland's Aquaculture", online: Scottish Government <http://aquaculture.scotland.gov.uk/data/site_details.aspx> (accessed 15 August 2022).

[347] Murray & Gubbins, *supra* note 333, at 96.

by a farm, expanded monitoring, and stricter enforcement. With these changes, the precautionary limit of 2,500 tonnes is no longer applicable to new (or amended) sites.[348]

SEPA adopted an explicit standard for the acceptability of new (or amended) sites based on a limit to the size of the predicted mixing zone. The mixing zone is the area in which wastes are not fully mixed and dispersed in the surrounding sea and therefore where some impact is considered acceptable. [349] The mixing zone cannot exceed an area equivalent to the area extending 100 metres from the pens in all directions, although its shape does not have to be symmetrical.[350] Scotland does not allow mixing zones to extend into locations where they would likely compromise the conservation status of marine protected areas or priority marine features.[351] Further, while the models do not assess interactions between farms, they are used to ensure that depositional zones do not overlap.[352] The pre-application process allows SEPA to advise the applicant on better locations and environmental carrying capacity. During operation, compliance with ecological quality standards is verified through monitoring.

SEPA has been recently designated the responsible authority to address interactions between farm and wild salmon. To discharge its responsibilities, it has drafted a risk-based, spatial framework for managing interaction between sea lice from marine finfish farm developments and wild Atlantic salmon in Scotland.[353] The

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[348] It is the expectation, both from industry and regulators, that Scottish finfish farming will transition to fewer larger sites in more exposed areas. This framework enables that transition. See: SEPA, Strengthened Framework, *supra* note 343; Young, Rae & Hughes, *supra* note 284.

[349] SEPA, Strengthened Framework, *supra* note 343.

[350] *Ibid*. The framework states: "it can extend more than 100 metres from the pens in some directions provided its total area does not exceed that of the equivalent symmetrical area". It should be noted that the same limit (100m) is applied "to all other discharges to the marine environment, including industrial discharges and discharges of sewage effluents" (*ibid*, at 4).

[351] SEPA, "Environmental Standards", online: SEPA <https://www.sepa.org.uk/regulations/water/aquaculture/environmental-standards/> (accessed 14 December 2022).

[352] Murray & Gubbins, *supra* note 333, at 96.

[353] SEPA, "Consultation: Proposals for a risk-based, spatial framework for managing interaction between sea lice from marine finfish farm developments and wild Atlantic salmon in Scotland" (December 2021), online: <https://consultation.sepa.org.uk/regulatory-services/protection-of-wild-salmon/user_uploads/10211201--public---wf-sl-consultation-sepa-template.pdf> (accessed 17 June 2022) [hereinafter SEPA, Consultation Proposal]. Consultation closed 14 March 2022. The proposal, and in particular the indicator of impact, draw from the Norwegian traffic light system (see below). The responses, both from environmental and industry organizations, criticized the framework among other reasons for: its lack clarity; the (initial) exclusion of existing sites form the framework; the exclusion of impact on sea trout; the limited timeframe considered (April/March); the scope of protected zones; the framework representing a *de facto* moratorium on salmon farming on the West coast; the untimely inclusion of new

framework considers the designation of wild salmon protection zones, and sea lice exposure thresholds applicable to those zones during the migration months. The framework, as proposed, would operate at least initially at the consenting level; any proposal where expected contribution of sea lice into the environment could not be accommodated within the sea lice exposure threshold would not be granted authorisation.[354]

6.3.5. Area Management

There have been several initiatives for area management in Scotland. These include the farm management areas, the disease management areas, fish health management reporting areas,[355] and area management agreements.[356] The two latter are non-statutory measures and are generally not in use.[357]

Farm Management Areas were first introduced by the industry in their CoGP. They are defined areas where farmers undertake to coordinate activities and synchronize

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consenting requirements in parallel with the ongoing regulatory review process; the lack of consideration of animal welfare and socio-economic consequences; and overreliance on untested models. In a feedback update published on 25 August 2022, SEPA considered some changes in the framework and notified further consultations during 2023 (SEPA, "SEPA's Analysis of the Feedback on its Consultation on the Introduction of a Regulatory Regime to Control Sea-Lice Loss from Fish Farms" (25 August 2022), online: SEPA <https://consultation.sepa.org.uk/regulatory-services/protection-of-wild-salmon/> (accessed 14 December 2022)).

[354] SEPA, Consultation Proposal, *supra* note 353, para 5.5. see also: para 6.1, 6.3 and 6.4.

[355] Fish Health management reporting areas were used by the industry association for monitoring sea lice abundances and to provide voluntary monthly reports aggregated across each area. Currently, sea lice monitoring and reporting is mandatory and on a farm basis (Thomas P Adams, Dmitry Aleynik & Kenneth D Black, "Temporal variability in sea lice population connectivity and implications for regional management protocols" (2016) 8 Aquacult Environ Interact 585).

[356] Area Management Agreements were made on a local basis between farmers and wild fish trust, but many of these are not in current use (*ibid*).

[357] *Ibid*. It should be noted that the Crown Estate Scotland will adopt new terms of references for leases starting in January 2023, including the obligation for finfish farm leases to submit a report on participation in collaborative management agreements to mitigate cumulative impacts and on management of plastic. See: Crown Estate Scotland, "Root and Branch Review", *supra* note 3. The objective of this new terms of reference is to comply with the requirement under the *Scottish Crown Estate Act 2019,* 2019 asp 1, that Crown Estate Scotland act in the best way to further the achievement of sustainable development in Scotland and to manage the assets in a way that is likely to contribute to the promotion or the improvement in Scotland of economic development, regeneration and social wellbeing. It was noted in the preparatory review that there are several different agreements that "have historically and largely continue to apply to the cumulative impact risk to wild salmon and sea trout, and producers (although they may include other effects on other receptors)" (Young, Rae & Hughes, *supra* note 284, Appendix 3).

production to reduce and manage risks posed by infectious agents and parasites.[358] To this end, operators are required to develop farm management agreements or, if no agreement can be reached, each company is required to prepare a farm management statement outlining production practices.[359] The *Fisheries and Aquaculture Act (Scotland) 2013* altered the non-statutory status of the Farm Management Areas. The Act includes a legal obligation to participate in Farm Management Agreements or to adopt Farm Management Statements, with explicit reference to the Farm Management Areas identified in the CoGP.[360] Farm Management Statements or Agreements must cover arrangements for fish health management; management of parasites; movement of live fish on and off the farms; harvesting of fish and; fallowing of farms after harvesting.[361] The Act further extends inspection and enforcement responsibilities to the Agreements or Statements.

Disease Management Areas, in turn, are government-established areas for the control of notifiable diseases, particularly infectious salmon anaemia.[362] While the boundaries of some Disease Management Areas and Farm Management Areas coincide, this is not always the case as both area-based measures are distinct and different in

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[358] Salmon Scotland, CoGP, *supra* note 309, Area Maps, at 2. There are currently 87 Farm Management Areas (*ibid*). According to Murray & Gubbins, *supra* note 333, furunculosis management was an original driver for collaboration but currently they are essential tools to control sea lice infestations. Boundaries are defined by the industry based on local knowledge and practical considerations. After the 2013 amendment to the *Aquaculture and Fisheries (Scotland) Act 2007*, 2007 asp 12, the Minister has the power to alter its boundaries (*ibid)*.

[359] Salmon Scotland, CoGP, *supra* note 309, Chapter 4 "Seawater Lochs", para 3.87 and ff.

[360] *Aquaculture and Fisheries (Scotland) Act 2007*, 2007 asp 12, as amended by the *Aquaculture and Fisheries (Scotland) Act 2013,* 2013 asp 7, s 4A. The Act further gives the Scottish Ministers the authority to alter the boundaries of a Farm Management Areas, but generally they are defined by the industry (Murray & Gubbins, *supra* note 333, at 94).

[361] *Ibid,* s 4A(4).

[362] Disease Management Areas were established in the Final Report of the Joint Government/Industry Working Group on Infectious Salmon Anaemia in January 2000 but have been revised since their initial adoption. Murray & Gubbins, *supra* note 333, explain that the boundaries of the areas are defined by a simple circle model. Where the circles overlap, farms are included within the same Disease Management Area, which stretches until a separation of twice the circle radius is encountered. Since only active sites are considered, the boundaries may change as sites become inactive. There are currently 54 Disease Management Areas in Scotland (Marine Scotland, "Disease management Areas" (12 February 2018), online: Marine Scotland <https://www.webarchive.org.uk/wayback/archive/20180514134843/http://www.gov.scot/Topics/marine/Fish-Shellfish/FHI/managementagreement> (accessed 21 June 2022).

purpose.[363] Disease Management Areas are also considered in the location of new sites: there is a presumption against farming at new sites that bridge existing areas.[364]

6.3.6. Operational and Monitoring Requirements

During operation, farmers are subject to a number of obligations under the different permits and under regulations: the planning consent and environmental management plan, the CAR permit, the farm management agreement or statement, the APB approval and biosecurity measures plan,[365] and regulations issued under the *Aquaculture and Fisheries (Scotland) Act 2007*, the *Aquaculture and Fisheries (Scotland) Act 2013*, and the *Aquatic Animal Health (Scotland) Regulations 2009*. These obligations include some monitoring obligations. However, the limited focus of environmental monitoring post-consent has been considered a weakness of the current regulatory framework, thus failing to assess the overall environmental sustainability of the industry.[366] The gap is being filled by research projects addressing, for example, genetic introgression in wild salmon[367] or prevalence of sea lice in wild salmon and trout.[368] Some key operational and monitoring requirements for environmental protection and the management of escapes and sea lice are summarized below.

a) Environmental Monitoring

Under the CAR permit, the permit holder is under the obligation to monitor the environmental impacts of the farm. Monitoring focuses on benthic impact from organic matter and in-feed medicine Emamectin benzoate, with the objective of ensuring that the impacts of the farm do not exceed environmental quality standards.

Monitoring of sediments is based on a site-specific monitoring plan that seeks to capture the depositional patterns and high risk areas of the farm, focusing on two impact

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[363] CoGP, *supra* note 309, Explanatory and Contextual Notes, at 10.
[364] Murray & Gubbins, *supra* note 333.
[365] Young, Rae & Hughes, *supra* note 284, at 39. See also *supra* note 312.
[366] McGhee, Falconer & Telfer, *supra* note 290.
[367] J Gilbey et al, "A national assessment of the influence of farmed salmon escapes on the genetic integrity of wild Scottish Atlantic salmon populations" Scottish Marine and Freshwater Science Vol 12 No 12 (Marine Scotland Science, 2021), online: <https://data.marine.gov.scot/dataset/national-assessment-influence-farmed-salmon-escapes-genetic-integrity-wild-scottish-atlantic> (accessed 23 June 2022).
[368] Fisheries Management Scotland, "Monitoring" (nd), online FMS <https://fms.scot/fish-farming/fish-farming-monitoring/> (accessed 22 June 2022).

areas: the edge of the containment array, and beyond the allowable mixing zone.[369] SEPA has established distinct environmental quality standards for each of these areas.[370] In the case of the area beyond the allowable mixing zone, the benthic conditions must achieve at least "good status" under the categorization of the regulations implementing the Water Framework Directive. If thresholds are exceeded, SEPA has the authority to vary or revoke a consent if compliance does not improve, or if there is evidence that the water environment and its ecology have been harmed. While this authority was generally not exercised, SEPA has committed to a stronger approach to enforcement where compliance with standards is "non-negotiable".[371]

b) Escapes

Under the *Aquaculture and Fisheries (Scotland) Act 2007, Aquaculture and Fisheries (Scotland) Act 2013*, and the *Aquatic Animal Health (Scotland) Regulations 2009*, the Scottish Ministers have the authority to prescribe technical requirements for equipment to be used for or in connection with fish farming for the containment of fish.[372] They further have the authority to approve, whether in whole or in part, any code of practice issued (whether by them or by another person) with respect to the containment of fish on fish farms.[373] The Ministers can also request information on containment of fish on fish farms, the prevention of escape of fish from fish farms, and the recovery of escaped fish;[374] and to inspect, monitor and enforce such provisions. In 2015, the government and

[369] SEPA, Strengthened Framework, *supra* note 343.
[370] At pen edge, processes must be functioning to break down and assimilate waste, as measured by number of species, and abundance, of re-worker polychaete worms (minimum of 2 species with a combined abundance of more than 1,000 individuals per $m^{2)}$. At the edge of the mixing zone, in turn, sediments must present good infaunal quality index status as defined in the regulations implementing the WFD (i.e., IQI 0.64 at any time) (*Scotland River Basin District (Standards) Directions 2014*, Table A3.1; the *Solway Tweed River Basin District (Standards) (Scotland) Directions 2014*; or where an appropriate standard has not yet been specified in Directions, a standard representing equivalently good quality that we have derived using the best available science). These indices apply to soft bottoms. For Emamectin Benzoate, the interim environmental standard is 235 ng per kg of marine sediment (dry weight) at pen edge, and 23.5 ng per kg of marine sediment (dry weight) at the edge of the mixing zone (generally 100m from the cage).
[371] SEPA, Strengthened Framework, *supra* note 343. Environmental monitoring results (satisfactory/borderline/unsatisfactory/unclassified) are published for each site online: Scottish Aquaculture <http://aquaculture.scotland.gov.uk/> (accessed 19 December 2022).
[372] *Aquaculture and Fisheries (Scotland) Act 2013,* 2013 asp 7, ss 3(1) and (2).
[373] *Aquaculture and Fisheries (Scotland) Act 2007,* 2007 asp 12, s 7
[374] *Ibid,* s 1(3).

industry published the Technical Standard for Scottish Finfish Aquaculture[375] which is currently being revised. It further adopted an Aquaculture Code of Practice addressing Containment of and Prevention of Escape of Fish on Fish Farms in relation to Marine Mammal Interactions.[376] Reporting obligations in case of escape are included in the *Aquatic Animal Health (Scotland) Regulations 2009.*[377] Further, the Scottish Government has committed to "take forward a programme of work to make fish farm containment measures and regulation more robust, including the introduction of penalties for fish farm escapes".[378]

c) Sea Lice

Sea lice regulation has evolved over time, from voluntary reporting commitments by the industry to increasingly stricter[379] monitoring and reporting requirements under the authority of the *Aquaculture and Fisheries (Scotland) Act* 2007, as amended. Currently, farms are required to provide weekly reports of the average number of adult female sea lice (*L. salmonis*) counted per fish per site.[380] If the average number exceeds a defined threshold (2 adult female sea lice per fish), the Fish Health Inspectorate will increase monitoring of that site. If an intervention limit (average of 6 adult female sea lice per fish or more) is exceeded, the operator is required to take action to reduce the weekly average

[375] Marine Scotland, "A Technical Standard for Scottish Finfish Aquaculture" (June 2015), online: Scottish Government <https://www.gov.scot/publications/technical-standard-scottish-finfish-aquaculture/> (accessed 15 December 2022).
[376] Scottish Government, "Aquaculture Code of Practice Containment of and Prevention of Escape of Fish on Fish Farms in relation to Marine Mammal Interactions" (September 2021), online: Scottish Government <https://www.gov.scot/publications/aquaculture-code-practice-containment-prevention-escape-fish-fish-farms-relation-marine-mammal-interactions/> (accessed 22 June 2022). The Code was approved by the Scottish Ministers in the *Fish Farming Code of Practice (Scotland) Order 2021*, SSI 2021/340.
[377] Escapes events are published online: Scottish Aquaculture <http://aquaculture.scotland.gov.uk/> (accessed 19 December 2022).
[378] Marine Scotland, "Salmon Interactions Working Group Report: Scottish Government Response" (October 2021), online: Scottish Government <https://www.gov.scot/publications/salmon-interactions-working-group-report-scottish-government-response/documents/> (accessed 15 August 2022), at 3-4.
[379] Reporting was required only when the counting exceeded an average of 3 adult female sea lice per fish (from July 2017 to June 2019) or an average of 2 adult female sea lice per fish (from June 2019 to March 2021). Intervention limits were an average of 8 adult female sea lice per fish, later reduced to 6 adult female sea lice per fish.
[380] *Fish Farming Businesses (Reporting) (Scotland) Order 2020,* SSI 2020/447 (entered into force in March 2021). Reports are submitted one week in arrears. Weekly monitoring data is published for each site online: Scottish Aquaculture <http://aquaculture.scotland.gov.uk/> (accessed 19 December 2022).

within a limited time period or enforcement action will be taken.[381] It should be noted that the thresholds considered in the CoGP are stricter than those adopted by the authority under the *Aquaculture and Fisheries (Scotland) Act* 2007.[382]

6.4. Aquaculture Legal Framework in Norway

Norway is the biggest producer of Atlantic salmon in the world. From its origins in the late 1960s, the industry has not only grown but also substantially changed from a "a small and marginal industry, run by small entrepreneurs based on trial and error, to a large, industrialized, science-driven industry"[383] which today is Norway's second largest export.[384] Not only is Norway a leading producing salmon country, but Norwegian companies dominate the finfish farming industry with operations in other countries (including Canada, Chile and Scotland). Further Norway is considered a leader in technological innovation, scientific research, and regulatory approaches.[385] While the Norwegian aquaculture industry also comprises other algae, finfish and shellfish (Atlantic cod, Arctic charr, Atlantic halibut, cleaner fish, blue mussel, Great Atlantic scallops, and oysters), salmonids (Atlantic salmon and rainbow trout) represent more than 90% of the national aquaculture production.[386]

Aquaculture in Norway is distributed along the entire West and North coast, with more than 1,000 production licenses issued for marine salmonid (Atlantic salmon,

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[381] See: Marine Scotland, "The Regulation of Sea Lice in Scotland" Topic Sheet Number 71 v 4, online: <Marine Scotland https://www.gov.scot/publications/fish-health-inspectorate-sea-lice-information/> (accessed 22 June 2022).

[382] The recommended intervention thresholds in the CoGP are an average of 0.5 adult female *L. salmonis* per fish during the period 1st February to 30th June; and average of 1.0 adult female *L. salmonis* per fish during the period 1st July to 31st January (CoGP, *supra* note 309, ch 4, at 18).

[383] Bjørn Hersoug, "'One country, ten systems': The use of different licensing systems in Norwegian aquaculture" (2022) 137 Marine Policy 104902, at 1 [hereinafter Hersoug, "One country"].

[384] Norwegian Government, *The Aquaculture Strategy: A Sea of Opportunities* (6 July 2021), Foreword. [Havbruksstrategien: Et hav av muligheter], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/havbruksstrategien-et-hav-av-muligheter/id2864482/> (accessed 11 July 2022) [Google Translate].

[385] Jon Olaf Olaussen, "Environmental problems and regulation in the aquaculture industry: Insights from Norway" (2018) 98 Marine Policy 158; Griggs Report, *supra* note 284; Tonje C Osmundsen, Petter Almklov & Ragnar Tveterås, "Fish farmers and regulators coping with the wickedness of aquaculture" (2017) 21 Aquaculture Economics & Management 163, at 172.

[386] Fisheries Directorate [Fiskeridirectoratet], "Statistics for Aquaculture", online: Directorate of Fisheries <https://www.fiskeridir.no/English/Aquaculture/Statistics> (accessed 17 March 2023). The vast majority (about 95%) is Atlantic salmon.

rainbow trout and trout) farming and 986 licensed marine sites.[387] Further, Norway has diversified its technology with increased land-based (grow-out) salmon farming facilities and development licenses for offshore aquaculture.[388] Approximately 120 salmon farming companies produced ca. 1,3 million tons of Atlantic salmon in 2021, with a value of around US$ 6 billion.[389] About 95% of aquaculture production is exported.[390] The industry has ambition (and arguably capacity) for a 5-fold increase in production by 2050.[391]

In 2021, the Norwegian government released a new Aquaculture Strategy, "A Sea of Opportunities"[392] outlining several priority areas for aquaculture development in Norway for the next 10 to 15 years.[393] The Strategy makes an explicit reference to other

[387] Fisheries Directorate [Fiskeridirectoratet], "Key figures from Norwegian Aquaculture Industry 2020", online: <file:///C:/Users/mceng/Downloads/nokkeltall-havbruk-2020-eng.pdf> (accessed 23 June 2022) (in English), at 5; Ann-Magnhild Solås et al, *Salmon farming in the North: Regulating societal and environmental impacts*, NOFIMA Report 47/2020 (December 2020), online: NOFIMA <https://nofima.brage.unit.no/nofima-xmlui/bitstream/handle/11250/2722359/Rapport+47-2020+Salmon+farming+in+the+North.pdf?sequence=1> (accessed 7 August 2022).

[388] Hersoug, "One country", *supra* note 383. Recently, the Government suspended licence applications for land-based fish farms for a period of six months, however.

[389] Norwegian Government, "Aquaculture Strategy", *supra* note 384, ch 3. A few large companies control a large proportion of total production capacity, but there are many small and medium-sized players, including local and family-owed companies. Other finfish species are also farmed in Norway, with cod and haddock being near commercial scale.

[390] *Ibid*, ch 3.

[391] The study "Value Creation Based on Productive Seas in 2050" (Verdiskaping basert på produktive hav i 2050, VBPH), elaborated by a working group of the Royal Norwegian Science Society and the Norwegian Technical Science Academy, concluded that the salmon and salmonid farming industry would likely expand five-fold by 2050 (Jennifer L Bailey & Sigrid Sandve Eggereide, "Indicating sustainable salmon farming: The case of the new Norwegian aquaculture management scheme" (2020) 117 Marine Policy 103925, at 3). This became the goal of the industry and supported by the government. In connection with the launch of the new aquaculture strategy (2021), the Minister of Fisheries and Seafood stated that Norway should aim to increase its production of these species to 5 million tonnes by 2050 (Markus Sørlie, "An introduction to the Government's new aquaculture strategy" (30 August 2021) online: Simonsen Vogt Wiig <https://svw.no/en/insights/an-introduction-to-the-governments-new-aquaculture-strategy> (accessed 11 July 2022)). Hersoug et al caution, however, that the 5-fold increase by 2050 is ambitious and even impossible within the current traffic light system if using the dominant technology (Bjørn Hersoug, Eirik Mikkelsen & Tonje C Osmundsen, "What's the clue; better planning, new technology or just more money? The area challenge in Norwegian salmon farming" (2021) 199 Ocean & Coastal Management 105415 [hereinafter Hersoug, Mikkelsen & Osmundsen, "What's the clue"]).

[392] Norwegian Government, "Aquaculture Strategy", *supra* note 384. Previously, Norway had released two aquaculture strategies focusing on economic growth and on environmental sustainability, respectively. These are: Norwegian Ministry of Fisheries and Coastal Affairs, *Strategy for a Competitive Norwegian Aquaculture Industry* (2007) and Norwegian Ministry of Fisheries and Coastal Affairs, *Strategy for an Environmentally Sustainable Norwegian Aquaculture Industry* (2009).

[393] Sørlie, *supra* note 391.

relevant and recent national strategies, including Blue Ocean, Green Future (2020),[394] the Coastal Strategy (2021),[395] Food Nation Norway (2021),[396] and the National Strategy for a Green, Circular Economy (2021).[397]

The Aquaculture Strategy supports further growth and the creation of jobs[398] but in a framework of environmental sustainability.[399] Efficient, coordinated and knowledge-based management are identified as key elements to support and strengthen sustainable growth. The government supports a technologically neutral regulation; thus, it will focus on goal-oriented regulations (results to be achieved) rather than the requirement to use specific solutions.[400]

Highlighting the need to address aquaculture in the context of climate change and to reduce the environmental footprint, the Strategy identifies three main environmental concerns currently limiting growth: the impacts of sea lice on wild salmonids, genetic influence of escaped salmon on wild salmon populations, and fish health and welfare concerns. The Strategy announces stronger regulations to address these concerns. From a governance perspective, fragmentation of aquaculture regulatory framework was identified as a barrier for sustainable growth.[401] The government announced the establishment of a committee to assess and make recommendations for an overhaul of the licensing system with the objective of simplification (including an assessment of the

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[394] Ministry of Trade, Industry and Fisheries (Norway), *Blue Ocean, Green Future: the Government's commitment to the ocean and ocean industries*, online: Regjeringen <https://www.regjeringen.no/contentassets/564afd76f1e34ccda982f785c33d21b9/en-gb/pdfs/regjeringens-havrapport-engelsk.pdf> (accessed 11 July 2022) [English version].

[395] Norwegian Government, *Coastal Strategy* (21 June 2021) [Kyststrategi – Nye jobber langs kysten vil gi vekst og utvikling i Distrikts-Norge], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/kyststrategi/id2862477/> (accessed 11 July 2022) [Google Translate].

[396] Norwegian Government, *Food Nation Norway* (12 February 2021), online: Regjeringen <https://www.regjeringen.no/no/dokumenter/matnasjonen-norge/id2834496/> (accessed 12 July 2022) [Matnasjonen Norge] [Google Translate].

[397] Norwegian Government, *National Strategy for a Green, Circular Economy* (16 June 2021) [Nasjonal strategi for ein grøn, sirkulær økonomi], online: Regjeringen https://www.regjeringen.no/no/dokumenter/nasjonal-strategi-for-ein-gron-sirkular-okonomi/id2861253/ (accessed 11 July 2002) [Google Translate]. See also: Norway's Strategy for Developing a Green, Circular Economy, Regjeringen <https://www.regjeringen.no/contentassets/a116f209e493471bb26c81cf645152a3/kld_strategi_sirkularokonomi_sammendrag_eng_0507.pdf> (accessed 11 July 2022) [English version].

[398] Norwegian Government, "Aquaculture Strategy", *supra* note 384, Objective 5.

[399] *Ibid*, Objective 2.

[400] *Ibid*, ch 4 s 4.1.

[401] *Ibid*, ch 8.

production license maximum allowable biomass, the special licenses, the licenses for inland aquaculture and for offshore aquaculture). Other announced measures include: a better coordination of site assessments under the Planning and Building Act and the Aquaculture Act; an assessment of the current site structure to reduce the disease and parasite infection pressure between sites; further review of regulatory framework for offshore aquaculture; and incentives for land-based aquaculture.[402]

A separate strategy for fish containment based on a "zero escape" vision was adopted in 2017.[403] The objectives of the strategy are to prevent escapes through sound technology and risk management, and to minimize genetic interactions with wild salmon populations in case of escapes. The Strategy supports, therefore, the protection of wild Atlantic salmon consistent with the adopted quality norm.[404] To this end, the strategy has five focus areas: knowledge, dissemination of experience and dialogue, a strong safety culture, effective safety regulations and professional preparedness.

6.4.1. General Legal and Institutional Framework

The regulatory framework for aquaculture in Norway has progressively evolved since its initial framework in 1973.[405] The economic, technological, market, and social changes of the industry have been main drivers of this evolution.[406] The implementation of some of

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[402] *Ibid*, ch 6, 8, 9, 10.

[403] Norwegian Government, *Strategy against escapes from aquaculture* (31 March 2017) [Strategi mot rømming fra akvakultur] online: Rejgeringen <https://www.regjeringen.no/no/dokumenter/strategi-mot-rommingfra-akvakultur/id2547105/> (accessed 12 July 2022) [Google Translate].

[404] Kvalitetsnorm for ville bestander av atlantisk laks (Salmo salar) (FOR-2013-09-20-1109) [Quality norm for wild stocks of Atlantic salmon (Salmo salar)]. The norm was adopted under the authority of the Act of 19 June 2009 No 100 Relating to the Management of Biological, Geological and Landscape Diversity [Nature Diversity Act] [unofficial translation to English provided by the Ministry of the Environment], online: Regjeringen <https://www.regjeringen.no/en/dokumenter/nature-diversity-act/id570549/> (accessed 7 August 2022) § 13. See also: Hans Christian Bugge, *Environmental Law in Norway*, 4th ed (Alphen aan den Rijn, Netherlands: Kluwer Law International, 2022) at 208. Its purpose is to provide guidance to the authorities to ensure that wild populations of Atlantic salmon are safeguarded and rebuilt to a size and composition that ensures diversity within the species and utilizes the salmon's production and harvesting opportunities. Bugge, *ibid*, notes however that the Ministers may balance the objective of the quality norm with other societal objectives.

[405] A first provisional aquaculture legislation was drafted in 1973 following the initial recommendations of the Lysø commission. A permanent legislation was subsequently adopted in 1981 (Solås et al, *supra* note 387).

[406] Bjørn Hersoug, "Why and how to regulate Norwegian salmon production? The history of Maximum Allowable Biomass (MAB)" (2021) 545 Aquaculture 737144 [hereinafter Hersoug, "History of MAB"]; Bjørnar Michaelsen-Svendsen, "Implementation of the Traffic Light System in Norwegian salmon

the relevant EU directives under the Agreement on the European Economic Area[407] (and in particular the WFD) has also had influence in the Norwegian legal framework. Increased focus on environmental sustainability also results from the 1992 amendment to the Norwegian Constitution to recognize a right to a healthy environment,[408] as well as the passing of the Nature Diversity Act.[409]

During the first years of fish farming, the main focus was to regulate who could operate farms and where.[410] In 2005, Norway enacted a new Aquaculture Act in response to the need for "legislation that provides better for a future-oriented development of the industry and establishes a more modern framework for the exercise of public administration".[411] This new legislation focused less on who and more on how the activity was regulated.[412] Four focus areas guided the new Act: growth and innovation in the industry, simplification for the industry and administration, the sustainability of the environment, and the relationship to other users of the coastal zone.[413] Consequently, the Act's stated purpose is "to promote the profitability and competitiveness of the aquaculture industry within the framework of a sustainable development and contribute to the creation of value on the coast."[414]

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aquaculture: success or failure for whom?" (Master Thesis, International Fisheries Management, UiT The Arctic University of Norway: 2019)[unpublished].

[407] 2 May 1992 [1994] OJ L1/3.

[408] The Constitution of the Kingdom of Norway, LOV-1814-05-17 (as amended) [unofficial translation provided by the Stortinget], online: Lovdata <https://lovdata.no/dokument/NLE/lov/1814-05-17> (accessed 7 August 2022). Article 112 of the Norwegian Constitution reads: "Every person has the right to an environment that is conducive to health and to a natural environment whose productivity and diversity are maintained. Natural resources shall be managed on the basis of comprehensive long-term considerations which will safeguard this right for future generations as well.

In order to safeguard their right in accordance with the foregoing paragraph, citizens are entitled to information on the state of the natural environment and on the effects of any encroachment on nature that is planned or carried out.

The authorities of the state shall take measures for the implementation of these principles."

[409] Nature Diversity Act, *supra* note 404.

[410] Hersoug, "History of MAB", *supra* note 406; Michaelsen-Svendsen, *supra* note 406.

[411] Norwegian Ministry of Fisheries and Coastal Affairs, "The Aquaculture Act", at 3, online: Regjeringen <https://www.regjeringen.no/globalassets/upload/kilde/fkd/reg/2005/0001/ddd/pdfv/255327-l-0525_akvakulturloveneng.pdf> (accessed 23 June 2022) (English version).

[412] Hersoug, "History of MAB", *supra* note 406.

[413] *Ibid.*

[414] Act of 17 June 2005 no 79 relating to aquaculture (Aquaculture Act), s 1, in chapter 6 of Ministry of Fisheries and Coastal Affairs, *supra* note 411 [English version]; also Lov om akvakultur (akvakulturloven), LOV 2005-06-17-79, online: Lovdata <https://lovdata.no/> (accessed 15 December 2022).

Other Acts are also relevant to marine finfish farming and several permits are required under them:[415] the Act on Food Production and Food Safety,[416] the Pollution Control Act,[417] the Act on Ports and Coastal Water,[418] and the Planning and Building Act.[419] Several regulations have been issued under the authority of one or more of these Acts. The Nature Diversity Act,[420] in turn, provides principles for public decision-making that will have an impact on nature.[421] These principles shall be taken into account for, *inter alia*, municipal planning, allocation of aquaculture permits, and environmental impact assessments.[422]

Responsibility for the administration of these Acts lies on different authorities and, mostly through a process of delegation, in different jurisdictional levels (national, regional (county - fylke[423]) and local (municipality- kommune[424])).[425] Key national agencies include the Directorate of Fisheries (Fiskeridirektoratet), the Food Safety Authority (Mattilsynet) and the Coastal Administration (Kystverket). The county councils (fylkeskommunen) have the "authority to coordinate the legal process [for obtaining an aquaculture licence] and make final decisions on allocations of salmon and trout farms pursuant the Aquaculture Act".[426] The county governor (Statsforvalteren) has delegated

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[415] They are explicitly mentioned in the Aquaculture Act, *ibid*, §§ 6(d) and 8.
[416] Act of 19 December 2003 No 124 (as amended) relating to food production and food safety etc. (Food Act) [English text available online: FAO Ecolex]. See also: Lov om matproduksjon og mattrygghet mv. (matloven), online: Lovdata <Lovdata.no> (accessed 15 December 2022).
[417] Act of 13 March 1981 no 6 relating to protection against pollution and relating to waste [unofficial translation provided by the Ministry of the Environment], online: Regjeringen <https://www.regjeringen.no/en/dokumenter/pollution-control-act/id171893/> (accessed 7 August 2022).
[418] Act of 21 June 2019 n 70 [Lov om havner og farvann (havne- og farvannsloven], online: Lovdata <https://lovdata.no/dokument/NL/lov/2019-06-21-70> (accessed 7 August 2022).
[419] Act of 27 June 2008 No 71 relating to Planning and the Processing of Building Applications [unofficial translation to English provided by the Ministry of the Environment], online: Regjeringen <https://www.regjeringen.no/en/dokumenter/planning-building-act/id570450/> (accessed 7 August 2022).
[420] Nature Diversity Act, *supra* note 404.
[421] Ingunn Elise Myklebust, "Aquaculture law and administration in Norway" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Edward Elgar 2016) 336; Ingrid Kvalvik, Ann-Magnhild Solås & Patrick Berg Sørdahl, "Introducing the ecosystem services concept in Norwegian coastal zone planning" (2020) 42 Ecosystem Services 101071, at 5.
[422] Nature Diversity Act, *supra* note 404, §§ 4, 10; Myklebust, *supra* note 421, at 342.
[423] Bjørn Hersoug, "The Battle for Space: the Position of Norwegian Aquaculture in Integrated Coastal Zone Planning" in Erlend Moksness (ed), *Global Challenges in Integrated Coastal Zone Management* (John Wiley & Sons, 2013), ProQuest Ebook Central, https://ebookcentral-proquest-com.ezproxy.library.dal.ca/lib/dal/detail.action?docID=1118510 [hereinafter Hersoug, "Battle"].
[424] *Ibid*.
[425] Solås et al, *supra* note 387, at 31; Myklebust, *supra* note 421, especially at 339-340, 357-359.
[426] Myklebust, *supra* note 421, at 347.

responsibility for the implementation of the Pollution Control Act in matters relating to discharge in addition to broad responsibility for environmental matters.[427] The municipalities, in turn, are primarily responsible for making "legally-binding area plans, both onshore and offshore, pursuant to the Planning and Building Act".[428] The authorities are supported by research undertaken by the Institute of Marine Research (Havforskningsinstituttet), the Veterinary Institute (Veterinærinstituttet), and the Scientific Committee for Food and the Environment (Vitenskapskomitéen for mat og miljø – VKM).[429]

The Aquaculture Act has an explicit requirement for these authorities to undertake an efficient and coordinated processing of applications. Under the authority of § 8, the Minister has prescribed provisions relating to the coordination of application processing, including timelines.[430]

6.4.2. Licensing System: General Framework

Aquaculture in Norway is a license-based activity. No person may engage in aquaculture activities without registration as the holder of an aquaculture licence in the aquaculture register.[431] In the case of marine salmon farming, there are two licenses (more precisely, a license issued in two steps,[432] two sub-licenses,[433] or a "promise of a license" and a license[434]): a production license ("tillatelse") that provides the right to farm fish, subject to a production capacity limit currently indicated by maximum allowable biomass (MAB); and a site license providing the right to farm at a specific site ("lokalitet"),

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[427] *Ibid*. The county governor (statsforvalteren) is the King's and Government's representative counties. The title of the authority in Norwegian was "fylkesmannen" until January 2021. See: Bugge, *supra* note 404, at 21.
[428] Myklebust, *supra* note 421, at 339.
[429] Norwegian Government, "Aquaculture Strategy", *supra* note 384. Most government agencies have delegated responsibilities to their regional offices.
[430] Aquaculture Act, *supra* note 414, § 8; Regulation on coordination and deadlines in the processing of aquaculture licence applications, FOR-2010-05-18-708 [Forskrift om samordning og tidsfrister i behandlingen av akvakultursøknader] (as amended), online Regjeringen <https://lovdata.no/dokument/SF/forskrift/2010-05-18-708?q=FOR-2010-05-18-708> (accessed 7 August 2022), as cited in Solås et al, *supra* note 387, at 26.
[431] Aquaculture Act, *supra* note 414, § 4, § 8 (official Translation). Regulations on the Aquaculture Register (FOR-2005-12-28-1706) [Forskrift om Akvakulturregisteret (A-registerforskriften)] (Google Translate); Bugge, *supra* note 404, at 253.
[432] Solås et al, *supra* note 387.
[433] Hersoug, "History of MAB", *supra* note 406, at 6.
[434] Michaelsen-Svendsen, *supra* note 406.

subject to a MAB reflecting the carrying capacity of the site.[435] The two are, obviously, related, as the right to farm fish can only be exercised in a specific site. The relationship between the two is more complex, however, as one production license can be split in different sites, and one site can be used for several production licenses[436] (including production licenses belonging to different companies).[437]

The number of production licenses issued by the Government at any given time are limited, which is a characteristic and novel feature in the regulatory system. As noted by Hersoug, Norway is the only jurisdiction in which the Government proactively regulates salmon production growth through the MAB.[438] In other jurisdictions, the governments adopt a reactive approach by responding to industry applications (and with the objective of limiting negative externalities). More on this will be explained below.

Environmental considerations are a key component of the aquaculture license. A license may only be issued if "it is environmentally responsible".[439] Further, "[a]quaculture facilities shall be established, operated and abandoned in an environmentally responsible manner".[440] The Minister may prescribe, by administrative decision or regulations, detailed provisions to ensure environmentally responsible aquaculture.[441]

While early licenses were allocated for free, since 2002 they have been allocated at a fixed price or through auction.[442] Aquaculture licenses are not time limited.[443] They

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[435] Hersoug, "History of MAB", *supra* note 406, at 6.
[436] *Ibid*, at 8. This is why Norwegian sites can hold biomass of 4,000 tonnes or more, while each production license only allows a maximum biomass of 780 tonnes (or 945 in the Northern Regions).
[437] *Ibid*, at 8.
[438] *Ibid*, at 7. It should also be noted that there have been calls to eliminate the production license, and therefore the direct production control of the government. More recently, the overhaul of the licensing system announced in the 2021 Aquaculture Strategy, *supra* note 384, ch 8, suggests a revision of limits based on MBA.
[439] Aquaculture Act, *supra* note 414, § 6. Bugge, *supra* note 404, at 253 refers to "environmentally justifiable", and adds that the term is a flexible concept involving a broad assessment of possible negative environmental effects on one hand and social and economic advantages on the other.
[440] Aquaculture Act, *supra* note 414, § 10.
[441] *Ibid*. These may include requirements for preventative measures, labeling of aquatic organisms, use of sterile aquatic organisms, and use of alien organisms.
[442] Prices have varied. Early licenses were allocated at a price of 10 million Norwegian Kroner (NOK). In the latter round of increased capacity, the auction reached between 750 and 200 NOK (Hersoug, "One country", *supra* note 383).
[443] The platform of the current government includes the objective of making future farming permits time limited. Regjeringen, "Hurdalsplattformen for en regjering utgått fra Arbeiderpartiet og Senterpartiet 2021-2025" [The Government Platform of the Labor Party and the Center Party, 2021-2025][Google Translate],

can be transferred and mortgaged, but as a general rule they cannot be leased.[444] Licenses can be amended and revoked by the Minister in the following circumstances:

> a) if such actions are necessary due to environmental considerations;
>
> b) if there are changes in any material assumptions underlying the licence;
>
> c) in the event of gross or repeated contravention of the provisions prescribed in or pursuant to this Act;
>
> d) if the licence is not used, or only used to a limited extent; or
>
> e) if one or more of the licences required pursuant to other relevant legislation have lapsed.[445]

The amendment and revocation may be time limited (contingent on the improvement or amendment of specific circumstances); it may consist in the alteration of the scope of application of the license or the right to use the license.[446]

6.4.3. Production License: Evolution and Traffic Light System

As mentioned, the decision to issue production licenses is a governmental decision. Historically, the Government allocated production licenses through irregular rounds. The production capacity of each licence was limited to a maximum allowable biomass (MAB). The MAB is the biomass that cannot be exceeded at any point in time[447]: 780 tons, or 945 tons in the northern county Troms and Finnmark.[448]

Originally, the limited number of licenses (and production capacity) was instituted as a regulatory means to avoid production that exceeded market demand and to achieve "as far as possible an ownership structure established based on the owners operating the facilities themselves."[449] To that end, licenses were non-transferable based

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online: Regjeringen <https://www.regjeringen.no/no/dokumenter/hurdalsplattformen/id2877252/> (accessed 16 December 2022), at 24.

[444] Aquaculture Act, *supra* note 414, §§ 19 and 20.

[445] *Ibid*, § 9.

[446] *Ibid*, § 9 para 2 and 3 (as amended by Act 2019).

[447] The MAB has been implemented flexibly in occasions, either by providing increases in MAB in exceptional circumstances or through the "Bremnes" model allowing to average MAB throughout the year (Hersoug, "History of MAB", *supra* note 406, at 4). The regulations also consider the possibility of "interregional biomass limits" that provide farmers with operational flexibility.

[448] *Ibid*, at 4.

[449] Hersoug, "One country", *supra* note 383, at 3.

on a "one farmer, one license" policy.[450] Over time, the policy objectives changed.[451] However, the Government maintained the structure of the system to pursue different economic, social and environmental objectives.[452]

In the late 2000s, there were increasing concerns about environmental impacts of salmon farming and consequent opposition to aquaculture growth. These included concerns that the regulation did not sufficiently consider the evaluation of cumulative burdens of the industry in an "expanded area".[453] Through a long policy process, the Government devised a new system to make decisions on production growth to fulfill two main objectives: provide predictability to the industry (i.e. when decisions would be made and based on what criteria) and promote environmental sustainability. The resulting "traffic light" system was included in new regulations in 2017.[454]

The system divides the Norwegian coast in 13 production zones;[455] assigns each issued production license to one of the production zones; evaluates the environmental condition of each zone; rates it with a traffic light system;[456] and links this indicator to

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[450] Hersoug, "History of MAB", *supra* note 406, at 3.

[451] Production was always capped, although the system evolved from net pen volume (varying over time from 8,000m^3 in 1973, 5,000m^3 in 1975, 3,000m^3 in 1981, increased to 5,000 m^3 and 8,000 m^3 in 1985, and 12,000m^3 in 1988), introducing an additional measure of limiting the maximum farming density in 1985 (25kg/ $m^{3,}$ still applicable to this date), and feed quota (in 1996). Norway abandoned the "one farmer, one license" policy in 1991, making licenses transferable (Hersoug, *ibid*, at 2-3). Feed quotas were abandoned in 2005, when maximum allowable biomass per license was introduced as an indirect mechanism to control production. The MAB per license was set at 780 tons, and 900 tons in the two northernmost counties (Troms and Finnmark) due to lower water temperatures and slower growth. The MAB of Troms and Finnmark was later modified to 945 tons (*ibid*, at 4). See also: Riksrevisjonen [Office of the Auditor General of Norway], The Office of the Auditor General's investigation into the management of aquaculture, Document 3:9 (2011–2012) (6 March 2012) [English version][in file with author] at 89.

[452] Solås et al, *supra* note 387, at 24.

[453] Bailey & Eggereide, *supra* note 391, at 3.

[454] To implement the new system, the Norwegian Parliament amended the Aquaculture Act, adding a paragraph 3 to § 9. The government issued three regulations: Forskrift om produksjonsområder for akvakultur av matfisk i sjø av laks, ørret og regnbueørret (produksjonsområdeforskriften) (FOR-2017-01-16-61)[Regulations relating to production areas for aquaculture of fish in the sea of salmon, trout and rainbow trout (Production Areas Regulations)]; Forskrift om kapasitetsjusteringer for tillatelser til akvakultur med matfisk i sjø av laks, ørret og regnbueørret i 2020 (FOR-2020-02-04-105) [Regulations on capacity adjustments for permits for aquaculture with food fish in the sea of salmon, trout and rainbow trout in 2020]; Forskrift om kapasitetsjusteringer for tillatelser til akvakultur med matfisk i sjø av laks, ørret og regnbueørret i 2022 (FOR-2022-06-07-972) [Regulations on capacity adjustments for permits for aquaculture with food fish in the sea of salmon, trout and rainbow trout in 2022].

[455] Production zones were designed using physical oceanographic analyses that tracked currents and other conditions that would affect the spread of salmon lice larvae and other contagions (Bailey & Eggereide, *supra* note 391).

[456] *Ibid.*

"action rules".[457] Green zones can increase production (6%, subject to payment for additional production capacity)[458]; yellow zones are required to maintain production capacity; and red zones are required to reduce production (6%).[459] In green zones, the Government may decide to implement the production capacity increase by announcing new production licenses or by offering increased volumes (MAB) to existing licenses (subject to payment).[460]

The environmental condition of the production zone is assessed on an annual basis by an expert group; the Minister classifies the zones and adjusts production capacity every two years. The assessment of environmental sustainability is based on one indicator: the impact of lice (*Lepeophtheirus salmonis*) on wild salmonids.[461]

Although the action rule operates at the production zone level (thus affecting all licenses in the respective zone), there is an exemption applicable to sites that do not contribute to the environmental problem.[462] Operators that comply with strict conditions preventing or reducing the exposure of wild salmon to salmon lice[463] are offered an increase in production capacity regardless of the classification of their production zone.

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[457] *Ibid*, at 7.
[458] "Growth might occur by increasing the maximum allowable biomass (…) at existing sites or through the issuing of new [production licenses]" (*ibid*, at 3).
[459] *Ibid*; Hersoug, "One country", *supra* note 383, at 4.
[460] Solås et al, *supra* note 387, at 25.
[461] Production Area Regulations, *supra* note 454, § 8 para 2. The environmental indicator is complex, and it is assessed by the expert committee through seven analyses based on different information sources (sea lice reports from farms, sea lice count in wild smolts, oceanographic information) and three models (models of dispersion and infection, models of mortality). See: Evaluation Committee, "An Evaluation of the Scientific Basis of the Traffic Light System for Norwegian Salmonid Aquaculture" (The Research Council of Norway, December 2021), online: <https://www.forskningsradet.no/siteassets/publikasjoner/2021/an-evaluation-of-the-scientific-basis-of-the-traffic-light-system-for-norwegian-salmonid-aquaculture.pdf> (accessed 27 June 2022)
[462] Production Areas Regulations, *supra* note 454, § 12.
[463] According to the Regulations, this production growth can operate if the operator has "a production method that does not release salmon lice larvae from the pen to the open sea during the last production cycle and for a minimum period of 12 months", as documented by an independent professional body. It can further operate if the farmer has not more than 0,1 sexually mature female salmon lice per salmon with all lice counting between 1st of April and 30th September (or the discard of eggs and the free-floating stages of the salmon lice into the environment from the farm, would have been the same as from a corresponding number of fish with a lice level of 0,1 sexually mature female lice on average per fish) and the salmon has not been treated with drugs more than once during the production cycle (Production Area Regulations, *supra* note 454, § 12; Michaelsen-Svendsen, *supra* note 406, at 20). The increase can be up to 6%.

During the first classification of production zones in 2017, the system was applied with some flexibility as a "trial period".[464] In 2019, two production zones (zones 4 and 5) were classified as red zones and were required to reduce production. Twenty-five companies in zone 4 unsuccessfully sued the government.[465] In the most recent assessment, again two zones (production zones 3 and 4) were classified red and are required to reduce capacity.[466]

The traffic light system has received several criticism during its design and implementation.[467] The decision to implement only one indicator as a measure of environmental sustainability is not considered aligned with holistic and ecosystem approaches.[468] The government has announced the intention to include other environmental indicators in the traffic light system.[469] The indicator itself was criticized as it relies heavily on models rather than measured impact on wild populations.[470] The thresholds have been criticized as insufficiently precautionary and inconsistent with

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[464] Bailey & Eggereide, *supra* note 391, at 13. Two zones classified as red were not required to reduce production; one zone classified yellow was offered an increase in production. Olaussen notes that an underlying problem is that aquaculture is governed by the Ministry of Industry and Fisheries, while the wild salmon is under the management of another department, the Ministry of Climate and Environment. Thus, the Ministry of Industry and Fisheries exercised its right to consider other factors in allowing a growth in production in one yellow zone and did not prioritize wild salmon protection, under the remit of a different Ministry (Olaussen, *supra* note 385, at 162).

[465] Sogn og Fjordane tingrett TSOFT-2020-109859; Gulating lagmannsrett – LG-2021-80234; Hersoug, "One country", *supra* note 383, at 5; Vince McDonagh, "Traffic light dispute goes to Norway's Supreme Court" (21 May 2022), online: Fish Farmer <https://www.fishfarmermagazine.com/news/traffic-light-dispute-goes-to-norways-supreme-court/> (accessed 12 July 2022); Vince McDonagh, "Traffic light farmers denied Supreme Court appeal" (26 August 2022), Fish Farmer <https://www.fishfarmermagazine.com/news/traffic-light-farmers-denied-supreme-court-appeal/> (accessed 15 December 2022).

[466] Regulations on capacity adjustments for permits for aquaculture with food fish in the sea of salmon, trout and rainbow trout in 2022, *supra* note 454.

[467] Michaelsen-Svendsen, *supra* note 406, at 2.

[468] Olaussen, *supra* note 385; Bailey & Eggereide, *supra* note 391, at 13, note that "Norway has also adopted an ecosystem approach to marine management as well as the EU Water Framework Directive. While the latter was mentioned, there was very little linkage of the salmon aquaculture management scheme to these efforts. Again, the launching of a management scheme with a single indicator/action rule communicates a simplistic view of the environment to the public".

[469] Regjeringen, "Hurdalsplattformen", *supra* note 443, at 24. The White Paper 16 (2014-2015) stated that the system was design as a modular system, so that indicators for different environmental impacts can be taken in and out of the system depending on whether the environmental impact is relevant (White Paper 16 (2014-2015), "Predictable and environmentally sustainable growth in Norwegian salmon and trout farming", [Meld St 16 (2014-2015) Forutsigbar og miljømessig bærekraftig vekst i norsk lakse- og ørretoppdrett] [Google Translate] [hereinafter White Paper 16] at 2.2).

[470] Bailey & Eggereide, *supra* note 391. The traffic light system assessment is produced by an Expert Group and is the result "of a complex process of integrating several models, data analyses and expert assessments" and is not a "quantitative or purely mechanistic outcome" (Evaluation Committee, *supra* note 461, at 8 and 36).

Norwegian international commitments under NASCO.[471] Its adoption at the level of a production zone encompassing several farms was also criticized as entailing "collective punishment".[472]

Despite the criticism, with promises to improve the system over time[473] and a continuous review of the knowledge-base,[474] the system is now fully operational. Furthermore, the "production zone" has been adopted as a unit of analysis for most environmental risks associated to aquaculture in the annual risk assessment of Norwegian aquaculture published by Institute of Marine Research.[475]

6.4.4. Special Licenses and Development Licenses

Aside from the "standard" or commercial production license for salmonid farming, the Act also authorizes issuing special purpose licenses for broodstock, education, research, exhibition, and development.[476] The development licenses deserve a special mention. In 2015, the Government implemented a temporary licensing scheme (November 2015 – November 2017) to issue development licenses to support aquaculture projects involving significant innovation and requiring significant investment.[477] The scheme resulted in the

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[471] NASCO, Guidance on Best Management Practices to address impacts of sea lice and escaped farmed salmon on wild salmon stocks (adopted in June 2009 and revised in June 2010), SLG(09)5; NASCO, November 2021 Evaluation of the Revised Implementation Plan under the Third Reporting Cycle (2019 – 2024) from the Review Group to Norway, IP(21)12, online: NASCO <https://nasco.int/conservation/third-reporting-cycle-2/> (accessed 7 August 2022).

[472] Bailey & Eggereide, *supra* note 391, at 11.

[473] *Ibid*, at 7, noting that the White Paper presented to the Stortinget (Norwegian Parliament) stated that "work to develop an indicator [for effluent or pollution] that might fit into the action rule system should be started".

[474] Evaluation Committee, *supra* note 461.

[475] See: Institute of Marine Research, Risk Reports from Fish Farming [Risikorapport norsk fiskeoppdrett] online: Havforskningsinstituttet <https://www.hi.no/hi/nettrapporter?query=&fast_serie=risikorapport-norsk-fiskeoppdrett> (accessed 12 July 2022) [Google Machine Translate]; LB Andersen et al, "Risk understanding and risk acknowledgement: a new approach to environmental risk assessment in marine aquaculture" (2022) 79 ICES J of Marine Science 987.

[476] Hersoug, "One Country", *supra* note 383, at 5. These licenses are issued on an ongoing basis, free of charge, and for a limited time. The MBA associated to these special purpose licenses is significant, which carries concerns about them undermining the licensing system as well as complexity and fragmentation. Hersoug, *ibid*, notes that "the special licenses make up 21% of the total number of licenses, and 17% of the total MAB capacity". It should be noted that these permits are not permanent. The Government committed to a review to determine whether they are satisfying its objectives (Norwegian Government, "Aquaculture Strategy", *supra* note 384, ch 8).

[477] Hersoug, "One Country", *supra* note 383, at 5; Hersoug, Mikkelsen & Osmundsen, "What's the clue", *supra* note 391, at 7.

issuing of more than 100 development licenses to 18 different projects,[478] and has been critical to the development of innovative technologies, including high-energy farms and closed containment.[479]

Development licenses are free of charge, issued for a limited time (15 years), and convertible to commercial (standard) licenses at a fixed (and substantially reduced) price.[480] Unlike other special licenses, they are subject to the traffic light system for production adjustments.[481]

6.4.5. Site License

While the production license provides the right to farm finfish (with a limited MAB), this production licence is not linked to a particular site. The second part of the aquaculture licence, thus, is an application to assign a license to one or more sites. The site must be suitable, which triggers the need to assess it under different pieces of legislation and by different national, regional, and local authorities.

The key legislation addressing the issuing of a site license is the Aquaculture Act, and the granting authority is the county council. Nevertheless, the license cannot be issued without permits issued under other pieces of legislation, which assess the site based on sectoral requirements. These include the Coastal Administration under the Ports and Water Act; the Food Safety Authority under the Food Safety Act and the Animal Welfare Act; and the county governor under the Pollution Control Act. In practice, each of these agencies has a *de facto* "veto right" on new or amended sites.[482]

Additionally, the aquaculture site cannot be cleared in contravention of the land use plan issued by the respective municipality under the Planning and Building Act, the conservation measures adopted under the Nature Diversity Act, or the conservation

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[478] Hersoug, Mikkelsen & Osmundsen, "What's the clue", *supra* note 391. During the application period, more than 100 applications requesting more than 800 licenses were submitted. Not all applications were accepted. Hersoug, "One Country", *supra* note 383, notes that many of the rejections were appealed.
[479] Osmundsen et al refer to a new proposed licensing scheme that would support technology development to address a range of environmental concerns (including sludge collection, electrification of feed barge, no use of copper, and fish labelling for traceability). See: Tonje C Osmundsen et al, "Aquaculture policy: Designing licenses for environmental regulation" (2022) 138 Marine Policy 104978, in particular at 8.
[480] Hersoug, "One Country", *supra* note 383.
[481] In case of production increases, payment of the corresponding fixed fee is postponed to the time of conversion to commercial license.
[482] Solås et al, *supra* note 387, at 26.

measures adopted under the Cultural Heritage Act,[483] unless the competent municipality or conservation authority grants a dispensation. Thus, the municipality and conservation authorities also intervene in the licensing process. In the case of the municipalities, the decision requires a period of public consultation.[484]

Norway has instituted a "single-window" process for an aquaculture site application, which is administered by the county council. The process and associated deadlines are regulated.[485] After receiving an application, the council must request the opinion of the relevant public authorities and the host municipality. The council is also responsible of determining whether the project requires an environmental impact assessment under the Environmental Assessment regulations. This is generally not required.[486]

In issuing a license, the county council has to consider and balance land use interests, in particular the applicant's land use requirements for planned aquaculture production, alternative use of the area for other aquaculture, other uses of the area, and conservation interests not included in the Nature Diversity Act or Cultural Heritage Act.[487] Further, the county council must ensure that the case is sufficiently informed before it is decided.[488]

The Minister may prescribe provisions relating to the localisation of aquaculture activities, including the ban of, or conditions on, aquaculture in areas of special value to aquatic organisms.[489] Salmonid farms cannot be located in designated national salmon fjords and rivers.[490] They can normally not be placed in fishing or spawning areas.[491] The

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[483] Act of 9 June 1978 no 50 concerning the cultural heritage [unofficial translation provided by the Ministry of Climate and the Environment], online: Regjeringen <https://lovdata.no/dokument/NLE/lov/1978-06-09-50?q=lov%201978-06-09-50> (accessed 7 August 2022).
[484] Myklebust, *supra* note 421, at 344.
[485] See: *supra* note 430.
[486] Myklebust, *supra* note 421. It should be noted, however, that the designation of aquaculture areas in the municipal master plan (see below) requires a SEA. Thus, there is already environmental information to support the decision of the county council.
[487] *Ibid.*
[488] According to the Administrative Act § 17 and Nature Diversity Act, *supra* note 404, § 8. See: FOR-2010-05-18-708 Note 7.
[489] Aquaculture Act, *supra* note 414, § 14.
[490] In 2007, the Norwegian Parliament designated national salmon rivers and national salmon fjords, where no new salmon farms could be established. Existing farms in those areas are subject to stronger regulations pertaining to escapes, salmon lice and fish disease (Forskrift om særskilte krav til akvakulturrelatert virksomhet i eller ved nasjonale laksevassdrag og nasjonale laksefjorder, (FOR-2009-06-22-961) (as

Food Safety Authority requires minimum distances between sites, and between site and processing plants, to mitigate the risk of infection.[492]

An important component of the assessment is to determine the site-specific MAB (that is, the production capacity that is consistent with carrying capacity at the site level), which is based on site-specific conditions to prevent unacceptable levels of emissions and to maintain fish health. Site-specific MAB are assessed based on oceanographic information, presence of vulnerable habitats in the vicinity, emissions of the facility, operational practices, and modelling outcomes.[493] Despite the legal and administrative guidance, the process and decision-making have been labeled as highly "discretionary" because the assessment of the different factors, including the determination of site carrying capacity, relies on expert assessment.[494]

6.4.6. Coastal Plans and Aquaculture

As noted, aquaculture sites cannot be cleared in contravention to land use plans developed by the municipalities under the Planning and Building Act. The planning authority of the municipalities deserve some further comments.

