TRANSPARENCY AND COMMUNICATION IN NORWEGIAN AND NOVA
SCOTIAN SALMON AQUACULTURE INDUSTRIES

By

Justin Trueman

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Abstract

Trueman, J. (2019). Transparency and communication in Norwegian and Nova Scotian salmon aquaculture industries [graduate project]. Halifax, NS: Dalhousie University.

The Atlantic salmon aquaculture industry has the potential to have a significant contribution to economic development and seafood production – particularly in rural and coastal communities. However, the