In 1989, the terrestrial planning system of the Act was extended to include the coastal area up to the baseline from which the territorial sea is measured; in 2009, the geographical scope was expanded to the coastal area up to a distance of one nautical mile

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amended) [Regulations on special requirements for aquaculture-related activities in or near national salmon rivers and national salmon fjords (regulations for national salmon fjords)]; Hersoug, Mikkelsen & Osmundsen, "What's the clue", *supra* note 391, at 5). Currently, the system has 52 national salmon rivers and 29 national fjords.

[491] Hersoug, Mikkelsen & Osmundsen, "What's the clue", *supra* note 391, at 4.

[492] The Food Safety Authority guidelines consider a minimum distance of 5km between farms of any size, between clusters of farms with coordinated fallowing, or between farms and clusters. Within a cluster, the guidelines also recommend a minimum distance between individual sites that can be "less than 2.5km". The guidelines on minimum distances were modified recently; in previous versions, the minimum distance between small farms (MAB of less than 3,600t) was 2.5km. Minimum distances of 5km are also recommended between farm and processing plant. See: *ibid*, at 5; Mattilsynett [Food Safety Authority], Forebyggende tiltak for å bedre fiskehelsen og fiskevelferden [Preventative measures to improve fish health and fish welfare] (last updated 5 April 2019), online: Mattilsynett <https://www.mattilsynet.no/fisk_og_akvakultur/akvakultur/drift_av_akvakulturanlegg/forebyggende_tiltak_for_aa_bedre_fiskehelsen_og_fiskevelferden.27623> (accessed 2 November 2022).

[493] See Hersoug, "One country", *supra* note 383.

[494] *Ibid* at 8.

measured from the baselines.[495] Currently, all aquaculture is situated within these coastal areas.[496] The primary responsibility for developing spatial plans, including coastal plans, lies on the municipalities (although, unlike planning on land, planning at sea is not mandatory for the municipality).[497] Thus, municipalities are considered to have a "gatekeeper role" regarding access to coastal space.[498] This role has also allowed the municipalities considerable bargaining power to successfully advocate for increased financial contributions from the aquaculture industry.[499]

The stated goal of the Planning and Building Act is that "municipal plans embrace sustainable development and contribute to coordination and an encompassing solution across sectorial borders."[500] To this end, the plan needs to establish goals for the physical, environmental, economic, social, and cultural development of the municipality, and thus consider the conservation of the quality of the environment and the conservation of areas of natural or cultural value, the protection of the Sami, the promotion of industrial development, public health and safety, and generally promote safe and healthy environments.[501]

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[495] Hersoug, "Battle", *supra* note 424. The extension to the area seaward up to the distance of 1 nautical mile was considered in the 2009 Planning and Building Act to harmonize the planning system with the WFD.
[496] Hersoug, Mikkelsen & Osmundsen, "What's the clue", *supra* note 391, at 3.
[497] Myklebust, *supra* note 421, at 345. Nevertheless, from the 225 coastal municipalities in Norway (reduced from 272 in 2019 through mergers (Kvalvik, Solås & Sørdahl, *supra* note 421)), most of them have adopted coastal zone plans, and most of them have included aquaculture areas in them.
[498] Håkan T Sandersen & Ingrid Kvalvik, "Access to aquaculture sites: A wicked problem in Norwegian aquaculture development" (2015) 14 Maritime Studies 27.
[499] The financial contribution to the municipalities has evolved over time largely at the insistence of municipalities, which perceived that they did not receive a fair share of the industry's profit while bearing significant planning and political costs. In 2017, the Parliament allocated 80% of the revenues resulting from the allocation of new production licenses to the municipalities and counties through an Aquaculture Fund. Municipalities were more interested, however, in a scheme that would give them consistent revenue and not only revenue from capacity increases. In 2021, the Government introduced a 0.4NOK per kilo of Atlantic salmon, rainbow trout or sea trout produced that directly benefits the municipalities. The contribution to the Aquaculture Fund was therefore reduced to 40% of the revenues resulting from production capacity increases (see: Hersoug, Mikkelsen & Osmundsen, "What's the clue", *supra* note 391, at 8). A new tax scheme applicable to the Norwegian salmon farming is currently being discussed.
[500] Planning and Building Act, *supra* note 419, § 1.1; Rachel Tiller, Tove Brekken & Jennifer Bailey, "Norwegian aquaculture expansion and Integrated Coastal Zone Management (ICZM): Simmering conflicts and competing claims" (2012) 36 Marine Policy 1086, especially at 1088-1089. Kvalvik et al note that "the municipality acts like an integrating body, responsible for ensuring that changes in spatial use are ecologically, economically and socially sustainable" (Kvalvik, Solås & Sørdahl, *supra* note 421, at 9).
[501] Planning and Building Act, *supra* note 419, § 3-1.

A municipal plan comprises policy and a binding master (area) plan.[502] Areas for aquaculture can be designated in the master plan either generally or for specific species or group of species.[503] The municipality can also adopt sub-plans for more detailed planning for land use.[504]

The planning process considers formal opportunity for public participation, as well as coordination with sectoral agencies.[505] Further, a plan under the Act requires a strategic impact assessment (SEA).[506] The municipal plan and the "master plan" are assessed periodically.[507]

While the municipality has broad, and strengthened, autonomy,[508] the Act emphasizes coordination of central government, regional and municipal functions as a key principle for its implementation.[509] This coordination is achieved through different and complex mechanisms. Both the county and the national government can issue non-biding guidelines on planning.[510] Both levels of government also have the authority to issue legally binding plan provisions or regional plans.[511]

Central and regional authorities do participate in the preparation and discussion of municipal plans, including through the SEA.[512] Further, the county, sectoral agencies, other municipalities, and the Sami Parliament, have the right to raise objections to a

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[502] *Ibid*, § 11-2 and 11-5, respectively. The land-base element of the master plan is binding for new projects or the expansion of existing projects (subject to dispensation) (§ 11-6). See also: Bugge, *supra* note 404, at 319-322. The master plan considers six land-use objectives, including the use and conservation of the sea and river systems and associated shore zones (with sub-objectives include traffic, shipping lanes, fishing, aquaculture, drinking water, nature and outdoor recreation areas, or a combination of these sub-objectives) (Planning and Building Act, *supra* note 419, § 11-7(6)).
[503] Planning and Building Act, *supra* note 419, § 11-11.
[504] *Ibid*, ch 12. Bugge, *supra* note 404, at 323-326.
[505] Planning and Building Act, *supra* note 419, § 1.4, 3.2 and ch 5.
[506] Regulations on impact assessments (FOR-2017-06-21-854) (as amended) [Forskrift om konsekvensutredninger (Google Translate)]; Eirik Mikkelsen, Patrick Berg Sørdahl & Ann-Magnhild Solås, "Transparent and consistent? Aquaculture impact assessments and trade-offs in coastal zone planning in Norway" (2022) 225 Ocean & Coastal Management 106150, at 3.
[507] A newly elected municipal council, within the first year of the election, must develop a planning strategy and assess whether changes to the communal plan are necessary. The master plan must be revised every 4 years, although some have been revised less frequently (Bugge, *supra* note 404, at 319; 323; Ingrid Kvalvik & Roy Robertsen, "Inter-municipal coastal zone planning and designation of areas for aquaculture in Norway: A tool for better and more coordinated planning?" (2017) 142 Ocean & Coastal Management 61, at 69).
[508] Municipality self-rule has been strengthened through constitutional and legal reforms and through instructions to sectoral agencies (Mikkelsen, Sørdahl & Solås, *supra* note 506, at 9).
[509] Myklebust, *supra* note 421, at 344.
[510] Tiller, Brekken & Bailey, *supra* note 500, at 1088-1089.
[511] *Ibid.*
[512] *Ibid.*

proposed plan when it is inconsistent with defined national, regional, or local priorities and objectives.[513] A consensus-based resolution to the conflict is promoted with mediation. However, if mediation is unsuccessful, the objection is decided by the Ministry of Local Governments and Modernisation.[514] This is a prerogative that has not been exercised often.

The Act also promotes the elaboration of intermunicipal plans, in particular for coastal plans,[515] either by initiative of the municipalities, at the request of the regional planning authority (the county council) or central government.[516] In this case, each municipal council retains the authority to make decisions regarding individual developments, unless it voluntarily decides to delegate this authority to the intermunicipal planning board.[517] The option of intermunicipal plans have been considered beneficial in particular for coastal zone plans, as municipalities are rather small, and fjords and coastal areas are usually under the jurisdiction of several municipalities.[518] The atomization of decision-making, it is argued, is inconsistent with the holistic and ecosystem-based approaches to the management of the coastal area.[519]

6.4.7. Operational and Monitoring Requirements

The Norwegian Aquaculture Act requires aquaculture facilities to be established, operated and abandoned in an environmentally responsible manner.[520] The Ministry of

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[513] Planning and Building Act, *supra* note 419, § 5-4. Myklebust, *supra* note 421, at 345.
[514] Myklebust, *supra* note 421, at 346.
[515] The Planning and Building Act, *supra* note 419, § 9-1, reads: "Two or more municipalities should cooperate on planning pursuant to this Act when it is expedient to coordinate planning across municipal borders" (as cited in Kvalvik & Robertsen, *supra* note 507, at 64). A majority of municipalities can also request regional planning authority to take over the planning work as a regional master plan, on the basis of planning work that has been conducted (*ibid*, at 64 citing the Planning and Building Act § 9-4).
[516] Planning and Building Act, *supra* note 419, §§ 9.1., 9.3., 9.4. and 9.7; Kvalvik & Robertsen, *supra* note 507, at 64. Regional planning authority or central government authorities may request municipalities to enter into inter-municipal cooperation when it is considered necessary to safeguard and discharge important national and regional considerations and functions that extend beyond the individual municipality. Inter-municipal planning can also be initiated as the implementation of a regional planning strategy, or the central government authority may decide that the planning work shall be continued in the form of a regional master plan.
[517] Planning and Building Act, *supra* note 419, § 9.3; Kvalvik & Robertsen, *supra* note 507.
[518] Kvalvik & Robertsen, *supra* note 507, at 62. It should be noted that the Norwegian government has engaged in a political process to merge municipalities to create bigger local government units (*ibid*, at 69).
[519] *Ibid*.
[520] Aquaculture Act, *supra* note 414, § 10. Further, § 5 of the Salmon Operation Regulations states that "The operation must be technically, biologically and environmentally sound" (Forskrift om drift av

Trade, Industries and Fishery has the authority to establish, by administrative decisions or regulations, further detailed provisions to ensure environmentally responsible aquaculture.[521] The Ministry also has the authority to require, in an individual decision or by regulation, that any person who holds or applies for an aquaculture licence undertakes or pays for the necessary environmental investigations to document the environmental condition within the locality's area of influence when establishing, operating and discontinuing aquaculture.[522] Specific monitoring obligations have been established by regulations.[523] Further, regulations under other legislation also can impose operational restrictions or requirements to the aquaculture farm. The authorities can also impose conditions in the sectoral permits, an authority that is commonly exercised by the county governor under the Pollution Control Act.[524]

An internal controls regulation requires that the industry systematically implements measures to meet legislative requirements addressing environmental sustainability, fish health, and fish welfare.[525] Under this regulation, the industry must ensure that the regulatory requirements are known, and clear responsibilities are assigned

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akvakulturanlegg (akvakulturdriftsforskriften), FOR-2008-06-17-822 [Regulations on the operation of aquaculture facilities (the Aquaculture Operations Regulations)] [Google Machine Translate] as amended).

[521] Aquaculture Act, *supra* note 414, § 10. See also § 6: the Minister may grant an aquaculture licence if it is environmentally responsible.

[522] *Ibid* § 11, as amended in 2013. The environmental investigations may include investigations to clarify whether and how the aquaculture activity causes, has caused or may cause an impact on the environment. It is important to note that the original § 11 considered the authority to request environmental information "of the site", an expression that did not capture the geographical scope of the potential impacts resulting from aquaculture (Norwegian Government (King in Council), Prop 103 L (2012–2013) Endringer i akvakulturloven [Proposal for Amendments to the Aquaculture Act], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/prop-103-l-20122013/id720309/> (accessed 16 March 2023)[Google Machine Translate]).

[523] Forskrift om tillatelse til akvakultur for laks, ørret og regnbueørret (laksetildelingsforskriften), FOR-2004-12-22-1798 [Salmon Allocation Regulations] [Google Machine Translation] s 36; Aquaculture Operations Regulations, *supra* note 520, §§ 35 and 36.

[524] Miljødirektoratet [Environmental Agency], "Akvakultur: Forurensningsmyndighetenes forventninger til oppdrettsanlegg i sjø" ["Expectations for Aquaculture on the Sea"], online: <https://www.miljodirektoratet.no/publikasjoner/2017/april-2017/forurensningsmyndighetenes-forventninger-til-oppdrettsanlegg-i-sjo/> (accessed 5 August 2022) [Google Translate]; I Dahl, "Analyse av regelverket: Regelverket knyttet til produksjon, areal- og lokalitetsforvaltning og områdesamarbeid i havbruksnæringen", NOFIMA Report 33/2020, online: NOFIMA <file:///E:/BackUp%202022-07-16/01%20ALL%20ENGLER/004%20Jurisdictions%20literature/Norway/Reports/NOFIMA%203%202020%20evaluacion%20de%20medidas.pdf > (accessed 7 August 2022) ["Regulatory analysis: Regulations relating to production, land and site management and regional cooperation in the aquaculture industry"] [Google Machine Translate]

[525] Regulations on internal control to comply with aquaculture legislation (IK-Aquaculture) (FOR-2004-03-19-537) (as amended) [Forskrift om internkontroll for å oppfylle akvakulturlovgivningen] [Google Machine Translate].

within the company. It must formulate clear goals, assess the risks associated to the operations, adopt mitigation measures, and systematically monitor and review the internal controls.

All sites must have an operational plan approved by the Fisheries Directorate and the Fish Safety Authority.[526] The operational plan must contain, as a minimum, information on the sites that will be stocked, the fallowing period, and the sites that may be left inactive.[527] As a minimum, sites must be fallowed for 2 months.[528] However, the Fish Health Authority may require longer fallowing period or a coordinated fallowing period in an area to prevent the spread of virus and pathogens.[529] While coordinated fallowing has been implemented as a voluntary measures by the industry, since 2017 the Fish Health Agency has communicated its intention to make broader use of its regulatory powers.[530]

All sites must also prepare a contingency plan in case of emergencies.[531] Further, the Aquaculture Operations Regulations contains due diligence obligations in relation to operational aspects, including: installation and marking of structures, prevention and mitigation of escapes, recapture obligations, environmental monitoring, risk-based fish health surveillance, sanitary measures, record keeping and reporting obligations, maximum fish density,[532] stocking, feeding, handling and care, slaughter, and training.

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[526] Aquaculture Operations Regulations, *supra* note 520, § 40. The plan must be presented in October for the next production cycle (2 years).
[527] *Ibid*.
[528] *Ibid*, § 40.
[529] *Ibid*, § 40. The preferred approach is for direct agreement between the farmers in an area. Both the Fisheries Directorate and the Food Safety Authority can make decision on coordinated allowing. Regulations do not specify criteria for the size of the area nor the duration of coordinated fallow. The authorities stive for a coordinated fallowing period of at least one month (Peter Gullestad et al, Effektiv og bærekraftig arealbruk i havbruksnæringen Rapport fra et ekspertutvalg oppnevnt av Fiskeri- og kystdepartementet (Oslo, 4 February 2011) [Efficient and sustainable land use in the aquaculture industry Report from an expert committee appointed by the Ministry of Fisheries and Coastal Affairs][Google Translate]).
[530] See: Norwegian Government, "Aquaculture Strategy", *supra* note 384, ch 6. See also: Dahl, *supra* note 524 (criticizing the lack of rules and guidance for the exercise of the authority to require coordinated fallowing for sites in close proximity). Note that, according to Dahl, *ibid*, the Fish Safety Authority has also authorized sites located closer together (less than 2.5km) when coordinated fallow is implemented.
[531] Aquaculture Operations Regulations, *supra* note 520, § 7.
[532] The regulations considered a maximum farming density of 25kg/m3 (*ibid*, § 25) and a maximum number of fish in each cage of 200 000 (*ibid* § 47a).

a) Escapes

The operator has an obligation to take particular care to prevent fish from escaping, that any escape is detected as quickly as possible, and that the escape is limited as much as possible.[533] The installation and operation of aquaculture facilities in the marine environment requires compliance with construction, maintenance, and inspection requirements under the Norwegian Standard 9415:2009 on Floating fish farms, or other European or international standards with the same safety level.[534] If an escape occurs, or is suspected, the operator must notify the authorities and must immediately attempt to recapture the escaped fish within a distance of 500m from the cages.[535]

Further, § 13a of the Aquaculture Act and a 2015 regulation have established a joint responsibility scheme for escapes to reduce the probability of genetic impacts.[536] The mandatory scheme requires the industry to form and fund an association[537] that will plan and implement mitigation measures (removal of escapees) in rivers where the presence of escaped salmon exceeds defined thresholds.[538] The scheme builds on a long-standing government monitoring program assessing the proportion of farmed salmon in more than 200 Norwegian rivers.[539]

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[533] *Ibid*, § 37.

[534] Forskrift om krav til teknisk standard for flytende akvakulturanlegg (NYTEK-forskriften) FOR-2011-08-16-849 [Regulations on requirements for technical standards for floating aquaculture facilities (NYTEK regulations)] [Google Machine Translate].

[535] Aquaculture Operations Regulations, *supra* note 520, §§ 37, 38.

[536] Regulations on joint responsibility for fishing, etc. of escaped farmed fish (FOR-2015-02-05-89) (as amended) [Forskrift om fellesansvar for utfisking mv. av rømt oppdrettsfisk] [Google Machine Translate]. The regulation implements § 13a of the Aquaculture Act introduced in 2013.

[537] The established association is OURO, online: OURO <https://utfisking.no/>. The holder of a license is exempt of payment if all fish in the sites linked to the license have a tracking system in place. If the fish in sites linked to the license cannot reproduce, the licence holder pays a reduced fee (25%) (Regulations on joint responsibility, *supra* note 536, §5).

[538] The association shall implement a recapture scheme in rivers where the proportion of escaped farmed fish is greater than 10% (*ibid*, § 2). In 2021, recapture was undertaken in 22 rivers (Environmental Agency, Aquaculture: Environmental Status, online: <https://miljostatus.miljodirektoratet.no/tema/hav-og-kyst/fiskeoppdrett/> (accessed 5 August 2022) [Google Machine Translate]. According to the White Paper 16, *supra* note 469, the objective of the government is to stimulate the development of effective tracking tools so that in the long term, the financial responsibility falls solely on the company responsible for the escaped fish.

[539] See: KA Glover et al, "Domesticated escapees on the run: the second-generation monitoring programme reports the numbers and proportions of farmed Atlantic salmon in >200 Norwegian rivers annually" (2019) 76 ICES J of Marine Science 1151, doi:10.1093/icesjms/fsy207. The monitoring program was initiated in the 1980s. An upgraded national monitoring program was established in 2014. From 2014, the monitoring of escaped farmed fish in rivers has increased considerably (White Paper 16, *supra* note 469; Riksrevisjonen, *supra* note 451, at 49).

b) Environmental Monitoring

Norway has comprehensive baseline assessment and monitoring requirements to assess that the organic matter of the farm can be assimilated by the environment, currently enshrined in the Norwegian Standard 9410:2016.[540] The Standard 9410:2016 is based on the MOM (Modelling -- On-growing fish farms -- Monitoring) system,[541] which integrates the elements of environmental impact assessment, monitoring of impact and environmental quality standards.[542] The current version of the Standard distinguishes two zones for the regulation of organic matter: a) the local impact zone, i.e., the area beneath and close to the farm where larger particles (waste feed) settles; and b) the intermediate zone, i.e., area beyond the local impact zone, where smaller particles (finely divided waste feed and faeces) and resuspended matter from the sediment settle. The extent of each of these areas is site-dependent and established through modelling and monitoring. Nevertheless, the local impact zone does usually not extend beyond 25m from the cage edge, while the intermediate impact zone usually does not extend beyond 500-600m from the cages.

Finfish farms operators are required to carry out environmental monitoring.[543] The Standard 9410:2016 considers two types of survey of different complexity and accuracy: the B-survey in the local impact zone, and C-survey in the intermediate impact zone.[544] The B-test in the local impact zone is inexpensive, easy to perform, and performed more frequently.[545] The monitoring results allow the classification of the site

[540] NS 9410:2016, Miljøovervåking av bunnpåvirkning fra marine akvakulturanlegg (Environmental monitoring of benthic impact from marine aquaculture) (unofficial version) in file with author [Google Machine Translation]. The standard was first published in 2000 and amended in 2007 and 2016.
[541] Arne Ervik et al, "Regulating the local environmental impact of intensive marine fish farming: I. The concept of the MOM system (Modelling – Ongrowing fish farms – Monitoring)" (1997) 158 Aquaculture 85; Pia Kupka Hansen et al, "Regulating the local environmental impact of intensive, marine fish farming: II. The monitoring programme of the MOM system (Modelling–Ongrowing fish farms–Monitoring)" (2001) 194 Aquaculture 75.
[542] Ervik et al, *supra* note 541.
[543] Aquaculture Operations Regulations, *supra* note 520, § 35.
[544] An earlier version of the NS 9410 included an A-survey as a simple measurement of the rate of sedimentation of organic material below the fish farm (Hansen et al, *supra* note 541). The A-survey was eliminated from the standard in 2007.
[545] It includes three groups of indicators: quantitative (presence/absence) measure of macrofauna (Group I); chemical parameters (Group II), and sensory parameters (Group III). B-tests are generally required once every production cycle but monitoring frequency increases if monitoring results show less than Category 1 (very good) status.

in one of 4 categories representing increased environmental impact. Category 4 (very poor) indicates unacceptable impact.

The Directorate of Fisheries is the agency responsible for receiving and assessing B-tests, and to decide on mitigation responses if B-tests show unacceptable sediment conditions.[546] A site in poor condition would normally be required to adjust its production plan, while a site in very poor condition (category 4) would be required to submit an extended B-survey and to fallow until sediment conditions improve.[547] A site with consistent poor performance may be decommissioned by the relevant authorities.[548]

The C-test, in turn, seeks to detect more subtle changes to benthic conditions at a distance from the cages[549] using biodiversity indicators (quantitative assessment of macro infauna).[550] Copper is also monitored in the station closest to the cages, if copper has been used in the site. Two sets of thresholds apply to C-test. One threshold applies exclusively to the C-test performed at the edge of the local impact zone and is defined in the Standard 9410:2016.[551] In the other stations, the benthic condition is assessed based on the criteria and thresholds for benthic assessment specified in the Guidance for the classification of coastal waters issued under the Water Regulations[552] implementing the

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[546] Pia Kupka Hansen, "Miljøpåvirkning på bunn som følge av partikulære organiske utslipp fra fiskeoppdrett" in Ellen Sofie Grefsrud et al (eds), *Risikorapport norsk fiskeoppdrett 2019: Miljøeffekter av lakseoppdrett*, para 4.1.2 [Environmental impact on the bottom as a result of particulate organic emissions from fish farming] [Google Machine Translate]online: Havforskningsinstituttet <https://www.hi.no/hi/nettrapporter/fisken-og-havet-2019-5#sec-5> (accessed 15 December 2022).
[547] Aquaculture Operations Regulations, *supra* note 520, § 36; Environment Protection Authority (Tasmania), *A Review of Tasmanian and International Regulatory Requirements for Salmonid Aquaculture* (Environment Protection Authority, Tasmania, 2019).
[548] Environment Protection Authority (Tasmania), *supra* note 547.
[549] The number and location of stations is determined on a case-by-case basis, guided by the baseline information, and must be justified in the monitoring report. The standard does contain some indicative guidelines, however.
[550] The C-survey is generally required every 3rd production cycle but could be required every 2nd production cycle if monitoring shows conditions under acceptability thresholds. This would be the case if the mean results of the monitoring stations located within the transition (or mixing) zone fall within the moderate status category. On earlier versions of the Standard 9410, C-tests were only performed when required by the authorities. At the time, it was estimated that only 10% of farms had to undertake a C-test monitoring.
[551] The station at the edge of cages or station (C-1) is classified in 1 of 4 categories based on macrofauna abundance and diversity.
[552] Direktoratsguppen vanndirektivet, Veileder 02:2018: Klassifisering av miljøtilstand i vann (2018) [Directorate Group Water Directive, Supervisor 02: 2018: Classification of environmental status in water (2018)] [Google Translate]. According to this Guidance, the benthic condition can be assessed as very good, good, moderate, poor or very poor. Different thresholds for these categories have been established for eight different water types (open exposed coast, moderately exposed coast/fjord, protected coast/fjord, fjord affected by freshwater, fjord highly affected by freshwater, naturally oxygen-poor fjord, high current

WFD. At the edge of the intermediate zone, sediment biodiversity must achieve good status; a moderate status would trigger an alternate next cycle study to map the extent of the reduced state, and to determine whether the result is due to natural causes or the site's impact.[553] Since 2017, the C-tests are sent to the county governor's environmental protection departments rather than the Directorate of Fisheries.[554]

c) Sea Lice

As noted above, the prevalence of sea lice is a key component for the production zone regulations. Sea lice are also managed at the site level as well as in broader cooperation areas.[555] The regulations establish mandatory counting of sea lice, with more extensive counting requirements in the spring (coinciding with the migration of smolt). They also establish acceptability limits for the number of adult sea lice per fish, which are also stricter in the spring.[556] The regulations require sites to have a plan for effective control of sea lice, which must be coordinated with other aquaculture facilities within a specified geographical area.[557] In principle, it is the operators' responsibility to define the appropriate geographical area and the elaboration of the coordinated plan. However, if the Fish Safety Authority is not satisfied with the area definition or the content of the plan, it may lay down regulations applicable to defined zones to ensure the implementation of necessary measures. Such regulations may include requirements for coordinated treatments, salmon lice limit applicable to the zone, reduction of biomass, or additional counting requirements, among others.[558]

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straits, and distinctive water bodies) in six marine regions (Barents Sea, Norwegian Sea North, Norwegian Sea South, North Sea North, North Sea South, and Skagerrak)

[553] The required investigations are clarified with the authorities and may include an extended investigation area or analysis of tracers such as fatty acids and stable isotopes. In this case, further examination could include the reference station situated 1km away from the cages.

[554] Hansen, *supra* note 546, at 4.1.2.

[555] Regulations on the control of salmon lice in aquaculture facilities (lice regulation) (FOR-2012-12-05-1140) (as amended) [Forskrift om bekjempelse av lakselus i akvakulturanlegg][Google Machine Translate], online: Lovdata <https://lovdata.no/dokument/SF/forskrift/2012-12-05-1140?q=FOR-2012-12-05-1140> (accessed 7 August 2022).

[556] In the Southern part of the country, there should be at all times fewer than 0.2 adult female lice per fish between weeks 16 and 21, and 0.5 the rest of the year. In the three Northern zones, the limits of 0.2 adult female lice per fish applies between week 21 and 26 (*ibid*).

[557] *Ibid*, § 4. The plan must be submitted every year (October 1st) to the Food Safety Authority.

[558] *Ibid*, § 5.

CHAPTER 7. LAW AND POLICY COORDINATES FOR AN ECOSYSTEM APPROACH TO SALMON MARICULTURE

The previous Chapter describes the legal frameworks for aquaculture in four key salmon mariculture jurisdictions. This chapter addresses these legal frameworks in the broader context of the theoretical construction of the ecosystem approach to aquaculture (EAA) and the academic literature on ecosystems and the law discussed in chapters 2 and 3, and of the international obligations or soft law recommendations discussed in chapter 5. Connecting theory, international law, and State practice, the chapter seeks to provide a deeper understanding on the different means through which aquaculture legal frameworks are conceptualizing and enabling the implementation of an ecosystem approach (EA) for sustainable aquaculture. Equally important, the chapter seeks to shed light into the pathways in which legal structures stand as an obstacle to implementing an EAA.

In Chapter 3, a framework for the comparative assessment was presented focusing on three interrelated dimensions of EAA and associated procedural and substantive law and policy coordinates (namely, EAA as a social process, as a normative concept, and as adaptive and flexible approach). This resulted in four relevant questions for the comparative assessment:

- Do salmon mariculture laws and policies endorse EAA?
- Which legal structures or tools are in place to balance multiple ecological, social, and economic objectives?
- How do legal instruments address "beyond the farm" impacts (i.e. ecosystem-level and cumulative interactions)?
- How do salmon mariculture legal frameworks support adaptive management?

Based on the description of legal frameworks in Chapter 6, the second question was further refined to focus on aquaculture zoning and planning as a key legal instrument for balancing of different societal objectives (EAA Principle 2) and marine and coastal uses (EAA Principle 3).

7.1. Recognition of the Ecosystem Approach to Aquaculture

7.1.1. Theory

The EAA literature calls for legal frameworks to recognize an EAA explicitly, to recognize the principles of EAA, or to provide indirect support to key success factors. These include decentralization of decision-making, developing monitoring systems and data repositories, and promoting human capacity, financial resources, scientific research, and enforcement capabilities.[1] In other contexts, the explicit recognition of EA concepts in relevant legislation has also been highlighted as necessary, or at least helpful, for its legal operationalization and implementation.[2] An illustrative list of substantive and procedural EA concepts include: recognizing and outlining the precautionary approach; broadening stakeholder participation; promoting institutional coordination, cooperation and integration; considering species interactions; promoting sustainable development; and preserving marine biodiversity.[3]

The explicit recognition of principles for environmental decision-making (albeit not an ecosystem approach in particular) has been supported in the broader literature. Environmental principles[4] have an important role to play in law addressing complex social-ecological systems, where "simple, clear-cut rules" are not possible or desirable.[5] While flexible legal frameworks are needed to address this complexity, that flexibility

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[1] FAO, *Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010) at 24 [FAO, EAA Technical Guidelines]; Cecile Brugère et al, *Aquaculture planning: policy formulation and implementation for sustainable development*. FAO Fisheries and Aquaculture Technical Paper No 542 (Rome: FAO, 2010) Box 4 at 32.

[2] FAO EAF-Nansen Project, *A How-to Guide on legislating for an ecosystem approach to fisheries*. FAO EAF-Nansen Project Report No 27 (Rome: FAO, 2016).

[3] *Ibid*, component 1 and 2. The illustrative list also includes a concept that relates more specifically to fisheries: eg *avoiding overexploitation.*

[4] In this Chapter, the term "environmental principle" is used as distinct from "general principles of law recognized by civilized nations" (*Statute of the International Court of Justice*, 26 June 1945, 33 UNTS 993 (entered into force 24 October 1945), art 38(1)(c)). Therefore, it does not imply a statement concerning its status as an independent norm of international law. In this sense, I follow Proelss use of the term "principles" in Alexander Proelss, "The Contribution of the ITLOS to Strengthening the Regime for the Protection of the Marine Environment" in Angela Del Vecchio & Roberto Virzo (eds), *Interpretations of the United Nations Convention on the Law of the Sea by International Courts and Tribunals* (Cham, Switzerland: Springer International, 2019) 93, note 8 at 95.

[5] Froukje Maria Platjouw, *Environmental Law and the Ecosystem Approach: Maintaining ecological integrity through consistency in law* (Oxon; New York: Routledge, 2016) at 130, citing Hans Christian Bugge, "Environmental Law's Fragmentation and Discretionary Decision-making: A Critical Reflection on the Case of Norway", in Erik Røsæg, Hans-Bernd Schäfer & Endre Stavang, (eds) *Law and Economics: Essays in Honour of Erling Eide* (Cappelen Damm Akademisk, 2010).

needs to be balanced with legal certainty, predictability, and normative direction. One of the means to achieve that balance is by legislating by means of general principles.[6]

Regulating by principles "imply stating a certain normative direction and indicating different possible factors that may be taken into account and weighed against another, without the aspiration of exactly denoting or determining the outcome of the decisionmaking".[7] Environmental principles can bridge "the gap between the objective of sustainable development [the ideal] and the directly applicable and enforceable environmental legal rules."[8]

In practical terms, environmental principles can be useful tools to interpret broad or unclear legal norms, and for the consistent exercise of discretionary administrative powers.[9] Further, they can promote consistency of decision-making in fragmented legal and institutional landscapes.[10] To fulfill these objectives, however, it is a prerequisite that the environmental principle has an intelligible content and that it is consistently understood and applied. This is not always the case, however, as principles themselves are flexible.[11]

7.1.2. International Law and Policy

International agreements do not directly address aquaculture; therefore, there is no international agreement requiring an EAA. This stands in contrast to fisheries management, for which there are extensive calls to implement an EA in international[12]

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[6] Jonas Ebbesson, "The rule of law in governance of complex socio-ecological changes" (2010) 20 Global Environmental Change 414, at 418-419. Another suggested approach is legislating by means of framework laws, which set the objectives or goal-oriented norms, but leaving the competent authority to decide on the means.
[7] *Ibid*, at 418.
[8] Platjouw, *supra* note 5, at 126.
[9] *Ibid*. See also: Ulrich Beyerlin & Thilo Marauhn, *International Environmental Law* (Oxford, UK; Portland, USA: Hart/CH Beck/Nomos 2011), at 37.
[10] Platjouw, *supra* note 5, a 127.
[11] *Ibid*.
[12] It is generally considered that the EAF has been recognized in the United Nations Fish Stock Agreement (*Agreement for the Implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*, 4 August 1995, 2167 UNTS 3 (entered into force 11 December 2001)). See: Cecilia Engler, "Beyond rhetoric: navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management" (2015) 23 Environ Rev 288; Sarah Ryan Enright & Ben Boteler, "The Ecosystem Approach in International Marine Environmental Law and Governance", in TG

and regional agreements.[13] Arguably, EAF can be considered an international minimum standard under the LOSC.[14] As a direct consequence of this broader endorsement, there is also a stronger theory and practice on the content of EAF and its supporting implementation tools.

While there is no independent legal obligation to implement an EAA, States may be bound to implement an EA to aquaculture management to the extent it is recognized as an international obligation, either through a global or regional agreement or as customary international law. The status of EA as a principle of customary international law is generally denied,[15] although the question has not been addressed extensively in academic literature.[16] Nevertheless, there are two areas in which EA has received a stronger endorsement: the conservation and sustainable use of biological diversity, and oceans management.

The EA is not mentioned explicitly in the Convention on Biological Diversity (CBD) but the Contracting Parties to the CBD explicitly adopted the EA as the primary framework of action to be taken under the Convention.[17] There is a reasonable question on whether the endorsement of the EA in a decision of the Contracting Parties can amount to an international obligation to implement the principle in the absence of an

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O'Higgins et al (eds), *Ecosystem-Based Management, Ecosystem Services and Aquatic Biodiversity: Theory, Tools and Applications* (Springer Link (Open Access), 2020) 333).

[13] It has been explicitly endorsed in the *Convention on the Conservation on the Living Marine Resources in the Antarctica* (CCAMLR), 20 May 1980, 1329 UNTS 48 (entered into force 7 April 1982); the preambular provisions of the *Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries* (NAFO Convention), 24 October 1978, 1135 UNTS 370 (entered into force 1 January 1979) (as amended), and the *Convention on Future Multi-lateral Cooperation in North-East Atlantic Fisheries*, 18 November 1980 (entered into force 17 March 1982) (as amended), as well as in the substantive provisions of the *Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean*, 14 November 2009, 2899 UNTS 211 (entered into force 24 August 2012).

[14] *United Nations Convention on the Law of the Sea*, 10 December 1982, 1833 UNTS 397 (entered into force 16 November 1994) [hereinafter LOSC], art 61(3): in establishing the total allowable catch and other management measures for living resources, States shall take into account, *inter alia*, generally recommended international minimum standards, whether subregional, regional, or global. Art 119(1)(a) imposes a similar obligation for States fishing for the same stock in the high seas.

[15] Dan Tarlock, "Ecosystems" in Daniel Bodansky, Jutta Brunnée & Ellen Hey (eds), *The Oxford Handbook of International Environmental Law* (Oxford: Oxford University Press, 2007) 574; Arie Trouwborst, "The Precautionary Principle and the Ecosystem Approach in International Law: Differences, Similarities and Linkages" (2009) 18 RECIEL 26.

[16] Elisa Morgera, "The ecosystem approach and the precautionary principle" in Elisa Morgera & Jona Razzaque (eds), *Biodiversity and Nature Protection Law* (*Elgar Encyclopedia of Environmental Law*, v3) (Cheltenham, UK: Edward Elgar Publishing, 2017) 70 at 70.

[17] CBD, "Decision II/8 Preliminary Consideration of Components of Biological Diversity Particularly under Threat and Action which Could Be Taken under the Convention", adopted by the Conference of the Parties during the Second Ordinary Meeting held in Jakarta, Indonesia, 6 - 17 November 1995, at para 1.

explicit recognition in the text of the Convention. Indeed, a subsequent agreement on the interpretation of the text or application of its provisions may amount to an authoritative and binding interpretation of its text.[18] This argument should be rejected, however. The decisions of the Contracting Parties to the CBD generally considered non-binding, as they do not follow the procedure to amend the convention or adopt new annexes or protocols.[19] More pointedly, Decision VII/11 explicitly refers to the CBD principles for EA as a voluntary instrument.[20] Nevertheless, the decision of the Contracting Parties undoubtedly represents a strong commitment to implement EA in the national implementation of their obligations under the CBD.

EA has also a basis on oceans law and policy. EA has been endorsed in the context of marine management agreements and policy instruments. Several regional agreements have codified the EA to marine management,[21] although with qualified language.[22] More broadly, the global community has endorsed the EA to oceans management in several policy instruments, including implicitly in Agenda 21,[23] and explicitly in the Johannesburg Plan of Implementation,[24] and the Sustainable

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[18] *Vienna Convention on Law of Treaties*, 23 May 1969, 1155 UNTS 331 (entered into force on 27 January 1980), art 31(3)(a).
[19] *Convention on Biological Diversity*, 5 June 1992, 1760 UNTS 69, arts 28-31.
[20] CBD, Decision VII/11 on Ecosystem Approach adopted by the Seventh Ordinary Meeting of the Conference of the Parties held in Kuala Lumpur, Malaysia, 9 - 20 February 2004, para 3, calls on "parties and other Governments to implement the ecosystem approach, keeping in mind that in applying the ecosystem approach, all principles need to be considered, with appropriate weight given to each, in accordance with local conditions, and keeping in mind also that the implementation of the ecosystem approach and all principles need to be considered as voluntary instruments and should be adapted to local conditions and implemented in accordance with national legislation".
[21] See, eg: Commission for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR), "Statement on the Ecosystem Approach to the Management of Human Activities: Towards an Ecosystem Approach to the Management of Human Activities", adopted during the Joint Ministerial Meeting of the Helsinki and OSPAR Commissions held in Bremen, Germany, 25-26 June 2003.
[22] See eg: *Convention for the Protection of the Marine Environment of the North-East Atlantic Commission*, 22 September 1992, 2354 UNTS 67 (entered into force 25 March 1998)(OSPAR Convention), Annex V "Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area", art 3(1)(b)(iv) calling upon the Commission to "aim for the application to an integrated ecosystem approach", subject to the limitations of art 4.
[23] Agenda 21, para 17.1, recognizes the need for "new approaches to marine and coastal area management and development, at the national, subregional, regional and global levels, approaches that are integrated in content and are precautionary and anticipatory in ambit, as reflected in the following programme areas" (United Nations Conference on Environment and Development, *Agenda 21: Programme of Action for Sustainable Development*, UN Doc. A/Conf. 151/26 (1992)).
[24] United Nations (UN), *Report of the World Summit on Sustainable Development*, A/CONF.199/20/EN, Resolution 2, para 30(d).

Development Goals.[25] Further, international policy statements on aquaculture have called for an EAA.[26]

7.1.3. Lessons from State Practice

The jurisdictions under study all endorse the EA in the policy seascape to different degrees and, in some cases, in legally binding instruments. Indeed, EA is a legislated principle for decision-making and management in the Chilean General Act on Fisheries and Aquaculture (LGPA), the Norwegian Nature Diversity Act (in relation to biodiversity conservation), by reference in the *Nature Conservation (Scotland) Act 2004* (in relation to biodiversity conservation) and in the *Marine (Scotland) Act 2010* (in relation to marine planning). It is also recognized as a principle to be implemented, at the discretion of the competent Ministers, in the Canadian (federal) *Fisheries Act*, *Species at Risk Act* and the *Oceans Act*. EA is further a foundational principle to several EU Directives. Particularly relevant for aquaculture planning and management in Scotland and Norway is the EU Water Framework Directive (WFD).

The extent to which the legislated principle applies directly to aquaculture varies and, in some cases, can be contested. In the case of Chile, despite the explicit recognition of the EA for management under the LGPA, a narrow interpretation can be construed to conclude that the EA does not apply to aquaculture planning and management. This interpretation is supported by the textual provisions of the Act, which circumscribe the EA to the management of fishery resources, rather than the aquatic resources inclusive of aquaculture resources.[27] It is also supported by the definition of "ecosystem approach"

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[25] UN, Department of Economic and Social Affairs, "Sustainable Development", online: https://sdgs.un.org/goals/goal14 (accessed 10 September 2021), Target 14.2 and associated indicator.
[26] FAO, "Phuket Consensus: A re-affirmation of commitment to the Bangkok Declaration", adopted by the FAO/NACA Global Conference on Aquaculture Millennium +10: Farming the Waters for People and Food (Phuket, Thailand, 22-25 September 2010), online: FAO <http://www.fao.org/tempref/FI/DOCUMENT/aquaculture/aq2010/Phuket_Consensus_13-12-2010.pdf>; FAO, "Shanghai Declaration", adopted by the participants to the Global Conference on Aquaculture Millennium +20 held in Shanghai, 22-25 September 2021, online: <https://aquaculture2020.org/declaration/> (accessed 6 April 2022), section 2 para 17.
[27] See in particular art 1B and 1C of the Chilean General Fisheries and Aquaculture Act (Ley General de Pesca y Acuicultura, DS N° 430 de 1991, del Ministerio de Economía, Fomento y Reconstrucción [hereinafter LGPA]). Indeed, article 1B of the LGPA calls for the adoption of precautionary and ecosystem approaches to the "conservation and sustainable use of hydrobiological (aquatic) resources" and, arguably, to the "safeguard of ecosystems in which they exist". The term hydrobiological resource is broad and includes not only fishery resources but also aquaculture resources: aquaculture is the production of

(i.e. the "approach that considers the interrelationship between predominant species in a specified area"[28]), which was evidently drafted with fisheries in mind and even in that context has been criticized as being too narrow.[29]

A broader interpretation can be sustained on the basis of articles 1, 1B and 1C of the LGPA. Indeed, the scope of the Act includes (among other activities) fisheries and aquaculture. The objective of the Act is to conserve and sustainably use the hydrobiological resources (both fishery and aquaculture resources) and the safeguard of the marine ecosystems. To achieve all these objectives, the Act requires the implementation of precautionary and ecosystem approaches.[30] Government policies appear to have interpreted the provisions broadly or, in any case, they have extended the implementation of the EA to the aquaculture sector explicitly. The SUBPESCA's institutional mission considers the implementation of an EA for both the fisheries and

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hydrobiological resources organized by man. Nevertheless, article 1C calls to adopt the approach in the framework of the national fisheries policy, without mentioning the national aquaculture policy. Further, the language used in 1C(c) on the EA is different than the languages of other numerals of the same article, including the numeral addressing precautionary approach. While article 1C(b) calls to apply the precautionary approach in the management and conservation of hydrobiological resources and their ecosystems, article 1C(c) on ecosystem approach refers to the management and conservation of fishery resources and their ecosystems. The term "fishery resources" is not defined but, arguably, it must be understood as referring to resources subject to capture fisheries. Other provisions of the LGPA confirm that the term "fishery resources" is limited to capture fisheries (eg, art 155(a)). See also: Pablo Ignacio Garrido Darricarrére, "Análisis de la Incorporación del Principio Precautorio y Enfoque Ecosistémico en la Ley General de Pesca y Acuicultura en un Contexto de Cambio Climático" (LLB Thesis, Universidad de Concepción, 2018) [unpublished](in file with author) [Analysis of the Incorporation of the Precautionary and Ecosystem Approach in the General Fisheries and Aquaculture Act in the Context of Climate Change] [translation by author].

[28] LGPA, *supra* note 27, art 1C.

[29] FAO, "Asistencia para la revisión de la Ley General de Pesca y Acuicultura, en el marco de los instrumentos, acuerdos y buenas prácticas internacionales para la sustentabilidad y buena gobernanza del sector pesquero", Informe Final Proyecto UTF/CHI/042/CHI (Santiago: FAO, 2016), online: SUBPESCA <https://www.subpesca.cl/portal/616/articles-94917_informe_final.pdf> (accesed 26 October 2022) [Support in the revision of the General Fisheries and Aquaculture Act, in the framework of international instruments, agreements and good practices for sustainability and good governance of the fisheries sector][translated by author]. It is noteworthy that the definition proposed in the Bill was more comprehensive: "an integrated approach whereby decisions related to the management of fishery resources are considered in the context of the functioning of the broader marine ecosystems in which they occur" (translated from Spanish original). A motion to change the definition was passed despite the critical views of the representatives of the Government that participated in the process. Nevertheless, neither the EA nor the precautionary approach were discussed in-depth during the parliamentary debate (Garrido Darricarrére, *supra* note 27).

[30] Christian Paredes & Ignacio Martínez, "El régimen jurídico-ambiental de la salmonicultura en Chile" (TERRAM, Cartilla Informativa No 1, actualizada a enero 2020) ["Environmental legal regime of salmon aquaculture in Chile"], online: <https://www.terram.cl/publicaciones/> (accessed 6 November 2022).

aquaculture sector.[31] While the National Aquaculture Policy adopted in 2003 did not enshrine the ecosystem (or precautionary) approach explicitly, its objective focuses on three main areas broadly consistent with the principles of EAA: economic growth, environmental sustainability, and equitable access to the activity.[32] The sectoral climate change adaptation plan, in turn, highlights the ecosystem and precautionary approaches to fisheries and aquaculture management as central to enhance the resilience of the marine environment and coastal communities.[33] More recently, the EA was included as a guiding principle in the Framework Act on Climate Change.[34] Broader ocean and biodiversity policy instruments also highlight the need to implement ecosystem and precautionary approaches for the conservation and sustainable use of marine resources, including by developing participatory planning and management of marine areas based on the EA.[35]

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[31] SUBPESCA's stated mission is to regulate and manage the fisheries and aquaculture activities through policies, standards and management measures under an ecosystem and precautionary approach that promotes conservation and sustainability of hydrobiological resources for the productive development of the sector ["Regular y administrar la actividad pesquera y de acuicultura, a través de políticas, normas y medidas de administración, bajo un enfoque precautorio y ecosistémico que promueva la conservación y sustentabilidad de los recursos hidrobiológicos para el desarrollo productivo del sector"]. Online: SUBPESCA <https://www.subpesca.cl/portal/616/w3-propertyvalue-538.html> (accessed 3 June 2022).

[32] Gobierno de Chile, *Política Nacional de Acuicultura* (2003), online: SUBPESCA <https://www.subpesca.cl/portal/616/w3-propertyvalue-38050.html> (accessed 26 October 2022): section 2 on General Objective: "Promover el máximo nivel posible de crecimiento económico de la acuicultura chilena en el tiempo, en un marco de sustentabilidad ambiental y equidad en el acceso a la actividad" [Promote the highest possible level of economic growth of Chilean aquaculture over time, within a framework of environmental sustainability and equity in access to the activity] [Machine translation by Deepl].

[33] Gobierno de Chile, *Plan de Adaptación al Cambio Climático para Pesca y Acuicultura* (2015) [Climate Change Adaptation Plan for Fisheries and Aquaculture], online: Ministerio del Medio Ambiente <https://mma.gob.cl/cambio-climatico/> (accessed 26 October 2022).

[34] Ley Marco de Cambio Climático N° 21,455 (Diario Oficial 13 Junio 2022), art 2(c) [Framework Act on Climate Change]. The ecosystem approach is defined as one "that considers the conservation of ecological system structure and function, the hierarchical nature of biological diversity, and the cycles of matter and energy flows between the interdependent living and non-living components of ecological systems" [in original text: "aquel que considera la conservación de la estructura y función del sistema ecológico, la naturaleza jerárquica de la diversidad biológica y los ciclos de materia y flujos de energía entre los componentes vivos y no vivos interdependientes de los sistemas ecológicos"] [Deepl Machine Translator]. The relationship between definitions of the approach provided in the LGPA (*lex specialis*) and other sectoral laws (climate change mitigation and adaptation) and policies (biodiversity strategy) has not been addressed.

[35] Gobierno de Chile, *Política Oceánica Nacional de Chile*, adopted by DS N° 74 of 2018 issued by the Ministry of Foreign Affairs; Gobierno de Chile, *Estrategia Nacional de Biodiversidad 2017-2030*, online: Ministerio del Medio Ambiente <https://biodiversidad.mma.gob.cl/> (accessed 27 October 2022). The Strategy seeks to incorporate an ecosystem approach to policy, regulatory, management and planning instruments that may affect biodiversity, including marine planning instruments subject to strategic environmental assessment, with the goal of net zero loss of biodiversity. The Strategy's definition of the EA is aligned with the definition adopted by the Conference of the Parties to the CBD.

While endorsing the EA for aquaculture planning and management, the Chilean government has not outlined what the approach entails for aquaculture management or what measures implement an EAA. The approach, therefore, remains unintelligible despite its codification. Nevertheless, several LGPA principles and goals are consistent with elements of an EAA and therefore provide a starting point to articulate its normative content. The LGPA emphasizes: science and knowledge-base decision making; precautionary approach; transparent and participatory regulatory processes; long-term objectives; and periodic assessment of the efficacy of adopted measures.[36] Substantive environmental goals include ensuring that aquaculture activities do not affect the ecological balance ("equilibrio ecológico") in the leased area; ensuring operations at levels compatible with carrying capacity of the water body; safeguarding aquatic life; and preventing anaerobic conditions.[37]

In the case of Norway, the EA, together with other relevant principles,[38] is codified in the Nature Diversity Act as a guideline for the exercise of public authority that may affect natural diversity. Individual decisions shall state how these principles have been applied.[39] Thus, decisions under the Aquaculture Act as well as decisions adopted under other legislation directly applicable to aquaculture planning and management must consider the EA and explicitly state how it has been considered in the decision. The ecosystem approach is enshrined in §10, entitled ecosystem approach and cumulative environmental effects, which reads: "any pressure on an ecosystem shall be assessed on the basis of the cumulative environmental effects on the ecosystem now or in the future."[40] Considering cumulative impacts requires to prevent the degradation of landscapes, ecosystems, habitat types and species by looking at the sum of past, present

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[36] *Ibid*.
[37] LGPA, *supra* note 27, arts 74 and 87.
[38] These include the principle of knowledge-base decision, the precautionary principle, the user-pays principle, the use of environmentally sound techniques and methods of operation (Act of 19 June 2009 No 100 Relating to the Management of Biological, Geological and Landscape Diversity [Nature Diversity Act], §§8-12 [unofficial translation to English provided by the Ministry of the Environment], online: Regjeringen <https://www.regjeringen.no/en/dokumenter/nature-diversity-act/id570549/> (accessed 7 August 2022).
[39] *Ibid*, §7. See also: Hans Christian Bugge, *Environmental Law in Norway*, 4th ed (Alphen aan den Rijn, Netherlands: Kluwer Law International, 2022) para 507 at 206. Whether each decision implements the EA as defined in the Act is debatable, however. For example, it was noted in Chapter 6 that, according to some scholars, the traffic light system fails to consider an EA (see Chapter 6, note 468).
[40] Nature Diversity Act, *supra* note 38, §10. See also: Bugge, *supra* note 39, para 510.

and future impact. It also requires considering the effects in the context of different scales (municipal, county, and national level).[41]

The preparatory work of the Act clarifies that the linkage between ecosystem approach and cumulative impacts (or total load of "small decisions" in the environment[42]) reflects the centrality of considering cumulative impacts within the approach but does not exhaust its meaning.[43] Indeed, at least two other elements were linked to the EA. First, the Act outlines objectives for the conservation of species, habitat types, and ecosystems. In the relevant part, it states that: "The objective is […] to maintain ecosystem structure, functioning and productivity to the extent this is considered to be reasonable."[44] Maintaining ecosystem integrity – a goal consistent with the normative content of EA - is therefore a qualified obligation for all private and public actors.[45] Second, the EA was linked to quality objectives for biodiversity conservation.[46] These provisions do not put emphasis on social and economic objectives; nevertheless, the implementation of the principles in the Act must be weighed against other important public interests.[47] The need for trade-offs between environmental, social, and economic

[41] Miljøverndepartementet, "Veileder: Naturmangfoldloven kapittel II: Alminnelige bestemmelser om bærekraftig bruk– en praktisk innføring" (January 2012) [Ministry of the Environment, "Guide: Natural Diversity Act Chapter II: General provisions on sustainable use – a practical introduction"][Google Translate].
[42] Bugge, *supra* note 39, para 510.
[43] The formal legislation proposal states that the EA can hardly be captured in one provision; however, it also states that the principle of cumulative impact reflects the central element of EA and that justifies including it as a separate legal principle in the Act. (Environmental Ministry, Om lov om forvaltning av naturens mangfold (naturmangfoldloven), Ot.prp. nr. 52 (2008–2009), at 102, online: Regjeringen <https://www.regjeringen.no/no/dokumenter/otprp-nr-52-2008-2009-/id552112/> (accessed 29 September 2022) [On the Act on the Management of Nature's Diversity (The Nature Diversity Act)][Google Translate]).
[44] Nature Diversity Act, *supra* note 38, §4. See also The Constitution of the Kingdom of Norway, LOV-1814-05-17 (as amended) [unofficial translation provided by the Stortinget], art 112, online: Lovdata <https://lovdata.no/dokument/NLE/lov/1814-05-17> (accessed 7 August 2022).
[45] Nature Diversity Act, *supra* note 38, §6. According to Bugge, *supra* note 39, para 506, the duty of care applies to individuals in their personal capacity as well as in their professional work, to companies, organizations, and public bodies.
[46] Environmental Ministry, *supra* note 43, at 104 [Google Translate].
[47] Nature Diversity Act, *supra* note 38, § 14, for measures adopted under the Act. The need to balance different objectives is also implicit in the objective of ecosystem conservation, which calls for proportionality in the implementation of the Act ("to the extent this is considered to be reasonable") (Bugge, *supra* note 39, para 505 at 205). See also Bugge, *ibid*, at para 502 at 204, noting that the objective of the Act is not strict conservation.

objectives is also explicit in other relevant legislation.[48] Thus, ecological considerations do not necessarily represent a "hard limit" to anthropogenic interventions.

Norway has also endorsed EA as a guiding principle in the planning and management of marine resources in the territorial waters, EEZ and continental shelf.[49] In offshore areas, the implementation of integrated ecosystem-based management is based on management plans for marine areas approved by the Stortinget (Norwegian Parliament) on the basis of white papers.[50] For the coastal area (landward of 1nm measured from the baseline), this management approach is operationalized through the development of integrated plans for coastal waters and in the fjords pursuant to the EU Water Framework Directive.[51]

Similarly to Norway, the EAA has not been recognized in Scotland explicitly but there is a duty to consider EA in aquaculture planning and management as a result of non-sectoral policies. According to the *Nature Conservation (Scotland) Act 2004*, every Scottish public body and office-holder has a duty to further the conservation of biodiversity so far as is consistent with the proper exercise of its functions, having due

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[48] Eg, Act of 13 March 1981 No 6 (as amended) relating to the Protection Against Pollution and to Waste (Pollution Control Act), § 11 [unofficial translation provided by Regjeringen]; Act of June 2005 No 79 (as amended) Law on Aquaculture (Aquaculture Act) §1 [unofficial translation provided by Fiskeri- og Kystedepartamentet]; Act of 27 June 2008 No 71 (as amended) relating to the planning and the processing of building applications (Planning and Building Act), §§ 1-1 and 3-1[unofficial translation provided by Regjeringen]. See also: Platjouw, *supra* note 5, at 155-156; Bugge, *supra* note 39, paras 187-188 at 86.

[49] Norwegian Government, *Protecting the Riches of the Sea*, Report No 12 (2001–2002) to the Stortinget [English][hereinafter Norwegian Government, "Protecting the Riches of the Sea"]. The document describes the tools and processes which help lay the foundations for an overall policy on the marine environment, i.e. a policy where the sum of all influences is assessed on the basis of what is known about the structure of the ecosystem, the way in which it functions and its condition. In the white paper, the government noted that "we still have a long way to go in terms of being able to implement the ecosystem approach to management as an overall principle across all sectors and different factors affecting the environment". Although not relevant for aquaculture, it should be mentioned that an EA has also been codified in the *Marine Resources Act* (Act of 6 June 2008 no 37 relating to the management of wild living marine resources) governing the harvesting and other utilisation of wild living marine resources and genetic material derived from them (with the exception of anadromous salmonids, s 3). See: Directorate of Fisheries <https://www.fiskeridir.no/English/Fisheries/Regulations/The-marine-resources-act> (accessed 18 October 2022).

[50] Bugge, *supra* note 39, para 65 at 39. On the management plans, the Norwegian Government stated: "The management plans implement an integrated, ecosystem-based management regime by evaluating the cumulative effects of all human activities on the marine environment and by managing the use of the oceans in a way that maintains the natural functions of ecosystems and ecosystem services. Ecosystem services are a vital basis for long-term value creation." (Norwegian Government, "Norway's integrated ocean management plans — Barents Sea–Lofoten area; the Norwegian Sea; and the North Sea and Skagerrak", Report No 20 (2019–2020) to the Stortinget [English]).

[51] Norwegian Government, "Protecting the Riches of the Sea", *supra* note 49, at 19 and 21-22.

regard to one or more strategies for the conservation of biodiversity (collectively the Scottish Biodiversity Strategy) prepared by the Scottish Ministers, and to the Convention on Biological Diversity.[52] With the Scottish Biodiversity Strategy explicitly endorsing the EA,[53] it follows that public bodies exercising any functions for aquaculture planning and management that may affect biodiversity must follow an EA. The Strategy does define EA in line with Decision V/6 of the CBD: "an approach that encourages the integrated management of land, water and living resources and promotes conservation and sustainable use in an equitable way".[54] Thus, the strategy embraces a broader concept of EA that explicitly includes its social dimension, as reflected in the references to sustainable use and equity. This is further clarified in the three key steps for implementation recognized in the Strategy: taking into account how ecosystems work; taking into account the services that ecosystems provide to people; and involving people in decision-making.[55]

EA has also been endorsed for marine planning in the UK Marine Policy Statement and Scotland's 2015 National Marine Plan adopted under the *Marine and Coastal Access Act 2009* and the *Marine (Scotland) Act 2010*.[56] These plans constitute the framework for relevant public decision-making: a public authority must take any authorisation or enforcement decision in accordance with the appropriate marine plans unless relevant considerations indicate otherwise.[57] Therefore, the plans "require that an ecosystem approach be adopted for marine planning – both plan making and decision making."[58]

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[52] *Nature Conservation (Scotland) Act 2004*, 2004 asp 6, s 1.
[53] Scottish Government, *2020 Challenge for Scotland's Biodiversity*, ch 1 on Healthy Ecosystems, online: Scottish Government <https://www.sepa.org.uk/environment/biodiversity/> (accessed 28 September 2022).
[54] *Ibid,* Glossary at 83. See also at 13.
[55] *Ibid*, at 8 and 13.
[56] *Marine and Coastal Access Act 1999*, s 44; *Marine (Scotland) Act 2010,* 2010 asp 5, ss 5ff. See: HM Government, "UK Marine Policy Statement" (March 2011) (the UK Marine Policy Statement was adopted by the relevant Ministers for all nations of the United Kingdom); Scottish Government, *Scotland's National Marine Plan: A Single Framework for Managing Our Seas* (Edinburgh: The Scottish Government, 2015) [hereinafter Scottish Government, "Scotland's National Marine Plan"].
[57] *Marine (Scotland) Act 2010, supra* note 56, s 15(1).
[58] Anne-Michelle Slater & Alison MacDonald, "Embedding Law in Participatory Processes Enables an Ecosystem Approach to Marine Decision Making: Analysis of a North Sea Example" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Brill E-Book, 2019) 256 at 265.

The UK Marine Policy Statement and the Scotland's 2015 National Marine Plan define ecosystem-based approach to the management of human activities as "an approach which ensures the collective pressure of human activities is kept within the levels compatible with the achievement of good environmental status; that does not compromise the capacity of marine ecosystems to respond to human induced changes; and that enables the sustainable use of marine goods and services".[59] The Scottish National Marine Plan further asserts that in promoting an EA, it puts the marine environment "at the heart of the planning process to promote ecosystem health, resilience to human induced change and the ability to support sustainable development and use."[60] A reference to environmental limits to individual policies, plan or activities is explicitly included.[61]

The relevance of this endorsement for mariculture is nuanced, however, as marine aquaculture planning is subject to the terrestrial planning system which "falls short of requiring" an EA.[62] Nevertheless, national planning guidelines for aquaculture under the *Town and Country Planning (Scotland) Act 2007* are coordinated with the marine plans under the *Marine (Scotland Act) 2010.*[63] Thus, marine ecosystem-based planning is at least indirectly relevant for aquaculture planning.

The endorsement of EA in NS, if at all, is more questionable. The province does not recognize the principle. Ecosystems or ecosystem approach are not mentioned in the *Fisheries and Coastal Resources Act* (FCRA); neither are other environmental principles for decision-making.[64] This omission is striking for two reasons. First, the legal recognition of principles guiding decision-making was explicitly recommended in the

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[59] Scottish Government, "Scotland's National Marine Plan", *supra* note 56, note 27 and Glossary. Further, the *Marine (Scotland) Act 2010*, *supra* note 56, s 11, supports the EA to marine management by requiring keeping relevant matters under review, including the physical, environmental, social, cultural, and economic characteristics of the Scottish marine area and the living resources which the area supports.
[60] Scottish Government, "Scotland's National Marine Plan", *supra* note 56, at 11.
[61] *Ibid.*
[62] See: Slater & MacDonald, *supra* note 58, at 267. But see also: the references to ecosystem services in the current and proposed National Planning Frameworks (Scottish Government, "Ambition, Opportunity, Place: Scotland's Third National Planning Framework" (2014); Scottish Government, "Scotland 2045: Our Fourth National Planning Framework" (Draft) (2021), both online: Scottish Government <https://www.transformingplanning.scot/national-planning-framework/> (accessed 19 October 2022)).
[63] See: Scottish Government, "Planning Circular 1/2015: Relationship between the statutory land use planning system and marine planning and licencing" (2015), online: Scottish Government <https://www.gov.scot/publications/fish-farm-consents-guidance-and-support/> (accessed 28 September 2022).
[64] There are no mentions of precaution, prevention, integration, adaptation, or adaptive management.

Doelle/Lahey Panel.[65] Second, the provincial *Environment Act*[66] (which addresses environmental negative externalities of other industries[67]) already recognizes some of these principles and further makes explicit references to ecological integrity as a key consideration in its implementation.[68]

Despite the omission, provincial legislation clearly spells out the need for sustainable aquaculture that balances ecological, social, and economic goals in a manner consistent with Principles 1, 2 and 3 of the EAA. The provincial goal for aquaculture, recently stated in the *Environment Goals and Climate Change Reduction Act*,[69] is to "support low-impact sustainable aquaculture", a goal that highlights the need to prevent and mitigate environmental and social impacts.[70] The purpose of Part V of the FCRA addressing aquaculture, as defined in s 43A,[71] and the criteria for licensing decision-making spelled out in the *Aquaculture Licence and Lease Regulations*,[72] further reinforces the economic, social, and environmental objectives of aquaculture management. It can be argued, however, that the environmental objectives in the FCRA and the *Aquaculture Licence and Lease Regulations* are too vague and narrow to be

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[65] Meinhard Doelle & William Lahey, *A New Regulatory Framework for Low-Impact/High-Value Aquaculture in Nova Scotia*. The Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia (2014) [hereinafter NS, Independent Aquaculture Review], ch 6 at 35, online: NSDFA <https://novascotia.ca/fish/aquaculture/reference-material/> (accessed 24 May 2022). The authors state: "a regulatory framework should be clear on the principles that have guided the development of the framework and that will guide its continuing evolution and its administration." The suggested are good governance principles and include: effectiveness, openness, transparency, accountability, proportionality, integration, and precaution (understood as encompassing adaptive management).

[66] *Environment Act,* 1994-1995, c 1, as amended.

[67] NS, Independent Aquaculture Review, *supra* note 65, at 46.

[68] *Environment Act* [NS], s*upra* note 66, s 2, recognizes *inter alia* the following principles: sustainable development, precautionary approach, pollution prevention, integration, stewardship principle, polluter pays principle.

[69] *Environment Goals and Climate Change Reduction Act*, SNS 2021, c 20.

[70] The Independent Aquaculture Review explicitly highlights the consistency of this objective with the EAA. Low impact aquaculture, in Doelle/Lahey Panel, is aquaculture that has "low level of adverse environmental and social impact, which decreases over time" (NS, Independent Aquaculture Review, *supra* note 65, at vii). Doelle and Lahey note, however, that "low impact" is not a specific statutory standard but an overarching goal of the regulatory framework as a whole, and acting together with other factors (*ibid*, note 14). It is noteworthy that the provincial legislation endorses "low-impact" aquaculture but does not include an explicit requirement to ensure "high-value" also included in the Independent Report, stressing the need for enhancing social and economic benefits.

[71] Section 43A balances ecological (s 43A(b)(h)), social (s 43A(d),(g)) and economic (s 43A (g)(i)) objectives. It is also consistent with the NSDFA vision for the aquaculture sector: "[a]n economically, environmentally, and socially sustainable aquaculture industry creating year-round jobs and increased wealth throughout rural coastal Nova Scotia" (online: NSDFA <https://novascotia.ca/fish/about/> (accessed 18 March 2022).

[72] *Aquaculture Licence and Lease Regulations*, NS Reg 347/2015 (as amended), s 3.

consistent with the objective of ensuring the protection of ecosystems structure and functions.[73]

At the federal level, the EA is explicitly considered in the three main pieces of legislation under the responsibility of DFO. The *Oceans Act*[74] recognizes the ecosystem and precautionary approaches explicitly in the Preamble, although the substantive provisions on "integrated management of oceans and marine resources" have been considered equivalent to, or encompassing, ecosystem-based management. The *Fisheries Act*[75] and the *Species at Risk Act*[76] allow, but do not mandate, the adoption of an ecosystem approach. The federal government has committed to implementing ecosystem-based management,[77] and DFO has engaged in extensive work to develop frameworks

[73] The *Fisheries and Coastal Resources Act*, SNS 1996, c 25, as amended [hereinafter FCRA], ss 43A(b),(h), simply calls to "ensure aquaculture is conducted under conditions and in accordance with controls that protect the environment" and is conducted "with due regard to the health, well-being and recovery of species at risk".

[74] SC 1996, c 31. Its Preamble states that "Canada holds that conservation, based on an ecosystem approach, is of fundamental importance to maintaining biological diversity and productivity in the marine environment". It also states that Canada "promotes the integrated management of oceans and marine resources", a term that has been considered synonym to ecosystem-based management. The substantive provisions of the *Oceans Act*, however, do not refer explicitly to EA or ecosystem-based management. However, sustainable development, integrated management and precautionary approach are explicit principles guiding the development of the national ocean strategy.

[75] RSC, 1985, c F-14. According to section 2.5, when making a decision under the Act, the Minister *may* consider, *inter alia*: (a) the application of a precautionary approach and an ecosystem approach; (b) the sustainability of fisheries; (c) scientific information; (d) Indigenous knowledge of the Indigenous peoples of Canada that has been provided to the Minister; (e) community knowledge; (f) cooperation with any government of a province, any Indigenous governing body and any body — including a co-management body — established under a land claims agreement; (g) social, economic and cultural factors in the management of fisheries; (h) the preservation or promotion of the independence of licence holders in commercial inshore fisheries; (i) the intersection of sex and gender with other identity factors. The recognition of principled decision-making in an otherwise discretionary Act was a welcomed aspect of the new "modernized" Act. The provision is weak, in any case, as the consideration and weight of the principles is discretionary for the Minister. Further, some key principles are restricted to fisheries (e.g. sustainability; social, economic, and cultural factors) which are not directly applicable in DFO's involvement in aquaculture.

[76] SC 2002, c 29, s41(3). The Minister is allowed, but not obliged, to adopt a multi-species or ecosystem approach when preparing recovery strategies. While this provision had been mostly dormant since the *Species at Risk* was enacted, it has been recently strengthened by the Pan-Canadian Approach to Transforming Species at Risk in Canada adopted by the federal and provincial governments in 2018 (https://www.canada.ca/en/services/environment/wildlife-plants-species/species-risk/pan-canadian-approach.html). The new approach seeks to enhance multi-species and ecosystem-based approach in a strengthen collaborative environment to deliver better and more effective conservation outcomes and biodiversity conservation. It focuses on shared priority places, species, and threats. Aquatic spaces and species have not been prioritized.

[77] See, eg DFO, "Canada's Oceans Strategy: Our Oceans, Our Future" (Ottawa: DFO, 2002).

and guidance for ecosystem-based science[78] and management of human activities,[79] in particular fisheries.[80] Despite these efforts, a nation-wide framework for EA or ecosystem-based management is not yet available.[81] Recognition of the EA for the aquaculture sector is explicit in DFO's policies and vision,[82] but there is little guidance on how it would or should be operationalized by the Department,[83] in particular in provinces in which the provincial government has lead responsibility for the sector. Indeed, the most relevant articulation of an EAA to date is the initiative to establish

[78] DFO, "A New Ecosystem Science Framework in Support of Integrated Management" (Ottawa: DFO, 2007), online: DFO https://publications.gc.ca/collections/collection_2007/dfo-mpo/Fs23-521-2007E.pdf.
[79] For a history of different efforts, see: Alida Bundy et al, *DFO Maritimes Region Ecosystem Based Management (EBM) Framework Workshop II: Incorporating social, cultural and governance aspects*, Can Tech Rep Fish Aquat Sci 3440 (2021); Jack Daly, Alida Bundy & Robert Stephenson, *Maritimes Region Workshop to Develop a Consensus EBM Framework to Assess the Cumulative Impacts of Fishing*, Can Tech Rep Fish Aquat Sci 3368 (2020).
[80] Stacey D Paul & Robert L Stephenson, *The integration of full-spectrum ecosystem-based management in Canadian fisheries management plans*, Can Tech Rep Fish Aquat Sci (Ottawa: DFO, 2020).
[81] See, eg: Daly, Bundy & Stephenson, *supra* note 79, at 4.
[82] A key albeit dated document is the 2002 Aquaculture Policy Framework adopted by DFO in response to the 1995 Aquaculture Development Strategy. The Policy defines the Department's vision for aquaculture: "to benefit Canadians, now and in the future, through the culture of aquatic organisms, while upholding the ecological and socio-economic values associated with Canada's oceans and inland waters" (online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/management-gestion/vision-eng.htm> (accessed 17 March 2022)). The first of nine supporting principles states that DFO will "support aquaculture development in a manner consistent with its commitments to ecosystem-based and integrated management, as set out in departmental legislation, regulations and policies." Other principles are relevant for EAA. Principle 2 refers to science-based decision-making and risk-management approaches. Principle 7 commits to "responsible development of the aquaculture sector". Principle 3 addresses "communication with" Canadians (rather than Canadians' participation or engagement in decision-making). Principle 4 recognizes the need to respect constitutionally protected Aboriginal and treaty rights and the right of affected Aboriginal communities to participate in aquaculture development. Several principles address the need of the industry, including: their recognition as legitimate users of land, water and aquatic resources (principle 5); the need to respond to industry needs in a solution-oriented and supportive manner (principle 8). Principles 6, 7 and 9 recognize the need for an enabling legal and regulatory framework and vertical and horizontal integration.
[83] A document under preparation, the Framework for Aquaculture Risk Management (DFO, "Framework for Aquaculture Risk Management" (July 2020), on file with author, Access to Information Request A-2021-01527 / INTAK), would provide a "structured and transparent process by which DFO will be conducting and communicating the assessment of risk from aquaculture activities and the selection of measures to reduce the risk to a level meet the department's sustainable development goals, conservation and protection" (*ibid*, at 21). The Framework is designed to be consistent with the Sustainable Fisheries Framework for ecosystem-based and precautionary management of fisheries. The document states that it includes "similar approaches and principles (…) to the extent possible" (*ibid*, at 8). An ecosystem-based approach to aquaculture management is not explicitly recognized. However, it does address the precautionary approach (providing broad guidelines on how DFO would implement it to the aquaculture sector) and mentions adaptive management, Indigenous knowledge, and the need to consider spatial and temporal scales of effects. The document was prepared at least partially as a response to the Commissioner of the Environment and Sustainable Development (CESD) Report noting that DFO has not determined and communicated how it applies the precautionary approach to managing aquaculture. The interim Framework for Aquaculture Risk Management was subject to public consultation, but the final document has not been finalized.

federal-provincial-Indigenous partnership arrangements to facilitate area-based planning and management of aquaculture operations in British Columbia.[84]

7.2. Aquaculture Zoning and Planning: Balancing Ecological, Economic, and Social Objectives

7.2.1. Theory

Integration and holistic planning and management of aquaculture activities is a key consideration for EAA, as it is for EA generally. The CBD highlights that EA is a "strategy for the integrated management of land, water and living resources (…)"[85] operating "at the ecosystem level of organisation".[86] The EAA, in turn, is a "strategy for the integration of the activity within the wider ecosystem".[87]

Integration has different dimensions. It demands a comprehensive understanding and assessment of all components of the systems and their interrelationships – the "big picture" – at different scales, as well as the consideration of environmental consequences of development activities.[88] It entails integration across sectors, across government levels, between modern science and traditional and local knowledge, multi-disciplinary integration, and integration across different legal and management strategies.[89] In sum, integration and holistic planning and management demands a comprehensive understanding and assessment of all ecological, social, cultural, and economic components (good, services, and pressures) interacting in a particular (spatially-defined) ecosystem, as well as interactions with adjacent ecosystems.[90] It also requires trade-offs

[84] DFO, "Departmental Plan 2021-2022", online: <DFO https://www.dfo-mpo.gc.ca/rpp/2021-22/dp-eng.html>. The initiative is only at the stage of pilot project at this time.
[85] CBD, Decision V/6 on Ecosystem Approach adopted by the Fifth Ordinary Meeting of the Conference of the Parties held in Nairobi, Kenya, 15 - 26 May 2000; and CBD, Decision VII/11, *supra* note 20, paragraph A.1.
[86] CBD, Decision VII/11, *supra* note 20, section A.3(a).
[87] FAO, EAA Technical Guidelines, *supra* note 1, at 2.
[88] UN, *Rio Declaration on Environment and Development*, UN Doc A/CONF.151/26 (vol I), 31 ILM 874 (1992), Principle 4.
[89] See: David VanderZwaag, Gloria Chao & Mark Covan, "Canadian Aquaculture and the Principles of Sustainable Development: Gauging the Law and Policy Tides and Charting a Course" (2002-2003) 28 Queen's LJ 281, in particular note 22 and accompanying text; Engler, *supra* note 12; Enright and Boteler, *supra* note 12; FAO, EAA Technical Guidelines, *supra* note 1, at 22, 27.
[90] CBD, Decision VII/11, *supra* note 20, Principle 3.

between different societal objectives.[91] Understood as a decentralized social process[92] (a consensus-building process), EAA underscores the need to "understand and factor in societal choices, the rights and interests of indigenous peoples and local communities, and intrinsic as well as tangible and intangible values attached to biodiversity, ultimately leading to a balance between local interests and wider public interest."[93]

Balancing different objectives and making these trade-offs has been considered one of the most difficult aspects of implementing EA generally,[94] and EAA in particular.[95] The structure of environmental law contributes to this difficulty, with fragmented legal landscapes effectively hindering the holistic demand of EA.[96] Fragmented legal frameworks that focus on isolation, disconnection and compartmentalization of environmental legal problems, regimes and institutions are ill-equipped to address the interlinkages of the ecological and social systems.[97] This primary obstacle is recognized by FAO when, in the Technical Guidelines on EAA, states that it aims is to "overcome sectoral and intergovernmental fragmentation of resources management".[98]

A further barrier to implementing these integrative and process-oriented dimension of EA is the understanding of environmental law as enabling technical solutions to well-defined negative externalities. The complexity of ecosystems and the multiple ways in which they support social needs requires instead transparent and holistic planning that balances different environmental, social, and economic objectives, needs,

[91] FAO, EAA Technical Guidelines, *supra* note 1, at 3, 5 and 7. See also: CBD, Decision VII/11, *supra* note 20, table 1 principle 1.
[92] CBD, Decision VII/11, *supra* note 20, para 3(c). On the importance of decentralization for ecosystem management, see generally chapter 3, note 71 and 72 and accompanying text.
[93] Morgera, *supra* note 16, at 73.
[94] Platjouw, *supra* note 5, at 27, 99; Murray A Rudd et al, "Ocean Ecosystem-Based Management Mandates and Implementation in the North Atlantic" (2018) 5 Frontiers in Marine Science, https://www.frontiersin.org/articles/10.3389/fmars.2018.00485, at 9.
[95] Cecile Brugère et al, "The ecosystem approach to aquaculture 10 years on: A critical review and consideration of its future role in blue growth" (2019) 11 Rev in Aquaculture 493, at 503.
[96] Platjouw, *supra* note 5, at 114.
[97] *Ibid.*
[98] FAO, EAA Technical Guidelines, *supra* note 1, at 5.

and uses, with the participation of affected stakeholders.[99] In balancing these different goals, however, proper weight must be given to maintaining ecological integrity.[100]

The integrative imperative and the balancing of different societal objectives attains to all public decisions regarding aquaculture, from policy setting to individual decisions.[101] In the context of operationalizing integrative and holistic management approaches at the ecosystem level, integrated coastal zone management or marine spatial planning (MSP) stand out as practical legal tools.[102] Space-based approaches are particularly relevant for aquaculture, a stationary activity where viability, productivity, and potential impacts are highly dependent on its location. Sectoral or multi-sectoral planning processes (particularly spatial planning processes) balance the multiple uses[103] and values[104] associated with common spaces and the multiple pressures on the ecological[105] and social system and align individual decisions with overall objectives. Zoning and strategic planning are thus particularly important legal tools to operationalize the three principles of EAA.

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[99] *Ibid*; see also Chapter 3 at note 208 and accompanying text.
[100] FAO, EAA Technical Guidelines, *supra* note 1, Principle 1; CBD, Decision VII/11, *supra* note 20, Principle 5. See generally "Substantive Law" in Chapter 3 section 6.
[101] See, for example: Norway Aquaculture Act, *supra* note 48, §§ 6, 16; NS *Aquaculture Licence and Lease Regulations*, *supra* note 72, s 3; or the unified consent proposed in Scottish Government, "A Review of the Aquaculture Regulatory Process in Scotland", Report by Russel Griggs (February 2022), online: Scottish Government <https://www.gov.scot/publications/review-aquaculture-regulatory-process-scotland/> (accessed 6 May 2022) [hereinafter Griggs Report].
[102] Niko Soininen & Froukje Maria Platjouw, "Resilience and Adaptive Capacity of Aquatic Environmental Law in the EU: An Evaluation and Comparison of the WFD, MSFD, and MSPD" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Brill E-Book, 2019) 17; Rudd et al, *supra* note 94, at 5.
[103] Consistent with Principle 3 of EAA: *aquaculture should be developed in the context of other sectors, policies and goals* (FAO, EAA Technical Guidelines, *supra* note 1).
[104] Consistent with Principle 2 of EAA: *aquaculture should improve human well-being and equity for all relevant stakeholders* (*ibid*).
[105] Consistent with Principle 1 of EAA: *aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society* (*ibid*). See also: Eirik Mikkelsen, Patrick Berg Sørdahl & Anne-Magnhild Solås, "Transparent and consistent? Aquaculture impact assessments and trade-offs in coastal zone planning in Norway" (2022) 225 Ocean & Coastal Management 106150, at 1.

7.2.2. International Law and Policy

States are under no international obligation to implement aquaculture zoning, integrated coastal zone management or MSP in marine areas under national jurisdiction.[106] International law is nevertheless relevant in two main ways. First, soft law instruments addressing marine governance, as well as aquaculture specifically, call for the implementation of these approaches. Second, several substantive and procedural obligations in international law are relevant to planning initiatives.

FAO recommends that aquaculture "should be a planned activity that is designed in a more responsible manner so as to minimize negative social and environmental impacts as much as possible".[107] Integrated coastal zone management is specifically endorsed in the Code of Conduct for Responsible Fisheries (CCRF).[108] A key consideration for integrated spatial management is to ensure the sustainable and integrated use of resources, taking into account ecological and social considerations.[109]

Integrated coastal and marine area management[110] and MSP[111] are also called for under the CBD. The CoP explicitly acknowledged integrated coastal and marine area management and MSP as tools for facilitating the application of the EA and expediting

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[106] *Directive 2014/89/EU establishing a framework for maritime spatial planning*, [2014] OJ L 257/135, requires European member States to establish and implement maritime (marine) spatial planning. The EU Directive was a driver for Scotland's marine spatial planning, with direct and indirect relevance for salmon mariculture. It is not directly applicable after Brexit. The Directive does not apply to Norway under the European Economic Agreement. Additionally, the scope of the Directive excludes "coastal waters or parts thereof falling under a Member State's town and country planning, provided that this is communicated in its maritime spatial plans" (*ibid*, art 2.1).

[107] José Aguilar-Manjarrez, Doris Soto & Randall Brummett, *Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture. A handbook*. Report ACS18071 (Rome, FAO; Washington, World Bank Group: 2017) at 3.

[108] FAO, *Code of Conduct for Responsible Fisheries*, Doc 95/20/Rev1 (October 31, 1995), art 10 [hereinafter FAO, CCRF].

[109] *Ibid*, art 10.1.1, reads: "States should ensure that an appropriate policy, legal and institutional framework is adopted to achieve the sustainable and integrated use of the resources, taking into account the fragility of coastal ecosystems and the finite nature of their natural resources and the needs of coastal communities.

[110] CBD, Decision VII/5 on Marine and coastal biological diversity adopted during the Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, 9-20 February 2004, Kuala Lumpur, Malaysia [elaborated Programme of Work], Programme Element 1: "Promote and improve the implementation of IMCAM at the local, national and regional level". Particular activities include: to promote the application of ecosystem-based management, including through integration of coastal management activities and watershed management and to encourage the application of the ecosystem approach, promote integrated multidisciplinary and multisectoral coastal and ocean management at the national level, and encourage States in developing ocean policies and mechanisms on integrated coastal management.

[111] CBD, Decision X/29 on marine and coastal biodiversity adopted during the Tenth Meeting of the Conference of the Parties held in Nagoya, Japan, October 2010, paras 15, 78.

progress towards the achievement of Aichi Biodiversity Targets. It has thus encouraged States Parties, and invited other governments, to apply or enhance such initiatives. The CoP has further called for the development of site selection methods for aquaculture in the context of broader integrated planning initiatives.[112]

Zoning approaches to guide siting decisions are also recommended under NASCO's Williamsburg Resolution to protect wild salmon populations. In article 8, the resolution recommends that State parties develop and apply river classification and zoning systems to guide the development of aquaculture management measures and identify rivers or areas that need special protection.[113] The consideration of wild salmon protection areas where aquaculture is prohibited or restricted is also recommended.[114]

In implementing zoning and integrated planning, States are bound to substantive and procedural obligations under international law. From a substantive perspective, States are required to consider environmental protection and conservation of biological diversity in their development plans and policies. The principle of integration is a core consideration in the concept of sustainable development. It is also itself a recognized principle of international law[115] and arguably a general principle of customary international law.[116]

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[112] CBD, Decision VII/5, *supra* note 110, para 45(b) calls for the development of effective site-selection methods, in the framework of integrated marine and coastal area management, taking into account the special needs and difficulties encountered by stakeholders in developing countries.

[113] NASCO, "Resolution by the Parties to the Convention for the Conservation of Salmon in the North Atlantic Ocean to Minimise Impacts from Aquaculture, Introductions and Transfers, and Transgenics on the Wild Salmon Stocks (the Williamsburg Resolution)", adopted at the Twentieth Annual Meeting of NASCO in June 2003 and amended at the Twenty-First Annual Meeting of NASCO in June 2004 and at the Twenty-Third Annual Meeting of NASCO in June 2006, CNL(06) 48, art 8 and Annex 6.

[114] *Ibid*, Annex 2 on General Measures to Minimise Impacts, para 1.2.

[115] Principle 4 of the Rio Declaration, *supra* note 88: "in order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it."

[116] Virginie Barral & Pierre-Marie Dupuy, "Principle 4: Sustainable Development through Integration" in Jorge E Viñuales (ed), *The Rio Declaration on Environment and Development: A Commentary* (Oxford: Oxford University Press, 2015) 157 at 168. The authors argue that the Rio Declaration is, in itself, evidence of emerging *opinion juris*. Several examples of State practice, including the practice of international organizations (World Bank) are presented as evidence of the material element of customary international law, although the authors acknowledge that, considering the wide divergence in the situations in which the principle of integration is implemented, it is more difficult to prove that these examples reflect uniform and coherent practice. The authors further justify their conclusion in the findings of the Arbitral Tribunal in the Iron Rhine Railway case. Discussing the principle of integration, the Arbitral Tribunal concludes that "this duty, in the opinion of the Tribunal, has now become a principle of general international law" (*Arbitration regarding the Iron Rhine ('Ijzeren Rijn") Railway between the Kingdom of Belgium and the Kingdom of the Netherlands*, Award of 24 May 2005, PCA 2003-03, 27 RIAA (2005) 35, para 59 (Arbitrators: Judge

From a procedural perspective, international law outlines qualified obligations to undertake EIA[117] and SEA[118] to support participatory and integrated decision-making that considers ecological components, including conservation of biological diversity, and interrelated socio-economic, cultural, and human-health aspects.[119] Participatory rights are further enshrined in international soft-law instruments[120] and regional agreements.[121] Further, procedural and substantive obligations addressing rights and interests of Indigenous Peoples are outlined in international agreements and non-binding instruments.[122]

Rosalyn Higgins, Professor Guy Schrans, Judge Bruno Simma, Professor Alfred HA Soons, Judge Peter Tomka).

[117] LOSC, *supra* note 14, art 204; CBD, *supra* note 19, art 14. See also: Decision V/18 calling for impact assessments to be incorporated in the marine and coastal biological diversity programmes. The obligations are qualified as they are to be undertaken by States "as far as practicable" (LOSC) and "as far as possible and as appropriate" (CBD). Further, the threshold for undertaking an EIA ("reasonable grounds", "substantial pollution", "significant and harmful change", or "significant adverse effects") are left to the discretion of States in implementing these provisions.

[118] CBD, *supra* note 19, art 14. At the regional level, the obligation is further enshrined in the Kyiv *Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context*, 21 May 2003, 2685 UNTS 140 (entered into force 2010) (Kyiv Protocol)(approved by Norway) and in EC, *Directive 2001/42/EC of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJL 197/30 [Strategic Assessment Directive].

[119] CBD, *supra* note 19, art 14, requiring allowing public participation in procedures "where appropriate"; CBD, "Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment", Annex to Decision VIII/28 adopted by the Conference of the Parties at its Eighth Meeting held in Curitiba, Brazil, 20-31 March 2006, UNEP/CBD/COP/DEC/VIII/28 (15 June 2006), online: CBD https://www.cbd.int/meetings/COP-08 (accessed 3 March 2022) at para A.5.

[120] Rio Declaration, *supra* note 88, Principle 10.

[121] *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*, 25 June 1998, 2161 UNTS 447 (entered into force 30 October 2001) (Aarhus Convention) (Norway, UK); *Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement),* 4 March 2018, UNTS I-56654 (entered into force 22 April 2021) (Chile).

[122] United Nations (UN), *Declaration on the Rights of Indigenous People*, Annex to Resolution 61/295 adopted by the United Nations General Assembly on 13 September 2007, A/RES/61/295; *International Labor Organization (ILO) Convention No 169 concerning Indigenous and Tribal Peoples in Independent Countries*, 27 June 1989, 1650 UNTS 383 (entered into force 5 September 1991). See also: CBD, Akwé: Kon Voluntary Guidelines for the Conduct of Cultural, Environmental and Social Impact Assessments regarding Developments Proposed to Take Place on, or which are Likely to Impact on, Sacred Sites and on Lands and Waters Traditionally Occupied or used by Indigenous and Local Communities, Annex to Decision VII/16 adopted during the Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, Kuala Lumpur, February 2004.

7.2.3. Lessons from State Practice

All legal frameworks for aquaculture analyzed in this Dissertation consider some form of strategic planning or aquaculture zoning. In Chile, the LGPA requires the designation of areas appropriate for aquaculture (AAA) but has also developed (but barely implemented) multi-sectoral marine planning under the National Policy on the Use of the Coastal Zone. In Norway and Scotland, planning for aquaculture occurs primarily as an extension of the terrestrial planning system to coastal and marine waters under the Planning and Building Act and the *Town and Planning (Scotland) Act 1997* (as amended). In NS, the FCRA considers a legal instrument to aquaculture zoning (the aquaculture development areas). This tool has not been implemented at the time of writing. Thus, NS stands out as the only jurisdiction without an implemented aquaculture zoning or broader integrated marine (spatial) planning.

The planning tools differ regarding to their spatial and material (sectoral or multisectoral) scope, content (criteria or zoning), their objectives, the studies required to support them, the opportunities for stakeholder engagement and public participation, their normative prescriptiveness, and the timeframe of the designations[123] (see table 4). Therefore, the standards recognized in the literature and international law are followed to different extents, and their suitability to support EAA also differs. The following sections provide a more detailed assessment of some of these elements: vertical integration (decentralization), horizontal (cross-sectoral) integration, knowledge base, and environmental limits in planning instruments.

a) Decentralized or Centralized Planning

The CBD Principles on EA highlight that "management should be decentralized to the lowest appropriate level".[124] Decentralized processes are considered more suitable to identify, assess and value ecological and social components interacting in a defined area, increasing efficiency, effectiveness, and equity. The case studies show different levels of

[123] On the limitations of considering zoning as "final products" generally and for aquaculture, see: Robin Kundis Craig, "Fostering adaptive marine aquaculture through procedural innovation in marine spatial planning" (2019) 110 Marine Policy 103555, in particular at 4.
[124] CBD, Decision VII/11, *supra* note 20, paragraph A.1.

decentralization, and different mechanisms for vertical integration, in planning systems for aquaculture.

Scotland and Norway adopt a decentralized (bottom-up) model to planning, although in both cases with extensive mechanisms for vertical integration to promote alignment of national and local interests.[125] The decision to involve Scottish local authorities in the planning of marine fish aquaculture had, as one of its objectives, to introduce "more transparency and democratic accountability by introducing decision making closer to those affected by marine fish farm developments."[126] Similarly, the Norwegian planning system is considered an important element of local democracy, and the Planning and Building Act is one of the most important pieces of environmental legislation.[127] While in both cases, resources and capacity of smaller management units, problems of fit, and inconsistent decision-making have been highlighted as obstacles to planning at the ecosystem level,[128] several legal mechanisms contribute to mitigate those difficulties.[129]

The Chilean LGPA and the NS FCRA, in turn, adopt a central and top-down approach to planning that is sectoral in nature and decided, at least formally, by sectoral (technical) ministers.[130] Centralized and technical conceptualizations of planning are, in principle, not supportive of EA in its dimension of social process. Nevertheless, the relevance of local involvement and stewardship in aquaculture planning has been recognized informally in NS and formally in Chile. In the case of NS, a joint science-

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[125] In Scotland, the Scottish Planning Framework and the National Marine Plan and regional marine plans (when adopted) provide national guideline to ensure that the local development plans consider national and regional interests. In Norway, the complex planning system considers national and regional guidelines and, in some cases, binding planning provisions. It further regulates the right and the process to object municipal master plans, when they are in conflict with national, regional or sectoral interests.

[126] Executive Note to the *Town And Country Planning (Marine Fish Farming) (Scotland) Order 2007*, SSI/2007/268, online: UK Legislation <https://www.legislation.gov.uk/ssi/2007/268/contents/made> (accessed 31 October 2022). See also: D Peel & MG Lloyd, "Governance and planning policy in the marine environment: regulating aquaculture in Scotland" (2008) 174 The Geographical Journal 361.

[127] Bugge, *supra* note 39, at 324-317; Mikkelsen, Sørdahl & Solås, *supra* note 105, at 2-3.

[128] Ingrid Kvalvik & Roy Robertsen, "Inter-municipal coastal zone planning and designation of areas for aquaculture in Norway: A tool for better and more coordinated planning?" (2017) 142 Ocean & Coastal Management 61; Griggs Report, *supra* note 101 (referring to local authorities but also other regulators).

[129] These include the support to the municipalities by the county councils, the central and regional planning guidelines and instruments, and the use of inter-municipal planning. In recent years, the government has also engaged in a process to merge smaller municipalities (Kvalvik & Robertsen, *supra* note 128, at 69).

[130] This aligns with the "expert-driven and technocratic post war-roots" of planning as explained by Mikkelsen, Sørdahl & Solås, *supra* note 105, at 1.

based and collaborative review process has been put in place between the province and one of its municipalities to develop the first provincial aquaculture development area.[131] The broad discretion enshrined in the FCRA in relation to both the process for designation and the content of development areas allowed the Minister to adopt this collaborative approach; it remains to be seen if it amounts to a consistent and explicit government policy. Vertical fragmentation of responsibilities over coastal and marine activities between the Canadian federal and NS provincial governments is a significant factor in the lack of uptake of integrated coastal zone or MSP, as several frustrated attempts of integrated coastal planning demonstrate.[132]

In Chile, two mechanisms have introduced some elements of decentralization to the spatial planning process. First, the AAAs need to be consistent with approved plans for the use of the coastal zone. These multi-sectoral plans are ultimately approved by the national authorities, but they are developed and agreed by a regional commission[133] (macrozoning) and the municipal councils (microzoning). The use of this planning instrument is lagging, however, as only two regional plans have been approved.

The second mechanism is a procedural requirement for the approval of the AAAs: the SUBPESCA needs to request the opinion of the respective regional commissions for the use of the coastal zone.[134] Although the commission has only an advisory nature,[135] this procedural requirement has resulted in a direct and practical means for the regional committees to steer the planning of the aquaculture sector, and the coastal and marine areas more broadly, under their jurisdiction.[136]

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[131] See: CMAR <https://cmar.ca/aquaculture-development-area/> (accessed 20 October 2022); Argyle's Business Park on the Sea <https://www.aquaculturereargyle.com/> (accessed 17 December 2022).
[132] Eg, Sonja L Eger & Simon C Courtenay, "Integrated coastal and marine management: Insights from lived experiences in the Bay of Fundy, Atlantic Canada" (2021) 204 Ocean & Coastal Management 105457.
[133] It is worth noting that after a constitutional reform of Chilean regional authorities, the President of Chile made the decision that the non-statutory regional commissions would be chaired by the elected regional Governors, contributing to the political accountability of the decisions of the coastal zones.
[134] This requirement was only introduced in 2010.
[135] Contraloría General de la República (Chile), Decision 94485 of 2014 and Decision 31971 of 2018, both online: CGR <https://www.contraloria.cl/web/cgr/#> (accessed 16 September 2022).
[136] The regional commissions are also consulted before the adoption of several instruments related to the use of the coastal and marine areas, including the designation of indigenous marine and coastal areas and marine leases for different purposes.

b) Multi-sectoral or Sectoral Planning

Norway has the only multi-sectoral approach to coastal planning that has been implemented at a significant scale,[137] although aquaculture is reportedly a major driver.[138] The Planning and Building Act establishes a "system of comprehensive social, economic, cultural and spatial planning in counties and municipalities, with the active participation of State authorities".[139] Thus, in addition to vertical integration, the Act also supports horizontal integration. Sectoral authorities have both the right and the duty to participate in the planning processes, and they do have a right to object to municipal plans that are in conflict with sectoral interests.[140] The delineation of responsibilities between planning and sectoral authorities is not entirely clear, however.[141]

Scotland extended its terrestrial planning system to coastal areas only for the purpose of exercising planning responsibilities over fish farming. Consequently, aquaculture zoning created sectoral, institutional, and legal fragmentation in marine planning.[142] This is particularly the case after the introduction of a marine planning regime under the *Marine (Scotland) Act 2010*. Some elements of the regulatory framework may contribute to coordination and consistent decision-making despite this fragmentation: the coordination of national terrestrial and marine planning policy instruments; the reliance on "criteria-based" (rather than spatial) planning in the local development plans; the flexible consent regime; and coordination among sectoral authorities.

The aquaculture zoning system in Chile offers yet another example of how sectoral fragmentation hinders integrated and holistic spatial planning. Indeed, the Chilean legal framework for coastal planning comprises different spatial definitions under different legislative authority, thinly coordinated through prioritization of uses. Coastal zone plans, indigenous marine areas, and national parks encompassing marine

[137] Chilean plans for the use of the coastal zone are also multi-sectoral but have not been implemented widely. For the nuanced situation of Scotland, see below.
[138] Mikkelsen, Sørdahl & Solås, *supra* note 105.
[139] Bugge, *supra* note 39, at 314.
[140] Planning and Building Act, *supra* note 48, §§ 1-4, 5-4 to 5-6.
[141] See *infra* note 164 and accompanying text.
[142] Sigrid Eskeland Schütz & Ann-Michelle Slater, "From strategic marine planning to project licences: Striking a balance between predictability and adaptability in the management of aquaculture and offshore wind farms" (2019) 110 Marine Policy 103556, at 7.

areas all have priority over aquaculture and exclude the designation of AAAs and the issuance of aquaculture leases. Yet these areas are established by different authorities, with different objectives, following different processes, and at different times.[143] While prioritization ensures protection of nature and protection of indigenous culture over economic development, it has also led to adversarial claims to the use of oceans,[144] it has hindered the achievement of sectoral policy objectives,[145] and defeats the aims of proactive, holistic, and harmonic development of the coast.

Contributing to the difficulties of fragmented instruments is the rigidity of the AAAs. In other jurisdictions, planning instruments are flexible and adaptable. They are periodically reviewed.[146] They also allow flexibility in individual decision-making processes, as planning authorities can provide a dispensation if material considerations so warrant.[147] The prescriptive legal effects of the Chilean AAA – the exclusion of aquaculture outside AAAs – is particular inflexible considering the legal and practical challenges of establishing new AAAs.

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[143] National Policy on the Use of the Coastal Zone, DS N° 475 of 1994, issued by the Ministry of Defense (Política Nacional de Uso del Borde Cosero del Litoral); LGPA, *supra* note 27; and Regulations on Marine Parks and Reserves in DS N° 38 of 2004, issued by Ministry of Economy, as amended (Reglamento Sobre Parques Marinos y Reservas Marinas de la Ley General de Pesca y Acuicultura); Act 20,249 on Coastal and Marine Areas of Indigenous Peoples and its Regulations in DS N° 134 of 2009 issued by the Ministry of Planning, Ministry of Economy, and Ministry of National Defense.

[144] See, eg: Supreme Court (Chile), Rol N° 24517 (2 October 2020); Corte de Apelaciones de Punta Arenas, Causa de Protección Rol N° 684 (2014). The Supreme Court case decided the invalidity of an aquaculture lease that completed its years-long application process (the legality assessment by the Auditor General) one day after the competent authority (Subsecretariat of Armed Forces) was notified of a judicial stay order for new marine or aquaculture leases due to the submission of an application for an Indigenous Peoples marine area.

[145] The relocation of sites located in "fire wall" areas or in national parks, required under Act 20,434, has been hindered by lack of available AAAs.

[146] The Norwegian municipal master plan is up for consideration and discussion every four years (Bugge, *supra* note 39, at 323). The local development plans must be revised every 5(10) years according to the *Town and Country Planning (Scotland) Act 1997*, s 16, as amended by *Planning (Scotland) Act 2019*.

[147] Planning and Building Act, *supra* note 48, ch 19; see also Bugge, *supra* note 39, at 332. *Town and Country Planning (Scotland) Act 1997*, s 25; see also Ann-Michelle Slater, "Aquaculture and the law: United Kingdom and Scotland" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Edward Elgar 2016) 412 at 421.

c) Knowledge Base for Planning

The nature of the planning exercises (ie, sectoral or multisectoral, technical or holistic) is linked to the knowledge base for planning. Scotland[148] and Norway[149] require SEA for planning instruments (fulfilling international and regional obligations), with Scotland also requiring Habitat Regulations Appraisal (screening and appropriate assessment, if applicable) under the *Conservation (Natural Habitats, &c) Regulations 1994*. Chile requires "technical studies", and NS does not specify the knowledge base for designation of aquaculture development areas.

SEA is a "formalized, systematic, and comprehensive process of identifying and evaluating the environmental consequences of proposed policies, plans or programmes to ensure that they are fully included and appropriately addressed at the earliest possible stage of decision-making on a par with economic and social considerations."[150] It supports the EAA by considering a broad range of aspects that are relevant for the balancing of societal objectives, including environmental and ecosystem protection as well as other values and uses associated to the coastal areas.[151] In practice, the scope and

[148] Chilean AAAs require technical studies that include environmental protection. In practice, the AAAs established in the early 1990s were not supported by environmental studies and simply excluded areas relevant for other existing uses and interests within the coastal area up to 1 nm measured from the normal or straight baselines. While the procedural and substantive standards for AAA approval have increased significantly with more recent legal reforms, they remain mostly untested due to the difficulties establishing new AAAs explained above.

[149] Planning and Building Act, *supra* note 48, § 4; Regulations on impact assessment (FOR-2017-06-21-854) (as amended) [Forskrift om konsekvensutredninger]; Agreement on the European Economic Area, [1994] OJ L 1/3), Annex XX No 1a and 1g; Strategic Environmental Assessment Directive, *supra* note 118; Bugge, *supra* note 39, at 317; Mikkelsen, Sørdahl & Solås, *supra* note 105, at 3.

[150] CBD, "Draft guidance on biodiversity-inclusive Strategic Environmental Assessment" in Annex to Decision VIII/28 adopted during the Eighth Meeting of the Conference of the Parties to the Convention on Biological Diversity, Curitiba, March 2006, para A.7. Kyiv Protocol, *supra* note 118, art 2(6) defines SEA as "evaluation of the likely environmental, including health, effects, which comprises the determination of the scope of an environmental report and its preparation, the carrying out of public participation and consultations, and the taking into account of the environmental report and the results of the public participation and consultations in a plan or programme".

[151] Eg, the Norwegian Regulations on impact assessment list factors to be considered in SEA/EIA, which include nature diversity, ecosystem services and environmental goals and targets, Sami natural and cultural basis, cultural monument and cultural environment, outdoor life, pollution, water environment (including river district management plans), soil sources, effects of climate change, landscape, architectural and aesthetic design, expression and quality, among others, and includes positive, negative, direct, indirect, temporary, permanent, short-term and long-term effects (Regulations on impact assessment (FOR-2017-06-21-854) (as amended) §21 [Forskrift om konsekvensutredninger] . Similarly, Schedule 3 of the *Scottish Environmental Assessment (Scotland) Act 2005,* 2005 asp 15, includes a non-exhaustive list of factors to be considered, including biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage (including architectural and archaeological heritage), landscape, and the

quality of SEA may vary. In Norway, for example, municipalities have significant discretion in deciding how to conduct the impact assessment, despite the existence of broad regulations and general guidelines addressing topics to be considered, possible methods to assess values and impacts, and how to present results.[152]

The comprehensive nature of SEA contrasts with the technical studies required in the Chilean system. The early AAAs designation were not supported by environmental information and had a narrow focus on excluding areas with user conflict. Since then, there has been only one significant recent process that led to designation of new AAAs, which provides insights on current practices. The process was carried out between 2013 and 2018 and focused on the designation of several small areas in the XII Region, each supporting only one farm, and located so as to comply with mandatory minimum distance requirements.[153] The supporting technical studies by SUBPESCA had a rather limited scope, focusing on a number of environmental variables (oxygen conditions, currents, and depth) and interactions between the proposed sites and alternative uses.[154] Indigenous interests were addressed in a dedicated indigenous consultation, as required under ILO 69, which concluded with the approval of the sites and a private agreement between the salmon industry and the Indigenous communities in the area.[155] The process lacked, however, important features of an holistic SEA, including early engagement with

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interrelationship between these factors, considering short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects.

[152] Mikkelsen, Sørdahl & Solås, *supra* note 105, at 3.

[153] SUBPESCA, Informe Técnico (D Ac) N° 877 de 2017, Propuesta de Nuevos Sitios de Áreas Apropiadas para el Ejercicio de la Acuicultura (AAA) en la XII Región de Magallanes y de la Antártica Chilena [Technical Report 877 of 2017, Proposal for New Sites of Appropriate Areas for Aquaculture (AAA) in the XII Region of Magallanes and Chilean Antarctica][translation by author].
This is a departure from previous designation processes, which identified large areas as AAA and left assessment of the suitability of individual sites to the application stage.

[154] *Ibid*. These included ports, defence, coves, fishing grounds, territorial user rights for benthic species, touristic interests, protected areas and Indigenous communities. The environmental conditions included in the technical studies are those considered in the Aquaculture Environmental Regulations to assess the suitability of individual sites (Aquaculture Environmental Regulations, DS N° 320 of 2001, issued by the Ministry of Economy, as amended). The lack of consideration of more comprehensive environmental concerns, including indirect and cumulative impacts, is related to the lack of environmental baseline information that has been noted for the Southern regions of Chile (see, eg: Renato A Quiñones et al, "Environmental issues in Chilean salmon farming: a review" (2019) 11 Rev in Aquaculture 375).

[155] *Ibid*, at 11-12.

stakeholders, definition of sustainability and environmental objectives, and assessment of broader and cumulative environmental concerns.[156]

The limitations of the technical studies became evident during the environmental assessment of two lease applications in the newly designated AAAs.[157] Environmental and indigenous organizations applied for judicial review of the EIA approvals of these applications on several grounds, including that the assessment of individual sites was in effect a fragmentation of one larger project with broader and cumulative impacts, including potential impacts on the conservation objectives of a national reserve. The tribunal ruled in their favour,[158] ordering a new EIA that considers the evaluation of all new sites in one process.

The legal framework in NS does not have procedural requirements for the designation of an aquaculture development area, aside from a consultation with federal and provincial agencies (as may be required by law) and with a person, group of persons or organization that the Minister considers necessary or advisable in the circumstances. A strategic environmental assessment, recommended by the Independent Aquaculture Review, is not explicitly required. Under the FCRA, the Minister has ample discretion to decide on the knowledge base for their designation. The current initiative to establish the first provincial development area is framed as a "science-based collaborative review process" involving the collection and analysis of "ecological, economic, and social data".[159]

d) Environmental Conditions in Planning Instruments

Planning with an ecosystem approach requires a focus on ecosystems and on protecting ecosystem integrity. The relevant question is, therefore, to what extent do planning

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[156] See: Reglamento para la Evaluación Ambiental Estratégica, DS N° 32 de 2015 del Ministerio del Medio Ambiente [Regulations on Strategic Environmental Assessment][translated by author].
[157] The AAA were designated to facilitate relocation of aquaculture leases currently located in a national park. Thus, the two applications refer to relocation proposals. In total, the company is submitting 13 relocation applications.
[158] Comunidad Indígena Kawésqar Grupos Familiares Nómades del Mar y otros con Comisión de Evaluación Ambiental Región de Magallanes y la Antártica Chilena, R-16-2021 Tercer Tribunal Ambiental (27 December 2022). The timeframe for appeal is still pending. The main cumulative impacts considered in the judicial decision were associated with impacts of navigation to and from sites in the area.
[159] CMAR, "Aquaculture Development Area in the Municipality of the District of Argyle", online: CMAR <https://cmar.ca/aquaculture-development-area/> (accessed 29 October 2022).

instruments consider limits or conditions to aquaculture in order to ensure environmental protection? Conceptually, planning instruments may be within a continuum between a zoning instrument (determining where aquaculture is and is not allowed) to an environmental management instrument (establishing area-specific conditions or restrictions to aquaculture developments).

Most planning instruments consider exclusion zones for the purpose of protecting the marine environment, and particularly wild salmon. Norway has designated national salmon fjords and rivers and prohibits salmon farming in these areas. Further, national salmon fjords and rivers are considered in the municipal planning process. Similarly, the Scottish national planning policy has adopted a strong presumption against salmon farming in the East and North coast of Scotland. In both cases, the objective of this exclusion areas is to protect wild salmon, and the measures are consistent with NASCO's recommendation to designate salmon protection zones. In effect, it represents a precautionary "environmental bottom line" that excludes a balancing exercise between development and nature protection.

NS has not designated similar areas for protection (closed areas for aquaculture). It should be mentioned, however, that the availability of suitable areas for salmon farming are naturally limited in the province. The situation in Chile is somewhat different as salmon is not native to the country. Nevertheless, the Chilean legislation also considers strict incompatibility between salmon farming and national parks, marine parks and marine reserves, including buffer zones.

Whether zoning and spatial planning instruments can include further environmental restrictions is a question with an uncertain and contested answer. The Chilean AAAs, and particularly early AAAs, offer a good example of planning instruments used exclusively for zoning purposes. AAAs only designate areas which, in principle,[160] are acceptable for aquaculture. The only condition that can be included in the AAAs is the species or group of species that can be farmed in the area.[161] The first designated AAAs were, in any case, too vast to attach ecosystem-relevant limits or

[160] Within AAAs, the presumption is in favour of aquaculture developments as an application within an AAA can only be rejected based on specific siting or environmental standards considered in legislation and regulations.

[161] LGPA, *supra* note 27, art 67. This possibility was only introduced through the amendment of the LGPA in 2010 (Act 20434).

conditions, nor was there at the time enough scientific information to do so. As was already noted, the most recent designation of AAAs was not supported with ecosystem-level information; in any case the LGPA does not allow attaching environmental limits or conditions to AAAs.

While the NS situation remains untested, the FCRA gives ample discretion to the Minister to impose conditions and restrictions on the conduct of aquaculture and other activities in an aquaculture development area.[162] These conditions and restrictions could include area-based production limits or other restrictions based on ecosystem protection considerations. Whether the development areas will have a spatial scale that corresponds to ecosystem boundaries and whether the studies supporting their designation will consider relevant information to establish those limits or restrictions remains to be seen.

In Scotland and Norway, the capacity and mandate of planning authorities to impose environmental conditions is subject to contested legal interpretations, as such conditions may fall within the competence of other sectoral authorities. The situation has come up in Norway, in particular, offering yet another example of difficulties in sectoral fragmentation and coordination. It is clear that the municipalities have the authority to designate aquaculture zones, multi-purposes zones (including aquaculture), and zones for the farming of specific species.[163] Whether the municipality can, in addition, impose further environmental conditions or restrictions in designated areas or whether those environmental conditions must be imposed through sectoral legislation is unclear.[164] The

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[162] FCRA, *supra* note 73, s 56(1)(b).

[163] Planning and Building Act, *supra* note 48, §§ 11-7(6) and 11-11.

[164] According to Planning and Building Act, *ibid*, § 11-9(6), the municipality may adopt provisions regarding environmental quality, aesthetics, nature, landscapes, and green structures for the land-use element of the municipal master plan. § 11-11 further specifies that these provisions may include those regarding "the use and protection of water surfaces, water columns and bottom". For example, the municipality of Osterøy included additional requirements for some designated aquaculture areas, stating that they must have minimal to no release of organic particles to the recipient environment. While these conditions were first objected by the county council and the state administrator, they were nevertheless accepted in the sea and coast sub-plan. See also: Osterøy Kommune, Planskildring Sjø-Og Strandsoneplan. Arealplan etter Plan- og bygningslova § 11-5 Vedlegg 1 av 17 [Plan Description Sea And Beach Zone Plan. Area plan according to the Planning and Building Act § 11-5. Appendix 1 of 17] [Google Translate], online: Osterøy Kommune <https://www.osteroy.kommune.no/innhald/plan-bygg-og-eigedom/planar/vare-planer/> (accessed 30 October 2022). See also: Ingunn Elise Myklebust, "Miljøkrav i saker som gjeld akvakultur" (2018) 2 Kart og Plan 2 174 [Environmental requirements in aquaculture][Google Translate]. In discussing water pollution, Bugge notes that the municipalities "may", to some extent, lay down rules on discharges and water quality objectives. In practice, mainly the sectoral pollution legislation and regulation applies (Bugge, *supra* note 39, at 138).

new Aquaculture Strategy, while assessing the planning system positively, has identified the coordination of assessments under the Planning and Building Act (for the designation of aquaculture areas or multiple-use areas) and under the Aquaculture Act (for clearance of specific sites) as an issue to be clarified.[165]

Generally, the criteria-based planning system in Scotland could be adapted to consider area-specific restrictions or conditions based on ecosystem protection needs, in particular as planning instruments are required to consider cumulative impacts. A clear example is the Marine Scotland's Locational Guidelines. The Locational Guidelines are a simplified predictive tool of nutrient enrichment and benthic impact applied to individual lochs and voes. While an important tool for the spatial estimation of carrying capacity limits guiding individual decisions for new or expanded sites, it is restricted to lochs and voes and therefore has a decreasing practical importance in the context of siting applications for more exposed sites.

Another support tool for planning process in both Norway and Scotland are the river basin management plans and the classification of waters under regulations implementing the EU Water Framework Directive (WFD).[166] A water body classified in moderate (or worse) conditions for one or more quality elements potentially affected by salmon farming (e.g. benthic quality, water quality) is unlikely to be considered a suitable area for new aquaculture developments unless the exception criteria of the WFD are met.[167]

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[165] Norwegian Government, *The Aquaculture Strategy: A Sea of Opportunities* (6 July 2021), Foreword. [Havbruksstrategien: Et hav av muligheter], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/havbruksstrategien-et-hav-av-muligheter/id2864482/> (accessed 11 July 2022) [Google Translate].

[166] *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy* (Water Framework Directive), [2000] OJL 327/1 [hereinafter WFD]. In Norway, river basin management plans are adopted as regional plans under the Planning and Building Act. Although regional plans are not binding, the municipalities must consider the regional plans in their work (Planning and Building Act, § 8-2; Bugge, *supra* note 39, at 144, 328). While the river basin management plans adopted for 2016-2021 only considered organic waste from aquaculture facilities, the 2022-2026 plans include impacts of aquaculture on wild fish in watercourses with anadromous fish (sea lice, escapes). See: Synne Movik & Knut Bjørn Stokke, "Contested knowledges, contested responsibilities: The EU Water Framework Directive and salmon farming in Norway" (2015) 69 Norsk Geografisk Tidsskrift - Norwegian Journal of Geography 242 at 247. With the exception of specific fjords, the condition of fjords regarding nutrient pollution is at least good.

[167] WFD, *supra* note 166, art 4. For an example of planning instruments considering the water classification as one consideration, see: Argyll and Bute Council, "Local Development Plan Supplementary Guidance 2: Aquaculture Development (SG AQUA1)" (December 2016), online: <https://www.argyll-bute.gov.uk/ldp> (accessed 21 December 2022).

7.3. Beyond the Farm Management

7.3.1. Theory

FAO's first EAA principle requires that aquaculture development and management takes account of the full range of ecosystem functions and services and does not threaten the sustained delivery of these to society.[168] The principle has been associated to carrying (or assimilative) capacity: the aquaculture activity needs to be compatible with what the environment can tolerate. The holistic remit of EAA requires to consider ecosystem functions and services at different spatial scales, in particular farm and watershed level.[169]

Salmon mariculture can have several far field impacts (or impacts at the ecosystem scale), including: the spread of disease, pathogens, and parasites; the introduction of non-native species; coastal nutrient enrichment; or marine litter.[170] An EAA must address the logistical and conceptual complexity of understanding, characterizing, and mitigating, effects at the ecosystem level.[171] Further, aquaculture may have cumulative impacts[172] with other aquaculture farms or with other anthropogenic pressures. While "the environmental and social impacts of a single farm might be

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[168] FAO, EAA Technical Guidelines, *supra* note 1.

[169] FAO, *ibid*, adds the global level; however, as noted in chapter 2, a narrower definition of EAA was adopted in this Dissertation, that considers EAA as a place-based and multi-dimensional concept that focuses on aquaculture interactions (externalities) within defined and nested ecosystems, focusing on farm and watershed level.

[170] Jenny Weitzman et al, "Far-field and near-field effects of marine aquaculture" in Charles Sheppard (ed), *World Seas: An Environmental Evaluation Volume III: Ecological Issues and Environmental Impacts* (Elsevier, 2019) 197. Weitzman et al address near and far field effects based on a distance criterion (within ten of metres and more than hundred of meters, respectively). They note, however, that a fixed distance to classify the impact of a farm is decoupled from an ecosystem functioning perspective and that a precise, fixed, and global definition of a distance for the boundary between near-field and far-field becomes meaningless (*ibid*, at 197).

[171] *Ibid*.

[172] Cumulative impacts are generally defined as "changes to the environment that are caused by an action in combination with other past, present and future human actions" (C Murray, L Hannah & A Locke, "A Review of Cumulative Effects Research and Assessment in Fisheries and Oceans Canada" (2020) Can Tech Rep Fish Aquat Sci 3357, at 1, citing Hegmann et al, "Cumulative Effects Assessment Practitioners Guide." Report prepared for Canadian Environmental Assessment Agency (Hull, Quebec: 1999)). The European Environmental Agency defines cumulative impacts as "the impacts (positive or negative, direct and indirect, long-term and short-term impacts) arising from a range of activities throughout an area or region, where each individual effect may not be significant if taken in isolation. […] Cumulative impacts include a time dimension, since they should calculate the impact on environmental resources resulting from changes brought about by past, present and reasonably foreseeable future actions." See online: European Environmental Agency <https://www.eea.europa.eu/help/glossary/eea-glossary/cumulative-impacts> (accessed 4 November 2022).

marginal, more attention needs to be paid to the potentially cumulative ecosystem effects of collectives or clusters of farms and their aggregates at watershed/zone scale".[173]

Far field and cumulative impacts are distinct concepts, but they are often related. Indeed, the wider spatial scope of far field effects makes it more likely that it will interact with other farms (in particular in densely farmed areas) and human activities.[174] Both represent specific challenges to aquaculture regulation. It implies overcoming the limitations of traditional environmental law, where regulations are designed for environmental problems that are "well-bound, clearly defined, relatively simple, generally linear with respect to cause and effect".[175] Ebbesson highlights the legal challenges of defining individual responsibility when environmental damage cannot be linked to a specific act or actor, or results from multiple actors.[176] Traditional notions of legal responsibility and liability may be difficult or impossible to implement, and therefore the legal approach to control harmful activities must take another form.[177] Similarly and in the context of EAA, Bermúdez highlights the need to transition from (or at least complement) "farm-by-farm" regulatory approaches to regional approaches more suited to address ecological (far-field) effects of fish farming as well as cumulative effects.[178]

Practical tools to consider the totality of adverse effects on the environment from different pollution sources include comprehensive environmental assessments, cumulative effects assessments, and environmental quality standards when paired with legal consequences, sanctions, or restrictions where standards are exceeded.[179] These tools have also been mentioned in the context of EA[180] and EAA.[181]

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[173] FAO, EAA Technical Guidelines, *supra* note 1, at 10.
[174] Near field impacts can also be cumulative, however, in poorly planned aquaculture.
[175] See: chapter 3 note 39 and accompanying text.
[176] Ebbesson, *supra* note 6, at 415.
[177] *Ibid*. He makes this remark in relation to responsibility of States for transboundary harm; equivalent argument can be made for collective responsibility of actors at the domestic level.
[178] Jorge Bermúdez, "Legal and policy components of the application of the ecosystem approach to aquaculture to site selection and carrying capacity" in LG Ross et al (eds), *Site selection and carrying capacities for inland and coastal aquaculture*, FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6–8 December 2010, Stirling, the United Kingdom of Great Britain and Northern Ireland. FAO Fisheries and Aquaculture Proceedings No 21 (Rome: FAO, 2013) 117 at 120,121 and 125.
[179] Ebbesson, *supra* note 6, at 419. Other proposed measures include market instruments, which are not the focus of this Dissertation.
[180] See: WFD, *supra* note 166, and *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy*,

7.3.2. International Law and Policy

While neither the LOSC nor the CBD includes an explicit reference to cumulative effects or overall load of human activities on the (marine) ecosystems, their consideration may be considered implicit in the broad duty to protect and preserve the marine environment under the LOSC. Marine environment is understood to encompass both the physical estuarine and oceanic environment and its ecology, including individual biological components. States are required to protect the marine environment from future damage and to maintain and improve its present condition.[182] It is also implicit in the duty to conserve and sustainably use marine biological diversity (including ecosystem diversity) under the CBD.

More concrete obligations or soft law recommendations regarding cumulative or ecosystem-level impacts can be found in the international law and guidelines on EIA. The LOSC and the CBD require an EIA of activities and projects that are likely to pollute the marine environment or are likely to have significant adverse effects on biological diversity;[183] and the CBD further extends that obligation to programs and policies.[184] Regional instruments as well as soft law guidelines have further elaborated on the content of EIAs and SEAs. These instruments (including the Kyiv Protocol,[185] the CBD's Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment [186] and the UNEP

[2008] OJ L 164/19 (both considered to be implementing an EA through ecological quality standards). See also: Soininen & Platjouw, *supra* note 102; Karen L McLeod et al, "Scientific Consensus Statement on Marine Ecosystem-Based Management" (21 March 2005), online: Communication Partnership for Science and the Sea <http://compassonline.org/?q=EBM>.

[181] EAA Technical Guidelines, *supra* note 1, at 35; Bermúdez, *supra* note 178. See also Table 2 in Chapter 2.

[182] *South China Sea Arbitration (Republic of the Philippines v the People's Republic of China)* Award of 12 July 2016 (PCA Case Nº 2013-19), para 373 (Arbitrators: Judge Thomas A Mensah, Judge Jean-Pierre Cot, Judge Stanislaw Pawlak, Professor Alfred H Soons, Judge Rüdiger Wolfrum).

[183] LOSC, *supra* note 14, art 204(2); CBD, *supra* note 19, art 14(1)(a).

[184] CBD, *supra* note 19, art 14(1)(b).

[185] Kyiv Protocol, *supra* note 118, note to para 6 in Annex IV. Only Norway is a party to the Kyiv Protocol, however.

[186] CBD, "Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment", Annex to Decision VIII/28 adopted by the Conference of the Parties at its Eighth Meeting held in Curitiba, Brazil, 20-31 March 2006, UNEP/CBD/COP/DEC/VIII/28 (15 June 2006), online: CBD https://www.cbd.int/meetings/COP-08 (access 3 March 2022). In the context of the enhanced programme on marine and coastal biological diversity, environmental impact assessment that considers likely immediate, intermediate and long-term impacts on all levels of biodiversity, is particularly recommended for mariculture (CBD, Decision VII/5, *supra* note 110, para 45(a)).

Goals and Principles of Environmental Impact Assessment[187]) emphasize the need to include direct, indirect, cumulative, secondary, synergistic, permanent, and temporary, short-, medium- and long-term, positive and negative effects.[188] While the terminology in each of the main instruments vary, they all refer to the assessment of impacts that do not fall within traditional direct cause-effect relationships between activity and environmental damage.

International law and guidelines also provide specific goals in three substantive ecological concerns relevant to salmon farming, namely pathogen and parasite transmission, impacts of escapes on wild anadromous fish, and nutrient enrichment. The Aquatic Code adopted by the World Organization on Animal Health addresses the risk to pathogen transmission in the context of semi-open or semi-closed aquaculture establishments that are in close proximity in shared water bodies.[189] It highlights the need for a consistent set of biosecurity measures for all the aquaculture establishments that are epidemiologically linked, including synchronized fallowing,[190] formalized through area management agreements.[191] At the regional level, NASCO also encourages States parties to adopt aquaculture regions to provide a framework for management of the aquaculture industry and assist in controlling the spread of fish diseases and parasites.[192] For sea lice in particular, and in support of its international goal,[193] it recommends area management, risk-based, integrated pest management programmes that meet jurisdictional targets for lice loads at the most vulnerable life-history stage of wild salmonid.[194]

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[187] UNEP, "Goals and Principles of Environmental Impact Assessment", decision 14/25 of the Governing Council of UNEP (17 June 1987), online: Environmental Law Alliance Worldwide <https://www.elaw.org/content/un-unep-goals-and-principles-environmental-impact-assessment>, Principle 4(d).

[188] UNEP, *ibid* [direct, indirect, and cumulative effects]; Kyiv Protocol, *supra* note 118 [secondary, cumulative, synergistic, short-, medium- and long-term, permanent and temporary, positive and negative effects]; CBD, "Voluntary Guidelines", *supra* note 186 [indirect and cumulative effects].

[189] World Organisation for Animal Health, Aquatic Code, online: WOAH <https://www.woah.org/en/what-we-do/standards/codes-and-manuals/aquatic-code-online-access/> (accessed 9 December 2022), art 4.1.6.

[190] *Ibid*, arts 4.1.7 s 1(j) and 4.7.

[191] *Ibid*, art 4.1.6.

[192] Williamsburg Resolution, *supra* note 113.

[193] NASCO, Guidance on Best Management Practices to address impacts of sea lice and escaped farmed salmon on wild salmon stocks, SLG(09)5, (adopted in June 2009 and Revised in June 2010) [hereinafter NASCO, Guidance on BMP]. The stated goal for escapes is: "100% of farms to have effective sea lice management such that there is no increase in sea lice loads or lice-induced mortality of wild salmonids attributable to the farms".

[194] *Ibid*. "Area management" is defined as "an area based management approach designed to facilitate cooperation at a local level in order to achieve shared objectives including the maintenance of healthy

Article 196 of the LOSC requires States to "take all measures necessary to prevent, reduce and control (…) the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto". The provision is directly relevant to aquaculture of non-native species and likely also domesticated native species, such as *Salmo salar* in waters of the North Atlantic. The obligation in article 196 has been further elaborated by NASCO voluntary guidelines addressing the impact of escaped fish on wild Atlantic salmon. The Williamsburg Resolution focuses mostly on site-specific mitigation measures within the zero-escape goal,[195] as well as implementing tagging, marking or inventory tracking systems to facilitate the identification of farmed salmon in the wild, their separation from wild fish, and the identification of escapee's site or origin.[196] NASCO's Guidance further emphasizes the importance of implementing monitoring schemes to assess the number of escaped salmon in both rivers and fisheries and their relationship to reported incidents, as well as recapture programs.[197] Most recently, NASCO has urged States to develop and use innovative salmon farming technologies, both at sea and on land, to enable further progress toward the attainment of the international containment goal, prioritizing sensitive areas.[198]

Far field effects of nutrient emissions have been addressed regionally through instruments relevant to Norway and Scotland. Under the OSPAR Commission' eutrophication strategy, State parties have committed to combat eutrophication in the OSPAR maritime area, in order to achieve and maintain a healthy marine environment, where eutrophication does not occur.[199] The OSPAR Strategy is implemented through,

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stocks of farmed fish and the protection of the wild salmon stocks" (NASCO, "Explanations of Terms Used in the Guidance on Best Management Practices to Address Impacts of Sea Lice and Escaped Farmed Salmon on Wild Salmon Stocks in NASCO", Report of the Meeting of the NASCO/North Atlantic Salmon Farming Industry Liaison Group, CNL(10)16)).

[195] NASCO, Guidance on BMP, *supra* note 193. The stated goal is: "100% farmed fish to be retained in all production facilities".

[196] *Ibid.*

[197] *Ibid.*

[198] NASCO, "Statement on Salmon Farming from the Council of the North Atlantic Salmon Conservation Organization", CNL(22)49, online: NASCO <https://nasco.int/annual-meeting/thirty-ninth-annual-meeting-2022/#annual-reports-of-the-council-of-nasco> (accessed 9 December 2022), and Chapter 5 note 326 and accompanying text.

[199] OSPAR Commission, "Eutrophication Strategy", in OSPAR Commission, Annual Report 2002 - 2003, Vol 2 (OSPAR Commission, London, 2003), online: OSPAR <https://www.ospar.org/documents?v=6955> (accessed 2 November 2022), Annex 6, ch II, s 1.

inter alia, the EU's WFD.[200] The WFD requires national authorities to prevent deterioration of water quality, and to work to achieve good ecological status in all waters under their jurisdiction.[201]

7.3.3. Lessons from State Practice

The limitations of regulations that focus on site-by-site permitting and management have been identified in all salmon producing countries analyzed in this Dissertation, although to different extents and in different contexts. Perhaps more importantly, these limitations have been and continue to be a particular driver for regulatory reform.

A prime, and particularly dramatic, example of the insufficiency of site-by-site management was the Chilean outbreak of infectious salmon anaemia in 2007. Indeed, in the farm model at that time (farms in close proximity, very high density of fish, and independent production cycles) the spread of the virus was quick, expansive, and impossible to control. This event led to a regulatory overhaul and the adoption of an area management measure with coordinated production and biosecurity measures and farm density controls.

In Norway, the insufficiency of site-by-site measures to address some of the most important environmental problems of the industry were highlighted in two different reports issued in the early 2010s. In February 2011, an expert committee report on efficient and sustainable land use in the aquaculture industry made several regulatory proposals to address the three main challenges of the industry (namely escapes, sea lice, and production loss). The proposal focused on a reorganization of the salmon industry in production and exposure zones and the adoption of measures at the zone level to address collective problems, emphasizing joint industry responsibility.[202] In March 2012, the Auditor General reported to the Norwegian Parliament on the results of its investigation

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[200] *Ibid*, Annex 6, ch II, s 1. The WFD (*supra* note 166) is the most important instrument considering the current distribution of salmon mariculture. The WFD applies to coastal waters, defined in art 2(7) as surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters.

[201] WFD, *supra* note 166, arts 1 and 4.1(a)(ii).

[202] Peter Gullestad et al, "Effektiv og bærekraftig arealbruk i havbruksnæringen Rapport fra et ekspertutvalg oppnevnt av Fiskeri- og kystdepartementet" (Oslo, 4 February 2011) [Efficient and sustainable land use in the aquaculture industry Report from an expert committee appointed by the Ministry of Fisheries and Coastal Affairs][Google Translate].

into the management of aquaculture.[203] The Auditor was critical of a system that assessed matters relating to individual sites and not the overall load from several fish farms in an extended area when processing applications for fish farm licences.[204] Following these reports, the Norwegian government introduced several amendments to the regulatory framework for salmon farming, including the traffic light system.

Scotland has also raised the concern explicitly. During the 2017-2018 Parliamentary inquiry into salmon farming, the Committee noted that "[c]oncerns were expressed about the lack of a process of assessment of cumulative regional and national impact of salmon farms".[205] The Committee recommended, as a matter of priority, the development of strategic and spatial guidance to identify areas where growth could be supported, and the relocation of farms situated in areas where environmental impact is greatest.[206] Other reports also highlight regulatory shortcomings in addressing cumulative effects of sea lice impacts on wild fish[207] or the continuous use of acoustic deterrence devices.[208] Stakeholders have also raised the need for holistic assessment at the area level with direct management implications.[209] Partially responding to these concerns, SEPA is

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[203] Riksrevisjonen [Office of the Auditor General of Norway], The Office of the Auditor General's investigation into the management of aquaculture, Document 3:9 (2011–2012) (6 March 2012) [English version][in file with author].
[204] *Ibid*.
[205] The Scottish Parliament, Rural Economy and Connectivity Committee, "Salmon Farming in Scotland" SP Paper 432, 9th Report (Session 5) (27 November 2018), at 109 [hereinafter Scottish Parliament, "Salmon Farming in Scotland"], para 399, at 91. The Scottish Inshore Fisheries Trust stated that "the sector is inadequately regulated with regard to: site location; cumulative impact of multiple salmon farms; ecosystem impacts; impacts on other industries; transparency and reporting obligations." (*ibid* para 475 at 108).
[206] *Ibid*, recommendations 51, 52 and 53, at 92-95. The Norwegian traffic light system was mentioned in this debate.
[207] Salmon Interactions Working Group, Report (April 2020), online: Scottish Government <https://www.gov.scot/publications/report-salmon-interactions-working-group/> (accessed 7 October 2022) [hereinafter SWIG Report]. The working group recommends that "consenting of new developments should be managed within an adaptive spatial planning model which is risk based, of suitable resolution, underpinned by best available scientific evidence, and takes into account the cumulative effects of management practices of existing developments and impacts on wild salmonid fish" (Recommendation 2.4). The Working Group adds that the right spatial scale is the farm management area.
[208] Scottish Parliament, "Salmon Framing in Scotland", *supra* note 205, at 76.
[209] A witness to the Rural Economy and Connectivity Committee stated: "That would involve thinking about what the monitoring was telling us about all the fish farms in an area—we could do that at sea-loch scale, for example—and what that meant for the management of the individual farms in the area." (Scottish Parliament, Rural Economy and Connectivity Committee, Official Report, 18 April 2018, online: Scottish Parliament <https://archive2021.parliament.scot/parliamentarybusiness/report.aspx?r=11469&c=2083029> (accessed 7 October 2022)).

currently considering a spatially risk-based framework for managing interactions between sea lice from marine finfish farms and wild Atlantic salmon.[210]

In NS, the Independent Aquaculture Review acknowledged the relevance of considering cumulative impacts in several recommendations. First, it recommended a broad goal for the aquaculture regulatory framework that comprises far field and cumulative impacts by emphasizing the availability of unimpaired environmental services.[211] Second, it highlighted the need to address cumulative impacts in deciding aquaculture licenses.[212] Third, it recommended strategic assessments of coastal areas within its recommended zoning system.[213] The 2015 regulatory amendment did not follow those recommendations closely, however.

Far field effects and cumulative effects are addressed at different stages of aquaculture management: planning, siting, and operation. Strategic planning and spatial planning are considered the most important and suitable legal and management tools to address the full extent of human pressures on an ecosystem or its components. This aspect was addressed in the previous section.

Licensing or consenting processes and standards for individual sites require the assessment of cumulative and far field impacts. Scottish competent authorities have, in

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[210] SEPA, Proposals for a risk-based framework for managing interaction between sea lice from marine finfish farm developments and wild Atlantic salmon in Scotland (last updated 25 August 2022), online: SEPA <https://consultation.sepa.org.uk/regulatory-services/protection-of-wild-salmon/> (accessed 6 November 2022).

[211] NS, Independent Aquaculture Review, *supra* note 65. The report states the goal as "ensuring aquaculture is conducted under conditions and in accordance with controls that will protect the environment by preventing significant harm to the environment or to the continuing availability in the short, medium and longer term of unimpaired environmental services to aquaculture and to other users of those environmental services" (*ibid*, at 32-33). The Report notes that this goal is consistent with two guiding principles unanimously recommended by the Round Table, which explicitly mention "ecosystem health" and "carrying capacity". The two guiding principles were: "ensure the maintenance of long term ecosystem health in the areas where aquaculture takes place" and "ensure that the net environmental impact of an aquaculture operation, from startup to decommissioning, does not exceed the ecological carrying capacity of its location" (*ibid*).

[212] The Independent Aquaculture Review, *ibid*, recommended that the scoping documents for new sites include an "overview of all current and recent activities in the area that have the potential to be affected by the proposed operation or that have the potential to interact cumulatively with coastal ecosystems that have the potential to be impacted by the proposed operation." The responsiveness to cumulative effects of aquaculture in an area was recommended as one of the principles guiding licensing decisions.

[213] *Ibid.*

this respect, a particular mandate in the licensing processes for CAR permits,[214] planning permits,[215] and EIA.[216] Norwegian authorities, in turn, are bound to consider cumulative impacts (overall load) on the ecosystem in making decisions on permits for salmon farms.[217] In Chile, the assessment of cumulative and synergistic effects is required during the environmental impact assessment process for both environmental impact studies and statements.[218]

NS regulatory framework does not address the assessment of cumulative impacts explicitly. The recommended broad goal for the aquaculture regulatory framework in the Independent Aquaculture Review was not followed closely. The Act recognizes a general goal of ensuring that "aquaculture is conducted under conditions and in accordance with controls that protect the environment".[219] Cumulative effects were not considered explicitly in the decision-making criteria listed in the *Aquaculture Licence and Lease Regulations*, although cumulative or far-field effects may be considered implicit in at least three of them (namely, the optimum use of marine resources, the sustainability of wild salmon and the number and productivity of other aquaculture sites in the public waters surrounding the proposed aquacultural operation).[220] How these provisions will be

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[214] *The Water Environment (Controlled Activities) (Scotland) Regulations 2011*, SSI 2011/209 s 11(3) with reference to Annex IV of the EIA Directive (currently *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment* [2012] OJ L 26/1 (as amended).

[215] According to the Scottish Planning Policy, the local plans should set out the issues that will be considered when assessing specific proposals, which could include impacts on, and benefits for, local communities; economic benefits of the sustainable development of the aquaculture industry; landscape, seascape and visual impact; biological carrying capacity; effects on coastal and marine species (including wild salmonids) and habitats; impacts on the historic environment and the sea or loch bed; interaction with other users of the marine environment; and the *cumulative effects on all of the above factors* (Scottish Planning Policy, at para 251 at 56 (emphasis added)).

[216] *The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017,* SSI 2017/102, Schedule 3 (Selection Criteria for Screening Schedule 2 developments) and Schedule 4 (Information for Inclusion in EIA Report).

[217] Nature Diversity Act, *supra* note 38, §10.

[218] This has been ruled by the Supreme Court despite deficient text of the Framework Act for the Environment. See: Inmobiliaria Toro Mazotte N° 115 SA con Servicio de Evaluación Ambiental, Causa Rol N° 7610 de 2019, Corte Suprema (Chile), online: Diario Constitucional <https://www.diarioconstitucional.cl/wp-content/uploads/2019/12/corte-suprema-rol-7610-2019.pdf> (accessed 2 November 2022).

[219] FCRA, *supra* note 73, art 43A(b).

[220] The guidance provided by NSDFA regarding the criteria for decision-making requires to highlight interactions between the farm and the ecological and social system "within the region of the proposed development" without specifying spatial scale. It should include activities in the area that may be affected by the proposed development. In interpreting criterion 3(a) of the *Aquaculture Licence and Lease Regulations, supra* note 72, (optimum use of marine resources), the Guidance focuses on integrated

interpreted and implemented by the NS Aquaculture Review Board remains to be seen. In turn, DFO has, since the amendment to the *Fisheries Act* in 2019,[221] an explicit mandate to assess cumulative impacts when exercising its powers for the conservation and protection of fish and fish habitat.[222]

It is beyond the scope of this Dissertation to undertake a systematic assessment on the extent to which licensing and permitting processes consider cumulative impacts, the scope of those assessments, and their knowledge base. Likely, the effective implementation of legislative requirements varies between States, within States, and in time. Nevertheless, the regulatory and technical tools supporting cumulative assessment and decision should be mentioned.

Effectively addressing cumulative impacts is a complex and knowledge-intensive matter and knowledge is not always available.[223] Simple regulatory tools have been

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assessment, noting that the criterion implies providing "a cohesive look at the overall picture of the development, its overall effects, impacts, and benefits. The optimum use of marine resources is the over-riding theme of all of the other factors to be considered in decisions on marine aquaculture operations" (NSDFA, "Guide for Finfish Marine Aquaculture Development Plans", online: NSDFA <https://novascotia.ca/fish/aquaculture/licensing-leasing/> (accessed 8 January 2023)).

[221] *Fisheries Act*, RSC, 1985, c F-14 (as amended), s 34.1(1)(d). DFO defines cumulative impact as "any cumulative harmful impacts on fish and fish habitat that are likely to result from the work, undertaking or activity in combination with other works, undertakings, or activities that have been or are being carried out." DFO further notes: "The consideration of cumulative effects provides a better understanding of the challenges to the aquatic ecosystem outside of the context of the reviews of specific works, undertakings, or activities. The Department is responsible for collecting the information needed to consider the cumulative effects of a proposed work, undertaking or activity" (C Murray, L Hannah and A Locke, *A Review of Cumulative Effects Research and Assessment in Fisheries and Oceans Canada*. Can. Tech. Rep. Fish. Aquat. Sci. 3357 (2020), at 18).

[222] DFO's most recent review of marine aquaculture applications in NS, within the network review, considers the assessment of cumulative impacts of human activity in the area of interest as well as an assessment of genetic interactions with wild salmon populations potentially affected by a site (DFO Maritimes Region, Science Review of the Proposed Marine Finfish Aquaculture Boundary Amendment and New Sites, Liverpool Bay, Queens County, Nova Scotia. DFO Can Sci Advis Sec Sci Resp 2022/039). Genetic interaction with wild Atlantic salmon considered threshold values of 4% and 10% of farmed fish in the rivers, based on academic literature and consistent with Norwegian regulatory thresholds. The NSARB had not held its adjudicative hearing for this application at the time of writing. It is also worth noting that DFO's advice provided just two years earlier did not assess cumulative impact "in detail" (DFO, DFO Maritimes Region Review of Proposed Marine Finfish Aquaculture Boundary Amendment, Rattling Beach, Digby County, Nova Scotia. DFO Can. Sci. Advis. Sec. Sci. Resp. 2020/015).

[223] J Kyrönviita et al, "Achieving Blue Growth Post-Weser: a Study of Aquaculture Regulation in the Nordic Region" (2021) 18 JEEPL 256, highlight the scientific challenges of assessing potential effects of single farms on ecological and chemical objectives. For scientific gaps, see eg: ICES, *Working Group on Environmental Interactions of Aquaculture (WGEIA)*. ICES Scientific Reports 2:112 (2020), online: ICES <http://doi.org/10.17895/ices.pub.7619> (accessed 14 July 2022). In the case of Chile, the designation of ecological quality standards (normas secundarias de calidad ambiental) lags behind, with only five standards adopted, all for inland waters. One ecological quality standard for the marine environment (V Region) is currently in elaboration (online: Ministerio del Medio Ambiente Planes y Normas:

adopted to mitigate cumulative impact in knowledge-limited environments, in particular requiring minimum distances between farms or the avoidance of overlapping depositional areas. Yet more sophisticated regulatory and technical tools are increasingly used in the aquaculture context, including sectoral and cross-sectoral instruments. Regulatory tools include: the Norwegian traffic light system adjusting production capacity based on risk of mortality of wild salmonids resulting from sea lice from fish farms; and the regulations implementing the WFD with the objective of preventing deterioration of coastal waters and achieving good ecological and chemical status.[224] Technical tools contributing to knowledge-based decisions include dispersion and deposition models (including for example the Scottish locational guidelines and proposed risk-based framework for sea lice interactions), the classification of salmon rivers based on conservation status,[225] or the aquaculture risk report developed by the Institute of Marine Research in Norway.[226]

A key feature of these tools is that they provide ecosystem-level information and define threshold for acceptable cumulative impact of proposed new (or amended) sites in the context of other existing or proposed sites and other anthropogenic activities in the

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<https://planesynormas.mma.gob.cl/normas/mostrarCategoria.php?tipo_norma=calidad> (accessed 23 December 2022).

[224] WFD, *supra* note 166, art 4. In the Weser case, the Court of Justice of the European Union ruled that these objectives are binding: an aquaculture facility cannot be consented or expanded if the new or expanded site will jeopardize the achievement of the WFD objectives or will result in deterioration of the chemical or ecological status (as defined by elements in Annex V of the WFD) unless a derogation is granted (ECJ *Bund v Germany*, C-461/13 [2015] ECR I-433). The implementation of the WFD and the Weser ruling to the aquaculture sector is not consistent among European countries (Kyrönviita et al, *supra* note 223). In the Norwegian context, the legal nature of the WFD is reportedly uncertain and "may become an issue for further discussion" but it forms a "very important framework and basis for sectoral policy and numerous decisions" (Bugge, *supra* note 39 at 145). Indeed, the ecological and chemical status of coastal waters have been considered as one factor in some decisions on permits under the Pollution Control Act or the Aquaculture Act. Two quality elements have been particularly important: the eutrophication status and the presence of copper in sediments.

[225] Eg Scottish assessment and classification of the status of inland salmon rivers under the *Conservation of Salmon (Scotland) Regulations 2016,* SSI 2016/115.

[226] See eg: Statsforvalteren i Vestland, [County Governor of Vestland], Løyve til utslepp for Sjøtroll Havbruk AS på lokaliteten 18898 Skaftå i Osterøy commune [Release permit for Sjøtroll Havbruk AS at location 18898 Skaftå in Osterøy municipality] reference 2019/9399 (18 May 2022); Statsforvalteren i Vestland, [County Governor of Vestland], Løyve til ny plassering av anlegg og avslag på søknad om auke i MTB på lokaliteten 12086 Alsåkervik i Kvinnherad commune [Permission for a new location of facilities and rejection of an application for an increase in MTB on location 12086 Alsåkervik in Kvinnherad municipality], reference 2019/7337 (4 October 2019), both online: Miljødirektoratet <https://www.norskeutslipp.no/no/Listesider/Virksomheter-med-utslippstillatelse/?SectorID=90> (accessed 2 November 2022). The county governor has an obligation to make decisions based on the best information available under the Nature Diversity Act, *supra* note 38, §8; this includes the classification of waters under the regulation implementing the WFD and the annual risk report of the Institute of Marine Research.

relevant area. Therefore, they can be understood as a concrete expression of the flexible, clear, specific and measurable rules[227] interpreting otherwise broad and integrative goals. These protection standards may be non-binding; in any case, the competent authorities are left with significant discretion on the weight that they should be given in particular decisions.[228] Nevertheless, they can guide decision-making processes while also increasing transparency and accountability.

The assessment of State practice also offers several examples of regulatory approaches to address far field and cumulative impacts during operation, including different forms of cooperative agreements to regulate operations or join responsibility schemes to address common problems. These can be broadly divided in four categories: extended monitoring obligations; fish health management areas; joint responsibility schemes; and area-based production capacity regulations.

a) Extended Monitoring

Monitoring the impacts of operations is an important component of all legal frameworks for aquaculture. The scope of monitoring requirements imposed to farmers varies, yet a distinct trend is the expansion of monitoring obligations to consider not only near field but also far field effects, sometimes through joint monitoring schemes. These expanded monitoring obligations are consistent with EAA requirements and also with the polluter pays principle.

The requirements for benthic monitoring provide a good example of these trends. While all legal frameworks consider monitoring of organic matter sedimentation in the area of most impact (below the cages), Norway and Scotland extend the monitoring to a transitional or mixing zone and require that at the outer edge of that zone the sediment achieves good ecological status (that is, a condition that deviates only slightly from those normally associated with the surface water body type under undisturbed conditions).[229] This extended monitoring, equivalent to allowable zone of effects, has long been

[227] See Chapter 3 note 164 and accompanying text.
[228] Under art 4(7) of the WFD, *supra* note 166, States can make exceptions to the otherwise biding objectives provided that conditions are met.
[229] WFD, *ibid*, Annex V, section 1.2 on Normative definitions of ecological status classifications.

recognized as a way to operationalize the focus on far field effects.[230] Yet the trend towards investigations of the wider area of impact of individual farms is relatively recent[231] and not implemented consistently across jurisdictions.

While the Chilean Aquaculture Environmental Regulations have a prescriptive and limited approach to benthic monitoring, the country provides a different example of expanding monitoring obligations under the general environmental objectives of articles 74 and 87 of the LGPA. Recent regulations require the implementation of mandatory real-time and online system (buoys) for the monitoring of water quality variables both at the site and at a distance of the site.[232] This latter measure can be implemented collaboratively by the operators in each neighborhood, providing one example of voluntary collective or joint measure at the watershed level.

Aside from regulatory monitoring obligations, flexible licensing mechanisms also allow imposing further monitoring requirements in the respective licenses or environmental impact assessments. While the Chilean licensing system is more rigid,[233] operators have sometimes included voluntary commitments in their EIA statements to address ecological concerns.[234] In other jurisdictions, applicable legislation provide discretion to authorities to attach monitoring conditions, including monitoring of far-field effects. The environmental management program as a condition of the planning permits issued pursuant the *Town and Country Planning (Scotland) Act 1997* is one such example. The Norwegian legislation further allows the imposition of proportionate financial contribution obligations to perform investigations.[235]

There is a question whether NS aquaculture legislation provides the authority to impose an extended monitoring requirement. Indeed, s 64(e) of the FCRA allows the Minister to make regulations "respecting the environmental monitoring, conservation and

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[230] Weitzman et al, *supra* note 170, at 197.
[231] It was included as a general and binding requirement in Norway only in 2016. Before, extended investigations were required at the discretion of the relevant authorities.
[232] DS N° 1 of 2020, issued by the Minister of Economy, establishing regulations for the real-time online monitoring of environmental parameters in aquaculture clusters [Aprueba Reglamento de Control en Línea de Parámetros Ambientales de las Agrupaciones de Concesiones de Acuicultura], in particular art 8. The monitoring program is being implemented in stages.
[233] Competent authorities do not have discretion to impose site-specific conditions, and monitoring (follow-up) programs in the context of EIA can only be included in the evaluations of environmental impact studies, which as a general rule are not required for salmon farming.
[234] Eg monitoring of marine mammals in the vicinity of the site.
[235] Aquaculture Act, *supra* note 48, § 11; Pollution Control Act, *supra* note 48, § 51.

protection of licensed or leased areas". The reference to monitoring "of licensed or leased areas" rather than monitoring of effects of authorized activities can be interpreted as restricting the spatial scope of monitoring requirements established by regulations, an interpretation that is not consistent with the principles of EAA.[236] A different interpretation can be supported on the basis of the broader discretion provided to the NSARB and the Administrator in deciding conditions for aquaculture leases and licences. Indeed, the NSARB and the Administrator can issue such leases and licences subject to any conditions they considered appropriate, necessary, or advisable.[237] Article 10 of the FCRA, authorizing the Minister to adopt quality objectives as well as procedures, practices and methods for monitoring and analysis, supports an interpretation allowing broader regulatory powers.

b) Fish Health Areas

A second group of "beyond the farm" measures comprise regulatory requirements for coordinated and synchronous biosecurity measures for all farms within an area, including in particular single-year stocking, coordinated treatment, and coordinated fallowing. Such measures are required to contain the outbreak of pathogens and parasites, provide effective treatment, and ensure that newly stocked salmonid is not going to be infected by persistent pathogens and parasites in the natural environment. It is a measure that responds, therefore, to a collective problem that arises from the mutual dependence of sites on good fish health status. They benefit the environment, the farmed fish, and the operators alike.

A key feature common in many fish health areas is their reliance on voluntary agreements by operators, backed by the enforcement powers and, in many cases, by default regulatory powers of the State.[238] Fish health areas (farm management areas) and

[236] It is worth reiterating that a similarly narrow wording in the Norwegian Aquaculture Act, § 11, was amended to include the authority to require environmental monitoring in the area of influence of the site (see Chapter 4, note 522).
[237] FCRA, *supra* note 73, 51(1)(b) and 58(2).
[238] Karkkainen addresses "regulatory penalty default rules" as a "gap-filling rule that intentionally imposes a harsher outcome than the parties themselves might prefer, thereby creating an incentive to contract around the default rule toward an explicit alternative term" (Bradley C Karkkainen, "Information-Forcing Regulation and Environmental Governance" in Gráinne de Búrca & Joanne Scott (eds), *Law and New Governance in the EU and US* (Oxford; Portland: Hart Publishing, 2006) 293).

coordinated fish health management agreements were implemented in Scotland through the industry Code of Good Practices in 2006.[239] Farm management agreements or statements were made later mandatory under the *Aquaculture and Fisheries (Scotland) Act 2013*. Direct agreements between farmers operating within an area to coordinate fallowing ("brakkleggingsgruppen" or fallow group) has also been the preferred approach in Norway. Nevertheless, the Fish Health Authority has the legal authority to require coordinated fallowing of all farms within an area.[240]

In Chile, coordinated management at the neighborhood level was introduced to address the infectious salmon anaemia crisis of 2007. The National Fisheries Service (SERNAPESCA) strictly regulates the production period and coordinated fallowing (3 months between periods) of all farms within a neighborhood.[241] The regulatory framework further promotes direct cooperative action between operators in the neighborhood (and adjacent neighborhoods) through the adoption of voluntary management plans. These plans can consider, for example, single-year stocking, extending fallowing (beyond the minimum mandatory fallowing per neighborhood), coordinated treatment, alternate use of sites, sites' configuration, segregated maritime routes, coordinated waste disposal, among others. The authority can enforce the commitments of the agreements but generally cannot impose these requirements directly if farmers fail to reach agreement.

NS has the legal tools to designate an area with multiple aquaculture sites as an aquaculture management area for the purpose of managing the health of aquatic animals.[242] Holders of leases in the management area are required to have a written agreement regarding fish health practices; the Minister has powers to approve the

[239] Disease Management Areas for the control of furunculosis were already in place in the early 1990s (Scottish Government, "Report of the SOAFD Annual Survey of Fish Farms for 1991", online: Scottish Government https://www.gov.scot/publications/scottish-fish-farm-production-surveys-1979-2010/ (accessed 23 October 2022)).
[240] See also: Norwegian Government "Aquaculture Strategy", *supra* note 165.
[241] The production period is 24 months in the X and XI Regions (which under certain conditions can be extended to 33 months), and 33 months in the XII Region (DS N° 319 of 2001, issued by the Minister of Economy, as amended [Fish Health Regulations], art 58G). During one production period, there can be only one production cycle of Atlantic salmon, and two production cycles of Coho salmon or Rainbow trout.
[242] *Aquaculture Management Regulations,* NS Reg 348/2015, as amended, *s* 16.

agreement, amend the agreement, or impose requirements directly if the licence holders fail to reach agreement.[243] The management areas are currently not in place.[244]

c) Joint Responsibility Scheme

The escapes of farmed salmonids represent a significant ecological and genetic risk to wild fish populations. All jurisdictions adopt preventative measures during siting and operations,[245] as well as contingency measures in case of breach of containment,[246] which may include recapture of escaped fish.[247] Presence of farmed fish in the wild is nevertheless common, either due to escape underreporting, loss of fish during routine operations, or poor success rate of escapees' recapture. Origin of salmon escapees often cannot be determined.[248] The presence of farmed salmon in the wild is therefore a problem of collective responsibility.

The Norwegian regulations have adopted a joint responsibility scheme that complements other preventative and mitigation measures and acts as a last "barrier" to prevent and reduce damage to wild salmon.[249] According to the scheme, the industry is required to establish and fund an organization tasked with planning and undertaking recapturing activities in rivers where farmed fish exceeds defined acceptable levels.[250]

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[243] *Ibid*, s 17. Agreements must include: shared procedures under their Fish Health Management Plans; coordinated treatments (where applicable); coordinated fallow periods; and communication protocols concerning all fish health issues of common concern.
[244] Nevertheless, in most cases farms in close proximity belong to the same company and therefore, coordinated management can be implemented directly through the farm management plans.
[245] These include following technical standards (eg NYTEK), having structures certified by professional engineers, and mandatory inspection and maintenance of infrastructure.
[246] These include reporting obligations, including number and size of escaped fish and fish health status.
[247] Recapture is required in Chile (for 30 days after the escape event) and Norway (within an area of 500m around the cages). NS requires to specify, in the containment section of the farm management plan, the responses to breaches but without explicitly requiring recapture. Recapture programs require federal approval. In Scotland, the recapture of escaped salmon requires agreement of the respective District Salmon Fishery Board. The Boards are associations of salmon fishing right owners and have the power and duty to protect and improve salmon and sea trout fisheries within legally-defined salmon fishery districts.
[248] In NS, the *Aquaculture Management Regulations*, *supra* note 242, s 15(h), require that the containment section of the farm management plan includes a finfish marking plan.
[249] Norwegian Government, *Strategy against escapes from aquaculture* (31 March 2017) [Strategi mot rømming fra akvakultur] online: Regjeringen <https://www.regjeringen.no/no/dokumenter/strategi-mot-rommingfra-akvakultur/id2547105/> (accessed 12 July 2022) at 13 [Google Translate].
[250] The association must consider planning measures to reduce the occurrence of escaped farmed fish in rivers where monitoring, using annual percentages or spawning fish counts, shows that the proportion of escaped farmed fish is 4% or more. In rivers where the proportion of escaped farmed fish is greater than 10%, recapture is required (Forskrift om fellesansvar for utfisking mv av rømt oppdrettsfisk (FOR-2015-

The risk of harm to wild salmon is therefore reduced by removing excessive farmed fish from affected rivers.

The scope of application and the outcome-oriented approach of these regulatory scheme (that is, its focus on the status of the ecosystem, as defined through an environmental quality standard and defined acceptability thresholds) align with the EAA and ecosystems and the law, more generally. It is also consistent with NASCO recommendations.

d) Area-based Production Capacity Regulations

Both Chile and Norway have adopted measures directed to address overall production capacity at the area level. In Chile, a complex indicator-based system that controls maximum farming density at the neighborhood level applies in parallel to a voluntary company-based scheme to reduce stocking of fish. Norway, in turn, adopted the traffic light system to determine production capacity adjustments based on an indicator of environmental sustainability at the area level (namely the risk of increased mortality of wild salmonids resulting from the aggregate impact of sea lice from fish farms in a production zone). Both will be analyzed with more detail in the next section as they also provide examples of adaptive management at the area level.

7.4. Adaptive and Flexible Management

7.4.1. Theory

Uncertainty is a key feature of complex and dynamic systems. We have limited capacity to understand (let alone model and control) ecosystems in the full complexity of their interactions and feedbacks at different spatial and temporal scales. Management with a focus on ecosystems requires principles, processes, and methods to deal with uncertainty. The precautionary approach and adaptive and flexible management are legal or policy tools to address complexity and uncertainty in social-ecological systems. The relationship between precautionary approach and adaptive management (AM) is not clear, however. Generally, the academic literature and jurisprudence have considered adaptive

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02-05-89) (as amended) [Regulations on joint responsibility for fishing, etc. of escaped farmed fish], §2 [Google Translate]).

management a form of, or means to implement, precaution;[251] or a mechanism to "offset" precaution (rather, the paralyzing effects of precaution).[252] Yet others consider that the concepts have a different area of influence: AM is an appropriate tool when risk is low (low risk of substantive and non-reversible damage); there is some degree of uncertainty; and the risk is controllable.[253]

AM is generally defined as a "decision-making process based on the structured and iterative implementation of management measures, with comprehensive monitoring of relevant system indicators, in the attempt to achieve specific management goals or objectives, reduce uncertainty, or increase knowledge about the system that an agency is charged with managing."[254] AM requires, therefore, that traditional front-end assessment procedures are supplemented with iterative decision-making processes.

There are different understandings of what AM is, its scope of influence, and how it can be implemented. A distinction between "active" and "passive" AM and AM lite speaks to these complexities. Further, adaptive management can operate at different levels in the environmental planning and management process. It can be discussed at the plan and programme level, "seeking to facilitate effective and legitimate regulation of

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[251] See, eg: Annecoos Wiersema, "Uncertainty, Precaution, and Adaptive Management in Wildlife Trade" (2015) 36 Mich J Int'l L 375; Bohman, considers AM as an "expression" of the precautionary principle (Brita Bohman, "The Ecosystem Approach as a Basis for Managerial Compliance: An Example from the Regulatory Development in the Baltic Sea Region" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Brill E-Book, 2019) 80 at 86.

[252] Miguel F Frohlich et al, "The relationship between adaptive management of social-ecological systems and law: a systematic review" (2018) 23 Ecology & Society 23; Neil Craik, "Implementing Adaptive Management in Deep Seabed Mining: Legal and Institutional Challenges" (2020) 114 Marine Policy 103256; IUCN, "Guidelines for Applying the Precautionary Principle to Biodiversity Conservation and Natural Resource Management", approved by the 67th meeting of the IUCN Council (14-16 May 2007), Principle 12.

[253] Robin Kundis Craig & JB Ruhl, "Designing Administrative Law for Adaptive Management" (2014) 67 Vanderbilt L Rev 1. New Zealand's Courts have defined the factors to be considered in the implementation of AM, which include: a) the extent of the environmental risk (including the gravity of the consequences if the risk is realised); (b) the degree of uncertainty; and (c) the extent to which an adaptive management approach will sufficiently diminish the risk and the uncertainty (*Sustain Our Sounds Incorporated v The New Zealand King Salmon Company Limited & Ors* SC 84/2013 [2014] NZSC 40, as cited by Craik, *supra* note 252).

[254] Craig & Ruhl, *supra* note 253, at 63. See also: Robin Kundis Craig et al, "A proposal for amending administrative law to facilitate adaptive management" (2017) 12 Environ Res Lett 074018. It should be mentioned that adaptive management and adaptive governance are related but different concepts. Adaptive management is a component of adaptive governance; adaptive governance is the "social context that facilitates adaptive management" (Brian Chaffin et al, "Transformative Environmental Governance" (2016) 41 Annu Rev Environ Resour 399-423).

[…] the environmental media";[255] or it can be discussed at the project level, "pertaining to the adaptivity of environmental impact assessments, licensing and its conditions, and monitoring".[256]

For AM to fulfill this role, certain elements must be required, or at least allowed, in legal frameworks.[257] First, an AM measure or plan should set reasonably certain and enforceable objectives, indicators and thresholds. This first requirement is necessary for the adequate implementation of the following steps of AM. Importantly, in defining objectives, indicators and thresholds, AM can contribute to the definition of "hard" substantive environmental law for the protection of ecosystem integrity and to the balance between flexibility and predictability or certainty.[258] Second, legal frameworks must establish a monitoring regime and a process for the evaluation of monitoring results. "Management cannot be adaptive if no one is paying attention to what is happening on the ground".[259] Third, the monitoring process should lead to a review and adjustment of measures or decisions adopted.[260] Thus, the responsible authorities must have the capacity to alter conditions of permits or management arrangements,[261] including withdrawal.[262] Fourth, the AM process should not be exempt from public participation and transparency requirements.[263]

7.4.2. International Law and Policy

There is no explicit legally binding requirement to implement AM in international law. Indeed, the term is alien to the legally binding international instruments analyzed in

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[255] Soininen & Platjouw, *supra* note 102, at 23.
[256] *Ibid.*
[257] Fischman notes: "Practitioners of adaptive management need new legal frameworks that force them to state measurable objectives for an action and to identify thresholds that will trigger specific responses to monitoring" (See: Robert L Fischman, "Letting Go of Stability: Resilience and Environmental Law" (2019) 94 Ind LJ 689).
[258] Platjouw, *supra* note 5, at 133-140.
[259] Wiersema, *supra* note 251, at 393.
[260] See, eg: Ebbesson, *supra* note 6; Jan McDonald & Megan C Styles, "Legal Strategies for Adaptive Management under Climate Change" (2014) 26 J Envtl L 25, at 37, 38; Martin ZP Olszynsk, "Adaptive Management in Canadian Environmental Assessment Law: Exploring Uses and Limitations" (2010) 21 J Envtl L & Prac 1, at 5.
[261] McDonald & Styles, *supra* note 260, at 48.
[262] Ebbesson, *supra* note 6, at 418.
[263] Craig & Ruhl, *supra* note 253.

Chapter 5.[264] Nevertheless, the interpretation of the substantive and procedural obligations of the LOSC and the CBD allows concluding that passive AM is implicit in their texts.

The LOSC, as was analyzed, contains a broad duty to protect and preserve the marine environment.[265] States shall take, individually or jointly as appropriate, all measures consistent with the Convention that are necessary to prevent, reduce and control pollution of the marine environment from any source,[266] including pollution resulting from the use of technologies under their jurisdiction or control,[267] and the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto.[268] These obligations do not only operate at the policy and plan level but at the level of individual projects. The LOSC considers a qualified obligation to undertake an EIA[269] but, more pointedly, to "keep under surveillance" the effects of any activities which they permit or in which they engage, in order to determine whether these activities are likely to pollute the marine environment.[270] Interpreted in a consistent and coherent manner, these provisions allow concluding that the LOSC requires States to adopt measures both for the assessment and the ongoing monitoring of a project to ensure that marine pollution and significant and harmful changes to the marine environment are not only prevented but also reduced and controlled. The general emphasis of the LOSC on scientific research[271] further emphasizes the imperative of ongoing science-based decision making.

The CBD, in turn, requires identifying processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and

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[264] Without mentioning AM explicitly, the Kyiv Protocol, *supra* note 118, art 12 on Monitoring, enshrines its main elements: monitoring the significant environmental effects of the implementation of the plans and programmes to identify, at an early stage, unforeseen adverse effects and to be able to undertake appropriate remedial action.
[265] LOSC *supra* note 14, art 192.
[266] *Ibid*, art 194, using the best practicable means at their disposal.
[267] *Ibid*, art 196.
[268] *Ibid*.
[269] *Ibid*, art 206.
[270] *Ibid*, art 204(2).
[271] *Ibid*, art 204(1) and Part XIII.

other techniques.[272] Similarly to the LOSC, the provision implies that activities must be subject to ongoing monitoring or surveillance, and that regulation and management measures will be taken when monitoring shows significant adverse effect on biological diversity.[273]

Despite the lack of recognition in constituent agreements, AM has a wide endorsement in soft law instruments. Under the umbrella of the CBD, the Malawi Principles highlight that the "ecosystem approach must utilize adaptive management in order to anticipate and cater for [ecosystem] changes and [surprise] events".[274] Further, AM has been called for in marine protected areas[275] and biodiversity-inclusive EIA.[276]

AM has also been called for the aquaculture sector in particular. While neither FAO's CCRF nor the Technical Guidelines on EAA make a reference to AM, the need to not only assess but also monitor aquaculture stressors and their effects on ecological features and related economic and social consequences is explicitly mentioned in both documents.[277] More recent assessments of EAA explicitly recognize AM as one of its key elements.[278] The sectoral relevance of the concept is clear in FAO's five principles of sustainable agriculture and four pillars for implementation, which highlight adaptability as an implementation requirement for sustainable agriculture.[279] At the regional level, AM is also explicitly called for in NASCO's Guidance on Best Management Practices in

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[272] CBD, *supra* note 19, art 7(c).
[273] *Ibid*, art 8(l).
[274] CBD, Decision VII/11, Principle 9. See also: CBD Secretariat, Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity (Montreal: CBD Secretariat, 2004), Principle 4 at 11-12.
[275] CBD, Decision VII/5 on Marine and coastal biological diversity adopted during the Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, 9-20 February 2004, Kuala Lumpur, Malaysia.
[276] Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment, Annex to Decision VIII/28 adopted by the Conference of the Parties at its Eighth Meeting held in Curitiba, Brazil, 20-31 March 2006, UNEP/CBD/COP/DEC/VIII/28 (15 June 2006), online: CBD https://www.cbd.int/meetings/COP-08 (access 3 March 2022).
[277] CCRF, *supra* note 108, art 9.1.5 calls on States to "establish effective procedures specific to aquaculture to undertake appropriate environmental assessment and monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities." FAO, EAA Technical Guidelines, supra note 1, at 28-29, 40-42.
[278] Cecile Brugère et al, "The ecosystem approach to aquaculture 10 years on: A critical review and consideration of its future role in blue growth" (2019) 11 Rev in Aquaculture 493.
[279] FAO, *Building a Common Vision for Sustainable Food and Agriculture* (Rome: FAO, 2014), online: FAO <https://www.fao.org/3/i3940e/i3940e.pdf > (accessed 12 May 2022).

particular reference to the impacts of sea lice and escaped farmed salmon on wild salmon stocks.[280]

7.4.3. Lessons From State Practice

The State practice on flexible and AM can be analyzed at different levels. At the policy and regulatory level, flexibility and adaptability are facilitated by a general approach to legislation that relies on subsidiary instruments (regulations or policies) for implementation, and the frequent regulatory and policy assessment processes.[281] This level of flexibility is reflected in the dynamism of the regulatory frameworks in all jurisdictions.

Flexibility and adaptability can also be assessed at the level of spatial planning instruments, as was mentioned in section 7.2. Two elements of adaptability and flexibility stood out: the periodic review of some planning instruments, and flexible consenting schemes that allow dispensations from general planning policies or instruments.

Flexibility and adaptability can also be analyzed at the development (farm) level, which is the focus of this section. Three different approaches to achieve flexibility and adaptability are discussed in more detail. First, licencing schemes have different mechanisms that facilitate context-specific and AM responses. Second, regulations implementing specific monitoring schemes with associated acceptability thresholds and management responses are discussed. Third, AM measures adopted at the area level are addressed in more detail.

a) Flexibility and Adaptability in the Licensing Schemes

The implementation of flexible AM requires flexible licensing terms and conditions and the opportunity and authority to alter or revoke them. Several tools for flexibility could be identified from State practice.

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[280] NASCO, Guidance on BMP, *supra* note 193.

[281] Jorge Bermúdez, "Legal Implications of an Ecosystem Approach to Aquaculture" in D Soto, J Aguilar-Manjarrez, N Hishamunda, N (eds), *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings* No 14 (Rome: FAO, 2008) 67 at 76. See also Ebbesson, *supra* note 6, at 418, addressing flexibility through framework laws setting open-textured rules, principles and goal-oriented norms.

One of the flexibility mechanisms included in legal frameworks is the use of supplementary documents to license or permits, which must be submitted periodically (in short intervals) and are reviewed and approved by authorities. Farm management plans by site (NS) or neighborhood (Chile), environmental management plans (Scotland), operation plans (Norway), biosecurity measures plans (Scotland), and contingency plans (Norway, Chile) allow operators and authorities to adjust operations to changing environmental or fish health conditions.

This flexibility is not necessarily joined with transparency, however, as these instruments are often confidential.[282] NS provides a glaring example of the tension between flexibility and transparency. In NS, the maximum allowed production or maximum biomass at a site is currently identified in the farm management plan, rather than the licence or lease. This practice provides great flexibility, both to the operator and the Administration, to adjust maximum production or biomass to the specific conditions of the site, based on its overall performance and monitoring results.[283] This flexibility includes, presumably, the opportunity to increase allowed biomass. The flexibility comes at the expense of transparency and accountability, however, as farm management plans are not public.[284]

A second tool to achieve flexibility and adaptability is the authority to alter or revoke licence terms and conditions. The legal frameworks in Norway and, to a lesser extent, Scotland provide significant discretion to authorities to vary or revoke permits. According to the Norwegian Aquaculture Act, an aquaculture licence permits the production of specific species in limited geographic areas "subject to the prescribed restrictions on the scope of the licence that apply at any given time".[285] The Minister has further the authority to amend or revoke aquaculture licences (including time-limited or

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[282] See Craig & Ruhl, *supra* note 253.

[283] A licence and lease holder must prepare a Farm Management Plan and submit it to the Minister for approval before the initial stocking; the health section of the Farm Management Plan must be updated every year. The operator must adhere to the Plan, including by keeping records to demonstrate that its procedures have been followed and that action was taken at critical control points. The Minister has the authority to require amendments to the document and to audit it. The *Aquaculture Management Regulations*, *supra* note 242, do not prescribe additional procedural requirements for the Plan's approval.

[284] Freedom of Information Requests for farm management plans have been denied under the *Freedom of Information and Protection of Privacy Act,* SNS 1993, c 5 (as amended) s 7(2)(b), on the basis that NSDFA "does not have custody or control of the records" (See: FOIPOP Application 2018-065335-FIS, online NS Government <https://openinformation.novascotia.ca/> (accessed 19 September 2022)).

[285] Aquaculture Act, *supra* note 48, § 5.

contingent amendment or revocations[286]) on several grounds. Two of these grounds are particularly relevant. The Minister can amend or withdraw an aquaculture license if it is "necessary due to environmental considerations" and if there are "changes in any material assumptions underlying the licence".[287] These grounds are not linked to contraventions to license conditions or regulations.[288] With the limitations that the Norwegian administrative legal system imposes to administrative decisions,[289] this broad authority allows for the adaptation of aquaculture developments to changing environment and for the prioritization of environmental protection over the individual rights afforded under an aquaculture license.

The licence can also be withdrawn when other required sectoral permits have lapsed.[290] The authority to amend or revoke those permits is therefore also relevant. The authority to alter or rescind permits under the Pollution Control Act is similarly broad and not linked to the contraventions to license conditions. Indeed, a permit can be altered, including to impose new conditions, or rescinded if the damage or nuisance caused by pollution proves to be significantly greater than or different from that anticipated when the permit was issued. Further, it can be altered or rescinded when the damage or nuisance can be reduced without unreasonable cost to the polluter or when new technology makes substantial reduction of pollution possible.[291] The flexibility afforded to the county governor, therefore, allows the adjustment of permits to new and changing environmental conditions or technological innovations.

The discretion to regulate the use, to vary, or to revoke licenses has been exercised on several occasions. The temporary reduction of MAB for production licenses

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[286] *Ibid*, § 9 (as amended).
[287] *Ibid*, § 9(a) and (b).
[288] *Ibid*, § 9(c) and (d).
[289] See: Bugge, *supra* note 39, at 29-31 and 373ff. At 374, Bugge notes that in making decisions, the authority must respect the wording of the authorizing rule and certain general principles and limitations: the authority must assess and consider all relevant issues, the decision cannot be blatantly unreasonable or discriminatory. Whether the principle of proportionality also applies is currently debated.
[290] Aquaculture Act, *supra* note 48, § 9(e).
[291] Pollution Control Act, *supra* note 48, § 18. It is also worth noting that, according to this provision, the permit may be altered or withdraw if it is more than 10 years since it was issued. The alteration or withdrawal of a permit needs to consider the costs involved for the polluter as well as other advantages or disadvantages of the decision. The discretion to alter a permit when new technology makes substantial reduction of pollution possible is linked to the principle of environmentally sound techniques and methods of operations (generally associated to Best Available Technology) endorsed in the Nature Diversity Act, *supra* note 38, § 12 and in the Pollution Control Act, 2(3). See also Bugge, *supra* note 39, at 77.

located in red zones under the traffic light system is one example of regulatory restrictions of licence conditions, and its validity was upheld by the Norwegian Courts.[292] In another case, a pollution permit issued under the Pollution Control Act was withdrawn because sensitive corals were discovered in the area of influence of the project after the permit had been issued. In this case, too, the court upheld the withdrawal.[293]

In Scotland, each of the licenses required for marine fish farming has its own rules for duration, conditions, amendment, and revocation. The two key permits addressing location and production are the planning permit issued by local authorities and the SEPA CAR permit.[294] The planning permissions, once granted, are permanent.[295] SEPA, however, has ample authority to review, amend (vary), suspend, and revoke CAR permits.[296] The specific grounds for the exercise of this authority are not specified in the Regulations, however. Further, the revocation authority has reportedly not been exercised.[297]

The NS legislation operationalizes flexibility in the licensing scheme through different legal approaches. While the FCRA does not address the authority to vary a

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[292] Sogn og Fjordane tingrett TSOFT-2020-109859; Gulating lagmannsrett – LG-2021-80234; Bjørn Hersoug, "'One country, ten systems': The use of different licensing systems in Norwegian aquaculture" (2022) 137 Marine Policy 104902, at 5; Vince McDonagh, "Traffic light dispute goes to Norway's Supreme Court" (21 May 2022), online: Fish Farmer <https://www.fishfarmermagazine.com/news/traffic-light-dispute-goes-to-norways-supreme-court/> (accessed 12 July 2022); Vince McDonagh, "Traffic light farmers denied Supreme Court appeal" (26 August 2022), Fish Farmer <https://www.fishfarmermagazine.com/news/traffic-light-farmers-denied-supreme-court-appeal/> (accessed 15 December 2022).

[293] Hordaland tingrett THOD-2020-168236 (20-168236TVI-THOD/1) (22 February 2022), online: Lovdata <https://lovdata.no/> (accessed 15 December 2022). The case is under appeal. Another aspect of the case is worth noting. The plaintiffs argued that the uncertain interactions between the farm and the newly discovered corals could have been subject to additional monitoring obligations and, if appropriate, mitigation measures (thus, an adaptive management approach). The defendants argued, and the Court agreed, that although there was uncertainty on the degree of interaction, the impact to corals, and the sensitivity of corals, there were sufficient indications based on scientific evidence that the impacts on the unique corals may be significant and potentially irreversible. Thus, the precautionary approach should apply.

[294] The lease issued by the Crown Estate Scotland is also relevant; however, the Crown Estate is not a regulatory agency. Leases on Crown land are usually issued for 25 years.

[295] Slater, *supra* note 147, at 422; Schütz & Slater, *supra* note 142, at 7. The inadequacy of a terrestrial planning system applied in the coastal waters was represented to the Parliament during the salmon farming review (written submission from Scottish Wildlife Trust to the Rural Economy and Connectivity Committee, Scottish Parliament).

[296] *The Water Environment (Controlled Activities)(Scotland) Regulations 2011*, SSI 2011/209, s 21, 22 and 29.

[297] The Scottish Parliament, Rural Economy and Connectivity Committee, "Salmon Farming in Scotland" SP Paper 432, 9th Report (Session 5) (27 November 2018) para 505 at 113. This was stated in evidence in the parliamentary review of salmon farming in 2018.

license or lease ex officio, the *Aquaculture Licence and Lease Regulations* allow the Administrator to vary a license based on the results of a performance review that must be undertaken at designated times.[298] The FCRA and the *Aquaculture Licence and Lease Regulations* provide authority to revoke a license or lease only on limited grounds related to contraventions to the license conditions or regulations.[299] However, and unlike the Norwegian and Scottish case, license and leases are time-limited although they can be renewed under a simplified administrative procedure. The NS Aquaculture Administrator has therefore the opportunity to revise the licence and its conditions every 10 years (lease every 20 years), vary its conditions, or not renew it. To this end, it must take into consideration a formal (but generally not public)[300] performance review and submit the application to public consultation.[301]

The Chilean licensing system, in turn, does not have any of the flexibility mechanisms of other jurisdictions. The LGPA explicitly states that the lease allows to undertake aquaculture activities with respect to the species or group of species identified in the respective decision with no other restrictions than those imposed by the LGPA, or regulations adopted under it.[302] The environmental decision issued by the regional evaluation commission also does not consider the option of including site-specific monitoring obligations or follow-up plan or to amend the environmental decision, as most finfish farms are assessed via an environmental statement rather than a study.[303] It follows, therefore, that adaptive responses are not tailored to site-specific conditions but

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[298] *Aquaculture Licence and Lease Regulations*, *supra* note 72, ss 73(2). The performance review is required in support of certain applications, but also following the first production cycle as determined in the initial issuance of a license and any time the Minister considers it necessary (*ibid*, s 72).
[299] FCRA, *supra* note 73, s 59A.
[300] Performance reviews are not published in a proactive manner. Freedom of Information Requests have been granted under the *Freedom of Information and Protection of Privacy Act,* SNS 1993, c 5 (as amended) s 7(2)(b) and redacted documents have been provided (See: NS Government, Freedom of Information and Protection of Privacy Application 2019-08984-FIS, online NS Government <https://openinformation.novascotia.ca/> (accessed 19 September 2022).
[301] The *Aquaculture Lease and License Regulations* consider consultations with provincial and federal authorities as part of the general process for decisions adopted by the Administrator. The NSDFA has not considered this requirement to apply to applications to renew licenses or leases (NS Government, Freedom of Information Application, *supra* note 300).
[302] LGPA, *supra* note 27, art 69.
[303] Act 19300 of 1994, Ley sobre Bases Generales del Medio Ambiente (as amended) [hereinafter Framework Environmental Act], art 12; Reglamento del Sistema de Evaluación de Impacto Ambiental, DS N° 40 de 2012, del Ministerio del Medio Ambiente [Regulations on the Environmental Impact Assessment System, as amended], art 18. See also: General Auditor, Opinion 3811 of 2017.

must be established in regulations adopted under legal authority, and in particular the Fish Health Regulations (under article 86) and the Aquaculture Environmental Regulations (under article 87).

The option to revoke a lease (the majority issued for indefinite period of time[304]) is also limited. Under article 142 of the LGPA, a lease can only be revoked under defined grounds, the majority of which involve a contravention to the terms of the licence or regulatory requirements.[305] Only in exceptional cases, poor environmental or biosecurity performance may lead to the revocation of a lease.[306] The limited powers of the government agencies to review, alter, and withdraw existing licenses, together with the lack of available space due to the legal and practical difficulties in designating new AAAs, has left both the industry and the authority with limited opportunities to adapt to unsustainable, new, or changing environmental circumstances.

b) Adaptive Management in Regulations

Monitoring the effects of aquaculture on the broader ecological system is an important component of all regulatory frameworks, with government-supported monitoring programs[307] as well as monitoring obligations for licence holders consistent with the polluter-pays principle. The scope of these monitoring programs and obligations in each case study varies. In some cases, monitoring obligations are joined by the other elements required for the implementation of AM: defined acceptability thresholds, mandatory mitigation measures or responses when thresholds are exceeded, and transparent information. The monitoring obligations, availability of thresholds, and mitigation measures identified in Chapter 6 are summarized in Table 5.

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[304] Leases issued before the time limit of 25 years was introduced in 2010 were grandfathered.
[305] In 2022, the Environmental Superintendency revoked the EIA approval issued for three salmon farms in the XII Region. The operator (the Norwegian company Nova Austral) infringed the terms of the environmental decision (in particular production limits), causing damage to a protected area (National Park Alberto de Agostini). This is the first time EIA decisions have been revoked. The measure is under judicial review in the Third Environmental Tribunal. See: SMA <https://portal.sma.gob.cl/> (accessed 9 November 2022).
[306] LGPA, *supra* note 27, art 142 k), m) and n).
[307] Some examples of government funded monitoring include: monitoring of farmed fish in rivers (Norway); monitoring of sea lice abundance in wild salmonid smolt (Norway); monitoring and management program for harmful algal blooms (Chile); essential ocean variables (temperature, dissolved oxygen, and intermittent salinity measurements) in coastal waters (NS-CMAR); genetic introgression studies (Norway, Scotland).

The information on Table 5 deserves a few general comments. First, there is a relatively low uptake of AM approaches (more precisely, adaptive management approaches that satisfy transparency requirements). This finding is consistent with the academic literature identifying post-consent monitoring as a shortcoming in aquaculture management.[308]

Second, AM approaches have been implemented at the site and area level. At the site level, all jurisdictions have adopted AM measures for two salmon mariculture pressures: organic particulate matter and sea lice.[309] These pressures can be directly linked to a particular facility and its impacts are relatively well understood. Therefore, this mode of AM (and particularly AM as applied to benthic monitoring) can be considered to be "focused on limiting operational uncertainty, effectively seeking to ensure compliance with predicted outcomes".[310]

Mitigation responses are in some cases prescriptive. For example, exceeding (soft bottom) benthic impact thresholds below the cages requires that the site fallows until benthic conditions recover.[311] In other cases, however, mitigation responses are flexible and at the discretion of the competent authorities. Norwegian benthic monitoring in the extended area of impact (the transition zone) provides perhaps the clearest example of a flexible response. An unacceptable C-test triggers the need to undertake further investigations to determine the cause and extent of the negative effect and appropriate mitigation measures.[312] Flexible adaptive responses are better suited to address complex ecological issues and the uncertainties on anthropogenic pressure, mitigation measures,

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[308] Clara McGhee, Lynne Falconer & Trevor Telfer, "What does 'beyond compliance' look like for the Scottish salmon aquaculture industry?" (2019) 109 Marine Policy 103668, at 4; Quiñones et al, *supra* note 154. Note, however, that the environmental management plan attached to the planning consents (Scotland) includes monitoring obligations and has been considered adaptive. Nevertheless, it was not included in Table 5 because the environmental management plans do not have transparent thresholds and associated management responses if the thresholds are exceeded.

[309] NS salmon lice protocols are contained in the Farm Management Plan, however, and are not public. Metals (copper) and chemicals (medicine) are only included in a few monitoring protocols and AM measures.

[310] See Craik, *supra* note 252, at 7, and Chapter 3 note 126 and accompanying text.

[311] In Chile, Aquaculture Environmental Regulations, *supra* note 154, art 19 and Order 3612 of 2009 issued by SUBPESCA (as amended) (Order under the Aquaculture Environmental Regulations) s 31; in Canada (federal), *Aquaculture Activities Regulations*, SOR/2015-177, s 10(1)(c) and 11(2); in Norway, Aquaculture Operations Regulations s 36, although in this case, the measure is adopted at the discretion of the fisheries and environmental authorities (Fisheries Directorate in consultation with the County Governor).

[312] NS9410:2016 (unofficial) (on file with the author) [Google Translate].

and system responses.[313] They resemble the "managerial compliance" described by Bohman and presented as a solution "to issues that have resisted regulation through the more traditional law-making processes".[314] Nevertheless, managerial compliance can suffer from lack of transparency and accountability.[315]

c) Area-based Adaptive Production Capacity Limits

Two jurisdictions, Chile and Norway, have adopted adaptive management measures that operate at the area level: the Chilean "neighborhoods" and the Norwegian "traffic light system" in production zones. Both models have *prima facie* some similarities. In both cases the systems consider the use of specific indicators and defined thresholds to adjust production capacity (or a proxy) within a defined area. In both cases, the model was introduced to address negative effects driven by the number, proximity, and farming density of farms within an area. Norway's white paper explicitly noted that, even if each individual location is operated within acceptable limits in isolation, the overall environmental burden in an area could be so great that the environment's carrying capacity is exceeded.[316] The ecosystem approach enshrined in the Nature Diversity Act, §10, was explicitly mentioned in relation to the overall load of sites within a production zone.[317] In the case of Chile, the connectivity of farms within an area and its impacts on the spread and prevalence of disease pathogens was the main driver of legislative

[313] Bohman, *supra* note 251, at 107, 110. Bohman argues that a managerial compliance model "seems to bridge many of the uncertainties arising from the regulatory structure and the complex environmental factors it seeks to address" (at 110).
[314] *Ibid*, at 108. Bohman addresses the managerial compliance model in the context of transboundary settings and describes it as a solution not only for addressing the complexities of ecosystems but also the consensual decision-making of international law.
[315] In Scotland, SEPA's strengthened framework committed to a non-negotiable compliance in part due to concerns that it had "not been performing well in monitoring the environmental performance of the industry or in enforcing the regulations which relate to its responsibilities" (The Scottish Parliament, "Salmon Farming in Scotland" *supra* note 297, at 17, 114. See also: Chapter 3 note 159 and accompanying text.
[316] Norwegian Government, White Paper 16 (2014-2015), "Predictable and environmentally sustainable growth in Norwegian salmon and trout farming", [Meld St 16 (2014-2015) Forutsigbar og miljømessig bærekraftig vekst i norsk lakse- og ørretoppdrett] [Google Translate] [hereinafter White Paper 16] para 2.2. See also: Norwegian Ministry of Trade, Industry and Fisheries, "Norwegian salmon farming: predictable and environmentally sustainable growth" (2015), online: Regjeringen <https://www.regjeringen.no/contentassets/e16872de15804dbb9a94261042f29245/havbruk_handout.pdf> (accessed 5 November 2022).
[317] *Ibid*.

amendments.[318] In sum, in both cases there was an explicit recognition that management at site level was not sufficient, and that some environmental interactions of aquaculture needed to be addressed cumulatively or collectively, at the area-level.

There are, however, significant differences between the two models. First, the measures address very different concerns. In Norway, the overall objective is to adjust production capacity to the carrying capacity of the environment, while the immediate objective is to reduce risk of salmon lice infection in wild populations of salmonids. In Chile, the concern addressed is fish health, the impacts of fish health on the farming industry, and the consequent wider social and economic impacts.[319]

This difference is reflected in the indicators and thresholds selected in each case. In Norway, the indicator and thresholds address an ecosystem-level impact. As noted in the White Paper that introduced the measure to the Norwegian Parliament, it is nature that sets the condition for aquaculture operations;[320] and the function and productivity of nature must be preserved.[321]

In the case of Chile, the chosen indicators are related to farm operations, in particular fish loss.[322] There is an indirect relationship between the farm operations and the potential impacts on the environment: low levels of fish loss could partially reflect good management practices and good environmental conditions. As noted in the NS Independent Aquaculture Review, fish health is one of the first signs of problems in

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[318] Mensaje Presidencial [Presidential Motion], 8 January 2009, in Biblioteca del Congreso Nacional, Historia de la Ley N° 20434, online: BCN <https://www.bcn.cl/portal/> (accesed 4 November 2022).
[319] Jessica Fuentes Olmos & Cecilia Engler, "Three pillars for sustainable marine aquaculture: the evolving regulatory framework in Chile" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA: Edward Elgar, 2016) 213, at 224.
[320] White Paper 16, *supra* note 316, at 8.
[321] White Paper 16, *supra* note 316, at 18. Reference was made, in this regard, to the need to preserve natures' function and productivity as a basis for safeguarding the opportunities for future generations to satisfy their needs. See also: Norwegian Constitution, art 112.
[322] See: Fish Health Regulations, *supra* note 241, art 58Ñ. In the case of alternative voluntary arrangement (the stocking reduction plan), the percentage of required stocking reduction is also determined based on operational indicators: fish loss, sea lice treatment, and antibiotic use. It is worth noting that the Norwegian white paper briefly addressed the suitability of fish loss as one indicator, dismissing it because research by the Institute of Marine Research concluded that there is no close connection between production loss or waste and the size of the biomass in an area. Further, fish loss (as well as other impacts) was considered a production problem and not a problem for the environment around the facilities.

farming conditions.[323] Nevertheless, the status of, or impacts on, ecosystems are not directly monitored in the Chilean neighborhood model.

The lack of attention to ecosystem status and ecosystem carrying capacity was noted during the discussion of the bill leading to the LGPA 2010 amendment, and several proposals to link the barrios to environmental carrying capacity at the watershed level were made.[324] The final uptake of these proposals was rather modest, however. Article 87 of the LGPA was amended to include the term environmental carrying capacity as one element of environmental regulations.[325]

Another important difference between the two models refers to the means of adjusting production conditions in the area. In the case of Norway, the system builds on an existing tool that (indirectly[326]) controls production: the production permits issued at the discretion of the Minister in irregular rounds, and its associated MAB limit. Thus, the structure of the Norwegian aquaculture license system (including the two-stage licensing structure (production and site permit) and the government discretion in issuing new production licenses) facilitated production capacity controls at the area level.

In the case of Chile, the licensing system and production controls are site-specific, and the LGPA did not provide any direct or indirect tool to control production at the area level. While in 2010 the legislator had an opportunity to introduce stronger controls, the amendment to the LGPA simply consolidated measures previously adopted by regulation on uncertain legal authority (namely the neighborhoods, coordinated biosecurity measures, and farming density controls).[327] Farming density controls, however, do not limit production or total biomass in the neighborhood. The full authorized production can be utilized by increasing the number of farming structures, an alternative only limited by lack of available space within the leased area and by increased costs.

The different approaches adopted in both jurisdictions are further evident in the exception rules. Both Norway and Chile consider an exception to mandatory production

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[323] NS, Independent Aquaculture Review, *supra* note 65, at 61, notes: "It was suggested to us on a number of occasions that ensuring the health of farmed fish is the very best way to avoid, eliminate or reduce the environmental impacts of fin-fish aquaculture that give rise to the greatest concern."
[324] History of Act 20434, eg at 390, 403, 424, 446-448, 537-541, 552-556, 789, 803-804, 815, 980.
[325] Act 20434, art 1(23)(a) amending article 87 of the LGPA.
[326] While MAB is not equivalent to production, it is foreseen that as permits are fully utilized, red zones will therefore reduce production.
[327] Fuentes & Engler, *supra* note 319, at 227.

capacity adjustment based on individual (i.e. site-specific) performance: the site does not contribute to the environmental problem (Norway) or does have exceptional operational indicators (Chile). The underlying reason for the exception is the same: resolve what was perceived as unfair "collective punishment", that is, holding a site (rather, the operator of a site) responsible for the conduct of others, or for an impact to which it has not contributed.

The Chilean system offers a second exception, however, that has turned into a completely independent and preferred regime: voluntary company-based stocking reduction programs. The stocking reduction program does not apply at the neighborhood level, however; a further disconnection from ecosystems and their ecological carrying capacity.

The Norwegian traffic light system has been criticized for over-simplification of ecosystem impacts, lack of precaution,[328] and being too complex. Yet it is the most developed model for adaptive production controls based on the state of the ecological system. It builds on several of the premises of an EAA and particularly Principle 1: it is area-based, it focuses on relevant (but limited) ecological components, it defines specific objectives and indicators, it is adaptive, and seeks to ensure that salmon farming production is compatible with what the environment can tolerate. The inclusion of further indicators of environmental sustainability, a Government commitment, may bring it closer to a model fully consistent with Principle 1 of EAA.

The Chilean model, while adaptive, is not ecosystem-based. Nevertheless, the legal framework has several structural elements that can serve as the foundation for the design of a regulatory framework that is aligned with ecosystem approaches. These include the nested spatial areas (region, macrozone, neighborhood, farm) and the extensive use of indicators to adjust allowed farming density or stocking at the site, neighborhood, and company level.

[328] Schütz & Slater, *supra* note 142, at 6 citing OK Fauchald, Juridisk utredning angående produksjonsområdeforskriften og kvalitetsnormen for villaks, til Norske Lakseelver, 4 November 2017.

7.5. Concluding Remarks

The previous sections addressed four specific questions to assess the extent to which the legal frameworks of four key salmon producing jurisdictions reflect the law and policy coordinates that facilitate the implementation of an EAA. The questions that follow, then, are: do legal frameworks have the elements (design features) that can support an EAA? And is EAA implemented? These are related but distinct questions; as noted in Chapter 1, legal design alone does not lead to effective EAA implementation. This Dissertation focuses on legal design: the enabling legal framework for EAA. However, the assessment in Chapters 6 and 7 can also shed some light on progress and challenges in actual implementation of EA to salmon mariculture planning and management.

The assessment of the four specific questions allows to conclude that the legal frameworks for salmon mariculture reflect the law and policy coordinates identified in this Dissertation to different extents. It also allows to conclude that persisting legal, scientific and technological challenges continue to hinder the full implementation of an EAA in all jurisdictions. Three other findings are perhaps more relevant and encouraging: there is a clearly stated need to transition to regulatory approaches consistent with EAA; there are distinct regulatory reform initiatives to align legal frameworks with the law and policy coordinates identified in this Dissertation; and there are examples of regulatory innovations that have addressed the challenges of managing salmon mariculture in the context of the wider ecosystems. It is worth summarizing those key trends, as well as persisting challenges and limitations.

A first aspect assessed in this Chapter is whether legal or policy frameworks explicitly endorse EA as a concept of relevance for aquaculture planning and management. This endorsement was observed in all jurisdictions studied, with the qualified exception of NS,[329] either in sectoral legislation (Chile, Canada - federal)[330] or policy instruments[331], or non-sectoral legal and policy instruments addressing

[329] The exception is qualified in two main ways: first, DFO is entitled to implement an EA in making decisions applicable to the aquaculture industry as may be necessary for the protection of fish and fish habitat (under the *Fisheries Act*) or aquatic species at risk and their critical habitat (under the *Species at Risk Act*). Second, the goals of the FCRA are consistent with at least some dimensions of EA.
[330] LGPA, *supra* note 27, art 1B and 1C.
[331] Eg: SUBPESCA institutional mission, National Ocean Policy, National Biodiversity Strategy (Chile, *supra* note 31 and 35); DFO's policies and vision (*supra* note 82).

conservation and sustainable use of biological diversity,[332] integrated river basin management,[333] and marine planning[334] (Scotland and Norway).

The relevant legal and policy instruments provide different definitions (or in some cases, no definition) of EA. In some definitions, the EA is linked to the integrated planning and management of aquaculture in the context of different economic, social, and ecological objectives. The recognition of different objectives, and need to balance them, is implicit in the emphasis given to sustainable use,[335] cultural and social needs,[336] and the need to consider public involvement in decision-making.[337] This conceptualization is consistent with Principle 2 and 3 of the EAA as defined by FAO, as well as with EA understood as an integrative and participatory decision-making process (a "social process"[338]). Definitions of EA also consider assessing and considering cumulative impacts or overall load on the environment,[339] and ensuring that aquaculture interactions with the environment do not exceed environmental limits[340] (sometimes defined through ecological objectives[341]) or carrying capacity.[342] These conceptualizations of EA emphasize ecological processes and outcome-oriented goals[343] related to the need to

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[332] *Nature Conservation (Scotland) Act 2004,* 2004 asp 6; Scottish Government, 2020 Challenge for Scotland's Biodiversity, *supra* note 53; Nature Diversity Act (Norway), *supra* note 38, §10.
[333] Norwegian Government, "Protecting the Riches of the Sea"*, supra* note 49; Act of 24 November 2000 No 82 on Watercourses and Groundwater (Water Resources Act) [Lov om vassdrag og grunnvann (vannressursloven); *Water Environment and Water Services (Scotland) Act 2003,* 2003 asp 3, and *Water Environment (Controlled Activities)(Scotland) Regulations* 2011, SSI 2011/209.
[334] *Marine (Scotland) Act 2010,* 2010 asp 5, and Scottish Government, "Scotland's National Marine Plan", *supra* note 56; Norwegian Government, "Protecting the Riches of the Sea"*, supra* note 49.
[335] Scottish Government, 2020 Challenge for Scotland's Biodiversity, *supra* note 53, ch 1 on Healthy Ecosystems at 13.
[336] *Ibid*, at 8 and 13
[337] *Ibid.*
[338] Morgera, *supra* note 16, at 73. She adds: "[The EA] entails the need to understand and factor in societal choices, the rights and interests of indigenous peoples and the local communities, and intrinsic as well as tangible and intangible values attached to biodiversity, ultimately leading to a balance between local interests and the wider public interest" (*ibid*).
[339] Norway's Nature Diversity Act, *supra* note 38, § 10, Scottish Government, "Scotland's National Marine Plan", *supra* note 56.
[340] Scottish Government, "Scotland's National Marine Plan", *supra* note 56.
[341] *Ibid*, at 12; Norwegian Government, *Protecting the Riches of the Sea, supra* note 49.
[342] LGPA, *supra* note 27, art 87; Scottish Government, "Scotland's National Marine Plan", *supra* note 56, section 7 on Aquaculture at 49, defining carrying capacity as "the potential maximum production a species or population can maintain in relation to available food resources, or other environmental limit, within an area" (*ibid* at 132).
[343] Craig Anthony (Tony) Arnold, "Fourth-Generation Environmental Law: Integrationist and Multimodal" (2010-2011) 35 Wm & Mary Envtl L & Pol'y Rev 771. See chapter 3, note 5864 and accompanying text.

maintain ecosystem structure, processes and productivity[344] or ecosystem balance.[345] They are, therefore, closely aligned to the "hard [environmental] law" advocated as necessary for the protection of ecosystem integrity.[346] They are also consistent with Principle 1 of the EAA as defined by FAO. Nevertheless, even definitions that emphasize ecological content are still receptive to the need to integrate and balance different societal objectives.[347]

The different definitions of EA(A) confirm earlier findings that the concept (generally and as applied to aquaculture) is multidimensional and complex and cannot be reduced to a single rule or norm. However, this multidimensionality and complexity remains a challenge for its practical implementation. Indeed, no jurisdiction has elaborated, in a comprehensive manner, on the specific meaning of EA for aquaculture planning and management or on the process, standards, or requirements for its operationalization. Thus, simply embedding the EA as a principle guiding decision-making does not, in itself, promote its actual implementation.[348] Procedural requirements, such as the need to justify how the EA was considered in decision making,[349] may contribute to defining the implications of an EA in particular contexts and therefore promote both actual implementation and transparency.

The Chapter further explores how legal frameworks for salmon mariculture reflect the law and policy coordinates that facilitate the implementation of an EAA understood as a social process. For this purpose, it assesses the use of spatial planning and aquaculture zoning as a main (but not only[350]) regulatory mechanisms for the holistic

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[344] Norway's Constitution, § 112 and Nature Diversity Act, *supra* note 38, §4. Platjouw considers the provision in the Nature Diversity Act as an overarching goal that does not apply directly to individual decisions and actions (Platjouw, *supra* note 5, at 161).
[345] Chilean LGPA, *supra* note 27, art 74.
[346] Platjouw, *supra* note 5, at 135.
[347] Eg Norway's Nature Diversity Act, *supra* note 38, §14.
[348] The Chilean aquaculture planning and management regime is a case in point. Despite the commitment and (arguably) the legal obligation (as introduced in the 2013 amendment to the LGPA) to implement EAA, the Chilean government has not taken steps to clarify how it will implement it for the aquaculture sector. DFO's (Canada) efforts to define EA is another example.
[349] This is required under the Nature Diversity Act, *supra* note 38, § 7 (Norway). However, it should be noted that the EA in § 10 of the Act refers to only one of the dimensions of EA identified in this Dissertations (total load on the environment).
[350] The balancing of economic, social objectives and interests is also relevant in other stages of the aquaculture planning and management process, including individual site decisions (eg Norwegian Aquaculture Act, *supra* note 48, §§ 6, 16; NS FCRA, *supra* note 73, and *Aquaculture Licence and Lease Regulations*, *supra* note 72, s 3; Scottish *Town and Country Planning (Scotland) Act 1997* (as amended)

consideration and balancing of different ecological, social and economic objectives and coordination of multiple uses of the common marine environment at appropriate spatial scales.

All jurisdictions assessed consider aquaculture planning or zoning instruments although with differing characteristics. Norway and Chile have implemented spatial planning (zoning) instruments. Scotland has implemented a criteria-based planning system; its local development plans or aquaculture frameworks enunciate the criteria that will be considered for the assessment of individual planning permits. In some cases, these are joined by spatially defined restrictions. NS has not yet implemented area planning and continues assessments on a site-by-site basis, although ongoing initiatives may represent a shift in aquaculture planning practices in the province.

Some forms of planning remain mostly centralized and technical (Chile, NS), with rigid effects (Chile) and limited public participation opportunities (Chile, NS). Other planning models align closer to the key legal coordinates of an EA identified in the academic literature: multi-sectoral, multi-level, participatory, flexible, and encompassing economic, social, and environmental objectives together reflecting sustainable development (Scotland, Norway). Generally, these decentralized (bottom-up) approaches are better suited to implement EAA understood as a social process for balancing different interests and uses.

It is particularly noteworthy that a shift towards more decentralized and participatory planning models is evident from the case studies. It has been noted elsewhere that international environmental law (and particularly the recognition of access rights and the recognition of rights of Indigenous Peoples) has increasingly strengthened governance, legitimacy, and democratic structures.[351] Aquaculture laws and regulations reflect this trend to some extent. Chile provides a good example. While the AAAs as included in the original LGPA were distinctively centralized, sectoral, and technical planning instruments, legal and policy amendments have introduced important, yet still

addressing "material considerations" in issuing planning permits). Further, a particular aspect considered in Principle 2 of the EAA, namely the equitable distribution of benefits, has been operationalized in both Norway and Chile through the distribution of aquaculture fees to the local communities (county and municipality in Norway, region and municipality in Chile). See Chapter 6, notes 197 and 499.

[351] Lavanya Rajamani & Jacqueline Peel, "International Environmental Law: Changing Context, Emerging Trends, and Expanding Frontiers", in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 1 at 15-16.

insufficient, elements of decentralization, participation, and meaningful consultation with Indigenous Peoples.[352] In the case of NS, while the legal framework considers a zoning instrument that is centralized, technical, and sectoral, its actual implementation (at least in the only process currently underway) aligns with decentralized and participatory process consistent with EAA. Thus, despite a legal framework that does not enshrine the features required to support EAA, the flexibility of the instrument and the discretion afforded to the Minister (both in terms of process and criteria for decision-making) can enable the implementation of an EAA through policy decisions.

While the bottom-up (decentralized and participatory) planning and zoning instruments are generally better fitted to implement an EAA, there are still obstacles and challenges that affect their potential to actualize the principles of EAA. Vertical and horizontal fragmentation remains an obstacle for comprehensive planning, as was evident in all case studies. Fragmentation gave rise to problems of spatial fit between planning units and ecosystems.[353] Vertical and intersectoral coordination and differing sectoral policy priorities were also evident. The uncertain jurisdiction of federal and provincial levels of government is a particularly severe challenge to achieving holistic marine spatial planning in NS. Other examples include fragmentation between marine spatial planning and planning for marine aquaculture in Scotland, competing sectoral responsibilities in Norway, and overlapping zoning instruments in Chile.

A further challenge for comprehensive planning with an EA is lack of relevant information, including ecological information at the system level and social and cultural information. SEA and meaningful public engagement, when well design and implemented, can support systematic assessments and the identification of knowledge gaps. Its application as an integrative and proactive assessment tool is, however, uneven in the four jurisdictions. Its practical implementation is reportedly uneven within jurisdictions, as well.[354]

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[352] This is also consistent with Principles 1 and 2 defined by the CBD for the implementation of the EA (Malawi Principles 1 and 2). See: CBD, Decision VII/11, *supra* note 20, Annex A.
[353] The problem of spatial fit between planning units and ecosystems was specifically noted in the case of Norway. It should be noted that the Planning and Building Act provides some solutions to overcome this difficulty, in particular through the use of national and regional guidelines and intermunicipal plans.
[354] Mikkelsen, Sørdahl & Solås, *supra* note 105.

The Chilean designation of AAAs in the XII Region in 2018 provides a good example of how the lack of comprehensive and holistic studies (such as in a robust SEA) inhibits the operationalization of an EAA. While the designation of AAAs was supported by technical studies and consultations that considered environmental impacts and conflicts of uses, the scope of those studies and consultations were narrow and fragmented. The studies did not consider all pressures resulting from new salmon mariculture activities in the area, did not consider cumulative impacts of the new AAAs, and did not seek to integrate the knowledge and values of local communities.[355] In other words, the studies were insufficient to assess the individual and cumulative interactions between the proposed new aquaculture areas and the wider social and ecological system.[356] The existing legislation provides a remedy to strengthen holistic assessment of AAA proposals: the Ministerial Council on Sustainability and Climate Change could recommend the President to require a SEA for their designation under the discretionary authority of the Framework Act on the Environment.[357]

A particular area of contention is the extent to which planning and zoning instruments can operationalize production limits compatible with carrying capacity at the area level. Generally, planning and zoning instruments assist decisions on where aquaculture can take place (site location) but not how much aquaculture the system (at the spatial level of the planning unit) can support. The consideration of carrying capacity at the level of the planning unit faces several challenges, including lack of baseline ecosystem information, lack of publicly available information on other activities in the

[355] See: SUBPESCA, Informe Técnico (D.Ac) N° 877 de 2017, Propuesta de Nuevos Sitios de Áreas Apropiadas para el Ejercicio de la Acuicultura (AAA) en la XII Región de Magallanes y de la Antártica Chilena [Technical Report 877 of 2017, Proposal for New Sites of Appropriate Areas for Aquaculture (AAA) in the XII Region of Magallanes and Chilean Antarctica][translation by author]; Comisión Regional de Uso del Borde Costero, Gobierno Regional de Magallanes y de la Antártica Chilena, CRUBC 2015, online: GORE <https://www.goremagallanes.cl/wordpress/crubc/> (accessed 17 March 2023)[translation by author].

[356] These shortcomings may be at least partially addressed through the EIA of site applications, but only after a court order (Comunidad Indígena Kawésqar Grupos Familiares Nómades del Mar y otros con Comisión de Evaluación Ambiental Región de Magallanes y la Antártica Chilena, R-16-2021 Tercer Tribunal Ambiental (27 December 2022)). This remedy is not efficient since it increases the processing time and cost of individual applications. It is also not effective, since the requirement relied on very particular circumstances, including the fact that all applications belonged to the same company.

[357] Ley N° 19300 sobre Bases Generales del Medio Ambiente [Framework Environmental Act] (as amended), art 7bis. The SEA may be required by the President, by recommendation of the Council, for any general policy or plan that affects the environment or sustainability.

area, the complexity of the required studies,[358] and the uncertain and dynamic nature of ecosystems' interactions. From a legal perspective, the fragmentation of responsibilities between planning and sectoral authorities challenges the introduction of ecological carrying capacity controls within planning instruments.[359]

The latter point is directly related to the third assessment in this Chapter addressing EAA as a normative content. Do legal frameworks adequately support the goal of maintaining ecosystem integrity (or "take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society")? In particular, the Chapter focuses on one key element of an EAA: the extent to which salmon mariculture laws have transitioned from management that focuses on single farms and its direct effects to approaches that consider the more indirect, non-linear, and uncertain impacts on the wider ecosystem (far-field effects and cumulative effects). The need to address these impacts is not only a key consideration of the holistic remit of the EAA; it is also the most difficult aspect of EAA because it defies traditional approaches to regulation focused on single stressors and single facilities in isolation, and to those direct impacts with clear causal relationship (and therefore clearly attributable to individual sites).[360]

Site-by-site regulatory approaches to management continue to be a distinct feature of aquaculture legal frameworks; they are the prevailing management approach in NS and Scotland and, to a significant extent, also Chile. Indeed, the aquaculture management system is centered on the licensing, operation and impacts of individual sites and on the narrow spatial scale of the site. This narrow focus is, in some cases, reflected in legislation.[361] Despite the fact that far field and cumulative impacts are considered, to

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[358] The limitation of the Scottish locational guidelines as a model to assess cumulative impacts of all sites in a loch or voe is a case in point.

[359] Norway provides a good example of this fragmentation: the sectoral authority (Directorate of Fisheries) has objected the attempts by the planning authorities (municipal councils) to specify environmental standard for some areas designated for aquaculture in the municipal master (area) plans. The coordination of competences in the designation of these areas remains a work in progress.

[360] See *supra* notes 175 and 176 and accompanying text, and Chapter 3 section 3.1.

[361] For example, the FCRA, *supra* note 73, s 64(e), allows the NS Minister to make regulations "respecting the environmental monitoring, conservation and protection of licensed or leased areas". Similarly, the Chilean LGPA, *supra* note 27, art 74, requires the lease holder to be responsible for maintaining the cleanliness and ecological balance of the leased area ("La mantención de la limpieza y del equilibrio ecológico de la zona concedida (…)"). Nevertheless, environmental regulations for aquaculture activities adopted under art 87 of the LGPA have broader objectives.

different extents, in the licensing process, the assessment and regulation focuses on sites considered in isolation.

The limitations of farm-by-farm approaches have been explicitly recognized in all jurisdictions. In Norway, Chile and to a more limited extent Scotland, that recognition has been accompanied by concrete and innovative regulatory initiatives addressing the more complex interactions of different aquaculture sites in an area, and of aquaculture farms and the environment. These include extended monitoring obligations, collaborative agreements for fish health, joint responsibility schemes, and area-based production capacity controls.

The evolution in Norway in this respect is worth noting since there has been an explicit discussion on the need to amend the Aquaculture Act to overcome the limitations of traditional approaches. In particular, the regulatory framework has been amended to address the overall effects of all salmon farms in an area (through the traffic light system); to extend monitoring obligations to the wider ecosystem (by allowing the Minister, in individual decisions or by regulation, to require monitoring surveys in the "area of influence" of individual sites or by requiring financial contributions to undertake wider investigations); and to address the challenges of attributing responsibility of ecosystem impacts (by establishing joint responsibility schemes).[362]

Legal structures that regulate salmon mariculture focusing on individual sites is not the only challenge of transitioning to management that considers the interactions between salmon farms and the wider ecosystem. An important limitation is the availability of information of the ecosystem functioning. Chile,[363] NS,[364] and Scotland[365] in particular have reported limited systematic monitoring and gaps in scientific research, yet knowledge gaps are also reported in Norway.[366] Another limitation is the lack of ecological quality standards used as a benchmark to assess unacceptable impacts. While

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[362] See in particular: Norwegian Government, White Paper 16 (2014-2015), "Predictable and environmentally sustainable growth in Norwegian salmon and trout farming", [Meld St 16 (2014-2015) Forutsigbar og miljømessig bærekraftig vekst i norsk lakse- og ørretoppdrett] [Google Translate]; Norwegian Government, Prop. 103 L (2012–2013) "Amendments to the Aquaculture Act" [Endringer i akvakulturloven], online: Regjeringen <https://www.regjeringen.no/no/id4/> (accessed 15 March 2023).
[363] Quiñones et al, *supra* note 154.
[364] NS, Independent Aquaculture Review, *supra* note 65, especially at 26-28.
[365] McGhee, Falconer & Telfer, *supra* note 308.
[366] Geir Lasse Taranger et al, "Risk assessment of the environmental impact of Norwegian Atlantic salmon farming" (2015) 72 ICES J of Marine Science 997, especially at 1013.

aquaculture-specific standard for benthic impact at the site level are in place in all jurisdictions, Chile and NS have not designated further ecological quality standards for the wider marine environment[367] (nor any other type of clear, specific, measurable,[368] and transparent standard to assess unacceptable ecological impact). In Scotland and Norway, the implementation of the WFD has strengthened the identification and implementation of ecological quality standards to classify the ecological status of coastal waters, thus supporting the implementation of an EA to marine activities.[369] These jurisdictions also offer other examples of standards designed to assess the impacts of salmon farming activities: Norway's Atlantic salmon quality norm (particularly its sub-standard on genetic integrity);[370] the Norwegian risk assessment and thresholds underpinning the traffic light system;[371] current work in Scotland towards an area-based risk assessment of sea lice related risk to wild salmon;[372] and the interim standard for acceptable levels of *Emamectin Benzoate* in the sediment.[373]

While the definition of clear, transparent benchmarks of unacceptable impact is a key element of the EAA and to strengthen the "hard law" for the protection of ecosystems integrity, defining those benchmarks faces several scientific and technical challenges. A systematic literature review of scientific research on environmental indicators of salmon mariculture effects confirms a skewed research focus on farm-scale

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[367] The Chilean Framework Environmental Act, *supra* note 357, art 32, referring to "normas secundarias de calidad ambiental" (secondary environmental quality norms), defined as norms establishing the values of the maximum or minimum permissible concentrations (within defined periods of time, if appropriate) of substances, elements, energy or combinations thereof, the presence or absence of which in the environment may represent a risk for the protection or conservation of the environment or the preservation of nature (*ibid*, art 2(ñ)).

[368] See *supra* note 241.

[369] The application of the WFD to salmon mariculture has been challenging, partially due to reported overlapping and contested responsibilities between environmental and sectoral authorities (Synne Movik & Knut Bjørn Stokke, "Contested knowledges, contested responsibilities: The EU Water Framework Directive and salmon farming in Norway" (2015) 69 Norsk Geografisk Tidsskrift - Norwegian Journal of Geography 242).

[370] Kvalitetsnorm for ville bestander av atlantisk laks (Salmo salar) (FOR-2013-09-20-1109) [Quality norm for wild stocks of Atlantic salmon (Salmo salar)].

[371] Forskrift om produksjonsområder for akvakultur av matfisk i sjø av laks, ørret og regnbueørret (produksjonsområdeforskriften) (FOR-2017-01-16-61)[Regulations relating to production areas for aquaculture of fish in the sea of salmon, trout and rainbow trout (Production Areas Regulations)].

[372] SEPA, "Proposals for a risk-based framework for managing interaction between sea lice from marine finfish farm developments and wild Atlantic salmon in Scotland" (last updated 25 August 2022), online: SEPA <https://consultation.sepa.org.uk/regulatory-services/protection-of-wild-salmon/> (accessed 6 November 2022).

[373] SEPA, "Interim Position Statement for Protecting the Water Environment until such Time as a Direction Is Issued on an EQS in Relation to Emamectin Benzoate in Finfish Farm Regulation" WAT-PS-17-03.

and benthic indicators of effects.[374] Additionally, lack of baseline information and concurrent anthropogenic stressors makes defining the acceptable state of the environment and establishing proportional controls challenging and even controversial.[375] Precautionary measures adopted during siting decisions,[376] trend indicators,[377] managerial approaches to assert compliance,[378] and reliance on proxies of unacceptable impacts[379] could be used to overcome some of these difficulties.

Further, monitoring and environmental quality standards do not necessarily lead to effective protection of ecosystem integrity. Indeed, some standards are not implemented as strict "environmental ceilings or floors" but can be balanced against other societal objectives.[380] In other cases, the acceptable thresholds of impact are not considered precautionary.[381]

The final assessment of the chapter addresses the extent to which salmon mariculture legal frameworks allow the flexible and adaptive management required to address the context-specific and dynamic nature of ecosystems. Flexibility in aquaculture regulations is operationalized through several mechanisms. At the planning and siting stage, flexibility is introduced in Scotland and Norway through the periodic revision of planning instruments and flexible consenting schemes that allow dispensations from

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[374] Megan E Rector et al, "Environmental indicators in salmon aquaculture research: A systematic review" (2022) 14 Rev in Aquaculture 156.

[375] J Kyrönviita et al, "Achieving Blue Growth Post-Weser: a Study of Aquaculture Regulation in the Nordic Region" (2021) 18 JEEPL 256, highlight the scientific challenges of assessing potential effects of single farms on ecological and chemical objectives.

[376] All jurisdictions adopt precautionary measures, for example, by avoiding highly sensitive habitats, by establishing minimum distances between sites or avoiding overlapping depositional zones. Norway and Scotland adopted clear and transparent precautionary measures: closed areas (North and East Coast in Scotland, national salmon fjords and rivers in Norway) and a precautionary biomass limit to salmon mariculture sites, which was implemented to address incomplete scientific information on waste dispersal and assimilation (Scotland). The latter measure was eliminated only recently.

[377] See: Engler, *supra* note 12, at 306.

[378] See: Brita Bohman "The Ecosystem Approach as a Basis for Managerial Compliance: An Example from the Regulatory Development in the Baltic Sea Region" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Brill E-Book, 2019) 80.

[379] The clearest example is the production controls introduced by Chile, which rely on fish loss, sea lice treatment, and antibiotic use as proxies for acceptable rearing practices and (indirectly) acceptable impacts on the environment.

[380] See WFD, art 4(7). See also: Bugge, *supra* note 39, at 145; Movik & Stokke, *supra* note 369.

[381] This criticism has been levied in particular with respect of the risk assessment thresholds in the production zone regulations. See: NASCO, November 2021 Evaluation of the Revised Implementation Plan under the Third Reporting Cycle (2019 – 2024) from the Review Group to Norway, IP(21)12, online: NASCO <https://nasco.int/conservation/third-reporting-cycle-2/> (accessed 7 August 2022).

general planning policies or instruments. In NS, the procedural effects of the zoning system allow for flexibility in siting decisions. During operations, flexibility is introduced through at least four mechanisms: supplementary operational documents (farm management plans, environmental management plans, operational plans, biosecurity measures plans, and contingency plans); authority to vary and revoke licenses (on broad grounds, including incomplete understanding of impacts at the time of licensing or changing environmental or technical conditions, subject to the restrictions of general administrative law); time-limited permits; and regulatory adaptive management (largely limited to benthic impacts over soft sediment[382] and sea lice[383] at the site level, but with more innovative adoption of area-based adaptive management of production capacity in Norway and Chile).

While the legal frameworks in Norway, Scotland and NS provide a significant amount of flexibility to adapt to changing circumstances,[384] the Chilean regulatory framework stands out for its rigidity. Sources of rigidity include: fixed and prescriptive AAAs; legal difficulties of establishing new AAAs in the context of a fragmented legal frameworks for coastal use; rigid application scheme for new licenses and leases; grandfathered permanent leases; limited authority to revoke licenses; and limited authority to consider site-specific conditions (including monitoring requirements) in the licensing and EIA process. This rigidity has already compromised environmental sustainability;[385] it is likely to compromise adaptation opportunities in the future.

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[382] All jurisdictions assessed have a benthic monitoring program and indicators and thresholds of unacceptable benthic impact (in some cases limited to soft bottom), with clearly delineated mitigation actions in case these thresholds are exceeded.

[383] Norway, Scotland and Chile have publicly available monitoring protocols for sea lice, thresholds of acceptable sea lice per salmon at the farm level, and mandatory mitigation measures in case those thresholds are exceeded. NS farmers are required to include these measures, including sea lice thresholds and mitigation measures, in their farm management plan. Therefore, they are not available to the public.

[384] This statement needs a nuanced caveat. From a legal perspective, that flexibility could be restricted by principles and rules of administrative law that could not be addressed in the context of this Dissertation. From a practical perspective, options for flexible adaptation may be limited due to the size of the industry and its importance for national and coastal economies.

[385] The rigid framework has been an impediment to the relocation of sites that are situated either in national parks or in the designated lease-free areas separating different neighborhoods and macrozones to contain spread of pathogens. As a consequence, key environmental and fish health objectives have not been achieved.

Table 4. **Zoning and Planning Instrument for Salmon Mariculture**

	NS ADA	Chile AAA	Chile Coastal Zone	Scotland Planning	Norway Planning
Marine Area Covered by Planning Tool	Not specified	Not specified, in practice coastal area up to 1nm measured from the baseline	Internal waters and territorial sea	Territorial sea; in practice, coastal area up to 3nm measured from the baseline	Coastal area up to 1nm measured from the baseline[1]
Spatial Scale for Planning	Not specified	Not specified, in practice regional	Regional/municipality	Local	Local Inter-municipal or regional
Content	Sectoral Zoning	Sectoral Zoning	Multisectoral Zoning	Sectoral Criteria-based (with some spatial components)	Multi-sectoral Zoning Development objectives
Competent Authority	Minister of Fisheries and Aquaculture, with approval of Cabinet	Minister of Defence/SUBPESCA	National Commission for the Use of the Coastal Zone/Regional commissions for the use of the coastal zone/municipalities (microzoning)	Local authority (within UK and national and regional planning guidance)	Municipality (with regional and national planning guidance) Inter-municipal or regional plans
Objectives	Not specified	Not specified, implicit conflict of use and	Sustainable Planning of the coastal zone[2]	Manage the development and use of land in the	Promote sustainable development for the

[1] The Marine Spatial Plans have started to designate aquaculture zones in areas outside of the spatial scope of the Planning and Building Act. There are no aquaculture sites issued in offshore areas at the time of writing.

	NS ADA	Chile AAA	Chile Coastal Zone	Scotland Planning	Norway Planning
		environmental protection	Ensure compatibility of different uses of the coastal zones, promoting their harmonious, integral, and balanced development, optimising their rational use, taking into account both current and future uses, and protecting the environment.	long term public interest, including by contributing to sustainable development and achieving national outcomes	benefit of individuals, society, and future generations.[3] The municipal master plan shall promote municipal, regional and national goals, interests and functions, and should cover all important goals and functions in the municipality
Information	Not specified	Technical Studies (SUBPESCA)	SEA	SEA Habitats Regulation Appraisal	SEA
Inter-sectoral Coordination	Departments or agencies of the Government or the	Consultation with agencies responsible for	National and regional commission integrated by	Planning Development Scheme must include	Proposal shall be sent to all central government,

[2] Enable and guide the balanced development of the different productive activities that take place on the coastline, in accordance with regional, local, and sectoral interests; tend to an adequate compatibility of the different activities that are carried out or can be carried out on the coastline; promote the preservation and conservation of coastal areas important for biological diversity.

[3] Plans shall: (a) establish goals for the physical, environmental, economic, social and cultural development of municipalities and regions, identify social needs and functions, and state how these functions can be discharged; (b) safeguard land resources, landscape qualities and the conservation of valuable landscapes and cultural environments (c) protect the natural basis for Sami culture, economic activity and social life (d) facilitate value creation and industrial and commercial development e) facilitate the good design of developed surroundings […] and [good] living standards in all parts of the country (h) promote societal safety by preventing the risk of […] damage to the environment and important infrastructure, material assets, etc. Planning shall promote coherence by ensuring that sectors, functions, and interests in an area are seen in an overall context through coordination of and collaboration on the discharge of functions between sector authorities and between central government, regional and municipal bodies, private organisations and institutions, and the public at large. Plans shall contribute to the implementation of international conventions and treaties within the scope of the Act. Adopted plans shall serve as a common basis for municipal, regional, central government and private-sector activity in the field of planning.

	NS ADA	Chile AAA	Chile Coastal Zone	Scotland Planning	Norway Planning
	Government of Canada, as may be required by the laws of the Province or of Canada	alternative uses of water bodies Consultation with Regional Commission on the Use of the Coastal Zone	representatives of relevant public authorities	Participation Statement In preparing main issues report, must seek the views, and have regard to any views expressed by, key agencies and Scottish Ministers Main issues report, environmental report and habitat regulations appraisal, and proposed local development plan is subject to consultation	regional and municipal authorities and other public bodies, private organisations and institutions that are affected by the proposal for comment within a stipulated time limit State and regional public authorities, other municipalities, and Sami Parliament can lodge an objection to master (area) plans At regional level: regional planning forums
Public Participation	Consultation with any person, group of persons or organization that the Minister considers necessary or advisable in the circumstances	Public consultation for a 60 day period (consultation should be publicized both at national and local level) Regional commissions integrated by representatives of key stakeholders	Regional commissions integrated by representatives of key stakeholders. Preparatory work of the regional commission must describe methodology for public engagement. Public consultation prior approval.	Main issues report, environmental report and habitat regulations appraisal, and proposed local development plan is subject to consultation	Municipality must ensure that public participation is facilitated. Planning programme and draft master (area) plan shall be circulated for comment and presented for public scrutiny for a time period of at least 6 weeks.
Indigenous Consultation	Not specified Fiduciary Crown duty to	Indigenous Consultation, if required by the sectoral	Indigenous Consultation, if required by the sectoral	n/a	Sami Parliament can object municipal plans

	NS ADA	Chile AAA	Chile Coastal Zone	Scotland Planning	Norway Planning
	consult, and where appropriate, accommodate Indigenous groups; "Terms of Reference for a Mi'kmaq-Nova Scotia – Canada Consultation Process"; NS Office of Aboriginal Affairs, "Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'Kmaq of Nova Scotia" (2012)	agency (ILO 69)	agency (ILO 69)		Procedures for consultations between state authorities and the Sámi Parliament
Conditions Attached to Planning	Yes	Only designation of specific species or group of species	Yes (microzoning), but not implemented	Yes (criteria-based planning)	Groups of species or aquaculture species that may be established separately or in combination; other environmental conditions in exceptional circumstances[4]
Exclusions	Closed areas (not implemented) Incompatible with marine	National Parks (including buffer zone) Indigenous Peoples'	National Parks (including buffer zone) Indigenous Peoples'	Presumption against salmon farms development in the East and North Coast	National salmon fjords and national salmon rivers

[4] The extent to which the municipal council can include environmental conditions to the aquaculture zones is not clear in the legislation and practice.

	NS ADA	Chile AAA	Chile Coastal Zone	Scotland Planning	Norway Planning
	renewable-electricity area as defined by the *Marine Renewable-energy Act*	Marine and Coastal Areas	Marine and Coastal Areas		
Legal Implications	Procedural consequence	Prescriptive	Identification of exclusion areas is prescriptive (alignment with AAA)	Planning permit must be consistent with plan, but dispensation can be given	Planning permit must be consistent with plan, but dispensation can be given
Planned Revision	No	No	No	10 years cycle[5]	4 years cycle[6]

[5] The local development plans were revised every 5 years, but the *Planning (Scotland) Act 2009* amended the relevant provision to increase the planning cycle.
[6] Reportedly, the plans are not always revised every 4 years.

Table 5. **Adaptive Management in Aquaculture Regulations**[1]

Jurisdiction	Indicator	Scope	Defined Threshold	Response
NS	Sediment (soft and hard)	Site	Environmental Monitoring Program *Aquaculture Activities Regulations*	Increased monitoring; adjustment to farm management plan; extended fallowing
Chile	Sediment (soft and hard)	Site	Order under Aquaculture Environmental Regulations	Extended fallowing
	Sea lice	Site	*Caligus* Specific Biosecurity Program	Culling
	Fish loss	Site	Order under the Fish Health Regulations	Reduction in production (between 10% and 60%)
	Fish loss	Area (neighborhood)	Fish Health Regulations and Fish Health Orders (Aquaculture Environmental Regulations)	Farming density reductions
	Sediment (soft and hard)			
	Loss of fish	Company[2]	Fish Health Regulations and Fish Health Orders	Production (stocking) reduction (between 1% and 16%) or increase (between 1% and 9%)
	Sea lice treatments			
	Antibiotic Use			
Scotland	Sediment (soft)	Site	*Water Environment (Controlled Activities) (Scotland) Regulations 2011* SEPA Strengthened Framework	Increased monitoring; adjustment to farm management plan; extended fallowing; enforcement notice
	Sediment (soft)	Extended area of effects	SEPA Strengthened Framework *The Scotland River Basin District (Standards) Directions 2014*	Increased monitoring; adjustment to farm management plan; extended fallowing
	Emamectin Benzoate	Site	*Water Environment (Controlled Activities) (Scotland) Regulations 2011*/Interim Quality Standard	Site-specific decision taking account the risk of deterioration; breaches considered in deciding on permit variations
	Sea lice	Site	*The Fish Farming Businesses (Reporting) (Scotland) Order 2020/ The Fish Farming Businesses (Record Keeping) (Scotland) Order 2008*/ MS-FHI Policy	Increased monitoring; adoption of satisfactory measures to bring number of sea lice down to acceptable levels; enforcement notice
Norway	Sediment (soft)	Site	Norwegian Standard 9410:2016	Increased monitoring; adjustment to farm

[1] This table includes only elements that fulfill four requirements: monitoring of defined indicators, acceptability thresholds, management response, and transparency. Other monitoring obligations or adaptive management practices (eg included in permits) are discussed in the main text.
[2] Company-based stocking reduction programs apply on a voluntary basis and as an exception to the neighborhood-level farming density reductions.

Jurisdiction	Indicator	Scope	Defined Threshold	Response
			Aquaculture Operation Regulations	management plan; extended fallowing
	Sediment (soft)	Extended area of effects	Norwegian Standard 9410:2016 Guide 02:2018 on Classification of environmental status of Water	Further investigation; if required, mitigation measures
	Copper in sediment	Site/Extended area of effects	Norwegian Standard 9410:2016 Guide 02:2018 on Classification of environmental status of water	Further investigation; if required, measures to reduce emissions
	Sea lice	Site	Regulations on the control of salmon lice in aquaculture facilities (lice regulation) (FOR-2012-12-05-1140) (as amended)	Measures must be implemented to ensure that the quantity of salmon lice does not exceed the limits, including, if necessary, the culling of fish; Food Safety Authority can make general or individual decisions
	Increased probability of wild salmon mortality due to sea lice exposure	Area (Production zone)	Regulations on production areas for aquaculture of food fish in sea of salmon, trout and rainbow trout (production area regulations)	Adjustment in Production Capacity (MAB of the production licenses in the production zone); (increase of 6%, maintain, or decrease of 6%)
	Presence of farmed salmon in rivers	Country	Joint Responsibility Regulations /Wild Salmon Quality Standard	Recapture obligation (damage prevention)

CHAPTER 8. CONCLUSION

The research goal of this Dissertation as stated in Chapter 1 was to contribute to the sustainability of salmon mariculture by identifying key law and policy coordinates for operationalizing an ecosystem approach to aquaculture (EAA). Through a three-part analysis – theory, international law, and State practice – the Dissertation provides a deeper understanding of the need for, and legal challenges of, holistic, integrative and dynamic aquaculture planning and management.

By undertaking this research, the Dissertation sought to strengthen legal scholarship on international and national salmon mariculture law. Further, it expected to make a contribution to scholarship on the legal dimensions of an ecosystem approach, using mariculture as a case study. This final chapter places the main findings of the research within this broader context.

The chapter starts with a brief summary of the analytical inquiries undertaken in this Dissertation, which serves both as a synthesis of the arguments laid out as well as a background to assess the limitations of the research, which are addressed in section two. The third, fourth and fifth sections address key findings regarding: ecosystem approach as a principle for environmental decision-making, salmon mariculture legal frameworks, and international law for mariculture. These sections also highlight areas for further research. A sixth and final section closes with a few words on aquaculture sustainability.

8.1. Charting Law and Policy Coordinates for EAA

The research goal of this Dissertation was to identify the key law and policy coordinates for operationalizing an EAA. This overarching goal was addressed through several related inquiries undertaken in sequence. First, the Dissertation undertook a critical description of the concept of EAA, placing it within the more general concept of EA (Chapter 2). Chapter 2 highlighted the complexities of EA, its multi-dimensional character, and conceptual and normative flexibility. It further criticized FAO's conceptualization of EAA as overreaching and confusing, ultimately failing to delineate the EAA. The Dissertation adopts an (arguably) narrower concept of EAA: a place-based and multi-dimensional concept that focuses on aquaculture interactions within defined and nested ecosystems. This narrower conceptualization does not negate the relevance of

high-level policies for salmon mariculture or of alternative approaches to address sustainability.[1] However, it recognizes these approaches as complementary to, rather than components of, an EAA.

Next, the Dissertation addressed the legal features supporting and enabling an EAA implementation, drawing from the literature on legal dimensions of EAA (Chapter 2, Section 5) and the broader literature addressing ecosystems and the law (Chapter 3). This analysis allowed to identify with more precision the features of "traditional" environmental law that are generally considered obstacles for the management of complex and adaptive systems, that is, laws and policies that are fragmented, state-centered (top-down), rigid and uniform, focused on narrow, static and often utilitarian substantive goals. It also allowed to identify regulatory developments that are considered better suited for the management of such systems, namely, legal frameworks that support decentralized and collaborative, participatory, flexible, adaptive, and contextual management with holistic goals that focus on maintaining systems integrity.

Building on these findings, the Dissertation identifies three inter-linked dimensions for EAA (and EA more generally), each comprising a subset of law and policy coordinates. In its first dimension, EAA is understood as a social process that seeks to integrate and balance diverse societal goals and interests through transparent and participatory processes at the appropriate scale. The second dimension of EAA is outcome-oriented, focusing on the objective of maintaining ecosystem structure and integrity adopting a system (holistic) view. This dimension also focuses on precautionary limits to environmental change, operationalized through tools such as ecological quality standards, ecological ceilings, ecological floors, and ecological triggers. The third dimension emphasizes EAA as an adaptive and flexible approach to management, emphasizing flexible management instruments, monitoring of relevant indicators, thresholds, action rules, and feedback loops.

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[1] Eg: FAO, *Achieving Blue Growth: Building vibrant fisheries and aquaculture communities* (FAO: 2018), online: FAO <https://www.fao.org/3/ca0268en/CA0268EN.pdf> (accessed 10 December 2022); High Level Panel of Experts on Food Security and Nutrition (HLPE), *Sustainable fisheries and aquaculture for food security and nutrition*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (Rome: HLPE, 2014); FAO, *Sustainable and circular bioeconomy in the climate agenda: Opportunities to transform agrifood systems* (Rome: FAO, 2022).

The Dissertation turned then to international law, with a primary focus on the 1982 *United Nations Convention on the Law of the Sea*[2] and the 1992 *Convention on Biological Diversity* (CBD)[3] (Chapters 4 and 5). Although there is no international treaty on aquaculture, international (hard and soft) law contributes to the analysis by outlining qualified substantive and procedural obligations that are consistent with the three identified dimensions of an EAA and their linked policy and law coordinates. Indeed, States have, under international law, substantive and procedural obligations for the protection and preservation of the marine environment and the conservation and sustainable use of biological diversity. The CBD, in particular, has adopted an ecosystem perspective to conservation and sustainable use of biological diversity. Further, the ever deepening relationship between international environmental law and human rights law has highlighted procedural and substantive obligations, including environmental democracy.

The Dissertation analyzed next whether and how the identified dimensions of EAA are recognized in the legal frameworks applicable to salmon mariculture of the most important salmon producing countries (Chapter 6) and compared key legal approaches (Chapter 7). Due to the complexity of the concept of EAA, on one hand, and the legal frameworks for aquaculture, on the other, the analysis focused on a subset of questions that were deemed most relevant and representative to the dimensions of EAA identified in previous Chapters. These questions are: Do law and policies formally recognize EAA? How does aquaculture planning integrate diverse ecological, social, and economic objectives? Which legal instruments address ecosystem-level and cumulative interactions? Do the aquaculture legal frameworks support adaptive management?

8.2. Limitations of Research

The research objective of this Dissertation was ambitious in three respects. First, it aimed at filling a significant gap in the aquaculture legal literature by identifying legal and policy coordinates for implementing EAA, widely considered an imperative for sustainable aquaculture. EAA (and EA more broadly) is, however, a notoriously complex

[2] *United Nations Convention on the Law of the Sea* (10 December 1982) 1833 UNTS 397, entered into force 16 November 1994 [hereinafter LOSC].
[3] *Convention on Biological Diversity*, 5 June 1992, 1760 UNTS 69 [hereinafter CBD].

and multi-dimensional concept that is at its core holistic and integrationist, making scope delimitation difficult. Second, the Dissertation aimed at providing an assessment on whether the identified law and policy coordinates are present in international and national legal frameworks relevant to salmon mariculture. Such frameworks are also complex, intersecting with many areas of law from constitutional to administrative, planning, trade, and property rights. Third, the Dissertation aimed at providing a representative assessment of aquaculture legal frameworks by assessing a significant number of salmon farming jurisdictions. Yet assessing and comparing aquaculture legal frameworks in four different jurisdictions is a challenging and demanding task.

These three ambitions, and their associated challenges, translated into limitations of the research and findings. First, the description of salmon mariculture legal frameworks focused to a large extent on structures, processes and principles guiding two main decisions, namely where and how much salmon mariculture is allowed. These are, indeed, the two key aspects guiding the integration of salmon mariculture with "the wider ecosystems".[4] It must be kept in mind, however, that the technical complexity of aquaculture is not reduced to these two questions.

Second, the analysis focuses on regulatory design, that is, identifying key principles, structures, processes, and tools embedded in legal frameworks that support or obstruct the operationalization of the different dimensions of EAA. A systematic account on implementation, enforcement and compliance was not considered in the scope of the Dissertation. Further in-depth analyses of the implementation of the tools and approaches identified in this Dissertation could expand knowledge on the prospects and challenges of implementing an EAA. These would benefit from different methodologies, including empirical and interdisciplinary studies. For example, focused comparison of the structure, content, scope, and legal effects of SEA or technical studies for aquaculture planning in different jurisdictions can shed light on the knowledge base for decision making, the ecosystem fit, coherence of legislated objectives,[5] and extent to which salmon mariculture planning operationalizes "hard" environmental limits including the

[4] FAO, FAO, *Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010).
[5] Froukje Maria Platjouw, *Environmental Law and the Ecosystem Approach: Maintaining ecological integrity through consistency in law* (Oxon; New York: Routledge, 2016), ch 8.

application of the precautionary approach.[6] The extent and modes of public engagement, participation, and transparency were only addressed generally and briefly in this Dissertation; other literature has done so to some extent.[7] Similarly, the mode, scope, and legal effect of consultations and engagement with Indigenous Peoples were not discussed in detail and have been addressed to a limited extent elsewhere.[8]

The study of foreign law is also a challenging endeavour, and it necessarily faces limitations when addressed from the perspective of an "epistemic outsider".[9] Indeed, each regulatory system is embedded in broader legal and policy contexts, in a particular legal culture, and in a particular social and economic culture that could not be fully explored in the context of this Dissertation. This is particularly the case of the influence of constitutional and administrative law in the interpretation and implementation of laws applying to salmon mariculture, as well as in the interpretation and implementation of "open texture" legal concepts.[10] The language barrier in the case of the Norwegian legal framework is an additional challenge. While the aim of this Dissertation was not to scrutinize salmon mariculture law vis-à-vis their respective domestic legal frameworks, it is recognized that exploring these linkages in more depth would likely provide a more detailed and nuanced knowledge of aquaculture laws and of ecosystem law as applied to aquaculture.

Despite these limitations, the research methodology adopted was useful to achieve the main research objective set out in the Chapter 1. First, the Dissertation provides a more comprehensive and clearer understanding of the concept of EAA and its legal implications and barriers. Second, it provides a coherent and practical analytical framework for assessing laws in relation to EAA, a framework that may also be useful in

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[6] For a national empirical assessment of consistency and predictability in SEA and zoning decisions in Norway, see: Eirik Mikkelsen, Patrick Berg Sørdahl & Ann-Magnhild Solås, "Transparent and consistent? Aquaculture impact assessments and trade-offs in coastal zone planning in Norway" (2022) 225 Ocean & Coastal Management 106150.
[7] Justin D Trueman, Ramón Filgueira & Lucia Fanning, "Transparency and communication in Norwegian and Nova Scotian Atlantic salmon aquaculture industries" 138 (2022) Marine Policy 104958.
[8] Dorothee Schreiber & Camilla Brattland (eds), *Salmon Cultures Indigenous Peoples and the Aquaculture Industry* (Rachel Carson Center. Perspectives 2012/4). See more generally: Barry Antonio Costa-Pierce, "The Anthropology of Aquaculture" (2022) 6 Frontiers in Sustainable Food Systems https://doi.org/10.3389/fsufs.2022.843743.
[9] Elisa Morgera, "Global Environmental Law and Comparative Legal Methods" (2015) 24 RECIEL 254.
[10] Emma Lees, "Value in Comparative Environmental Law" in Emma Lees & Jorge E Viñuales, *The Oxford Handbook of Comparative Environmental Law* (Oxford: Oxford University Press, 2019) 35 at 40.

other contexts. Third, it anchors the legal implications of EAA to hard and soft obligations under international law. Fourth, it provides a comprehensive and up-to-date understanding on the mechanisms (principles, structures, processes, tools) embedded in key salmon mariculture legal frameworks to decide where and how much salmon mariculture can be authorized. Fifth, it provides examples on how existing laws and policies represent an obstacle for implementing EAA, but also examples of regulatory strategies used to address the more complex interactions between salmon farming and the surrounding social and ecological system.

By undertaking these analyses, the Dissertation contributes to the development and reform of legal frameworks addressing salmon and finish mariculture consistent with the principles of EAA and aquaculture sustainability. It also provides the foundation for future work on EA and EAA and on salmon (and finfish) mariculture domestic and international legal frameworks. These contributions and future research directions are outlined next.

8.3. The Ecosystem Approach: A Legal Principle?

Although addressing EAA, the findings on this Dissertation allow to draw relevant conclusions for the concept of EA, its legal features, and its status as a legal principle. EA is increasingly a legislated principle for environmental decision-making (Chapter 7 section 7.1). Its codification is a relatively recent trend, however.[11] The explicit recognition of EA has already been noted in international or regional instruments,[12] and in particular in fisheries and marine protection instruments. In these contexts, EA and

[11] In the case studies of this Dissertation, the principle was introduced in legislation only in the last 15 years: the Norwegian Nature Diversity Act in 2009, the Chilean General Fisheries and Aquaculture Act (Ley General de Pesca y Acuicultura, or LGPA for its acronym in Spanish) in 2013, and the Canadian *Fisheries Act* in 2019. While the *Nature Conservation (Scotland) Act* 2004 was enacted earlier, it was only in the supplementary strategy of the Scottish National Biodiversity Strategy, *2020 Challenge for Scotland's Biodiversity,* published in 2020, that the EA was endorsed and included, by reference, in the Act.

[12] See Cecilia Engler, "Beyond rhetoric: navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management" (2015) 23 Environmental Reviews 288; Platjouw, *supra* note 5, in particular ch 2; Sarah R Enright & Ben Boteler, "The Ecosystem Approach in International Marine Environmental Law and Governance" in TG O'Higgins et al (eds), *Ecosystem-Based Management, Ecosystem Services and Aquatic Biodiversity* 333 (Springer: 2020), <https://doi.org/10.1007/978-3-030-45843-0_17>; David Langlet & Rosemary Rayfuse, "The Ecosystem Approach in Ocean Planning and Governance: An Introduction" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance Perspectives from Europe and Beyond* (Leiden; Boston: Brill Nijhoff, 2019) 1.

EAF are frequently codified either as a guiding or binding principle. The uptake in national legislation has been less documented, however.[13]

The EA has been codified in different contexts, including the conservation and sustainable use of biological diversity, marine (spatial) planning, and fisheries and aquaculture. It is also codified with different meanings, with legislation providing no definition, definitions that focus on ecological components of the system and overall loading (cumulative impacts), and broader definitions that encompass the three pillars of sustainable development. The effect of the legal recognition also varies, with some laws mandating its consideration and the need to justify how it was considered, other laws simply authorizing its implementation, and yet others not outlining its specific effects.

The differences in the domestic legal recognition of EA confirms, once again, that EA is a complex, confusing, and difficult[14] concept. Its flexibility has been highlighted as a positive feature, as the complexity of social-ecological systems will require different approaches in different contexts. As noted elsewhere, "the diversity of contexts – natural as well as social – in which an ecosystem approach is prescribed and pursued, renders the articulation of predetermined measures both unrealistic and unhelpful".[15] Yet flexibility can also lead to irrelevance, if it renders the approach unintelligible.[16]

By identifying three interlinked dimensions of EAA and EA more generally (Chapters 2 and 3), this Dissertation contributes to conceptual and practical relevance of EA. The idea that EA is multifaceted and comprises several elements has already been established in the scholarship and international documents.[17] The Dissertation adds to that

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[13] But see: Andrea Bryndum-Buchholz, Derek P Tittensor & Heike K Lotze, "The status of climate change adaptation in fisheries management: Policy, legislation and implementation" (2021) 22 Fish and Fisheries 1248.

[14] David Langlet & Rosemary Rayfuse, "Challenges in Implementing the Ecosystem Approach: Lessons Learned" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance Perspectives from Europe and Beyond* (Leiden; Boston: Brill Nijhoff, 2019) 445, at 445-446. See also Chapter 2.

[15] Langlet & Rayfuse, *supra* note 14, at 447.

[16] Platjouw, *supra* note 5, at 28, citing Hartje et al, note that the effective diffusion of the concept depends on the quality of the concept in terms of its theoretical justification and its internal consistency.

[17] See eg: *ibid*; Langlet & Rayfuse, *supra* note 14; Engler, supra note 12; Elisa Morgera, "The Ecosystem Approach and the Precautionary Principle" in Elisa Morgera & Jona Razzaque (ed), *Biodiversity and Nature Protection Law* (Cheltenham, UK: Edward Elgar, 2017) 70; Rachel D Long, Anthony Charles & Robert L Stephenson, "Key principles of marine ecosystem-based management" (2015) 57 Marine Policy 53; Vito de Lucia, "Competing Narratives and Complex Genealogies: The Ecosystem Approach in International Environmental Law" (2015) 27 J Envtl L 91; Steven L Yaffee, "Three Faces of Ecosystem Management" (1999) 13 Conservation Biology 713; CBD, Ecosystem Approach, Decision VII/11 adopted

knowledge in two ways. First, it organizes these different elements in three distinct, but interrelated, dimensions or perspectives for EAA implementation -- namely, EAA as a social process, as an outcome-oriented principle for decision-making, and as an adaptive and flexible approach. Understanding EAA and EA with these three different emphases allows for analytical clarity and facilitates practical implementation. Second, it links each of these three dimensions to a distinct set of law and policy coordinates, including legal values in tension. Admittedly, these are not airtight compartmentalisations of a complex approach for complex systems. Yet they provide a clear and practical theoretical framework to assess, review, and reform laws to move towards EAA implementation. As a framework, it can also be applied to other human activities interacting with the social and ecological system.

It is apparent that the EA is ripe for further, broader and more focused legal studies that address the concept as a legal principle rather than a policy concept.[18] Systematic studies on EA codification in domestic legislation offers an opportunity to understand whether the trend observed in the jurisdictions included in this Dissertation has also occurred, or is occurring, in other jurisdictions. Further, they can assess in which contexts EA is recognized, with which meaning, which effects, and with which associated legal instruments. Such studies could contribute to a sharper conceptualization of EA in the legal domain and facilitate implementation at an area (ecosystem-based management) or sectoral (EA to management)[19] level.

8.4. Salmon Mariculture Law: Complex, Evolving, and Transforming

This Dissertation confirms a common truism in aquaculture law and policy: aquaculture legal frameworks are complex, fragmented, technical, and detailed. Perhaps the most salient aspect arising from the description of aquaculture legal frameworks in Chapter 6, however, is their dynamic and evolving nature. Each jurisdiction addressed in this Dissertation has recently undergone and is currently actively engaged in regulatory review or reform processes.

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by the Seventh Ordinary Meeting of the Conference of the Parties held in Kuala Lumpur, Malaysia, 9 - 20 February 2004, Annex I.

[18] Ronán Long, "Legal Aspects of Ecosystem-Based Management in Europe" (2012) 26 Ocean Yearbook 417.

[19] On the distinction between the two concepts, see Chapter 2, Section 2.1.

Regulatory review and reform are driven by different needs. Ecological and fish health concerns are key drivers, as evidenced in the Norwegian traffic light system, the Scottish proposal for an area-based adaptive framework for sea lice management, or the 2010 substantive amendments to the General Fisheries and Aquaculture Act (LGPA) in Chile. Social acceptability and equity are also behind important reform initiatives, from the Nova Scotia (NS) regulatory reform in 2015 to the several tax reforms for the aquaculture sector in Norway. A third important driver is technological innovation, with clear examples being the assessment of regulatory frameworks for expanding mariculture to high energy areas in Norway and NS, or the development licenses in Norway. Finally, streamlining institutional and legal coordination are important reform drivers. The recommended overhaul of the licensing system in Scotland is a prime example. Other examples include the regulatory review for the licensing system and the assessment of better coordination between planning instruments and sectoral legislation in Norway, and the announced federal aquaculture act in Canada. In sum, regulatory frameworks have evolved and continue to evolve to address all aspects of sustainability: ecological (including fish health), social, technological, and governance.

The evolution of salmon mariculture law has also been guided by better and evolving knowledge on the complex and dynamic linkages between salmon farms and between farms and other components of the social and ecological system. Indeed, the evolving legal frameworks mirror to a significant extent the evolution of environmental law described in Chapter 3. The need to overcome features associated to "traditional" or first generation environmental law (e.g. centralized planning, site-by-site planning and management, the reliance on ex-ante assessments, focus on impacts with clear and direct cause-effect relationship) was explicit in the debates in most regulatory review processes and in the scholarly literature. In turn, the need for regulatory approaches that identify and enforce ecological limits to salmon mariculture production at different spatial scales was an explicit element of some regulatory reviews and continues to be at the forefront in national debates.[20]

[20] Eg, see in Chapter 7 the references to the history of the Chilean Act 20434 highlighting the need to define carrying capacity at the watershed level and ongoing efforts by private institutions to define limits to production by area (note 324 and accompanying text); the Norwegian reports stressing the need to focus on the impacts of salmon mariculture at the area level (Chapter 7 note 202 and accompanying text) and

Perhaps surprisingly, however, some of the ecosystem concerns have only been addressed in earnest relatively recently and in some cases are yet to be translated into regulatory requirements. The assumption of this Dissertation was that the most important salmon producing countries, including developed States with robust governance systems in place, would have developed legislation to address the complex environmental and social externalities of a well-established industry.[21] This assumption was at best only partially correct, as was noted in Chapter 7, section 7.5. This situation is a reflection of the demands that an EAA imposes on science and knowledge generation. It is also a consequence of the novelty of the aquaculture industry, often regulated under pre-existing and non-sectoral legislation. It further reflects the limited capacity of legal frameworks to manage complex and dynamic systems.

The analysis in Chapter 6 also allows to draw a further conclusion: that the aquaculture industry and associated legal frameworks are in a process of transformation. In Chile, Norway and to some extent Scotland, traditional salmon mariculture in sheltered areas is increasingly unavailable for further development. In Chile, there is a moratorium on new salmon farm applications in the Southern regions due to lack of available legal space.[22] In Norway, growth in each production zone is regulated and controlled through the traffic light system, and site availability is considered limited.[23] Similarly, the Scottish industry is reportedly seeking to establish bigger farms in more exposed areas.[24] Further, fish health guidelines (in Norway) and relocation initiatives (in Chile) are guiding a farming model with bigger farms located farther apart.

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ongoing discussions on the opportunities for addressing other ecological concerns under the traffic light system (Chapter 6 note 469 and accompanying text).

[21] See Chapter 1, note 130 and accompanying text.

[22] Orders N° 3264 of 2016, N° 875 of 2012 and N° 902 of 2020, issued by SUBPESCA. See also Chapter 6, note 168 and accompanying text.

[23] Bjørn Hersoug, Eirik Mikkelsen & Tonje C Osmundsen, "What's the clue; better planning, new technology or just more money? The area challenge in Norwegian salmon farming" (2021) 199 Ocean & Coastal Management 105415. The authors note, however, that it "is possible to produce considerably more than today within the Norwegian coastal zone, but some regions are clearly full" (at 8).

[24] See SEPA, "Protection of the Marine Environment: Discharge from Marine Net Pen Fish Farms. A Strengthened Regulatory Framework" (2019), online: SEPA <https://www.sepa.org.uk/media/433439/finfish-aquaculture-annex-2019_31052019.pdf> (accessed 30 November 2022), and Chapter 6, note 348 and accompanying text.

In these countries, the existing mariculture model has reached or is reaching the carrying capacity (understood in broad terms)[25] of sheltered coastal areas. Future development will need to take place elsewhere or with different technologies. This trend is further reinforced by international calls to adopt innovative technologies to protect wild Atlantic salmon[26] and decisions made in other jurisdictions that puts limits to open-pen aquaculture.[27] Facilitating these developments will, in turn, require regulatory reforms. Norway has already taken steps to facilitate this next stage in salmon mariculture from a technological and regulatory perspective.[28] Other jurisdictions need to follow suit.[29]

8.5. Salmon Mariculture and International Law

Salmon farming is undertaken today, and likely in the immediate future, in marine areas under national sovereignty. States have the right to exploit their natural resources pursuant to their environmental and developmental policies (Chapter 4). Nevertheless, this right must be exercised subject to procedural and substantive obligations arising from a complex patchwork of international and regional agreements (Chapter 5).

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[25] Jenny Weitzman & Ramón Filgueira, "The evolution and application of carrying capacity in aquaculture: towards a research agenda" (2020) 12 Rev in Aquaculture 1297. The authors define carrying capacity for aquaculture broadly as "the level of aquaculture that can be supported without violating the maximum acceptable limits of the farmed stock or environment" (at 1301).

[26] See: NASCO, "Statement on Salmon Farming from the Council of the North Atlantic Salmon Conservation Organization", CNL(22)49, online: NASCO <https://nasco.int/annual-meeting/thirty-ninth-annual-meeting-2022/#annual-reports-of-the-council-of-nasco> (accessed 9 December 2022), and Chapter 5 note 326 and accompanying text.

[27] Eg: Office of the Prime Minister, "Mandate Letter to the Minister of Fisheries and Oceans and the Canadian Coast Guard" (2019), in file with author; CBC, "Washington state ends commercial net pen aquaculture in Puget Sound" (15 November 2022), online: CBC <https://www.cbc.ca/news/canada/british-columbia/washingon-state-end-1.6652547> (accessed 30 November 2022); Ley N° 1355 Cultivo y Producción de Salmónidos: Prohibición en Aguas Lacustres y Marítimas de la Provincia (Provincia de Tierra del Fuego, Argentina)[Act 1355 on Salmonid Farming and Production: Prohibition in internal and maritime waters of the province, Province Tierra del Fuego, Argentina]; Finfish Farming Prohibited, AS 16.40.210; Jonas Kyrönviita et al, "Achieving Blue Growth Post-Weser: a Study of Aquaculture Regulation in the Nordic Region" (2021) 18 J Eur Environ Plan L 256, in particular in commenting on the judgements of the Swedish Land and Environmental Appeal Court, Cases MöD 2017:21, MöD 2017:22, M 8882-15 and M 2620-16.

[28] Eg: with development licenses (Chapter 6 note 479 and accompanying text) and the ongoing work to identify aquaculture areas in marine spatial plans outside of the municipal planning areas under the Planning and Building Act (Chapter 6 note 402 and accompanying text).

[29] Eg: NS has started a review of regulatory options for offshore aquaculture (Chapter 6 note 45 and accompanying text). The federal government plans to clarify the legal framework of offshore aquaculture in the announced federal aquaculture act (Chapter 6 note 49 and accompanying text), but the process of developing a Bill has not advanced. The complex jurisdictional distribution of responsibilities between provincial and federal government will require a strong political commitment to agree on a suitable management regime for offshore aquaculture.

It has been stated elsewhere that, while States "are offered a wide margin of discretion in relation to the appropriate level of environmental protection they choose for themselves, they are subject to more specific procedural requirements".[30] This procedural turn in international environmental law has enhanced governance, legitimacy and democratic structures in international and national environmental decision-making.[31] The influence of procedural international obligations was clearly identifiable in the assessment of legal frameworks in Chapter 6. These procedural requirements include, for example, the obligation to undertake environmental impact assessment (EIA) and strategic environmental assessment (SEA) for projects, plans and programs that can affect marine environment and biodiversity; the obligations to allow for public participation in environmental decision-making arising from Principle 10 of the Rio Declaration, the Aarhus Convention and the Escazú Agreement; and the obligations to consult with Indigenous Peoples under the ILO 69 Convention and the United Nations Declaration on the Rights of Indigenous People.

The procedural turn of international law is also "a troubling sign insofar as it takes the place of, rather than complements, politically contentious substantive standard-setting in international environmental law".[32] Indeed, the substantive obligations for the protection of the marine environment and the conservation and sustainable use of biodiversity identified in Chapter 5 are qualified, broad, and largely unenforceable.

The shortcomings of international environmental law to establish substantive ("hard") obligations applicable in areas under sovereignty are neither new nor exclusive to salmon mariculture. As noted in Chapter 3, there have been increasing calls to strengthen substantive international environmental law to protect Earth's system. Aside from academic work,[33] there are recent policy initiatives such as a proposed legally binding Global Pact on the Environment[34] that was later adopted only as a political

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[30] Lavanya Rajamani & Jacqueline Peel, "International Environmental Law: Changing Context, Emerging Trends, and Expanding Frontiers", in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 1, at 15-16.
[31] *Ibid.*
[32] *Ibid.*
[33] See Chapter 3, section 3.6. See also: Rajamani & Peel, *supra* note 30, section II.C at 6-8.
[34] United Nations General Assembly (UNGA), "Towards a Global Pact for the Environment", Resolution 72/277 adopted by the General Assembly on 10 May 2018, online: UN <https://www.un.org/en/ga/72/resolutions.shtml> (accessed 10 December 2022); International Group of Experts for the Pact, "Draft Global Pact for the Environment", available online: Global Pact for the

declaration,[35] and most recently, the United Nations Declaration on the Right to a Healthy Environment.[36] Whether and how such initiatives will influence the development of domestic environmental law generally and as applied to aquaculture remains to be seen.

International law developments specifically addressing salmon mariculture are unlikely but not out of the question.[37] This is particularly the case under regional agreements, and in particular under OSPAR and NASCO, provided the latter's Convention is amended to provide the Commission with legal authority to adopt binding measures addressing activities affecting the conservation of wild salmon, including salmon mariculture.[38] Binding international commitments would likely address mandatory use of best available technology either generally or in particularly vulnerable areas.

Further, the role of international law for aquaculture planning and management may become more direct and relevant if aquaculture developments extend farther offshore (Chapter 4). While legal questions are highly dependent on technologies deployed, procedural and substantive obligations, including "due regard" obligations[39], will need further attention by scholars and practitioners. A binding international agreement for the use of biodiversity in areas beyond national jurisdiction,[40] if adopted,

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Environment <https://globalpactenvironment.org/en/documents-en/the-pact-text/> (accessed 10 December 2022).

[35] United Nations Environment Assembly of the United Nations Environment Programme (UNEP), *Political declaration of the special session of the United Nations Environment Assembly to commemorate the fiftieth anniversary of the establishment of the United Nations Environment Programme*, Resolution UNEP/EA.SS.1/4 (8 March 2022), online: UNEP <https://www.unep.org/environmentassembly/follow-up-on-ga-res-73-333> (accessed 10 December 2022).

[36] UNGA, *The human right to a clean, healthy and sustainable environment*, Resolution A/RES/76/300 adopted by the General Assembly on 28 July 2022 (1 August 2022), online: UN <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N22/442/77/PDF/N2244277.pdf?OpenElement> (accessed 10 December 2022).

[37] As noted elsewhere, "international environmental law (…) is hostage to national sovereignty, and political will and its limits are equally the limits of international law" (Rajamani & Peel, *supra* note 30).

[38] This was already recommended in NASCO's performance review in 2011. See: NASCO, External Performance Review, CNL(12)11, online: NASCO <https://nasco.int/wp-content/uploads/2020/02/cnl_12_11.pdf> (accessed 10 December 2022). See also Chapter 5, note 312 and accompanying text.

[39] In particular, due regard obligations in the LOSC, *supra* note 2, arts 56(2), 58(3) and 87(2), as well as conditional rights in the high seas (art 87(1)(d)).

[40] UN, Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction, online: UN <https://www.un.org/bbnj/> (accessed 4 November 2022).

has also the potential to fill the existing gaps for the regulation of aquaculture in the high seas.

8.6. Towards Salmon Mariculture Sustainability

How can salmon mariculture and healthy coastal ecosystems coexist? That was the initial question in this Dissertation. Ultimately, it is a question about the sustainability of salmon mariculture assessed at the ecosystem level.

Sustainable agricultural development, including aquaculture, is defined by FAO as environmentally non-degrading, technically appropriate, economically viable and socially acceptable. None of these elements is static, and climate change and the biodiversity crisis will continue to affect how technical, economic and social sustainability of marine aquaculture is perceived and actualized. Developments towards sustainable salmon mariculture (and aquaculture more generally) have been evident in the past 40 years, as reflected in technical (e.g. feed, cage systems, delousing technologies, gene editing, and modern biotechnology) and governance innovations (e.g. voluntary certifications, sustainability reports, beyond compliance and corporate responsibility initiatives). In some cases, the solutions themselves give rise to ecological and ethical concerns.

The dynamism of salmon mariculture knowledge, technologies, practices, governance, and standards was particularly evident in the course of this PhD Programme. There is a shifting framework for salmon mariculture sustainability, within a shifting framework for environmental governance and environmental law more generally. The role of law in promoting sustainability or resilience of social-ecological systems is one piece in this puzzle. Legal frameworks can be obstacles for the sustainability process, they can be neutral, or they can steer development toward sustainability. By endorsing the dimensions and law and policy coordinates for EAA identified in this Dissertation, hopefully law can be assessed and reformed to act as the latter.

REFERENCES

INTERNATIONAL DOCUMENTS

International Agreements

Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (Fish Stocks Agreement or UNFSA), 4 August 1995, 2167 UNTS 3 (entered into force 11 December 2001).

Agreement on the Application of Sanitary and Phytosanitary Measures, 15 April 1994, 1867 UNTS 493 (SPS Agreement) (entered into force 1 January 1995).

Agreement on the Conservation of African-Eurasian Migratory Waterbirds, 15 August 1996, 2365 UNTS 203 (entered into force 1 January 1999).

Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 29 January 2000, 2226 UNTS 208, 39 ILM 1027 (entered into force 11 September 2003).

Convención para el Establecimiento de la Red de Acuicultura de las Américas, 18 April 2012, online: UNEP <https://leap.unep.org/sites/default/files/legislation/mul-129193.pdf> (accessed 27 December 2021).

Convention Concerning the Protection of the World Cultural and Natural Heritage, 16 November 1972, 1037 UNTS 151 (entered into force 17 December 1975).

Convention for the Conservation of Antarctic Marine Living Resources, 20 May 1980, 1329 UNTS 47 (entered into force 7 April 1982).

Convention for the International Council for the Exploration of the Sea, 12 September 1964, 652 UNTS 237, 7 ILM 302 (entered into force 22 July 1968).

Convention for the Protection of the Marine Environment of the North-East Atlantic, 22 September 1992, 2354 UNTS 67 (entered into force 25 March 1998).

Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 10 March 1988, 1678 UNTS 221 (entered into force 1 March 1992).

Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, 25 June 1998, 2161 UNTS 447 (entered into force 30 October 2001).

Convention on Biological Diversity, 5 June 1992, 1760 UNTS 69 (entered into force 29 December 1993).

Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere, 12 October 1940, 161 UNTS 193 (entered into force 30 April 1942) (Washington Convention).

Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, 5 September 2000, 2275 UNTS 43 (entered into force 19 June 2004).

Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean, 14 November 2009, 2899 UNTS 211 (entered into force 24 August 2012).

Convention on the Conservation of Migratory Species of Wild Animals, 23 June 1979, 1651 UNTS 333 (entered into force 1 November 1983).

Convention on the Conservation of Salmon in the North Atlantic Ocean, 2 March 1982, 1338 UNTS 33 (entered into force 1 October 1983).

Convention on Environmental Impact Assessment in a Transboundary Context, 25 February 1991, 1989 UNTS 309 (entered into force 10 September 1997).

Convention on Future Multilateral Co-operation in the Northwest Atlantic Fisheries, 24 October 1978, 1135 UNTS 370 (entered into force 1 January 1979), as amended.

Convention on Future Multi-lateral Cooperation in North-East Atlantic Fisheries, 18 November 1980, 1285 UNTS 130 (entered into force 17 March 1982).

Convention on the International Maritime Satellite Organization (INMARSAT), 3 September 1976, 1143 UNTS 105 (entered into force 16 July 1979).

Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 (Helsinki Convention), 9 April 1992, 2099 UNTS 197 (entered into force 17 January 2000) (as amended).

Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention), 2 February 1971, 996 UNTS 245, 11 ILM 969 (1972) (entered into force 21 December 1975).

International Convention for the Prevention of Pollution from Ships, *1973*, as modified by the *Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973* (MARPOL 73/78), 17 February 1978, 1340 UNTS 61 (entered into force 2 October 1983).

International Labor Organization (ILO) Convention No 169 concerning Indigenous and Tribal Peoples in Independent Countries, 27 June 1989, 1650 UNTS 383 (entered into force 5 September 1991).

Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity, 29 October 2010, UNEP/CBD/COP/DEC/X/1 (entered into force 12 October 2014).

Paris Agreement, 12 December 2015, U.N. Doc. FCCC/CP/2015/L.9/Rev/1 (Dec. 12, 2015) (entered into force 4 November 2016).

Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context, 21 May 2003, 2685 UNTS 140 (entered into force 11 July 2010).

Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement), 4 March 2018, UNTS I-56654 (entered into force 22 April 2021).

Statute of the International Court of Justice, 26 June 1945, 33 UNTS 993 (entered into force 24 October 1945).

United Nations Convention on the Law of the Sea, 10 December 1982, 1833 UNTS 397 (entered into force 16 November 1994).

United Nations Framework Convention on Climate Change, 9 May 1992, 1771 UNTS 107, 31 ILM 849 (entered into force 21 March 1994).

Vienna Convention on Law of Treaties, 23 May 1969, 1155 UNTS 331 (entered into force on 27 January 1980).

International Cases

Southern Bluefin Tuna (New Zealand v Japan; Australia v Japan), Provisional Measures, Order of 27 August 1999, ITLOS Reports 1999.

Chagos Marine Protected Area Arbitration (Mauritius v United Kingdom), Award of 18th March 2015, ICGJ 486 (PCA case Nº 2011-03) (Professor Ivan Shearer, Judge Sir Christopher Greenwood CMG QC, Judge Albert Hoffmann, Judge James Kateka, Judge Rüdiger Wolfrum).

Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011.

South China Sea Arbitration (Republic of the Philippines v the People's Republic of China) Award of 12 July 2016, (PCA Case Nº 2013-19) (Arbitrators: Judge Thomas A Mensah, Judge Jean-Pierre Cot, Judge Stanislaw Pawlak, Professor Alfred H Soons, Judge Rüdiger Wolfrum).

Pulp Mills on the River Uruguay (Argentina v Uruguay) (Merits 20 April 2010) [2010] ICJ Rep 2010.

Arbitration regarding the Iron Rhine ('Ijzeren Rijn") Railway between the Kingdom of Belgium and the Kingdom of the Netherlands, Award of 24 May 2005, PCA 2003-03, 27 RIAA (2005) 35 (Arbitrators: Judge Rosalyn Higgins, Professor Guy Schrans, Judge Bruno Simma, Professor Alfred HA Soons, Judge Peter Tomka).

EUROPEAN UNION DOCUMENTS

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive), [2000] OJ L 327/1.

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), [2008] OJ L 164/19.

Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, [1992] OJ L 206/7.

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, [2009] OJ L 20/7.

Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, [2001] OJ L 197/30 [Strategic Environmental Assessment Directive].

Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment [2012] OJ L 26/1, as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 [2014] OJ L 124/1.

Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning, [2014] OJ L 257/135.

ECJ *Bund v Germany*, C-461/13 [2015] ECR I-433.

NATIONAL DOCUMENTS – UNITED STATES OF AMERICA

Legislation

Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 USC 1801 - 1891(d).

Finfish Farming Prohibited, AS 16.40.210.

Jurisprudence

Inst for Fisheries Res v Hahn, 424 F Supp 3d 740, 2019 WL 6907079; and 499 F Supp 3d 657, 2020 WL 6495656.

Gulf Fishermen Ass'n v Nat'l Marine Fisheries Serv, 968 F 3d 454, 48 ELR 20175 (2020).

Gulf Fishermens Ass'n v. Nat'l Marine Fisheries Serv., 341 F Supp 3d 632 (2018).

NATIONAL DOCUMENTS – CANADA

Legislation

Constitution Act, 1867, 30 & 31 Victoria, c 3 (UK).

Fisheries Act, RSC, 1985, c F-14.

Species at Risk Act, SC 2002, c 29.

Oceans Act, SC 1996, c 31.

Health of Animals Act, SC 1990, c 21.

Food and Drugs Act, RSC, 1985, c F-27.

Pest Control Products Act, SC 2002, c 28.

Canadian Environmental Protection Act, 1999, SC 1999, c 33.

Impact Assessment Act, SC 2019, c 28, s 1.

Canadian Navigable Waters Act, RSC, 1985, c N-22.

Migratory Birds Convention Act, 1994, SC 1994, c 22.

Feeds Act, RSC, 1985, c F-9.

United Nations Declaration on the Rights of Indigenous Peoples Act, SC 2021, c 14.

Bill C-258, *An Act to amend the Fisheries Act (closed containment aquaculture)*, 1st Sess, 44th Parl, 2022.

Regulations

Feeds Regulations, SOR/83-593.

New Substances Notification Regulations (Organisms), SOR/2005-248.

Navigable Waters Works Regulations, CRC, c 1232.

Aquaculture Activities Regulations, SOR/2015-177.

Fishery (General) Regulations, SOR/93-53.

Maritime Provinces Fishery Regulations, SOR/93-55.

Atlantic Fishery Regulations, 1985, SOR/86-21.

Marine Mammal Regulations, SOR/93-56.

Aquatic Invasive Species Regulations, SOR/2015-121.

Health of Animals Regulations. CRC, c 296.

Reportable Disease Regulations, SOR/91-2.

Food and Drugs Regulations, CRC, c 870.

Strategies and Policies

Fisheries and Oceans Canada (DFO), "Aquaculture Policy Framework" (2002), online: DFO <https://waves-vagues.dfo-mpo.gc.ca/Library/263241eng.pdf>.

———, "Canada's Sustainable Aquaculture Program", online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/programs-programmes/sustainable-durable/index-eng.htm>.

National Code of Introductions and Transfers of Aquatic Organisms (2017).

Jurisprudence

Ecology Action Centre v Canada (Minister of the Environment), [2015] FCJ No 1534, 2015 FC 1412.

Ecology Action Centre v Canada (Minister of the Environment), [2016] FCJ No 1162, 2016 FCA 258.

Re Provincial Fisheries (1895) 26 SCR 444; AG British Columbia v AG Canada (1913) 15 DLR 308 (PC) [Re BC Fisheries].

Morton v. British Columbia (Minister of Agriculture and Lands) [2009] B.C.J. No. 193, 2009 BCSC 136.

Legislation

Coastal Protection Act, SNS 2019, c 3.

Environment Goals and Climate Change Reduction Act, SNS 2021, c 20.

Environment Act, SNS 1994-1995, c 1 (as amended).

Fisheries and Coastal Resources Act, SNS 1996 c 25 (as amended).

Freedom of Information and Protection of Privacy Act, SNS 1993, c 5 (as amended)

Regulations

Aquaculture Licence and Lease Regulations, NS Reg 347/2015, as amended by NS Reg 186/2019.

Aquaculture Management Regulations, NS Reg 348/2015, as amended by NS Reg 118/201.

Strategies and Other Documents

Memorandum of Understanding on Aquaculture Development between Minister of Fisheries and Oceans (Canada) one the First Part and Minister of Fisheries (Nova Scotia) on the Second Part (1995).

Memorandum of Understanding on Aquaculture Development between Minister of Fisheries and Oceans (Canada) and Minister of Agriculture and Fisheries (Nova Scotia) (2002)

Memorandum of Understanding for the Development and Management of the Aquaculture Industry between de Governments of New Brunswick, Prince Edward Island, Newfoundland and Labrador, and Nova Scotia (2021). The MoU replaced the previous "Atlantic Provinces' Memorandum of Understanding for the Development of the Aquaculture Sector" (2008).

Nova Scotia Government, *Aquaculture Strategy Creating Sustainable Wealth in Rural and Coastal Nova Scotia* (2012), online: Nova Scotia <https://novascotia.ca/fish/NS-Aquaculture-Policy.pdf>.

———, "Mandate Letter to the Honourable Steve Craig, Minister of Fisheries and Aquaculture" (14 September 2021), online: Government of NS <https://novascotia.ca/exec_council/letters-2021/ministerial-mandate-letter-2021-FA.pdf>.

One Nova Scotia, *Now or Never: An Urgent Call for Action for Nova Scotians. The Report of the Nova Scotia Commission on Building Our New Economy* (February 2014) [Ivany Report].

Jurisprudence

St Mary's Bay Coastal Alliance Society v Nova Scotia (Minister of Fisheries and Aquaculture), [2013] NSJ No 148, 2013 NSSC 105.

Websites

Nova Scotia Department of Fisheries and Aquaculture (NSDAF), <https://novascotia.ca/fish/aquaculture/>.

Nova Scotia Aquaculture Review Board (NSARB), <https://arb.novascotia.ca/>.

Centre for Marine Applied Research (CMAR), <https://cmar.ca/>.

Environmental Monitoring Program, Open Data, Environmental Monitoring Program Data <https://data.novascotia.ca/Fishing-and-Aquaculture/Environmental-Monitoring-Program-Data/9ay9-v8wn>.

Supplementary Material

Nova Scotia Department of Fisheries and Aquaculture's Report on Outcomes of Consultations for Lease and Licence AQ#1039.

DFO Maritimes Region, **"**Review Of The Proposed Marine Finfish Aquaculture Boundary Amendment, Rattling Beach, Digby County, Nova Scotia", Canadian Science Advisory Secretariat Maritimes Region Science Response 2020/015.

NSARB, Decision and Order 2021-001.

NSDFA, Application Notice, Kelly Cove Salmon Ltd.

Kelly Cove Salmon Ltd, Application: Liverpool Bay Finfish Marine Aquaculture Development Plans for NS1205 Liverpool – Boundary Amendment Brooklyn and Mersey Point – New Site Applications.

DFO Maritimes Region, Science Review of the Proposed Marine Finfish Aquaculture Boundary Amendment and New Sites, Liverpool Bay, Queens County, Nova Scotia, Canadian Science Advisory Secretariat Maritimes Region Science Response 2022/039.

NSDAF, Decision on Application to Renew a Marine Aquaculture Licence and Lease #1358 (18 August 2022).

NSDAF, Decision on Application to Amend a Marine Aquaculture Licence and Lease #0602 (October 19 2022).

NATIONAL DOCUMENTS – CHILE

[if appropriate, translated by author and with support of Deepl Free Machine Translation]

Legislation

Constitución Política de la República de Chile [Political Constitution of the Republic of Chile].

Ley General de Pesca y Acuicultura [General Fisheries and Aquaculture Act], DS N° 430 of 1992, issued by the Ministry of Economy, Promotion and Development (now Ministry of Economy and Tourism).

Ley N° 19,300 sobre Bases Generales del Medio Ambiente [Framework Environmental Act].

Ley N° 20,249 que crea el Espacio Costero Marino de los Pueblos Originarios [Act on the Coastal and Marine Areas of Indigenous Peoples].

Promulga el Convenio Nº 169 sobre Pueblos Indígenas y Tribales en Países Independientes de la Organización Internacional del Trabajo, DS N° 236 de 2008 del Ministerio de Relaciones Exteriores [Promulgates the Indigenous and Tribal Peoples Convention, 1989].

Ley N° 21,455 Ley Marco de Cambio Climático [Framework Act on Climate Change].

Promulga el Acuerdo Regional sobre el Acceso a la Información, la Participación Pública y el Acceso a la Justicia en Asuntos Ambientales en América Latina y el Caribe y su Anexo 1, DS N° 209 de 2022 del Ministerio de Relaciones Exteriores [Promulgates the Regional Agreement on Access to Information, Public Participation and Access to Justice in Environmental Matters in Latin America and the Caribbean and its Annex 1].

Regulations

Registro Público de Concesiones de Acuicultura, DS N° 113 de 2013, del Ministerio de Economía, Fomento y Turismo (MINECON) [Regulations on the National Public Registry on Aquaculture Leases].

Reglamento sobre Limitación de áreas de las Concesiones y Autorizaciones de Acuicultura, DS Nº 550 de 92 del MINECON [Regulations on Spatial Limits on the Aquaculture Leases].

Reglamento que Fija los Niveles Mínimos de Operación por Especie y Área, DS N 383 de 2007 del MINECON, y sus modificaciones posteriores [Regulations on Minimum Aquaculture Operation Levels by Species and Area, as amended].

Reglamento Ambiental para la Acuicultura, DS N° 320 de 2001, del MINECON, y sus modificaciones posteriores [Aquaculture Environmental Regulations, as amended].

Reglamento de Medidas de Protección, Control y Erradicación de Enfermedades de Alto Riesgo para las Especies Hidrobiológicas, DS N° 319 de 2001, del MINECON, y sus modificaciones posteriores [Fish Health Regulations, as amended].

Reglamento de Internación de Especies de Primera Importación, DS N° 730 de 1995 del MINECON, y modificaciones posteriores [Regulations for the First Introduction of Species into the Country, as amended].

Reglamento de Certificación y Otros Requisitos Sanitarios para la Importación de Especies Hidrobiológicas, DS N° 72 de 2011 del MINECON, y sus modificaciones posteriores [Regulations on Sanitary Certifications and other Sanitary Requirements for the Introduction of Hydrobiological Species to the Country, as amended].

Reglamento sobre Plagas Hidrobiológicas, DS N° 345 de 2005, del del MINECON, y sus modificaciones posteriores [Regulations on Invasive Aquatic Species, as amended].

Aprueba Reglamento de Control en Línea de Parámetros Ambientales de las Agrupaciones de Concesiones de Acuicultura, DS N° 1 de 2020, del del MINECON [Regulations on real-time environmental monitoring in salmon farm clusters].

Aprueba Reglamento que Establece Condiciones Sobre Tratamiento y Disposición Final de Desechos Provenientes de Actividades de Acuicultura, DS N° 64 de 2020, del MINECON [Regulations on conditions on treatment and final disposal of waste from aquaculture activities].

Aprueba el Reglamento de Registro de Personas Acreditadas para Elaborar los Instrumentos de Evaluación Ambiental y Sanitaria y las Certificaciones Exigidas por la Ley General de Pesca y Acuicultura y sus Reglamentos, DS N° 15 de 2011, del MINECON, y sus modificaciones posteriores [Regulations on Entities authorized to Prepare Environmental and Sanitary Evaluation Instruments and Certifications Required in the LGPA and its Regulations, as amended].

Establece Reglamento para la Entrega de Información de Pesca y Acuicultura y la Acreditación de Origen, DS N° 129 de 2013, del MINECON [Regulations for the Submission of Fisheries and Aquaculture Information and proof of origin].

Reglamento de la Ley N° 20.249 que Crea el Espacio Costero Marino de los Pueblos Originarios, DS N° 134 de 2009, del Ministerio de Planificación, del MINECON, y

Ministerio de Defensa Nacional [Regulations under Act 20249 on Coastal and Marine Areas of Indigenous Peoples].

Reglamento del Sistema de Evaluación de Impacto Ambiental, DS N° 40 de 2012, del Ministerio del Medio Ambiente, y modificaciones posteriores [Regulations on the Environmental Impact Assessment System, as amended].

Reglamento para la Evaluación Ambiental Estratégica, DS N° 32 de 2015, del Ministerio del Medio Ambiente [Regulations on Strategic Environmental Assessment].

Política Nacional de Uso del Borde Costero del Litoral, DS N° 475 de 1994, del Ministerio de Defensa [[National Policy for the Use of the Coastal Zone].

Declara Áreas de Usos Preferentes Específicos los Espacios del Borde Costero del Litoral de la XI Región Aisen del General Carlos Ibañez Del Campo, DS Nº 153 de 2004, del Ministerio de Defensa [Declares Preferential Uses Areas on the Coast of the XI Region].

Declara Áreas de Usos Preferentes Específicos los Espacios del Borde Costero del Litoral de la IV Región De Coquimbo, D.S. Nº 518 de 2005 del Ministerio de Defensa [Declares Preferential Uses Areas on the Coast of the IV Region].

Reglamento de Certificación y Otros Requisitos Sanitarios para la Importación de Especies Hidrobiológicas, DS N° 72 de 2011, del MINECON [Regulations on Certification and other fish health requirements for the Introduction of Aquatic Species].

Orders

Establece Metodología para Determinación de Banco Natural de Recursos Hidrobiológicos para Fines que Indica, Resolución N° 2353 de 2010, de la Subsecretaría de Pesca y Acuicultura (SUBPESCA) [Methodology to assess presence of fish banks].

Establece Metodología para la Caracterización Preliminar de Sitio e Información Ambiental (INFA), Resolución N° 3612 de 2019, de la SUBPESCA, y sus modificaciones posteriores [Methodology for baseline information and environmental monitoring, as amended].

Establece Metodología para el Levantamiento de Información, Procesamiento y Cálculos del Estudio de Ingeniería, y Especificaciones Técnicas de las Estructuras de Cultivo a la que se Refiere el Artículo 4° Letra E) del D.S. 320 de 2001, Resolución N° 1821 de 2020 de la SUBPESCA [Methodology for Baseline Information, Processing, and Calculations of the Engineering Study, and Technical Standard for the Farming Structures under the Aquaculture Environmental Regulations].

Establece las Características y Requisitos que se deben Cumplir en la Instalación de las Estaciones de Monitoreo de Conformidad con el Artículo 9° del Reglamento de Control en Línea de Parámetros Ambientales de las ACS, fijado por D.S. N° 1 de 2020, del

Ministerio de Economía, Fomento y Turismo, Resolución N° 3408 de 2021 de la SUBPESCA [Technical Requirements for the monitoring stations requied under article 9 of the Regulations on real-time environmental monitoring in salmon farm clusters].

Actualiza y Reemplaza Resolución que Establece Agrupaciones de Concesiones de Acuicultura de Salmónidos en Regiones que Indica, Resolución N° 2300 de 2022 de la SUBPESCA [Updates and replaces the order establishing salmon farm clusters in the regiones indicated].

Establece Macro-zonas que Indica en la Región de Los Lagos, Resolución N° 1548 de 2012 (SUBPESCA) [Establish Macro-zones in the X Region of Los Lagos].

Establece Macro-zonas que Indica en la Región de Aysén del General Carlos Ibáñez del Campo, Resolución N° 1549 de 2012, y sus modificaciones posteriores (SUBPESCA) [Establish Macro-zones in the XI Region of Aysen, as amended].

Establece Macro-zonas que Indica en la Región de Magallanes y Antártica Chilena, Resolución N° 2247 de 2014, (SUBPESCA) [Establish Macro-zones in the XII Region of Magallanes and Chilean Antarctic].

Declara como no Disponible Áreas Apropiadas para el Ejercicio de la Acuicultura de la X Región de Los Lagos, Resolución N° 875 de 2012 de SUBPESCA, y modificaciones posteriores [Declares as unavailable Areas Appropriate for Aquaculture in the X Region of Los Lagos, as amended].

Declara Como No Disponibles Áreas Apropiadas para el Ejercicio de la Acuicultura en la Región de Aysén, Resolución N° 902 de 2020 de SUBPESCA [Declares as unavailable Areas Appropriate for Aquaculture in the XI Region of Aysen].

Declara Como No Disponibles Áreas Apropiadas para el Ejercicio de la Acuicultura en la XII Región, Resolución N° 3264 de 2016 de SUBPESCA [Declares as unavailable Areas Appropriate for Aquaculture in the XII Region][translated by author].

Reglamento Interno de Funcionamiento de la Comisión Regional de Uso del Borde Costero de la República, Oficio Gabinete Presidencial N° 1 de 2005 de la Subsecretaria de Fuerzas Armadas [Rules of Procedure for the Regional Commission for the Use of the Coastal Zone].

Establece Indicadores Sanitarios, Ponderación de las Variables y Porcentajes de Reducción de Pérdidas (*sic*) Conforme al D.S. N° 319-2001, Resolución N° 904 de 2020 de SUBPESCA [Fish Health Indicators, Relative Weight, and Percentages of Stocking Reduction according to D.S. N° 319-2001].

Fija Descanso Sanitario Coordinado para las Agrupaciones de Concesiones de Salmónidos de las Regiones de los Lagos, de Aysén y de Magallanes, Que Indica, Resolución N° 1361 de 2022 del Servicio Nacional de Pesca y Acuicultura

(SERNAPESCA) [Coordinated fallowing for Salmon farm clusters of the X, XI, and XII Regions].

Establece Tramos de la clasificación y porcentaje reducción de siembra en Centros de cultivo. Fija Puntaje y Ponderación de los Elementos que Componen la Clasificación de las Agrupaciones de Concesiones, los Tramos de esta última, y las Correspondientes Densidades de Cultivo, Resolución N 1503 de 2003 de SUBPESCA, y sus modificaciones posteriores [Establishes classification and percentages of stocking reduction in salmon farms. Establishes criteria for the classification of salmon farm clusters and the allowed farming densities, as amended].

Fija Nómina de Especies Hidrobiológicas Vivas de Importación Autorizada, Resolución N° 2662 de 2021, de SUBPESCA [List of Aquatic Species for which import of live organisms is authorized].

Establece clasificación de enfermedades de alto riesgo, Resolución N° 1741 de 2013 de SUBPESCA [List of high risk diseases].

Programas Sanitarios Generales sobre registro de datos de laboratorio, manejo de enfermedades, manejo de desechos, reproducción de peces, manejo de mortalidades, manejo de alimentos, cosecha, transporte, limpieza y desinfección, sospecha de enfermedades de lista 1, para Región de Magallanes, vigilancia de susceptibilidad a antimicrobianos en la salmonicultura (Resoluciones 63, 65, 67, 68, 70 y 71, todas de 2003; 1468 de 2012; 2009, 2010, 2011, 2101 y 4866, todas de 2014; 1012 y 8228, ambas de 2015, 6246 de 2017, 591 de 2018, 386 y 1606, ambas de 2021, y 784 de 2022, todas del SERNAPESCA (http://www.sernapesca.cl/programas/programa-sanitario-general) [General Fish Health Programs].

Programas Sanitarios Específico para la Vigilancia Activa de Enfermedades de Alto Riesgo en Peces de Cultivo, Resolución N° 61 de 2003 de SERNAPESCA, y modificaciones posteriores [Specific Fish Health Program for Active Surveillance of High Risk Diseases].

Programa Sanitario Específico de Vigilancia y Control de Caligidosis. Resolución N° 60 de 2022 de SERNPESCA [Specific Fish Health Program for Sea Lice].

Instrucción General para la Implementación de un Sistema de Monitoreo Continuo en Centros de Engorda de Salmones (CES), Resolución N° 2662 de 2021, modificada por Resolución N° 1488 de 2022, ambas de la Superintendencia del Medio Ambiente [Instructions for the Implementation of a Continuous Monitoring System in Salmon Farms].

Strategies and Policies

Gobierno de Chile, *Politica Nacional de Acuicultura* (2003), online: SUBPESCA <https://www.subpesca.cl/portal/616/w3-propertyvalue-38050.html>.

———, “Estrategia Nacional de Biodiversidad 2017-2030” [National Biodiversity Strategy], online: Ministerio del Medio Ambiente <https://biodiversidad.mma.gob.cl/>.

———, “Plan de Adaptación al Cambio Climático para Pesca y Acuicultura” (2015) [Climate Change Adaptation Plan for Fisheries and Aquaculture], online: Ministerio del Medio Ambiente <https://mma.gob.cl/cambio-climatico/>.

Jurisprudence

Comunidad Indígena ATAP y otros con Comisión de Evaluación Ambiental de la Región de Magallanes, Rol 20-2019 Tercer Tribunal Ambiental (27 January 2021).

Comunidad Indígena ATAP y otros con Comisión de Evaluación Ambiental de la Región de Magallanes, Corte Suprema, Rol 14075-2021 (14 of July 2021).

Comunidad Indígena ATAP y otros con Director Ejecutivo del Servicio de Evaluación de Impacto Ambiental, Corte Suprema, Sentencia causa Rol 60548 (31 January 2022).

Comunidad Indígena Kawésqar Grupos Familiares Nómades del Mar y otros con Comisión de Evaluación Ambiental Región de Magallanes y la Antártica Chilena, R-16-2021 Tercer Tribunal Ambiental (27 December 2022).

Administrative Jurisprudence

Contralor General de la República (CGR), Dictamen E118757 de 2 de julio de 2021, Delegados presidenciales regionales, atribuciones, presidencia comisión de evaluación ambiental [Decision on regional representatives of the President, competences, and presidency of the regional evaluation comission].

———, Dictamen 34811 de 26 de agosto de 2017, sobre declaraciones de impacto ambiental, revisión, medio ambiente [Decision on impact assessments, review, environment].

———, Dictamen 3727 de 5 de febrero de 2019, sobre Medio ambiente, revisión resoluciones de calificación ambiental, requisitos, trámite excepcional, proyecto acuícola [Decision on environment, review of environmetnal assessment decisions, requirements, exceptional mechanism, aquacutlure project].

Fiscalía Nacional Económica, Oficio del Jefe de División Antimonopolios la Fiscal Nacional Económico de fecha 13 de abril de 2022, en Investigación en contra de SUBPESCA por posibles restricciones a la libre competencia en la industria salmonera, Rol N° 2529-19, [Investigation against SUBPESCA for possible restrictions to free competition in salmon industry] online: FNE <https://www.fne.gob.cl/wp-content/uploads/2022/04/inpu_004_2022-Rol-2529-19.pdf> (accessed 2 June 2022).

Websites

Contraloría General de la República, <https://www.contraloria.cl/web/cgr/>.

Gobierno de Chile, Sistema de Evaluación de Impacto Ambiental <http://seia.sea.gob.cl/busqueda/buscarProyecto.php>.

Ministerio del Medio Ambiente, Evaluación Ambiental Estratégica, <https://eae.mma.gob.cl/>.

Subsecretaria de Pesca, <https://www.subpesca.cl/portal/616/w3-channel.html>.

Servicio Nacional de Pesca, < http://www.sernapesca.cl/>.

Superintendencia del Medio Ambiente, <https://portal.sma.gob.cl/>.

Tribunales Ambientales, <https://tribunalambiental.cl/>.

Base Jurisprudencial del Poder Judicial, <https://www.pjud.cl/portal-jurisprudencia>.

Supplementary Material

DS N° 286 de 2018, del Ministerio de Defensa Nacional, que Modifica las Áreas Apropiadas para el Ejercicio de la Acuicultura (A.A.A.) en la Región de Magallanes y de la Antártica Chilena. [DS No 286 of 2018, issued by the Ministry of Defence, modifying the Appropriate Areas for Aquaculture (A.A.A.) in the XII Region of Magallanes and Chilean Antarctica].

Informe Técnico (D Ac) N° 877 de 2017, Propuesta de Nuevos Sitios de Áreas Apropiadas para el Ejercicio de la Acuicultura (A.A.A.) en la XII Región de Magallanes y de la Antártica Chilena. [Technical Report (D. Ac) No 877 of 2017, Proposal for New Sites of Appropriate Areas for Aquaculture (A.A.A.) in the XII Region of Magallanes and Chilean Antarctica]

DS N° 153 of 2004 del Ministerio de Defensa, que Declara Áreas de Usos Preferentes Específicos los Espacios del Borde Costero del Litoral de la XI Región Aisén del General Carlos Ibáñez Del Campo. [DS No 153 of 2004 issued by the Ministry of Defence, establishing Preferential Uses for the Areas of the Coastal Zone of the XI Region Aisén del General Carlos Ibáñez Del Campo].

Gobierno Regional de Aysén, Resolución N° 748 de 2019 que da inicio al proceso de evaluación ambiental estratégica de la modificación sustancial de la zonificación de uso del borde costero de la región de Aysén, expresada en áreas de uso preferentes específicos los espacios del borde costero del litoral de la XI región Aisén del General Carlos Ibáñez del Campo. [Aysén Regional Government, Order No 748 of 2019 initiating

strategic environmental assessment process of the substantial modification to the coastal zone plan of Aysén region, stating preferential uses for the space of the coastal zone].

Comisión de Evaluación Región de Magallanes y Antártica Chilena, Resolución que Califica Ambientalmente el Proyecto "Centro de Engorda de Salmonídeos, Canal Bertrand, al Norte de Isla Riesco, Comuna de Río Verde, Región de Magallanes y Antártica Chilena, Nº Pert 213121034" (Punta Arenas, 7 de diciembre 2021) [Regional Commission for Environmental Assessments, Decision "Salmon Farming Center, Bertrand Channel, North of Riesco Island, Municipality of Río Verde, Magallanes and Chilean Antarctic Region" (Punta Arenas, December 7, 2021)]

Comisión de Evaluación Región de Magallanes y Antártica Chilena, Resolución que Califica Ambientalmente el Proyecto "Centro de Cultivo de Salmónidos, Sur Islote Beytia, Nº de Solicitud 214121001" (Punta Arenas, 16 de febrero 2022) [Regional Commission for Environmental Assessments, Decision, "Salmon Farming Site, South Beytia Islet, Application No. 214121001" (Punta Arenas, February 16, 2022).]

Comisión de Evaluación Región de Los Lagos, Resolución Exenta Nº 140 de 2020, que Califica Ambientalmente el proyecto "Ampliación De Biomasa, Centro De Engorda De Salmones Isla Ica, Comuna De Chaitén, Región De Los Lagos" Puerto Montt [Regional Commission for Environmental Assessments, Decision 140 of 2020 "Biomass Increase, site Isla Ica, Chaitén municipality, Los Lagos Region].

NATIONAL DOCUMENTS – NORWAY

[if appropriate, documents translated with Google Machine Translate]

Legislation

The Constitution of the Kingdom of Norway, LOV-1814-05-17 (as amended) [English version for information purposes], Kongeriket Noregs grunnlov.

Act of June 2005 No 79 (as amended) Law on Aquaculture (Aquaculture Act) [English version for information purposes], Lov om akvakultur (akvakulturloven) (as amended).

Act of 19 June 2009 No 100 relating to the management of biological, geological and landscape diversity (Nature Diversity Act) [English version for information purposes], Lov om forvaltning av naturens mangfold.

Act of 13 March 1981 No 6 (as amended) relating to the Protection Against Pollution and to Waste (Pollution Control Act)) [English version for information purposes], Lov om vern mot forurensninger og om avfall (forurensningsloven).

Act of 27 June 2008 No 71 (as amended) relating to the planning and the processing of building applications (Planning and Building Act) [English version for information purposes], Lov om planlegging og byggesaksbehandling (plan- og bygningsloven).

Act of 19 June 2009 No 97 (as amended) relating to Animal Welfare [English version for information purposes], Lov om dyrevelferd.

Act of 19 December 2003 No 124 (as amended) relating to food production and food safety etc. (Food Act) [English text available online: FAO Ecolex], Lov om matproduksjon og mattrygghet mv. (matloven).

Act of 24 November 2000 No 82 on Watercourses and Groundwater (Water Resources Act)[English version for information purposes], Lov om vassdrag og grunnvann (vannressursloven).

Act of 21 June 2019 No 70 on Ports and Waters (Ports and Waters Act) [English version for information purposes],Lov om havner og farvann (havne- og farvannsloven).

Act of 9 June 1978 No 50 (as amended) on Cultural Heritage (Cultural Heritage Law) [English version for information purposes], Lov om kulturminner (kulturminneloven).

Regulations

Forskrift 15. desember 2006 nr. 1446 om rammer for vannforvaltningen (vannforskriften) [Framework for Water Management: the Water Regulations].

Forskrift om tillatelse til akvakultur for laks, ørret og regnbueørret (laksetildelingsforskriften) (FOR-2004-12-22-1798) (as amended) [Regulations on permits for aquaculture for salmon, trout and rainbow trout (salmon allocation regulations)].

Forskrift om produksjonsområder for akvakultur av matfisk i sjø av laks, ørret og regnbueørret (produksjonsområdeforskriften) (FOR-2017-01-16-61), as amended [Regulations on production areas for aquaculture of food fish in sea of salmon, trout and rainbow trout (production area regulations)].

Forskrift om kapasitetsøkning for tillatelser til akvakultur med matfisk i sjø av laks, ørret og regnbueørret i 2017-2018, (FOR-2017-12-20-2397) [Regulations on increasing capacity for permits for aquaculture of food fish in sea of salmon, trout and rainbow trout in 2017/2018].

Forskrift om kapasitetsjusteringer for tillatelser til akvakultur med matfisk i sjø av laks, ørret og regnbueørret i 2020 (FOR-2020-02-04-105) [Regulations on capacity adjustment for permits for aquaculture of food fish in sea of salmon, trout and rainbow trout in 2020].

Forskrift om kapasitetsjusteringer for tillatelser til akvakultur med matfisk i sjø av laks, ørret og regnbueørret i 2022 (FOR-2022-06-07-972) [Regulations on capacity adjustment

for permits for aquaculture of food fish in sea of salmon, trout and rainbow trout in 2022].

Forskrift om konsekvensutredninger (FOR-2017-06-21-854), as amended [Regulations on impact assessment].

Forskrift om etablering og utvidelse av akvakulturanlegg, zoobutikker m.m. (as amended) [Regulations on the establishment and expansion of aquaculture facilities, zoo shops m.m. (establishment regulations)].

Forskrift om drift av akvakulturanlegg (akvakulturdriftsforskriften) (FOR-2008-06-17-822), (as amended) [Regulations on the operation of aquaculture facilities (operation regulations)].

Forskrift om krav til teknisk standard for flytende akvakulturanlegg (NYTEK-forskriften) (FOR-2011-08-16-849) as amended [Regulations on requirements for technical standards for floating aquaculture facilities (NYTEK regulations)].

Forskrift om fellesansvar for utfisking mv. av rømt oppdrettsfisk (FOR-2015-02-05-89) (as amended) [Regulations on joint responsibility for fishing, etc. of escaped farmed fish].

Forskrift om internkontroll for å oppfylle akvakulturlovgivningen (IK-Akvakultur) (FOR-2004-03-19-537) (as amended) [Regulations on internal control to comply with aquaculture legislation (IK Aquaculture Regulations)].

Forskrift om bekjempelse av lakselus i akvakulturanlegg (FOR-2012-12-05-1140) (as amended) [Regulations on the control of salmon lice in aquaculture facilities (lice regulation)].

Forskrift om særskilte krav til akvakulturrelatert virksomhet i eller ved nasjonale laksevassdrag og nasjonale laksefjorder (FOR-2009-06-22-961) (as amended) [Regulations on special requirements for aquaculture-related activities in or near national salmon rivers and national salmon fjords (regulations for national salmon fjords)].

Kvalitetsnorm for ville bestander av atlantisk laks (Salmo salar) (FOR-2013-09-20-1109) [Quality norm for wild stocks of Atlantic salmon (Salmo salar)].

Forskrift om samordning og tidsfrister i behandlingen av akvakultursøknader (FOR-2010-05-18-708) (as amended) [Regulation on coordination and deadlines in the processing of aquaculture licence applications].

NS 9410:2016, Miljøovervåking av bunnpåvirkning fra marine akvakulturanlegg (unofficial version) [Environmental monitoring of benthic impact from marine aquaculture].

Direktoratsguppen vanndirektivet, Veileder 02:2018: Klassifisering av miljøtilstand i vann (2018) [Directorate Group Water Directive, Supervisor 02: 2018: Classification of environmental status in water (2018)].

Policies and Strategies

Norwegian Government, *The Aquaculture Strategy: A Sea of Opportunities* (6 July 2021), Foreword. [Havbruksstrategien: Et hav av muligheter], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/havbruksstrategien-et-hav-av-muligheter/id2864482/>.

———, *Strategy for a Competitive Norwegian Aquaculture Industry* (2007).

———, *Strategy for an Environmentally Sustainable Norwegian Aquaculture Industry* (2009).

———, *Blue Ocean, Green Future: the Government's commitment to the ocean and ocean industries*, online: Regjeringen <https://www.regjeringen.no/contentassets/564afd76f1e34ccda982f785c33d21b9/en-gb/pdfs/regjeringens-havrapport-engelsk.pdf> [English version].

———, *Coastal Strategy* (21 June 2021) [Kyststrategi – Nye jobber langs kysten vil gi vekst og utvikling i Distrikts-Norge], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/kyststrategi/id2862477/> (accessed 11 July 2022).

———, *Food Nation Norway* (12 February 2021), online: Regjeringen <https://www.regjeringen.no/no/dokumenter/matnasjonen-norge/id2834496/> (accessed 12 July 2022) [Matnasjonen Norge] (Google Translate}.

———, *National Strategy for a Green, Circular Economy* (16 June 2021) [Nasjonal strategi for ein grøn, sirkulær økonomi], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/nasjonal-strategi-for-ein-gron-sirkular-okonomi/id2861253/>.

———, *Strategy for Developing a Green*, *Circular Economy*, Regjeringen <https://www.regjeringen.no/contentassets/a116f209e493471bb26c81cf645152a3/kld_strategi_sirkularokonomi_sammendrag_eng_0507.pdf> (accessed 11 July 2022) [English version].

———, *Strategy against escapes from aquaculture* (31 March 2017) [Strategi mot rømming fra akvakultur] online: Regjeringen <https://www.regjeringen.no/no/dokumenter/strategi-mot-rommingfra-akvakultur/id2547105/>.

———, *A Sea of Opportunities: Government's Aquaculture Strategy* (6 July 2021), [Et hav av muligheter: regjeringens havbruksstrategi].

Other government documents

Norwegian Government (King in Council), Prop 103 L (2012–2013) Endringer i akvakulturloven [Proposal for Amendments to the Aquaculture Act], online: Regjeringen <https://www.regjeringen.no/no/dokumenter/prop-103-l-20122013/id720309/>.

Jurisprudence

Hordaland tingrett THOD-2020-168236 (20-168236TVI-THOD/1).

Sogn og Fjordane tingrett TSOFT-2020-109859.

Gulating lagmannsrett – LG-2021-80234.

Websites

Regjeringen [Norwegian Government], <https://www.regjeringen.no/no/id4/>.

Lovdata [Legal data], <https://lovdata.no/>.

Barentswatch, Sustainability in Aquaculture <https://www.barentswatch.no/havbruk/?lang=en>.

Akvakulturregisteret [Aquaculture register], <https://www.fiskeridir.no/Akvakultur/Registre-og-skjema/akvakulturregisteret>.

Supplementary Material

Planskildring Sjø-og Strandsoneplan, Arealplan etter Plan- og bygningslova § 11-5 Vedlegg 1 av 17 [Plan Description Sea and Beach Zone Plan. Area plan according to the Planning and Building Act § 11-5. Appendix 1 of 17]

Detaljregulering for Angelskår akvakulturområde i Osterøy kommune PlanID 1253-2019001 Planomtale med konsekvensvurdering og ROS-analyse [Detailed regulation for the Angleskår aquaculture area in Osterøy municipality. Plan ID 1253-2019001. Plan review with impact assessment and ROS analysis]

Statsforvalteren i Vestland, [County Governor of Vestland], Løyve til utslepp for Sjøtroll Havbruk AS på lokaliteten 18898 Skaftå i Osterøy commune [Release permit for Sjøtroll Havbruk AS at location 18898 Skaftå in Osterøy municipality] reference 2019/9399 (18 May 2022) [Permit under the Pollution Control Act]

Statsforvalteren i Vestland, [County Governor of Vestland], Løyve til ny plassering av anlegg og avslag på søknad om auke i MTB på lokaliteten 12086 Alsåkervik i Kvinnherad commune [Permission for a new location of facilities and rejection of an application for an increase in MTB on location 12086 Alsåkervik in Kvinnherad municipality], reference 2019/7337 (4 October 2019).

Statsvorfalteren i Troms og Finnmark [State administrator Troms and Finnmark], Tillatelsen til virksomhet etter forurensningloven for Cermaq Norway AS ved lokalitet 13996 Hamnefjord [Permit to operate under the Pollution Act for Cermaq Norway AS at location 13996 Hamnefjord].

NATIONAL DOCUMENTS – SCOTLAND

Legislation

Animal Health and Welfare (Scotland) Act 2006, 2006 asp 11.

Aquaculture and Fisheries (Scotland) Act 2007, 2007 asp 12.

Aquaculture and Fisheries (Scotland) Act 2013, 2013 asp 7.

Environmental Assessment (Scotland) Act 2005, 2005 asp 15.

Marine (Scotland) Act 2010, 2010 asp 5.

Nature Conservation (Scotland) Act 2004, 2004 asp 6.

Planning etc (Scotland) Act (2006), 2006 asp 17.

Scottish Crown Estate Act 2019, 2019 asp 1.

Town and Country Planning (Scotland) Act 1997 (UK), 1997, c 8.

UK Withdrawal from the European Union (Continuity) (Scotland) Act 2021, 2021 asp 4.

Water Environment and Water Services (Scotland) Act 2003, 2003 asp 3.

Regulations

Aquatic Animal Health (Scotland) Regulations 2009, SSI 2009/85 (as amended).

Aquatic Animal Health (Miscellaneous Modifications) (Scotland) Regulations 2011, SSI 2011/427.

Conservation of Salmon (Scotland) Regulations 2016, SSI 2016/115.

Fish Farming Code of Practice (Scotland) Order 2021, SSI 2021/340.

Fish Farming Business (Reporting) (Scotland) Order 2020, SSI 2020/447.

Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017, SSI 2017/102 (as amended).

Water Environment (Controlled Activities) (Scotland) Regulations 2011, SSI 2011/209 (as amended).

Strategies and Policies

Scottish Government, "Scotland's National Marine Plan: A Single Framework for Managing Our Seas" (Edinburgh: The Scottish Government, 2015).

———, "Scottish Planning Policy" (2014), online: Scottish Government <https://www.gov.scot/policies/planning-architecture/>.

———, "Ambition, Opportunity, Place: Scotland's Third National Planning Framework" (2014) at 67, online: Scottish Government <https://www.gov.scot/policies/planning-architecture/>.

———, "2020 Challenge for Scotland's Biodiversity", online: Scottish Government <https://www.sepa.org.uk/environment/biodiversity/>.

———, "Scotland 2045: Our Fourth National Planning Framework. Draft" (10 November 2021), online: Scottish Government <https://www.gov.scot/publications/scotland-2045-fourth-national-planning-framework-draft/>.

Scottish Government and Scottish Green Party, "Shared Policy Programme: Working Together to Build A Greener, Fairer, Independent Scotland" (1 September 2021).

Websites

Scotland's Aquaculture: <http://aquaculture.scotland.gov.uk/data/site_details.aspx>.

Supplementary Materials

Argyle and Bute Council, Argyle and Bute Development Plan (*Plana-leasachaidh Ionadail Earra-ghàidheal is Bhòid*) Written Statement (March 2015).

Online Local Development Plan (Map), https://www.argyll-bute.gov.uk/online-local-development-plan.

Supplementary Guidance 2: Coastal Development. Aquaculture Development (SG LDP AQUA 1).

Argyll and Bute Local Development Plan and Supplementary Guidance Environmental Report (October 2015).

Marine & Coastal Development Unit, Planning Services, Argyll & Bute Council, Loch Etive ICZM Plan: A Spatial Planning Framework for Future Development (March 2011).

Marine & Coastal Development Unit, Planning Services, Argyll & Bute Council, Loch Fyne ICZM Plan: A Spatial Planning Framework for Future Development (December 2009).

Scottish Sustainable Marine Environment Initiative, Sound of Mull MSP (August 2010).

Orkney Islands Council, Orkney Local Development Plan (April 2017).

Orkney Islands Council, Orkney Supplementary Guidance: Aquaculture (10 August 2017).

Orkney Islands Council, The Orkney Local Development Plan Proposed Plan Environmental Report (March 2016).

Planning Committee: 30 October 2019. Create Salmon Farming Site with Feed Barge at Mill Bay, Stronsay. Report by Executive Director of Development and Infrastructure.

Shetland Islands Council, Shetland Local Development Plan (September 2014).

Shetland Islands Council, Shetland LDP Supplementary Guidance: Aquaculture (April 2017).

Shetland Islands Council, Strategic Environmental Assessment (SEA) Shetland Islands Council Local Development Plan Final Environmental Report 3 October 2012.

Shetland Islands Council and NAFC Marine Center, Shetland Islands' Marine Spatial Plan (4th ed)(2015).

Application to develop a new Atlantic salmon farm comprising 12 x 120m-circumference cages and a 10m-diameter c-cap feed barge in Wick Of Gruting, Fetlar, Shetland (Reference 2019/012/MAR). Application decided on 7 April 2020.

NATIONAL DOCUMENTS – UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

European Union (Withdrawal Agreement) Act 2020 (UK), 2020 c 1.

Scotland Act 1998 (UK), 1998, c 46.

Conservation (Natural Habitats, etc) Regulations 1994, SI 1994/2716 (as amended).

HM Government, "UK Marine Policy Statement" (March 2011).

NATIONAL DOCUMENTS – ARGENTINA

Ley N° 1355 Cultivo y Producción de Salmónidos: Prohibición en Aguas Lacustres y Marítimas de la Provincia (Provincia de Tierra del Fuego, Argentina)[Act 1355 on Salmonid Farming and Production: Prohibition in internal and maritime waters of the province, Province Tierra del Fuego, Argentina];

SECONDARY MATERIAL

Aagaard, Todd S, "Environmental Law Outside the Canon" (2014) 89 Indiana Law Journal 1239.

Adams, Thomas P, Dmitry Aleynik & Kenneth D Black, "Temporal variability in sea lice population connectivity and implications for regional management protocols" (2016) 8 Aquacult Environ Interact 585.

Aguilar-Manjarrez, J, JM Kapetsky & D Soto. *The potential of spatial planning tools to support the ecosystem approach to aquaculture*. FAO/Rome. Expert Workshop. 19–21 November 2008, Rome, Italy. FAO Fisheries and Aquaculture Proceedings No 17 (Rome: FAO, 2010).

Aguilar-Manjarrez, José , Doris Soto & Randall Brummett, *Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture. A handbook*. Report ACS18071 (Rome, FAO; Washington, World Bank Group: 2017).

Ahmed, Nesar, et al, "Can greening of aquaculture sequester blue carbon?" (2017) 46 Ambio 468.

Aiken, Milam, "An Updated Evaluation of Google Translate Accuracy" (2019) 3 Studies in Linguistic and Literature 253.

Alleway, Heidi K, et al, "The Ecosystem Services of Marine Aquaculture: Valuing Benefits to People and Nature" (2019) 69(1) BioScience 59

Andersen, LB, et al, "Risk understanding and risk acknowledgement: a new approach to environmental risk assessment in marine aquaculture" (2022) 79 ICES J of Marine

Science 987.

Angel, Dror & Shirra Freeman. “Integrated aquaculture (INTAQ) as a tool for an ecosystem approach to the marine farming sector in the Mediterranean Sea” in D Soto (ed), *Integrated mariculture: a global review*. FAO Fisheries and Aquaculture Technical Paper No 529, 133 (Rome: FAO, 2009).

Angelo, Mary Jane, “Embracing uncertainty, complexity and change: an eco-pragmatic reinvention of a first-generation environmental law” (2006) 33 Ecology LQ 105.

Anton, Sierre & Katherine Hupp, “One Step Forward, Two Steps Back: NOAA's Assertion of Jurisdiction Over Aquaculture Faces Continuing Challenges'” (2021) Sea Grant L & Pol’y J 70.

Aqua, “Julio Salas en AquaForum Puerto Montt anunció una nueva Ley General de Acuicultura” [Julio Salas, Undersecretary for Fisheries and Aquaculture, announces a new Act on Aquaculture](10 November 2022), online: Aqua <https://www.aqua.cl/2022/11/10/julio-salas-en-aquaforum-puerto-montt-anuncio-una-nueva-ley-general-de-acuicultura/#>.

Arkema, Katie K, Sarah C Abramson & Brian M Deawsbury. “Marine ecosystem-based management: from characterization to implementation” (2006) 4 Front Ecol Environ 535.

Arnold, Craig Antony (Tony), “Fourth-Generation Environmental Law: Integrationist and Multimodal” (2010-2011) 35 Wm & Mary Envtl L & Pol'y Rev 771.

Arnold, Craig Antony (Tony) & Lance H Gunderson, “Adaptive Law and Resilience” (2013) 43 Env L Reporter News & Analysis 10426.

Arthur, Bronwyn H, *A Commentary on the Convention on Biological Diversity*, LLM Research Paper, Law Faculty, Victoria University of Wellington (1993) available online <https://core.ac.uk/download/pdf/82892004.pdf >.

Asche, Frank, et al, “Salmon Aquaculture: Larger Companies and Increased Production” (2013) 17 Aquaculture Economics & Management 322

Asche, Frank, et al, “The Salmon Disease Crisis in Chile” (2009) 24 Marine Resource Economics 405.

Bailey, Conner, “Human dimensions of an ecosystem approach to aquaculture” in D Soto, J Aguilar-Manjarrez & N Hishamunda, N (eds), *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and Aquaculture Proceedings No 14 (Rome: FAO, 2008) 37.

Bailey, Jennifer L & Sigrid Sandve Eggereide, “Indicating sustainable salmon farming: The case of the new Norwegian aquaculture management scheme” (2020) 117 Marine Policy 103925.

Baltic Marine Environment Protection Commission (Helsinki Commission - HELCOM)

and OSPAR Commission for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR), "Statement on the Ecosystem Approach to the Management of Human Activities: Towards an Ecosystem Approach to the Management of Human Activities", adopted during the Joint Ministerial Meeting of the Helsinki and OSPAR Commissions held in Bremen, Germany, 25-26 June 2003.

Baluyut, Elvira A, *Aquaculture Systems and Practices: A Selected Review*, ADCP/REP/89/43 (Rome, FAO: 1989).

Bangert, Kaare, "Internal Waters", Max-Planck Encyclopedia of Public International Law (online) (last updated February 2018).

Bankes, Nigel, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016).

Barnes, R, "Article 24" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 217.

Barry, Tricia K & David L VanderZwaag, "Preventing Salmon Escapes from Aquaculture in Canada and the USA: Limited International Coordinates, Divergent Regulatory Currents and Possible Future Courses" (2017) 16 RECIEL 58.

Barsh, Russel Lawrence, "Indigenous Peoples", in Daniel Bodansky, Jutta Brunnée & Ellen Hey, *The Oxford Handbook of International Environmental Law* (New York: Oxford University Press, 2017) 829.

Barton Jonathan R & Arnd Fløysand, "The political ecology of Chilean salmon aquaculture, 1982–2010: A trajectory from economic development to global sustainability" (2010) 20 Global Environmental Change 739.

Bell, Jennifer L et al, "Environmental Monitoring Tools and Strategies in Salmon Net Pen Aquaculture" (2022) Integrated Environmental Assessment and Management (in press).

Benson, Melinda Harm & Ahjond S Garmestani, "Embracing panarchy, building resilience and integrating adaptive management through a rebirth of the National Environmental Policy Act" (2011) 92 J Envt'l Management 1420.

Bermúdez, Jorge, "Legal and policy components of the application of the ecosystem approach to aquaculture to site selection and carrying capacity" in LG Ross et al, (eds), *Site selection and carrying capacities for inland and coastal aquaculture*. FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6–8 December 2010, Stirling, the United Kingdom of Great Britain and Northern Ireland. FAO Fisheries and Aquaculture Proceedings No 21 (Rome: FAO, 2013).

Bermúdez, Jorge, "Legal Implications of an Ecosystem Approach to Aquaculture" in D Soto, J Aguilar-Manjarrez & N Hishamunda, N (eds), *Building an ecosystem*

approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and Aquaculture Proceedings No 14 (Rome: FAO, 2008).

Berry, Chris & Alistair Davison, *Bitter Harvest A call for reform in Scottish aquaculture* (Perthshire, WWF Scotland, 2001).

Beyerlin, Ulrich & Thilo Marauhn, *International Environmental Law* (Oxford, UK; Portland, USA: Hart/CH Beck/Nomos 2011).

Beyerlin, Ulrich, "New Developments in the Protection of the Marine Environment: Potential Effects of the Rio Process" (1995) 55 ZaöRV 544.

Biber, Eric, "Adaptive Management and the Future of Environmental Law" (2013) Akron L Rev 933.

Blanco Gonzalez, Enrique & Femke de Boer, "The development of the Norwegian wrasse fishery and the use of wrasses as cleaner fish in the salmon aquaculture industry" (2017) 83 Fisheries Science 661.

Blitza, Eike, "Article 204" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1356.

Bohman, Brita, "The Ecosystem Approach as a Basis for Managerial Compliance: An Example from the Regulatory Development in the Baltic Sea Region" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Brill E-Book, 2019) 80.

Bohman, Brita, *Legal Design for Social-Ecological Resilience* (Cambridge: Cambridge University Press, 2021)(Kindle).

Bondad-Reantaso, MG, JR Arthur & RP Subasinghe (eds), *Understanding and applying risk analysis in aquaculture*. FAO Fisheries and Aquaculture Technical Paper No 519 (Rome: FAO, 2008).

Bosselmann, Klaus, "Losing the Forest for the Trees: Environmental Reductionism in the Law" (2010) 2 Sustainability 2424.

———, "The ever-increasing importance of ecological integrity in international and national law" in Laura Westra et al (eds), *Ecological Integrity, Law and Governance* (Routledge: 2018) 225.

———, "The Framework of Ecological Law" (2020) 50 Envtl Pol'y & L 479.

Boyd, Claude E, et al, "Achieving sustainable aquaculture: Historical and current perspectives and future needs and challenges" (2020) 51 J World Aquaculture Society 578

Boyd, David R, *The Environmental Rights Revolution: A Global Study of Constitutionalism, Human Rights and the Environment* (Vancouver: UBC Press,

2012).

Boyle, Alan E, “Marine Pollution under the Law of the Sea Convention” (1985) 79(2) Am J Int’l L 347.

Boyle, Alan & Catherine Redgwell, *International Law and the Environment*, 4th ed (Oxford: Oxford University Press, 2021).

Bradford, Jessica, Ramón Filgueira & Megan Bailey, “Exploring community-based marine aquaculture as a coastal resource management opportunity in Nova Scotia, Canada” (2020) 5 Facets 26.

Bravo, Francisco & Jon Grant, “Modelling sediment assimilative capacity and organic carbon degradation efficiency at marine fish farms” (2018) 10 Aquaculture Environment Interactions 309.

Brigolin, Daniele, et al, “Modelling biogeochemical fluxes across a Mediterranean fish cage farm” (2014) 5 Aquaculture Environment Interactions 71.

Brooker, Adam J, et al, “Sustainable production and use of cleaner fish for the biological control of sea lice: recent advances and current challenges” (2018) 183 Veterinary Record 383

Brugère, Cecile, et al, “Humanizing aquaculture development: Putting social and human concerns at the centre of future aquaculture development” (pre-conference version, 30 August 2021), thematic paper presented at the Global Conference on Aquaculture Millennium +20 held in Shanghai, 22-25 September 2021, online: <https://aquaculture2020.org/>

Brugère, Cecile, et al, “The ecosystem approach to aquaculture 10 years on: A critical review and consideration of its future role in blue growth” (2019) 11 Reviews in Aquaculture 493.

Brugère, Cecile, et al, *Aquaculture planning: policy formulation and implementation for sustainable development*. FAO Fisheries and Aquaculture Technical Paper No 542 (Rome: FAO, 2010).

Bryndum-Buchholz, Ancrea, Derek P Tittensor & Heike K Lotze, “The status of climate change adaptation in fisheries management: Policy, legislation and implementation” (2021) 22 Fish and Fisheries 1248

Buck, Bela H & Richard Langan, “Epilogue: Pathways Towards Sustainable Food Production” in Bela H Buck & Richard Langan (eds), *Aquaculture Perspective of Multi-Use Sites in the Open Ocean The Untapped Potential for Marine Resources in the Anthropocene* (Cham, Switzerland: Springer Open, 2017).

Bueno, Pedro B, “Social risks in aquaculture” in MG Bondad-Reantaso, JR Arthur & RP Subasinghe (eds), *Understanding and applying risk analysis in aquaculture*. FAO Fisheries and Aquaculture Technical Paper No 519 (FAO: Rome, 2008) 219.

Bueno, Pedro, et al, “Micronesian Association for Sustainable Aquaculture established”

FAO Aquaculture Newsletter 54 (March 2016) 24.

Bugge, Hans Christian, *Environmental Law in Norway*, 4th ed (Alphen aan den Rijn, Netherlands: Kluwer Law International, 2022).

Buschmann, Alejandro H, et al, "Salmon aquaculture and coastal ecosystem health in Chile: Analysis of regulations, environmental impacts and bioremediation systems" (2009) 52 Ocean and Coastal Management 243

Bush, Simon R & Peter Oosterveer, *Governing Sustainable Seafood* (London: Routledge, 2019).

California Environmental Associates, *Offshore Finfish Aquaculture: Global Reviews and US Prospects* (The David and Lucile Packard Foundation, 2018).

Camacho, Alejandro E, "Transforming the Means and Ends of Natural Resources Management" (2011) 89 NC L Rev 1405.

Canadian Council of Fisheries and Aquaculture Ministers (CCFAM), "National Aquaculture Strategic Action Plan (NASAPI)" (Archived), online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/nasapi-inpasa-eng.html>.

Carballeira Braña, Carlos Brais, et al, "Towards Environmental Sustainability in Marine Finfish Aquaculture" (2021) Front Mar Sci 8:666662.

Carocca, Claudio, et al, "Incompatibilidad de la salmonicultura con la Reserva Nacional Kawésqar: Antecedentes y contribuciones para el proceso de elaboración del plan de manejo de la Reserva Nacional Kawésqar" (Greenpeace: 2021), online: Greenpeace <http://greenpeace.cl/pdf/2021/04/informe-kaweskar%20%281%29.pdf>.

Carter, Caitriona, "Actor intentions implementing 'ecosystem Europe': The contested case of aquaculture" (2021) 124 Environmental Science and Policy 305.

___, *The Politics of Aquaculture: Sustainability Interdependence, Territory and Regulation in Fish Farming* (London; New York: Routledge, 2018).

Cataudella, Stefano, Fabio Massa & Donatella Crosetti, "Interactions between capture fisheries and aquaculture" in S Cataudella, F Massa, and D Crosetti (eds), *Interactions between aquaculture and capture fisheries: a methodological perspective*. Studies and Reviews. General Fisheries Commission for the Mediterranean No 78 (Rome: FAO, 2005).

CBD, Akwé: Kon Voluntary Guidelines for the Conduct of Cultural, Environmental and Social Impact Assessments regarding Developments Proposed to Take Place on, or which are Likely to Impact on, Sacred Sites and on Lands and Waters Traditionally Occupied or used by Indigenous and Local Communities, Annex to Decision VII/16 adopted during the Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, Kuala Lumpur, February 2004.

———, Decision II/10 on Conservation and sustainable use of marine and coastal biological diversity, adopted during the Second Ordinary Meeting of the Conference of the Parties to the CBD held in Jakarta, Indonesia, 6 - 17 November 1995 (Jakarta Mandate).

———, Decision II/8 adopted during the Second Ordinary Meeting of the Conference of the Parties to the CBD held in Jakarta, Indonesia, 6-17 November 1995.

———, Decision IV/5 on Conservation and sustainable development of marine and coastal biological diversity, including a programme of work, adopted during the Fourth Ordinary Meeting of the Conference of the Parties to the CBD held in Bratislava, Slovakia, 4-15 May 1998.

———, Decision V/6 on Ecosystem Approach, adopted by the Fifth Ordinary Meeting of the Conference of the Parties to the CBD held in Nairobi, Kenya, 15 - 26 May 2000.

———, Decision VII/11 on Ecosystem Approach adopted by the Seventh Ordinary Meeting of the Conference of the Parties held in Kuala Lumpur, Malaysia, 9 - 20 February 2004.

———, Decision VII/5 on Marine and coastal biological diversity adopted during the Seventh Ordinary Meeting of the Conference of the Parties to the CBD held in Kuala Lumpur, Malaysia, 9-20 February 2004.

———, Decision VIII/27 on Alien Species That Threaten Ecosystems, Habitats Or Species (Article 8 (H)): Further Consideration Of Gaps And Inconsistencies In The International Regulatory Framework, adopted during the Eighth Meeting of the Conference of the Parties to the CBD held in Curitiba, Brazil, 20-31 March 2006.

———, Decision X/2 on Strategic Plan for Biodiversity 2011-2020, adopted during the Tenth Meeting of the Conference of the Parties held in Nagoya, Japan, 18-29 October 2010.

———, Decision X/29 on marine and coastal biodiversity adopted during the Tenth Meeting of the Conference of the Parties held in Nagoya, Japan, October 2010.

———, “Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species”, Annex to Decision VI/23 adopted during the Sixth Meeting of the Conference of the Parties to the CBD held in the Hague, Netherlands, April 2002.

———, Mo’otz Kuxtal Voluntary Guidelines. Annex to Decision XIII/18 adopted during the Thirteenth Meeting of the Conference of the Parties to the CBD held in Cancun, Mexico, December 2016.

———, “Solutions for Sustainable Mariculture: Avoiding the Adverse Effects of Mariculture on Biological Diversity” (CBD Technical Series Nr. 12 (2004).

———, “Sustainable use of biological diversity in socio-ecological production landscapes: Background to the ‘Satoyama Initiative for the benefit of biodiversity and human well-being”, CBD Technical Series Nr. 52 (2010).

———, “Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment”, Annex to Decision VIII/28 adopted by the Conference of the Parties at its Eighth Meeting held in Curitiba, Brazil, 20-31 March 2006, UNEP/CBD/COP/DEC/VIII/28 (15 June 2006).

CBD Secretariat, “Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity” (Montreal: CBD Secretariat, 2004).

———, “Integrated Coastal Management for the Achievement of the Aichi Biodiversity Targets: Practical Guidance for Implementation Based on Experience and Lessons Learned from Coastal and Ocean Governance in the Seas of East Asia”, Technical Series No 76 (Montreal: CBD, 2015).

———, “Marine and Coastal Biodiversity: Revised Voluntary Guidelines for the Consideration of Biodiversity in Environmental Impact Assessments and Strategic Environmental Assessments in Marine and Coastal Areas” (21 August 2012), UNEP/CBD/COP/11/23.

CBD Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), Recommendation I/8 on Scientific, technical and technological aspects of the conservation and sustainable use of coastal and marine biological diversity adopted during the First Meeting of the SBSTTA, 4 - 8 September 1995, Paris, France.

Ceballos, Adams, Jorge David Dresdner-Cid & Miguel Angel Quiroga-Suazo, “Does the location of salmon farms contribute to the reduction of poverty in remote coastal areas? An impact assessment using a Chilean case study” (2018) 75 Food Policy 68.

Chaffin, Brian C, et al, “Transformative Environmental Governance” (2016) 41 Annu Rev Environ Resour 399.

Chaffin, Brian C, Hannah Gosnell & Barbara A Cosens, “A Decade of Adaptive Governance Scholarship: Synthesis and future directions” (2014) 19 Ecology & Society 56.

Chatham Partners, “Offshore Wind in High Seas: Unlimited potential beyond national control?” (December 2019), online: Chatham Partners <https://chatham.partners/site/assets/files/1031/chatham-partners-offshore-wind-farms-in-high-seas.pdf>.

Chávez, Carlos, et al, “Main Issues and Challenges for sustainable development of salmon farming in Chile: a socio-economic perspective” (2019) 11 Reviews in Aquaculture 403.

Chircop, Aldo & Peter L'Esperance, “Functional Interactions and Maritime Regulation:

The Mutual Accommodation of Offshore Wind Farms and International Navigation and Shipping" (2016) 30 Ocean Yearbook 439.

Chircop, Aldo, "Mariculture and Canadian maritime law: an unexplored relationship" in David L VanderZwaag & Gloria Chao (eds), *Aquaculture Law and Policy: Towards principled access and operations* (Oxon; New York: Routledge, 2006) 207.

Churchill, Robin, "The LOSC regime for protection of the marine environment: fit for the twenty-first century?" in Rosemary Rayfuse (ed), *Research Handbook on International Marine Environmental Law* (Edward Elgar, Elgaronline, 2017) 3.

Churchill, RR & AV Lowe, *The Law of the Sea*, 3d ed (Manchester: Manchester Univ Press: 1999)

Cid Aquayo, Beatriz Eugenia & José Barriga Parra, "Gobernanzas e Invisibilidades: Intereses y Racionalidades en la Regulación Socioambiental de la Salmónicultura en Chile" (2017) XX Ambiente & Sociedade 107.

Clarkson, Alexander Ross, "The Jurisdiction to Regulate Aquaculture in Canada" (LLM Thesis, UBC: 2014)[unpublished].

Colding, Johan & Stephan Barthel, "Exploring the social-ecological systems discourse 20 years later" (2019) 24 Ecology & Society 2.

Comisión de Pesca Continental y Acuicultura para América Latina y el Caribe, XV reunión, Ciudad de Panamá, Panamá, 22-24 enero 2018, FAORLC COPESCAALC-XV-4, online: FAO <https://www.fao.org/3/I8415ES/i8415es.pdf>.

Convention on Migratory Species (CMS), Resolution 12.14 "Adverse Impacts of Anthropogenic Noise on Cetaceans and Other Migratory Species" adopted by the Conference of the Parties at its 12th Meeting (Manila, October 2017).

———, Resolution 13.5 "Light Pollution Guidelines for Wildlife" adopted by the Conference of the Parties at its 13th Meeting (Gandhinagar, February 2020).

___, Resolution 7.2 "Impact Assessment and Migratory Species", adopted by the Conference of the Parties at its Seventh Meeting (Bonn, 18-24 September 2002).

Corner, Richard A, et al, "Multi-stakeholder perspectives on spatial planning processes for mariculture in the Mediterranean and Black Sea" (2020) 12 Reviews in Aquaculture 347.

Cosens, Barbara, "Legitimacy, Adaptation, and Resilience in Ecosystem Management" (2013) 18(1) Ecology and Society 3.

Costa-Pierce, Barry Antonio, "An ecosystem approach to marine aquaculture: a global review" in D Soto, J Aguilar-Manjarrez & N Hishamunda, N (eds), *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and

Aquaculture Proceedings No 14 (Rome: FAO, 2008) 81.

———, "Sustainable Ecological Aquaculture Systems: The Need for a New Social Contract for Aquaculture Development" (2010) 44 Marine Technology Society Journal 88.

———, "The Principles and Practices of Ecological Aquaculture and the Ecosystem Approach to Aquaculture" (2021) World Aquaculture 25.

Craig, Robin Kundis, "Fostering adaptive marine aquaculture through procedural innovation in marine spatial planning" (2019) 110 Marine Policy 103555.

———, "Learning to Think about Complex Environmental Systems in Environmental and Natural Resource Law and Legal Scholarship: A Twenty-Year Retrospective" (2017) 24 Fordham Environ L Rev 87.

———, "'Stationarity Is Dead': Long Live Transformation: Five Principles for Climate Change Adaptation Law" (2010) 34 Harv Envtl L Rev 9.

Craig, Robin Kundis & JB Ruhl, "Designing Administrative Law for Adaptive Management" (2014) 67 Vand L Rev 1.

Craig, Robin Kundis & Melinda Harm Benson, "Replacing Sustainability" (2013) 46 Akron Law Rev 841.

Craig, Robin K, et al, "A proposal for amending administrative law to facilitate adaptive management" (2017) 12 Environ Res Lett 074018.

Craik, Neil, "Implementing Adaptive Management in Deep Seabed Mining: Legal and Institutional Challenges" (2020) 114 Marine Policy 103256.

Cranford, Peter J, et al. "An Ecosystem-based approach and management framework for the integrated evaluation of bivalve aquaculture impacts" (2012) 2 Aquaculture Environment Interactions 193.

Crown Estate Scotland, "Root and Branch Review of Aquaculture Leasing Complete" (25 January 2022) online: CES <https://www.crownestatescotland.com/news/root-and-branch-review-of-aquaculture-leasing-complete>.

Custódio, Marco, et al, "Valuation of Ecosystem Services to promote sustainable aquaculture practices" (2020) 12 Reviews in Aquaculture 392.

Czybulka, Detlef, "Article 192", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1277.

———, "Article 194", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1295.

———, "Article 196", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH

Beck/Hart/Nomos, 2017) 1319.

Dahl, Irene, "Analyse av regelverket: Regelverket knyttet til produksjon, areal- og lokalitetsforvaltning og områdesamarbeid i havbruksnæringen", NOFIMA Report 33/2020 ["Regulatory analysis: Regulations relating to production, land and site management and regional cooperation in the aquaculture industry"] [Google Machine Translate].

———, "Adaptation of Aquaculture to Climate Change: The Relevance of Temporal International Framework from a Norwegian Perspective" in Elise Johansen, Signe Veierud Bush & Ingvild Ulrikke Jakobsen (eds), *The Law of the Sea and Climate Change: Solutions and Constraints* (Cambridge: Cambridge University Press, 2021) 289.

———, "Regional approaches to aquaculture and a case study of the North Atlantic Salmon Conservation Organization" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016) 103.

Dannemann, Victoria, "Patagonia chilena: ambientalistas exigen que salmoneras salgan de áreas protegidas" (6 October 2021), online: Deutsche Welle <https://www.dw.com/es/patagonia-chilena-ambientalistas-exigen-que-salmoneras-salgan-de-%C3%A1reas-protegidas/a-59429202>.

Davies, Ian P, et al, "Governance of marine aquaculture: Pitfalls, potential, and pathways forward" (2019) 104 Marine Policy 29.

de Búrca, Ggráinne & Joanne Scott, "Introduction" in Gráinne de Búrca & Joanne Scott (eds), *Law and New Governance in the EU and the US* (Oxford; Portland, OR: Hart Publishing, 2006) 1.

de Caro, Daniel A, et al, "Legal and institutional foundations of adaptive environmental governance" (2017) 22 Ecology and Society 32.

de Cruz, Peter, "Comparative Law, Functions and Methods" (2009) Max Planck Encyclopedia of Public International Law (last updated April 2009).

de Lucia, Vito, "Competing Narratives and Complex Genealogies: The Ecosystem Approach in International Environmental Law" (2015) 27 J Envtl L 91.

———, "The 'Ecosystem Approach' in International Environmental Law: a Biopolitical Critique" (PhD Thesis, Faculty of Law, UiT Arctic University of Norway, 2015)[unpublished]

Doelle, Meinhard & Phillip Saunders, "Aquaculture governance in Canada: A patchwork of approaches" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA: Edward Elgar, 2016) 183.

Doelle, Meinhard, et al, “The Regulation of Tidal Energy Development Off Nova Scotia: Navigating Foggy Waters” (2006) 55 UNBLJ 27.

Doelle, Meinhard & William Lahey, *A New Regulatory Framework for Low-Impact/High-Value Aquaculture in Nova Scotia*. The Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia (2014).

Dupuy, Pierre-Marie & Jorge E Viñuales, *International Environmental Law*, 2ed (Cambridge; New York, NY: Cambridge University Press, 2018).

Duvic-Paoli, Leslie-Anne, “The Status of the Right to Public Participation in International Environmental Law: An Analysis of the Jurisprudence” (2012) 23 YB Int’l Env L 80.

Ebbesson, Jonas, “Principle 10: Public Participation” in JE Viñuales (ed), *The Rio Declaration on Environment and Development* (Oxford: Oxford University Press, 2015) 287.

———, “The rule of law in governance of complex socio-ecological changes” (2010) 20 Global Environmental Change 414.

Ebbesson, Jonas & Ellen Hey, “Where in Law is Social-Ecological Resilience” (2013) 18(3) Ecology and Society 25.

Ecological Law and Governance Association, *Oslo Manifesto and Sienna Declaration*, online: ELGA https://elgaworld.org/ (accessed 15 February 2022).

Eger, Sondra L & Simon C Courtenay, “Integrated coastal and marine management: Insights from lived experiences in the Bay of Fundy, Atlantic Canada” (2021) 204 Ocean & Coastal Management 105457.

Elferink, Alex G Oude, “Artificial islands, installations and structures” Max-Planck Encyclopedia of Public International Law (online) (updated September 2013).

Elsner, Paul & Suzette Suarez, “Renewable energy from the high seas: Geo-spatial modelling of resource potential and legal implications for developing offshore wind projects beyond the national jurisdiction of coastal States” (2019) 128 Energy Policy 919.

Engle, Carole R & Jonathan van Senten, “Resilience of Communities and Sustainable Aquaculture: Governance and Regulatory Effects”(2022) 7 Fishes 268.

Engler, Cecilia, “Beyond rhetoric: navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management” (2015) 23 Environmental Reviews 288.

———, “Marco Jurídico de la Acuicultura en Chile y Políticas Nacionales Relevantes para el Manejo del Sector Acuícola. Informe Final” (Junio 2019), Annex A to the Final Report: FIPA Project 2017-17 "Propuesta de Política Nacional de Acuicultura de Chile para las Siguientes dos Décadas”[Aquaculture Law and

Policy Framework in Chile][translation by author].

Enright, Sarah Ryan & Ben Boteler, "The Ecosystem Approach in International Marine Environmental Law and Governance" in TG O'Higgins et al (eds), *Ecosystem-Based Management, Ecosystem Services and Aquatic Biodiversity* (Springer: 2020), 333.

Environment Protection Authority (Tasmania), *A Review of Tasmanian and International Regulatory Requirements for Salmonid Aquaculture* (Environment Protection Authority, Tasmania, 2019).

Environmental Agency (Norway), "Expectations for Aquaculture on the Sea", online: <https://www.miljodirektoratet.no/publikasjoner/2017/april-2017/forurensningsmyndighetenes-forventninger-til-oppdrettsanlegg-i-sjo/> [Google Translate].

Ervik, Arne, et al, 'Regulating the local environmental impact of intensive marine fish farming: I. The concept of the MOM system (Modelling – Ongrowing fish farms – Monitoring)" (1997) 158 Aquaculture 85.

Esty, Daniel C, "Next Generation Environmental Law: A Response to Richard Stewart" (2001) 29 Cap U L Rev 183.

European Commission, *Transforming the EU's Blue Economy for a Sustainable Future*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a new approach for a sustainable blue economy in the EU, Brussels, 17 May 2021, COM(2021) 240.

Evaluation Committee, "An Evaluation of the Scientific Basis of the Traffic Light System for Norwegian Salmonid Aquaculture" (The Research Council of Norway, December 2021), online: <https://www.forskningsradet.no/siteassets/publikasjoner/2021/an-evaluation-of-the-scientific-basis-of-the-traffic-light-system-for-norwegian-salmonid-aquaculture.pdf>.

Falconer, Lynne, et al, "Insight into real-world complexities is required to enable effective response from the aquaculture sector to climate change" (2022) 1 PLOS Clim e0000017, https://doi.org/10.1371/journal. pclm.0000017.

Falconer, Lynne, et al, "Using physical environmental parameters and cage engineering design within GIS-based site suitability models for marine aquaculture" (2013) 4 Aquaculture Environment Interactions 223.

Food and Agriculture Organization of the United Nations (FAO), *Adaptation strategies of the aquaculture sector to the impacts of climate change*, by Pedro B Bueno & Doris Soto, FAO Fisheries and Aquaculture Circular No 1142 (Rome, Italy: FAO, 2017).

———, *Aquaculture development*. FAO Technical Guidelines for Responsible Fisheries

No 5 (Rome: FAO, 1997).

———, *Aquaculture governance and sector development*. FAO Technical Guidelines for Responsible Fisheries No 5 Suppl 7 (Rome: FAO, 2017).

———, "Bangkok Declaration and Strategy on Aquaculture Development Beyond 2000", adopted by the FAO/NACA Conference on Aquaculture Development in the Third Millennium (20-25 February 2000 Bangkok, Thailand), online: FAO <http://www.fao.org/3/a-ad351e.pdf>.

———, *Basic Texts of the Food and Agriculture Organization of the United Nations*, Vol I and II, 2017 edition, online: FAO <https://www.fao.org/3/mp046e/mp046e.pdf>.

———, *Building a Common Vision for Sustainable Food and Agriculture* (Rome: FAO, 2014), online: FAO <https://www.fao.org/3/i3940e/i3940e.pdf >.

———, *Code of Conduct for Responsible Fisheries*. FAO Doc. 95/20/Rev/1; UN Sales No. E98.V.11 (1998), 1995 WTS 3.

———, Development of aquatic genetic resources: A framework of essential criteria. FAO Technical Guidelines for Responsible Fisheries No 5 Suppl 9 (Rome: FAO, 2018).

———, Draft Report of the Expert Consultation on the Development of Sustainable Aquaculture Guidelines Rome, Italy, 17-20 June 2019, Appendix 6: List of Thematic Modules and Guidelines, COFI:AQ/X/2019/Inf.8).

———, Ecosystem approach to aquaculture. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010).

———, *Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 4 (Rome: FAO, 2010).

———, Genetic resource management. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 3 (Rome: FAO, 2008).

———, *Global Strategic Framework for Food Security and Nutrition* (ROME: FAO, 2014).

———, Good aquaculture feed manufacturing practice. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 1 (Rome: FAO, 2001).

———, Health management for responsible movement of live aquatic animals. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 2 (Rome: FAO, 2007).

———, "Kyoto Strategy for Aquaculture Development", adopted by the FAO Technical Conference on Aquaculture (Tokyo, Japan, 1976), online: FAO <http://www.fao.org/3/ac442e/AC442e3.htm>.

———, "Phuket Consensus: A re-affirmation of commitment to the Bangkok Declaration", adopted by the FAO/NACA Global Conference on Aquaculture

Millennium +10: Farming the Waters for People and Food (Phuket, Thailand, 22-25 September 2010), online: FAO <http://www.fao.org/tempref/FI/DOCUMENT/aquaculture/aq2010/Phuket_Consensus_13-12-2010.pdf>.

———, Precautionary Approach to Fisheries. Part I: Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions. FAO Fisheries Technical Paper 350 (Rome: FAO, 1995).

———, Progress Made Towards Sustainable and Environmentally Sound Development, Addendum, Report submitted by the Food and Agriculture Organization of the United Nations, 11 September 1989, A/44/339/Add4, online: FAO <https://www.fao.org/3/z5278en/z5278en.pdf>.

———, Recommendations for prudent and responsible use of veterinary medicines in aquaculture. FAO Technical Guidelines for Responsible Fisheries No 5 Suppl 8 (Rome: FAO, 2019).

———, Report of the Expert Consultation on the Assessment of Socio-economic Impacts of Aquaculture. Ankara, Turkey, 4–8 February 2008, FAO Fisheries Report. No 861 (Rome: FAO, 2008).

———, Report of the third session of the Sub-Committee on Aquaculture. New Delhi, India, 4–8 September 2006.

———, Report of the Thirty-fourth Session of the Committee on Fisheries. Rome, 1–5 February 2021. FAO Fisheries and Aquaculture Report No 1336 (Rome: FAO, 2022), online: FAO <https://doi.org/10.4060/cb8322en>.

———, “Shanghai Declaration”, adopted by the participants to the Global Conference on Aquaculture Millennium +20 held in Shanghai, 22-25 September 2021, online: <https://aquaculture2020.org/declaration/>.

———, “Strategic Framework 2022-31” (Rome: FAO, 2021), online: <https://www.fao.org/3/cb7099en/cb7099en.pdf>.

———, The 2030 Agenda and the Sustainable Development Goals: The challenge for aquaculture development and management, by John Hambrey, FAO Fisheries and Aquaculture Circular No 1141 (Rome: FAO, 2017).

———, The ecosystem approach to fisheries. FAO Technical Guidelines for Responsible Fisheries No 4, Suppl 2 (Rome: FAO, 2003).

———, The State of World Fisheries and Aquaculture 2006 (Rome: FAO, 2007).

———, The State of World Fisheries and Aquaculture 2016: Contributing to food security and nutrition for all (Rome: FAO, 2016).

———, The State of World Fisheries and Aquaculture 2022: Towards Blue Transformation (Rome, FAO. https://doi.org/10.4060/cc0461en).

———, Use of wild fish as feed in aquaculture. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 5 (Rome: FAO, 2011).

———, Use of wild fishery resources for capture-based aquaculture. FAO Technical Guidelines for Responsible Fisheries No 5, Suppl 6 (Rome: FAO, 2011).

———, Technical guidelines on aquaculture certification (Rome: FAO, 2011).

———, *Blue Transformation - Roadmap 2022–2030: A vision for FAO's work on aquatic food systems* (Rome: FAO, 2022), online: FAO: <https://doi.org/10.4060/cc0459en>.

FAO/EAF-Nansen Project, *A How-to Guide on legislating for an ecosystem approach to fisheries*. FAO EAF-Nansen Project Report No 27 (Rome: FAO, 2016).

FAO/NACA Global Conference on Aquaculture Millennium +10: Farming the Waters for People and Food (Phuket, Thailand, 22-25 September 2010), online: FAO <http://www.fao.org/tempref/FI/DOCUMENT/aquaculture/aq2010/Phuket_Consensus_13-12-2010.pdf>.

Filgueira, Ramón, et al. "Inferring the potential for nitrogen toxicity on seagrass in the vicinity of an aquaculture site using mathematical model" (2021) 282 Journal of Environmental Management 111921.

Filgueira, Ramón, Jon Grant & Øivind Strand, "Implementation of marine spatial planning in shellfish aquaculture management: modeling studies in a Norwegian fjord" (2014) 24 Ecological Applications 832.

Fischman, Robert L, "Letting Go of Stability: Resilience and Environmental Law" (2019) 94 Ind LJ 689.

Fisheries and Oceans Canada (DFO), "A Discussion Paper: A Canadian Aquaculture Act" (2020), online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/act-loi/discussion-eng.html>.

———, "Aquaculture Production and Value: Canadian Aquaculture Production 2020", online: DFO <https://www.dfo-mpo.gc.ca/stats/aqua/aqua-prod-eng.htm>.

———, "Area-based Aquaculture Management in British Columbia", online: DFO <https://www.pac.dfo-mpo.gc.ca/aquaculture/abam-gaz-eng.html>.

———, "Federal Aquaculture Act", online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/act-loi/index-eng.html>.

———, "Pathways of Effects for Finfish and Shellfish Aquaculture", Canadian Science Advisory Secretariat (CSAS) Science Advisory Report 2009/071, online: CSAS <https://waves-vagues.dfo-mpo.gc.ca/Library/339745.pdf>.

———, "Regional Ocean Plan – Maritimes Region: Background and Program Description" (2014), online: DFO <https://waves-vagues.dfo-mpo.gc.ca/Library/365205.pdf>.

———, “The future of salmon aquaculture in British Columbia – Toward an open-net pen transition plan: A framework for discussion” (29 July 2022), online: DFO <https://www.pac.dfo-mpo.gc.ca/consultation/aquaculture/bc-transition-cb/cadre-discussion-framework-eng.html>.

———, Blue Economy Strategy: Your Oceans, Your Voice, Your Future. Engagement Paper. 2021.

———, Department Plan 2022-2023, online: DFO <https://www.dfo-mpo.gc.ca/rpp/2022-23/dp-eng.html>.

———, Federal Aquaculture Act: How We Got Here, online: DFO <https://www.dfo-mpo.gc.ca/aquaculture/act-loi/how-comment-eng.html>.

———, Forward Regulatory Plan 2022-2024, online: DFO <https://www.dfo-mpo.gc.ca/acts-lois/initiatives/rule-reglement-eng.htm#reg10>.

———, Framework for Aquaculture Risk Management (FARM) (Draft) (March 2021).

———, Proposal from the Area-based Management Technical Working Group to the Indigenous and Multi-stakeholder Advisory Body (22 May 2020), online: <https://www.dfo-mpo.gc.ca/aquaculture/publications/amb-twg-eng.html>.

Fisheries Directorate [Fiskeridirectoratet], “Key figures from Norwegian Aquaculture Industry 2020”, online: <file:///C:/Users/mceng/Downloads/nokkeltall-havbruk-2020-eng.pdf>.

Flannery, W, et al, “Evaluating conditions for transboundary marine spatial planning: Challenges and opportunities on the island of Ireland” (2015) 51 Marine Policy 86.

Flournoy, Alyson C, “Integrative environmental law: a prescription for law in the time of climate change” (2020) 30 Duke Envtl L & Pol'y F 225.

Føre, Heidi Moe, et al, “Technological innovations promoting sustainable salmon (Salmo salar) aquaculture in Norway” (2022) 24 Aquaculture Reports 101115.

Free, Christopher M, et al, “Expanding ocean food production under climate change” (2022) Nature, https://doi.org/10.1038/s41586-022-04674-5.

Froehlich, Halley E, et al, “Mind the gap between ICES nations’ future seafood consumption and aquaculture production” (2021) 78 ICES Journal of Marine Science 468, doi:10.1093/icesjms/fsaa066.

Frohlich, Miguel F, et al, “The relationship between adaptive management of social-ecological systems and law: a systematic review” (2018) 23 Ecology & Society 23.

Fuentes Olmos, Jesssica & Cecilia Engler, “Three pillars for sustainable marine aquaculture: the evolving regulatory framework in Chile” in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global,*

Regional and National Perspectives (Cheltenham, UK; Northampton, MA: Edward Elgar, 2016) 213.

Fundación Terram, "Corte de Apelaciones aumenta sanción a Nova Austral y suspende operación de uno de sus centros de cultivo" (30 December 2020), online: Fundación Terram <https://www.terram.cl/2020/12/corte-de-apelaciones-aumenta-sancion-a-nova-austral-y-suspende-operacion-de-uno-de-sus-centros-de-cultivo/?>.

Furuset, Anders, "Norway unveils new aquaculture strategy, seeks to overhaul wide range of regulations" (8 July 2021), online: IntraFish <https://www.intrafish.com/aquaculture/norway-unveils-new-aquaculture-strategy-seeks-to-overhaul-wide-range-of-regulations/2-1-1036872>

Galparsoro, Ibon, et al. "Global stakeholder vision for ecosystem-based marine aquaculture expansion from coastal to offshore areas" (2020) 12 Reviews in Aquaculture 2061.

Gardner Pinfold Consultants Inc, *State of Salmon Aquaculture Technologies*. Report prepared for Fisheries and Oceans Canada, the Ministry of Agriculture (British Columbia), and Sustainable Development Technology Canada (2019), available online: <https://www.dfo-mpo.gc.ca/campaign-campagne/aquaculture/study-eng.html>

Garmestani, Ahjond S, Craig R Allen & Heriberto Cabezas, "Panarchy, adaptive management and governance: policy options for building resilience" (2008) 87 Neb L Rev 1036.

Garmestani, Ahjond S, Craig R Allen & Melinda Harm Benson, "Can Law Foster Social-Ecological Resilience?" (2013) 18 Ecology and Society 32.

Garver, Geoffrey, "Moving from environmental law to ecological law: Frameworks, priorities and strategies" in Laura Westra et al (eds), *Ecological Integrity, Law and Governance* (Routledge, 2018) 141.

Gentry, Rebecca R, et al, "Exploring the potential for marine aquaculture to contribute to ecosystem services" (2020) 12 Reviews in Aquaculture 429.

Gephart, Jessica A, et al, "Environmental performance of blue foods" (2021) 597 Nature 360.

Gilbey, J, et al, "A national assessment of the influence of farmed salmon escapes on the genetic integrity of wild Scottish Atlantic salmon populations" Scottish Marine and Freshwater Science Vol 12 No 12 (Marine Scotland Science, 2021).

Gillespie,Alexander, "Ethical Considerations" in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 217.

Gillibrand, PA, et al, "Scottish Executive Locational Guidelines for Fish Farming: Predicted Levels of Nutrient Enhancement and Benthic Impact", Scottish Fisheries

Research Report Number 63/2002 (Fisheries Research Services, Marine Laboratory, Aberdeen, 2002).

Gjerde, Kristina M et al, *Regulatory and Governance Gaps in the International Regime for the Conservation and Sustainable Use of Marine Biodiversity in Areas beyond National Jurisdiction* (Gland, Switzerland: IUCN, 2008)

Glover, KA, et al, "Domesticated escapees on the run: the second-generation monitoring programme reports the numbers and proportions of farmed Atlantic salmon in >200 Norwegian rivers annually" (2019) 76 ICES Journal of Marine Science 1151, doi:10.1093/icesjms/fsy207.

Grebe, Gretchen S, et al, "An ecosystem approach to kelp aquaculture in the Americas and Europe" (2019) 15 Aquaculture Reports 100215.

Grumbine, R Edward, "What is Ecosystem Management?" (1994) 8 Conservation Biology 27.

Guilfoyle, Douglas, "Article 87" in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 678.

Gullestad, Peter, et al, Effektiv og bærekraftig arealbruk i havbruksnæringen Rapport fra et ekspertutvalg oppnevnt av Fiskeri- og kystdepartementet (Oslo, 4 February 2011) [Efficient and sustainable land use in the aquaculture industry Report from an expert committee appointed by the Ministry of Fisheries and Coastal Affairs][Google Translate].

Gunningham, Neil, "Regulation and Governance: Shifting Architectures" (2009) 21 J Envtl L 179.

Gunningham, Neil & Cameron Holley, "Next-Generation Environmental Regulation: Law, Regulation, and Governance" (2016) 12 Annu. Rev. Law Soc. Sci. 1.

Guzman, Andrew T, "A Compliance-Based Theory of International Law" (2002) 90 California Law Rev 1823.

Haas, Bianca et al, "Factors influencing the performance of regional fisheries management organizations" (2020) 113 Marine Policy 103787.

Hansen, Pia Kupka, "Miljøpåvirkning på bunn som følge av partikulære organiske utslipp fra fiskeoppdrett" in ES Grefsrud et al (eds), *Risikorapport norsk fiskeoppdrett 2019: Miljøeffekter av lakseoppdrett*, online: Havforskningsinstituttet https://www.hi.no/hi/nettrapporter/fisken-og-havet-2019-5#sec-5 [Google Machine Translate].

Hansen, Pia Kupka, et al, "Regulating the local environmental impact of intensive, marine fish farming: II. The monitoring programme of the MOM system (Modelling–Ongrowing fish farms–Monitoring)" (2001) 194 Aquaculture 75.

Harrison, James, *Saving the Oceans Through Law: The International legal Framework*

for the Protection of the Marine Environment (Oxford: Oxford University Press, 2017).

Hersoug, Bjørn, "'One country, ten systems': The use of different licensing systems in Norwegian aquaculture" (2022) 137 Marine Policy 104902.

———, "The Battle for Space: the Position of Norwegian Aquaculture in Integrated Coastal Zone Planning" in E Moksness, E Dahl and J Støttrup (eds), Global Challenges in Integrated Coastal Zone Management (John Wiley & Sons, 2013).

———, "Why and how to regulate Norwegian salmon production? – The history of Maximum Allowable Biomass (MAB)" (2021) 545 Aquaculture 737144.

Hersoug, Bjørn, Eirik Mikkelsen & Tonje C Osmundsen, "What's the clue; better planning, new technology or just more money? The area challenge in Norwegian salmon farming" (2021) 199 Ocean & Coastal Management 105415.

High Level Panel for a Sustainable Ocean Economy, *Transformations for a Sustainable Ocean Economy A Vision for Protection, Production and Prosperity* (December 2020), online: Ocean Panel <https://oceanpanel.org/ocean-action/transformations.html>.

High Level Panel of Experts on Food Security and Nutrition (HLPE), *Sustainable fisheries and aquaculture for food security and nutrition*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (Rome: HLPE, 2014).

Hirsch, Dennis D, "Symposium Introduction: Second Generation Policy and the New Economy" (2001) 29 Cap UL Rev 1.

Holley, Cameron, Neil Gunningham & Clifford Shearing, *The New Environmental Governance* (Oxon, UK; New York, USA: Earthscan, 2011).

Holling, CS & Gary K Meffe, "Command and Control and the Pathology of Natural Resource Management" (1996) 10 Conservation Biology 328.

Howarth, Leigh Michael, et al, "Using macroalgal bioindicators to map nutrient plumes from fish farms and other sources at a bay-wide scale" (2019) 11 Aquaculture Environment Interactions 671.

Howarth, Leigh Michael, GK Reid & L Lewis-McCrea, *Supporting the Development of Offshore Aquaculture in Nova Scotia* (Dartmouth, NS: CMAR, 2022).

Howarth, Leigh Michael, Margo Coughlin & Gregor K Reid, *Assessing climate change vulnerability of seafood industry dependent communities in Nova Scotia: Informing adaptation* (Dartmouth, NS: Centre for Marine Applied Research (Dartmouth, NS: CMAR, 2021).

Howarth, William, *The Law of Aquaculture* (Oxford: Fishing New Books, 1990).

Humby, Tracy-Lynn, "Law and Resilience: Mapping the Literature" (2014) 4 Seattle J

Envtl L 85.

Humphries, Fran, "The rising tide of access and benefit sharing in aquaculture" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, USA: Edward Elgar, 2016) 63.

Huntingford, FA & S Kadri, "Taking account of fish welfare: lessons from aquaculture" (2009) 75 Journal of Fish Biology 2862.

Hutchins, Todd Emerson, "Crafting an International Legal Framework for Renewable Energy on the High Seas" (2021) 51(2) Env't L 485.

ICES, Science Plan (Copenhagen: ICES, 2009), online: ICES <http://doi.org/10.17895/ices.pub.5469>.

———, Working Group on Environmental Interactions of Aquaculture (WGEIA). ICES Scientific Reports 2:112 (2020), online: ICES <http://doi.org/10.17895/ices.pub.7619>.

———, Code of Practice on the Introductions and Transfers of Marine Organisms 2005, online: ICES <https://www.nobanis.org/globalassets/ices-code-of-practice.pdf>.

Institute of Marine Research, Risk Reports from Fish Farming [Risikorapport norsk fiskeoppdrett] online: Havforskningsinstituttet <https://www.hi.no/hi/nettrapporter?query=&fast_serie=risikorapport-norsk-fiskeoppdrett> [Google Machine Translate].

Instituto Nacional de Derechos Humanos and Danish Institute for Human Rights, *The Salmon Industry and Human Rights in Chile: Sector-Wide Impact Assessment* (Santiago, Chile; Copenhagen, Denmark: Swedish International Development Cooperation Agency, 2021), online: <https://www.humanrights.dk/promoting-human-rights-fisheries-aquaculture>.

Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H-O Pörtner, DC Roberts, M Tignor, ES Poloczanska, K Mintenbeck, A Alegría, M Craig, S Langsdorf, S Löschke, V Möller, A Okem, B Rama (eds)] (Cambridge, UK; New York, NY, USA: Cambridge University Press, 2022).

International Maritime Organization (IMO), *Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone*, International Maritime Organisation, Resolution A.672(16) (19 October 1989).

IUCN, *Aquaculture and Marine Protected Areas: Exploring Potential Opportunities and Synergies* (2017) (brochure), online: IUCN <https://www.iucn.org/sites/dev/files/content/documents/aquaculture_and_marine_protected_areas.pdf>.

———, Sustainability of Fish Feed in Aquaculture: Reflections and Recommendations, online: IUCN <https://portals.iucn.org/library/sites/library/files/documents/2017-026-Summ.pdf>.

———, "Guidelines for Applying the Precautionary Principle to Biodiversity Conservation and Natural Resource Management", approved by the 67th meeting of the IUCN Council (14-16 May 2007).

———, Guide for the Sustainable Development of Mediterranean Aquaculture No 2: Aquaculture site selection and site management (Gland, Switzerland; Malaga, Spain: IUCN, 2009).

———, *Sustainability indicators for aquaculture sea cages in the Mediterranean* (Madrid, Spain: IUCN, 2011).

Iversen, Audun, et al, "Production cost and competitiveness in major salmon farming countries 2003–2018" (2020) 522 Aquaculture 735089.

Jessen, Sabine, "A Review of Canada's Implementation of the Oceans Act since 1997—From Leader to Follower?" (2011) 39 Coastal Management 20.

Johnson, Jennifer L, et al, "Interplays of Sustainability, Resilience, Adaptation and Transformation", in Walter Leal Filho, Robert W Marans & John Callewaert (eds), *Handbook of Sustainability and Social Science Research* (Springer, 2018).

Johnson, Teresa R, et al, "A Social-Ecological System Framework for Marine Aquaculture Research" (2019) 11 Sustainability 2522.

Jones, Alice R, et al, "Climate-Friendly Seafood: The Potential for Emissions Reduction and Carbon Capture in Marine Aquaculture" (2022) 72 BioScience 123.

Juan-Jordá, Maria José et al, "Report card on ecosystem-based fisheries management in tuna regional fisheries management organizations" (2018) 19 Fish and Fisheries 321.

Kapetsky, JM, J Aguilar-Manjarrez & J Jenness, A global assessment of potential for offshore mariculture development from a spatial perspective. FAO Fisheries and Aquaculture Technical Paper No 549 (Rome: FAO, 2013).

Karkkainen, Bradley C, "Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism" (2002) 21 Va Envtl LJ 189 .

———, "Information-forcing Regulation and Environmental Governance" in Gráinne de Búrca & Joanne Scott (ed), *Law and New Governance in the EU and the US* (Oxford, Portland: Hart, 2006) 293.

———, "Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward a Bounded Pragmatism" (2003) 87 Minn L Rev 943.

———, "Marine Ecosystem Management and A "Post-Sovereign" Transboundary Governance" (2004) 6 San Diego Int'l LJ 113.

Karkkainen, Bradley C, Archon Fung & Charles F Sabel. “After backyard environmentalism: Towards a performance-based regime of environmental regulation” (2000) American Behavioral Scientist 692.

Keiter, Robert B, “Beyond the Boundary Line: Constructing A Law of Ecosystem Management” (1993-1994) 65 U Colo L Rev 293.

———, “Ecosystems and the Law: Towards an Integrated Approach” (1998) 8(2) Ecological Applications 332.

Kim, Rakhyun E & Klaus Bosselmann, “Operatonalizing Sustainable Development: Ecological Integrity as a Grundnorm of International Law” (2015) 24 RECIEL 194.

Alexandre Kiss, “The Rio Declaration on Environment and Development” in Luigi Campiglio et al, *The Environment After Rio: International Law and Economics* (London; Norwell, MA: Graham & Trotman/Martinus Nijhoff, 1994) 55.

Kit, C & TM Wong, “Comparative Evaluation of Online Machine Translation Systems with Legal Texts” (2008) 100 Law Library Journal 299.

Koch, Hans-Joachim et al, *Legal Regimes for Environmental Protection: Governance for Climate Change and Ocean Resources* (Brill Nijhoff, 2015).

Kohen, Marcelo G, “Is the Internal Waters Regime Excluded from the United Nations Convention on the Law of the Sea?” in Lilian del Castillo (ed), *Law of the Sea, From Grotius to the International Tribunal for the Law of the Sea: Liber Amicorum Judge Hugo Caminos* (Leiden: Brill Nijhoff, 2015, eBook) 110.

Kotzé, Louis J & Rakhyun E Kim, “Earth System Law: The juridical dimension of earth system governance” (2019) 1 Earth System Governance 100003.

Kraly, Paul, “Evolution of Aquaculture in Nova Scotia”, prepared for Aquaculture Association of Nova Scotia (31 May 2019), online: Seafarmers <https://seafarmers.ca/about-us/history-of-aquaculture-in-nova-scotia/>.

Krause, Gesche, et al, “A revolution without people? Closing the people-policy gap in aquaculture development” (2015) 447 Aquaculture 44.

Krause, Gesche, et al, “Visualizing the social in aquaculture: How social dimension components illustrate the effects of aquaculture across geographic scales” (2020) 118 Marine Policy 103985.

Kristiansen, Tore S, et al, “Theoretical basis and principles for welfare assessment of farmed fish” in (eds), *Aquaculture* (Elsevier Science & Technology, ProQuest Ebook Central, 2020) 193.

Kvalvik, Ingrid, Ann-Magnhild Solås & Patrick Berg Sørdahlat, “Introducing the ecosystem services concept in Norwegian coastal zone planning” (2020) 42 Ecosystem Services 101071.

Kvalvik, Ingrid & Roy Robertsen, "Inter-municipal coastal zone planning and designation of areas for aquaculture in Norway: A tool for better and more coordinated planning?" (2017) 142 Ocean & Coastal Management 61.

Kwasniak, Arlene J, "Use and Abuse of Adaptive Management in Environmental Assessment Law and Practice: A Canadian Example and General Lessons" (2010) 12 J Envtl Assessment Pol'y & Management 425.

Langlet, David & Rosemary Rayfuse, "Challenges in Implementing the Ecosystem Approach: Lessons Learned" in David Langlet & Rosemary Rayfuse, (eds), *The Ecosystem Approach in Ocean Planning and Governance Perspectives from Europe and Beyond* (Leiden; Boston: Brill Nijhoff, 2019) 445.

———, "The Ecosystem Approach in Ocean Planning and Governance: An Introduction" in David Langlet & Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance Perspectives from Europe and Beyond* (Leiden; Boston: Brill Nijhoff, 2019) 1.

Layzer, Judith A, "The Purpose and Politics of Ecosystem-based Management" in Michael P Weinstein & R Eugene Turner (eds), *Sustainability Science: The Emerging Paradigm and the Urban Environment* (New York: Springer, 2012) 177.

Le Gouvello, R, C Brugère & F Simard, *Aquaculture and Nature-based Solutions: Identifying synergies between sustainable development of coastal communities, aquaculture, and marine and coastal conservation* (Gland, Switzerland: IUCN, 2022).

Le Gouvello, Raphaëla, et al, "Aquaculture and Marine Protected Areas: Exploring Potential Opportunities and Synergies" (2017) 27(S1) Aquatic Conserv: Mar Freshw Ecosyst 138.

Lebel, Louis, et al, "Innovation, Practice, and Adaptation to Climate in the Aquaculture Sector" (2021) 29 Reviews in Fisheries Science & Aquaculture 721.

Lees, Emma, "Value in Comparative Environmental Law" in Emma Lees & Jorge E Viñuales (eds), *The Oxford Handbook of Comparative Environmental Law* (Oxford: Oxford University Press, 2019) 35.

Link, Jason S & Howard Browman, "Integrating What? Levels of marine ecosystem-based assessment and management" (2015) 75 ICES Journal of Marine Science1170.

Link, Jason S et al, "Changing how we approach fisheries: A first attempt at an operational framework for ecosystem approaches to fisheries management" (2020) 21 Fish and Fisheries 393.

Little, DC, RW Newton & MCM Beveridge, "Aquaculture: a rapidly growing and significant source of sustainable food? Status, transitions and potential" (2016) 75 Proceedings of the Nutrition Society 274.

Liu, Hui & Jilan Su. “Vulnerability of China’s nearshore ecosystems under intensive mariculture development” (2017) 24 Environmental Science and Pollution Research 8957.

Løbach, Terje, et al, *Regional fisheries management organizations and advisory bodies. Activities and developments, 2000–2017*. FAO Fisheries and Aquaculture Technical Paper No 651 (Rome: FAO, 2020).

Long, Rachel D, Anthony Charles & Robert L Stephenson, "Key principles of marine ecosystem-based management” (2015) 57 Marine Policy 53.

Lowe, Vaughan, “Ships” in Nerina Boschiero et al (eds), *International Courts and the Development of International Law: Essays in Honour of Tullio Treves* (The Hague: Springer, 2013) 291.

Lund, Nicholas J, “Renewable Energy as a Catalyst for Changes on the High Seas Regime” (2010) 15 Ocean & Coastal LJ 95.

Luthman, O, M Jonell & M Troell, “Governing the salmon farming industry: Comparison between national regulations and the ASC salmon standard” (2019) 106 Marine Policy 103534.

Mackenzie, Ruth, et al, *An Explanatory Guide to the Cartagena Protocol on Biosafety* (Gland, Switzerland; Cambridge, UK: IUCN, 2003).

Maggio, Amber Rose, “Article 80”, in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 628.

Marine Scotland, “Disease management Areas” (12 February 2018), online: Marine Scotland <https://www.webarchive.org.uk/wayback/archive/20180514134843/http://www.gov.scot/Topics/marine/Fish-Shellfish/FHI/managementagreement>.

———, “Salmon Interactions Working Group Report: Scottish Government Response” (October 2021), online: Scottish Government <https://www.gov.scot/publications/salmon-interactions-working-group-report-scottish-government-response/>.

———, “Scottish Fish Farm Production Survey 2020”, online: Scottish Government <https://www.gov.scot/collections/scottish-fish-farm-production-surveys/>.

———, “Scottish Shellfish Farm Production Survey 2021”, online: Scottish Government <https://www.gov.scot/collections/scottish-shellfish-farm-production-surveys/>.

———, “The Regulation of Sea Lice in Scotland” Topic Sheet Number 71 v 4, online: <Marine Scotland https://www.gov.scot/publications/fish-health-inspectorate-sea-lice-information/>.

———, Salmon Interactions Working Group Report: Government Response (October 2021), online: Scottish Government <https://www.gov.scot/publications/salmon-

interactions-working-group-report-scottish-government-response/documents/>.

Mattilsynett [Food Safety Authority], Forebyggende tiltak for å bedre fiskehelsen og fiskevelferden [Preventative measures to improve fish health and fish welfare] (last updated 5 April 2019), online: Mattilsynett <https://www.mattilsynet.no/fisk_og_akvakultur/akvakultur/drift_av_akvakulturanlegg/forebyggende_tiltak_for_aa_bedre_fiskehelsen_og_fiskevelferden.27623>.

May, James R, "Constitutional Directions in Procedural Environmental Rights" (2013) 28 J Envtl L & Litigation 27.

McCoy, Henry D, *American and International Aquaculture Law* (Peterstown, WV: Supranational Publishing Company, 2000).

McDonagh, Vince, "Traffic light dispute goes to Norway's Supreme Court" (21 May 2022), online: Fish Farmer <https://www.fishfarmermagazine.com/news/traffic-light-dispute-goes-to-norways-supreme-court/> (accessed 12 July 2022).

McDonald, Jan & Megan C Styles, "Legal Strategies for Adaptive Management Under Climate Change" (2014) 26 J Envtl L 25.

McDorman, Ted L & T Ström, "Aquaculture and the multilateral trade regime: issues of seafood safety, labeling and the environment" in David L VanderZwaag & Gloria Chao, *Aquaculture Law and Policy: Towards principled access and operations* (Oxon; New York: Routledge, 2006) 355.

McGhee, Clara, Lynne Falconer & Trevor Telfer, "What does 'beyond compliance' look like for the Scottish salmon aquaculture industry?" (2019) 109 Marine Policy 103668.

McGraw, Katherine A & Michael B Rust, "Defining an ecosystem approach to aquaculture (EAA) for federal waters in the United States" in Proceedings of the 45th US-Japan Cooperative Program in Natural Resources (UJNR) Aquaculture Panel Scientific Mini Symposium "Potential of aquaculture to mitigate impacts of environmental change" held in Hiroshima, Japan, 17-18 October 2017, published in Special issue of the Bulletin of Japan Fisheries Research and Education Agency.

McIver, Iain, "Alignment with EU law and the Continuity Act", Scottish Parliament Information Center (SPICe) Briefing, SB 21-75 (29 October 2021), online: <https://sp-bpr-en-prod-cdnep.azureedge.net/published/2021/10/29/4f46ce9c-c87e-4f5e-9ccf-d28df6a8ca2e/SB%2021-75.pdf>.

McLeod, Karen L, et al, "Scientific Consensus Statement on Marine Ecosystem-Based Management" (2005).

Médici Colombo, Gastón, "El Acuerdo Escazú: La Implementación del Principio 10 de Río en América Latina y el Caribe" (2018) IX Revista Catalana de Dret Ambiental 1.

Metian, Marc, et al, “Mapping diversity of species in global aquaculture” (2020) 12 Rev in Aquaculture 1090.

Michaels, Ralf, “The Functional Method of Comparative Law” in M Reimann & R Zimmermann (eds), *The Oxford Handbook of Comparative Law* (Oxford: Oxford University Press, 2006).

Michaelsen-Svendsen, Bjørnar “Implementation of the Traffic Light System in Norwegian salmon aquaculture: success or failure for whom?” (Master Thesis, Norwegian College of Fishery Science, UiT The Arctic University of Norway: 2019).

Mikkelsen, Eirik, Patrick Berg Sørdahl & Ann-Magnhild Solås, “Transparent and consistent? Aquaculture impact assessments and trade-offs in coastal zone planning in Norway” (2022) 225 Ocean and Coastal Management 106150.

Miljøverndepartementet, “Veileder: Naturmangfoldloven kapittel II: Alminnelige bestemmelser om bærekraftig bruk– en praktisk innføring” (January 2012) [Ministry of the Environment, "Guide: Natural Diversity Act Chapter II: General provisions on sustainable use – a practical introduction"][Google Translate].

Ministry for Primary Industries (New Zealand), *Literature Review of Ecological Effects of Aquaculture* (Cawthron Institute; NIWA: August 2013).

Mitchell, Lisa & Aaron Ward, *Aquaculture Regulation in the Post Doelle-Lahey Era: An Analysis of Nova Scotia’s New Regulatory Framework* (Halifax: ECELAW, 2015).

Molinet, Carlos, et al, “Relation of mussel spatfall on natural and artificial substrates: Analysis of ecological implications ensuring long-term success and sustainability for mussel farming” (2017) 467 Aquaculture 211.

Moodie, Douglas, “Transgenic Fish: Some Canadian Regulatory Issues” in David L VanderZwaag & Gloria Chao (eds), *Aquaculture Law and Policy: Towards principled access and operations* (London: Routledge, 2006) 421.

Morgan, Bronwen & Karen Yeung, *An Introduction to Law and Regulation: Text and Materials* (Cambridge, UK: Cambridge University Press, 2017).

Morgera, Elisa, “Global Environmental Law and Comparative Legal Methods” (2015) 24 RECIEL 254

Morgera, Elisa, “The Ecosystem Approach and the Precautionary Principle” in Elisa Morgera & Jona Razzaque (ed), *Biodiversity and Nature Protection Law* (Cheltenham, UK: Edward Elgar, 2017) 70.

Mossop, Joanna, “The relationship between the continental shelf regime and a new international instrument for protecting marine biodiversity in areas beyond national jurisdiction” (2017) ICES Journal of Maine Science doi:10.1093/icesjms/fsx111.

Movik, Synne & Knut Bjørn Stokke, "Contested knowledges, contested responsibilities: The EU Water Framework Directive and salmon farming in Norway" (2015) 69 Norsk Geografisk Tidsskrift - Norwegian Journal of Geography 242.

Murray, Alexander G & Matthew Gubbins, "Spatial management measures for disease mitigation as practiced in Scottish aquaculture" (2016) 70 Marine Policy 93.

Murray, C, L Hannah & A Locke, "A Review of Cumulative Effects Research and Assessment in Fisheries and Oceans Canada" (2020) Can Tech Rep Fish Aquat Sci 3357.

Myklebust, Ingunn Elise, "Aquaculture law and administration in Norway" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Edward Elgar 2016) 336.

Nash, Colin E, *The History of Aquaculture* (Ames, Iowa: Blackwell Publishing, 2011).

Nash, CE, PR Burbridge & JK Volkman (eds), *Guidelines for Ecological Risk Assessment of Marine Fish Aquaculture,* US Dept Commer, NOAA Tech Memo NMFS-NWFSC-71.

NatureScot (then Scottish Natural Heritage), "Submission to Rural Economy and Connectivity Committee in Inquiry over Salmon Farming In Scotland" (May 2018), online: <https://archive2021.parliament.scot/S5_Rural/Scottish_Natural_Heritage.pdf >.

Neiland, AE, SA Shaw & D Bailly, "The social and economic impact of aquaculture: a European review", in N De Pauw & J Joyce (eds), *Aquaculture and the Environment*. European Aquaculture Society Special Publication No 16 (Gent, Belgium, 1991)

Neori, Amir, et al, "The need for a balanced ecosystem approach to blue revolution aquaculture" (2007) 49 Environment: Science and Policy for Sustainable Development 36.

Nilsson, Annika K & Brita Bohman. "Legal prerequisites for ecosystem-based management in the Baltic Sea area: The example of eutrophication" (2015) 44(Suppl 3) AMBIO 370–380, doi 10.1007/s13280-015-0656-6.

Nimmo, F et al, *Independent Review of the Consenting Regime for Scottish Aquaculture* (2016), online: Scottish Government <https://www.gov.scot/publications/independent-review-scottish-aquaculture-consenting/>.

Nordquist, Myron H et al, *United Nations Convention on the Law of the Sea: A Commentary* (Dodrecht; London; Boston: Martinus Nijhoff, 2002).

North Atlantic Salmon Conservation Organization (NASCO), "Agreement on Adoption of a Precautionary Approach" (CNL(98)46).

———, "Aquaculture Management in Canada: Advancing NASCO's International

Goals", Doc CNL(16)44 (2016).

———, Evaluation of the Revised Implementation Plan under the Third Reporting Cycle (2019 – 2024) from the Review Group to Norway (November 2021), IP(21)12.

———, Explanations of Terms Used in the Guidance on Best Management Practices to Address Impacts of Sea Lice and Escaped Farmed Salmon on Wild Salmon Stocks (adopted in June 2010), SLG(10)9.

———, External Performance Review, CNL(12)11.

———, Guidance on Best Management Practices to address impacts of sea lice and escaped farmed salmon on wild salmon stocks (adopted in June 2009 and revised in June 2010), SLG(09)5.

———, Guidelines for the Preparation and Evaluation of NASCO Implementation Plans and for Reporting on Progress, CNL(12)44.

———, *Handbook of Basic Texts*, online: NASCO <https://nasco.int/wp-content/uploads/2020/05/NASCO_Handbook.pdf>.

———, Report on Progress in Implementing the "Action Plan for taking forward the recommendations of the External Performance Review and the review of the 'Next Steps' for NASCO", CNL(13)38, CNL(19)17.

———, Resolution by the Parties to the Convention for the Conservation of Salmon in the North Atlantic Ocean to Minimise Impacts from Aquaculture, Introductions and Transfers, and Transgenics on the Wild Salmon Stocks (the Williamsburg Resolution), adopted at the Twentieth Annual Meeting of NASCO in June 2003 and amended at the Twenty-First Annual Meeting of NASCO in June 2004 and at the Twenty-Third Annual Meeting of NASCO in June 2006, CNL(06) 48.

———, "Statement on Salmon Farming from the Council of the North Atlantic Salmon Conservation Organization", CNL(22)49.

Nova Scotia Department of Fisheries and Aquaculture (NSDFA), "Aquaculture Statistics: Employment Statistics" (online: NSDFA <https://novascotia.ca/fish/aquaculture/economic-impact/>.

———, "Marine Finfish Farm Management Plan Minimum Compliance Requirements", online: NSDFA <https://novascotia.ca/fish/aquaculture/aquaculture-management/>

———, "Guide for Finfish Marine Aquaculture Development Plans", online: NSDFA <https://novascotia.ca/fish/aquaculture/licensing-leasing/>.

Norwegian Government, White Paper 16 (2014-2015), "Predictable and environmentally sustainable growth in Norwegian salmon and trout farming", [Meld St 16 (2014-2015) Forutsigbar og miljømessig bærekraftig vekst i norsk lakse- og ørretoppdrett] [Google Translate].

Nova Scotia Government, “Aquaculture Statistics”, online: Nova Scotia Government <https://novascotia.ca/fish/aquaculture/economic-impact/>.

Nova Scotia, Legislature, *Hansard archive for the Supply Subcommittee committee* (29 29 September 2017) online: NS Legislature <https://nslegislature.ca/legislative-business/committees/whole-house/subcommittee-whole-house-supply/archive/supply-subcommittee>.

———, *Hansard archive for the Economic Development committee* (13 September 2016), online: NS Legislature < https://nslegislature.ca/legislative-business/committees/standing/economic-development/archive/economic-development/index.htm\>.

Nowlan, Linda, “Brave New Wave: Marine Spatial Planning and Ocean Regulation on Canada’s Pacific” (2016) 29 JELP 151.

OECD, Glossary of Environment Statistics, Studies in Methods, Series F, No 67 (New York: United Nations, 1997).

Office of the Auditor General of Canada, “Salmon Farming” 2018 Spring Report of the Commissioner of the Environment and Sustainable Development to the Parliament of Canada (2018).

Office of the Prime Minister, “Minister of Fisheries, Oceans and the Canadian Coast Guard Mandate Letter” (13 December 2019), online: Office of the Prime Minister <https://pm.gc.ca/en/all-archived-mandate-letters>.

Olaussen, Jon Olaf, “Environmental problems and regulation in the aquaculture industry: Insights from Norway” (2018) 98 Marine Policy 158.

Orellana, Marcos, “Governance and the Sustainable Development Goals: The increasing importance of access rights in Principle 10 of the Rio Declaration” (2016) 25 RECIEL 50.

Organization for Economic Cooperation and Development (OECD), *The Ocean Economy in 2030* (Paris: OECD, 2016).

Osmundsen, Tonje C, et al, “Aquaculture policy: Designing licenses for environmental regulation” (2022) 138 Marine Policy 104978.

Osmundsen, Tonje C, et al, “The operationalisation of sustainability: Sustainable aquaculture production as defined by certification schemes” (2020) 60 Global Environmental Change 102025.

Osmundsen, Tonje C, Petter Almklov & Ragnar Tveterås, “Fish farmers and regulators coping with the wickedness of aquaculture” (2017) 21 Aquaculture Economics & Management 163.

OSPAR Commission, “Assessment of Impacts of Mariculture”, Biodiversity Series (2009), online: OSPAR <https://qsr2010.ospar.org/media/assessments/p00442_Impacts_of_Mariculture.pd

f>.

———, “Eutrophication Strategy”, in OSPAR Commission, Annual Report 2002 - 2003, Vol 2 (OSPAR Commission, London, 2003), online: OSPAR <https://www.ospar.org/documents?v=6955>.

———, Feeder Report 2021: Aquaculture, online: OSPAR <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/other-assessments/>.

———, Guidelines for Harmonised Quantification and Reporting Procedures for Nutrients (HARP-NUT). Guideline 2: Quantification and Reporting of Nitrogen and Phosphorus Discharges/losses from Aquaculture Plants (2004, revised in 2018), online: NASCO <https://www.ospar.org/convention/agreements?q=aquaculture&t=&a=&s=>.

———, *Quality Status Report 2010* (London: OSPAR Commission, 2010), online: OSPAR <https://qsr2010.ospar.org/en/index.html>.

Parliament of Canada, Senate, *An Ocean of Opportunities: Aquaculture in Canada* (H Fabian Manning) (June 2016).

Partelow, Stefan, et al, “Governing aquaculture commons” (2021) 14 Reviews in Aquaculture 729.

Peel, D & MG Lloyd, “Governance and planning policy in the marine environment: regulating aquaculture in Scotland” (2008) 174 The Geographical Journal 361.

Percy, David R, Nathanael Hishamunda & Blaise Kuemlangan, “Governance in marine aquaculture: the legal dimension” in A Lovatelli, J Aguilar-Manjarrez & D Soto (eds), *Expanding mariculture farther offshore: technical, environmental, spatial and governance challenges.* FAO Technical Workshop, 22–25 March 2010, Orbetello, Italy. FAO Fisheries and Aquaculture Proceedings No 24 (Rome: FAO, 2013) 245.

Phyne, John, “Along the Coast and in the State: Aquaculture and Politics in Nova Scotia and New Brunswick” in Conner Bailey, Svein Jentoft & Peter Sinclair (eds), *Aquacultural Development: Social Dimensions of an Emerging Industry* 69 (New York: Routledge, 1996).

Pillay, TVR, “Aquaculture Development: From Kyoto 1976 to Bangkok 2000” in RP Subasinghe et al, eds, *Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium*, Bangkok, Thailand, 20-25 February 2000 (Bangkok, Rome: NACA and FAO, 2001).

Platjouw, Froukje Maria, “The need to recognize a coherent legal system as an important element of the ecosystem approach” in Christina Voigt (ed), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law* (New York: Cambridge University Press, 2013) 158.

———, *Environmental Law and the Ecosystem Approach: Maintaining ecological integrity through consistency in law* (Oxon; New York: Routledge, 2016).

Proelss, Alexander, "Article 56", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 418.

———, "Article 60", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 464.

———, "The Contribution of the ITLOS to Strengthening the Regime for the Protection of the Marine Environment" in Angela Del Vecchio and Roberto Virzo (eds), *Interpretations of the United Nations Convention on the Law of the Sea by International Courts and Tribunals* (Cham, Switzerland: Springer International, 2019) 93.

Quiñones et al, Renato A ,"Environmental issues in Chilean salmon farming: a review" (2019) 11 Rev in Aquaculture 375.

Rajamani, Lavanya & Jacqueline Peel, "International Environmental Law: Changing Context, Emerging Trends, and Expanding Frontiers", in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 1.

RAMSAR, Resolution IX.1 on Additional Scientific and Technical Guidance for Implementing the RAMSAR wise use concept, adopted during the 9th Conference of the Parties held in Kampala, Uganda (2005), online: RAMSAR <https://www.ramsar.org/documents>.

Rector et al, Megan E, "Environmental indicators in salmon aquaculture research: A systematic review" (2022) 14 Rev in Aquaculture 156.

Reitz, John C, "How to Do Comparative Law" (1998) 46 The American Journal of Comparative Law 617.

Riksrevisjonen [Office of the Auditor General of Norway], The Office of the Auditor General's investigation into the management of aquaculture, Document 3:9 (2011–2012) (6 March 2012) [English version].

Robinson, Nicholas A, "Comparative Environmental Law: Evaluating How Legal Systems Address 'Sustainable Development'" (1997) 27 Env Pol'y & L 338

Roderburg, Jana, "Marine Aquaculture: Impacts and International Regulation" (2011) 25 Australian & New Zealand Maritime LJ 161.

Ross, LG, et al (eds), *Site selection and carrying capacities for inland and coastal aquaculture.* FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6–8 December 2010, Stirling, the United Kingdom of Great Britain and Northern Ireland. FAO Fisheries and Aquaculture Proceedings No 21 (Rome:

FAO, 2013).

Rudd, Murray A, et al, “Ocean Ecosystem-Based Management Mandates and Implementation in the North Atlantic” (2018) 5 Frontiers in Marine Science, https://www.frontiersin.org/articles/10.3389/fmars.2018.00485.

Ruhl, JB, “General design principles for resilience and adaptive capacity in legal systems - with applications to climate change adaptation” (2011) 89 NC L Rev 1373.

———, “In Defense of Ecosystem Services” (2015) 32 Pace Envtl L Rev 306.

Ruhl, JB, Steven E Kraft & Christopher L Lant. “The Law and Policy of Ecosystem Services” (Island Press, 2007).

Salcedo, Esteban, "Marine Renewable Energy Law and Policy in the Bay of Fundy: The Impact of Ambiguous Domestic Boundaries in Canada on Nova Scotia's Regulatory Framework" (2019) 24 Ocean & Coastal LJ 1.

Salimi, Jonni, “Machine Translation of Fictional and Nonfictional texts An examination of Google Translate’s accuracy on translation of fictional versus non-fictional texts” (2014), online: <http://www.diva-portal.org/smash/get/diva2:737887/FULLTEXT01.pdf>.

Salmon Chile, VI Informe de Sustentabilidad, Gestion 2020, online: SalmonChile https://www.salmonchile.cl/informe-sustentabilidad-2020/>.

Salmon Expert, “El Plan de Subpesca para relocalizar 500 concesiones de salmon da primer paso” [SUBPESCA plan to relocate 500 leases](24 December 2021), online: SalmonExpert <https://www.salmonexpert.cl/article/el-plan-de-subpesca-para-relocalizar-500-concesiones-de-salmon-da-primer-paso/>.

Salmon Scotland (formerly Scottish Salmon Producers’ Organisation or SSPO), *Scottish Salmon: A Better Future for Us All* (November 2020), online: <https://www.salmonscotland.co.uk/betterfuture> (accessed 16 June 2022).

———, *A Code of Good Practice for Scottish Finfish Aquaculture* (2010 Edition).

Sánchez-Jerez, P, et al, “Aquaculture's struggle for space: the need for coastal spatial planning and the potential benefits of allocated zones for aquaculture (AZAs) to avoid conflict and promote sustainability” (2015) 8 Aquaculture Environment Interactions 41.

Sandersen, Håkan T & Ingrid Kvalvik, “Access to aquaculture sites: A wicked problem in Norwegian aquaculture development” (2015) 14 Maritime Studies 27.

Saunders, Phillip M & Richard Finn, “Property Rights in Canadian Aquaculture: A Principled Approach” in David L VanderZwaag & Gloria Chao, *Aquaculture Law and Policy: Towards Principled Access and Operations* (Abingdon, New York: Routledge, 2006) 115.

Schönsteiner, Judith, “Algunas Reflexiones Preliminares sobre la Incorporación del

Derecho Internacional de los Derechos Humanos y Asuntos Económicos" in Ximena Gauché (ed), *X Coloquios de Derecho Internacional. Constitución Política y Derecho Internacional, Universidad de Concepción, 2021* (2021), online: Foro Constituyente Universidad de Concepción <https://foroconstituyente.udec.cl/storage/2021/08/2021_agosto31_Dossier_final_X_Coloquios_Derecho_Internacional.pdf>) 109.

Schramm, Daniel & Akiva Fishman. "Legal Frameworks for Adaptive Natural Resource Management in a Changing Climate" (2010) 22 Geo Int'l Envtl L Rev 491.

Schütz, Sigrid Eskeland & Ann-Michelle Slater, "From strategic marine planning to project licences: Striking a balance between predictability and adaptability in the management of aquaculture and offshore wind farms" (2019) 110 Marine Policy 103556.

Scotland Food and Drink, *Aquaculture Growth to 2030: A Strategic Plan for Farming Scotland's Seas* (2016), online: <https://www.salmonscotland.co.uk/sites/default/files/2021-06/Aquaculture_Growth_2030.pdf>.

Scottish Environmental Protection Agency (SEPA), "Consultation: Proposals for a risk-based, spatial framework for managing interaction between sea lice from marine finfish farm developments and wild Atlantic salmon in Scotland" (December 2021), online: <https://consultation.sepa.org.uk/regulatory-services/protection-of-wild-salmon/user_uploads/10211201--public---wf-sl-consultation-sepa-template.pdf >.

———, "Protection of the Marine Environment: Discharge from Marine Net Pen Fish Farms. A Strengthened Regulatory Framework" (2019), <https://www.sepa.org.uk/media/433439/finfish-aquaculture-annex-2019_31052019.pdf>.

———, "Water Environment (Controlled Activities) (Scotland) Regulations 2011: Licence Applicant Guidance, Form C: Point Source Fish Farm Discharges to the Water Environment" (2011), online: SEPA http://www.sepa.org.uk/water/water_regulation/regimes/aquaculture/marine_aquaculture/fish_farm_manual.aspx).

———, "WAT-PS-17-03: Interim Position Statement for Protecting the Water Environment until such Time as a Direction Is Issued on an EQS in Relation to Emamectin Benzoate in Finfish Farm Regulation".

Scottish Government, "A Review of the Aquaculture Regulatory Process in Scotland", Report by Russel Griggs (February 2022), online: Scottish Government <https://www.gov.scot/publications/review-aquaculture-regulatory-process-scotland/>.

———, "First stage of aquaculture review complete" (11 February 2022), online: Scottish Government <https://www.gov.scot/news/first-stage-of-aquaculture-

review-complete/>.

———, “Planning Advice Note PAN 1/2010: Strategic Environmental Assessment of Development Plans” (March 2010), online: Scottish Government <https://www.gov.scot/policies/environmental-assessment/strategic-environmental-assessment-sea/>

———, “Planning Circular 1/2007: Planning controls for marine fish farming” (2007).

———, “Planning Circular 1/2015: The relationship between the Statutory Land Use Planning System and Maine Planning and Licensing” (June 2015).

———, *Scotland's Marine Atlas: Information for The National Marine Plan* (16 March 2011), online: <https://www.gov.scot/publications/scotlands-marine-atlas-information-national-marine-plan/pages/5/>.

SERNAPESCA, Anuario Estadístico de Pesca y Acuicultura 2021, online: SERNAPESCA <http://www.sernapesca.cl/informacion-utilidad/anuarios-estadisticos-de-pesca-y-acuicultura>.

Sharon, Ori, et al, “Ecosystem services and judge-made law: A review of legal cases in common law countries” (2018) 29 Ecosystem Services 190.

Shaw, MR, JT Overpeck & GF Midgley, “Cross-chapter box on ecosystem-based approaches to adaptation—emerging opportunities”, in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, CB Field, VR Barros, DJ Dokken, et al (eds) (Cambridge, UK; New York, NY, USA: Cambridge University Press, 2014).

Silva, Hugo & Raimundo Soto, “Externalidades y Regulación de la Industria del Salmón en Chile y el resto del mundo” (July 2022). Informe Preparado para le Consejo del Salmon (July 2022) [Externalities and Regulations of the Salmon Industry in Chile and the World][translation by author], online: Consejo del Salmon <https://www.consejodelsalmon.cl/wp-content/uploads/2022/07/Estudio-PUC-Informe-Final-Julio-2022.pdf>.

Slater, Anne-Michelle, “Aquaculture and the law: United Kingdom and Scotland” in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Edward Elgar 2016) 412.

Soininen, Niko & Froukje Maria Platjouw, “Resilience and Adaptive Capacity of Aquatic Environmental Law in the EU: An Evaluation and Comparison of the WFD, MSFD, and MSPD” in David Langlet & Rosemary Rayfuse, *Ecosystem Approach in Ocean Planning and Governance: Perspectives from Europe and Beyond* (Leiden: Brill Nijhoff, 2018) 17.

Solås, Ann-Magnhild et al, Salmon farming in the North: Regulating societal and environmental impacts, NOFIMA Report 47/2020 (December 2020), online:

NOFIMA <https://nofima.brage.unit.no/nofima-xmlui/bitstream/handle/11250/2722359/Rapport+47-2020+Salmon+farming+in+the+North.pdf?sequence=1>.

Sørlie, Markus, "An introduction to the Government's new aquaculture strategy" (30 August 2021), online: Simonsen Vogt Wiig <https://svw.no/en/insights/an-introduction-to-the-governments-new-aquaculture-strategy>.

Soto, D, J Aguilar-Manjarrez & N Hishamunda (eds), *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and Aquaculture Proceedings No 14 (Rome: FAO, 2008).

Soto, Doris, et al, "Addressing aquaculture-fisheries interactions through the implementation of the ecosystem approach to aquaculture (EAA)" in RP Subasinghe et al (eds), Farming the Waters for People and Food. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand. 22–25 September 2010 (Rome; Bangkok: FAO; NACA, 2012).

Stec, Stephen & Jerzy Jendrośka, "The Escazú Agreement and the Regional Approach to Rio Principle 10: Process, Innovation, and Shortcomings" (2019) 31 J Envtl L 533.

Steeves, Laura & Ramón Filgueira. "Stakeholder perceptions of climate change in the context of bivalve aquaculture" (2019) 102 Marine Policy 121.

Stephens, Tim, "Article 197", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1328.

Stewart, Richard B, "A New Generation of Environmental Regulation" (2001) 29 Cap U L Rev 21.

Tanaka, Yoshifumi, *The International Law of the Sea*, 2nd ed (Cambridge, UK: Cambridge University Press, 2015).

Tett, Paul, "The Ecosystem Approach to Aquaculture" (Oban: Scottish Association for Marine Science, 2017).

___, "The Ecosystem Approach to Aquaculture and Spatial Planning" (2008), online: AquaSpace <http://www.aquaspace-h2020.eu/wp-content/uploads/2018/04/AquaSpaceMM-02-EAA-MSP-5Apr18.pdf>.

The Scottish Parliament, Rural Economy and Connectivity Committee, "Salmon Farming in Scotland" SP Paper 432, 9th Report (Session 5) (27 November 2018).

———, Official Report of Session 5, 30th Meeting on Wednesday 18 November 2020, "Salmon farming inquiry update", online: Scottish Government <https://archive2021.parliament.scot/parliamentarybusiness/CurrentCommittees/116919.aspx>.

———, Question ref. S6W-08393 answered by Mairi Gougeon on 3 May 2022, online: <https://www.parliament.scot/chamber-and-committees/written-questions-and-answers/question?ref=S6W-08393>.

———, Session 5 Legacy Report, SP Paper 1018, 5th Report (Session 5) (23 March 2021), online: <https://sp-bpr-en-prod-cdnep.azureedge.net/published/REC/2021/3/23/1254bf5f-3247-4a40-83f3-d7d97073fc66-1/RECS052020R5.pdf>.

Tigchelaar, Michelle, et al, "The vital roles of blue foods in global food systems" (2022) 33 Global Food Security 100637.

Tiller, Rachel, Tove Brekken & Jennifer Bailey, "Norwegian aquaculture expansion and Integrated Coastal Zone Management (ICZM): Simmering conflicts and competing claims" (2012) 36 Marine Policy 1086.

Troell, Max, et al, "Perspectives on aquaculture's contribution to the SDGs for improved human and planetary health" Background Paper for FAO Shanghai Symposium "Aquaculture and the SDGs", Thematic Paper presented at the Global Conference on Aquaculture 2020, Shanghai, China, 22-25 September 2021, online <https://aquaculture2020.org>

Trouwborst, Arie, "The Precautionary Principle and the Ecosystem Approach in International Law: Differences, Similarities and Linkages" (2009) 18 RECIEL 26)

Trueman, Justin D, Ramón Filgueira & Lucia Fanning, "Transparency and communication in Norwegian and Nova Scotian Atlantic salmon aquaculture industries" 138 (2022) Marine Policy 104958.

United Nations (UN), "World Charter for Nature", Annex to Resolution of the United Nations General Assembly 37/7 (28 October 1982).

———, Report on the Work of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its seventh meeting, A/61/156 (17 July 2006).

———, *Declaration on the Rights of Indigenous People*, Annex to Resolution 61/295 adopted by the United Nations General Assembly on 13 September 2007, A/RES/61/295.

United Nations Conference on Environment and Development, *Agenda 21: Programme of Action for Sustainable Development*, UN Doc. A/Conf. 151/26 (1992).

———, *Rio Declaration on Environment and Development*, UN Doc A/CONF.151/26 (vol I), 31 ILM 874 (1992).

UN Department of Economic and Social Affairs, "Sustainable Development", online: https://sdgs.un.org/goals/goal14 (accessed 10 September 2021).

United Nations Conference on the Human Environment, *Stockholm Declaration on the*

Human Environment, UN Doc. A/CONF.48/14, at 2 and Corr.1 (1972).

United Nations Environment Programme (UNEP)*, Environmental Rule of Law: First Global Report* (Nairobi: UNEP, 2019).

———, "Goals and Principles of Environmental Impact Assessment", decision 14/25 of the Governing Council of UNEP (17 June 1987), online: Environmental Law Alliance Worldwide <https://www.elaw.org/content/un-unep-goals-and-principles-environmental-impact-assessment>.

———, *Taking steps toward marine and coastal ecosystem-based management: an introductory guide* (Nairobi: UNEP, 2011).

United Nations General Assembly, "Harmony with Nature", Resolution 64/196 adopted by the General Assembly on 21 December 2009, A/RES/64/196 (12 February 2010).

———, Resolution 1803 (XVII) of 14 December 1962 on "Permanent sovereignty over natural resources".

———, Resolution 3201 (S-VI) "Declaration on the Establishment of a New International Economic Order" (1 May 1974).

———, Resolution 3281 (XXIX) "Charter of Economic Rights and Duties of States" (12 December 1974).

———, Resolution 66/288 "The future we want" (27 July 2012), Doc A/RES/66/288 (11 September 2012).

———, Resolution 69/292 on the Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (19 June 2015), Doc A/RES/69/292 (6 July 2015).

———, Resolution 70/01 "Transforming our world: the 2030 Agenda for Sustainable Development" (25 September 2015), Doc A/RES/70/1 (21 October 2015).

———, Resolution 76/71 on Sustainable fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments, Doc A/RES/76/71 (17 December 2021).

UN Secretary-General, *Gaps in international environmental law and environment-related instruments: towards a global pact for the environment*, A/73/419 (30 November 2018).

United Nations Secretary Generals' High-Level Panel on Global Sustainability, *Resilient People, Resilient Planet: A Future Worth Choosing* (New York: UN, 2012)).

Van Slyck, Kara M, "Salmon with a Side of Genetic Modification: The FDA's Approval

of AquAdvantage Salmon and Why the Precautionary Principle Is Essential for Biotechnology Regulation" (2017) 41 Seattle UL Rev 311

VanderZwaag, David L, "The international law and policy seascape for aquaculture: navigating tangled currents" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016) 11.

VanderZwaag, David L & Gloria Chao, *Aquaculture Law and Policy: Towards principled access and operations* (Oxon; New York: Routledge, 2006).

VanderZwaag, David L, et al, "Canada's international and national commitments to sustain marine biodiversity" (2012) 20 Environmental Reviews 312.

VanderZwaag, David L, Gloria Chao & Mark Covan, "Canadian Aquaculture and the Principles of Sustainable Development" in David L VanderZwaag & Gloria Chao, *Aquaculture Law and Policy: Towards Principled Access and Operations* (Abingdon, New York: Routledge, 2006) 49.

Viñuales, Jorge E, "Comparative Environmental Law: Structuring a Field" in Emma Lees & Jorge E Viñuales (eds), *The Oxford Handbook of Comparative Environmental Law* (Oxford: Oxford University Press, 2019) 3.

Viñuales, JE & J-F Mercure, "Pathway to Reframing Environmental Law" (2020) 50 Envtl Pol'y & L 509.

Voigt, Christina (ed), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law* (New York: Cambridge University Press, 2013).

Vöneky, Silja & Felix Beck, "Article 147", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1035.

Wacht, Frank, "Article 208", in Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Munich, Oxford, Baden-Baden: CH Beck/Hart/Nomos, 2017) 1391.

Wang, Haifeng, et al, "Progress in Machine Translation" (2021) Engineering https://doi.org/10.1016/j.eng.2021.03.023 (in press)

Weimin, Miao, "Recent developments in rice-fish culture in China: A holistic approach for livelihood improvement in rural areas" in Sena S De Silva & F Brian Davy, *International Development Research Centre, and Network of Aquaculture Centres in Asia-Pacific, Success Stories in Asian Aquaculture* (Ottawa; Bangkok; Dordrecht; New York: Springer, 2010).

Weitzman, Jenny, "Applying the ecosystem services concept to aquaculture: A review of approaches, definitions, and uses" (2019) 25 Ecosystem Services 194.

Weitzman, Jenny & Ramón Filgueira, "The evolution and application of carrying capacity

in aquaculture: towards a research agenda" (2020) 12 Reviews in Aquaculture 1297.

Weitzman, Jenny, et al, "Far-field and near-field effects of marine aquaculture" in Charles Sheppard (ed), *World Seas: An Environmental Evaluation Volume III: Ecological Issues and Environmental Impacts* (Elsevier, 2019) 197.

Westra, Laura, "The Ethics of Integrity and the Law in Global Governance" (2003-2004) 27 Environs Envtl L & Pol'y J 127.

Whitsitt, Elizabeth & Nigel Bankes, "Aquaculture and Trade: trade law and trade-related multilateral environmental agreements" in Nigel Bankes, Irene Dahl & David L VanderZwaag (eds), *Aquaculture Law and Policy: Global, Regional and National Perspectives* 33 (Cheltenham, UK; Northampton, MA, USA: Edward Elgar, 2016).

Wiersema, Annecoos, "A Train without Tracks: Rethinking the Place of Law and Goals in Environmental and Natural Resources Law" (2008) 38 Envtl L 1239.

———, "Wildlife" in Lavanya Rajamani & Jacqueline Peel (eds), *Oxford Handbook of International Environmental Law* (Oxford, UK: Oxford University Press, 2021) 554.

Willot, Pierre-Alexandre, et al, "Ecosystem service framework and typology for an ecosystem approach to aquaculture" (2019) 512 Aquaculture 734260.

Wolfrum, Rüdiger, "Purposes and Principles of International Environmental Law" (1990) 33 German YB Int'l L 308.

Wolfrum, Rüdiger & Nele Matz, "The Interplay of the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity" (2000) 4 *Max Planck Yearbook of United Nations Law* 445.

World Bank and United Nations Department of Economic and Social Affairs, *The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries* (Washington DC: World Bank, 2017) .

World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1987).

World Health Organization, "Vaccinating salmon: how Norway avoids antibiotics in fish farming" (29 October 2015), online: World Health Organization <https://www.euro.who.int/en/countries/norway/news2/news/2015/10/vaccinating-salmon-how-norway-avoids-antibiotics-in-fish-farming>

World Summit on Sustainable Development, *Johannesburg Declaration on Sustainable Development and Plan of Implementation of the World Summit on Sustainable Development: the final text of agreements negotiated by governments at the World Summit on Sustainable Development, 26 August-4 September 2002, Johannesburg,*

South Africa (New York: UN, 2003).

Yaffee, Steven L, "Three Faces of Ecosystem Management" (1999) 13 Conservation Biology 713.

Young, Avison, Webster Rae & Powis Hughes, "A Review of Rent and Lease Terms for Marine Aquaculture in Scotland" (January 2021), Report prepared from Crown Estate Scotland, online: CES <https://www.crownestatescotland.com/resources/documents/aquaculture-review-report-jan-2021>.

Young, Nathan, et al, "Limitations to growth: Social-ecological challenges to aquaculture development in five wealthy nations" (2019) 104 Marine Policy 216.

Young, Nathan & Ralph Matthews, *The Aquaculture Controversy in Canada: Activism, Policy, and Contested Science* (Vancouver, BC: UBC Press, 2010).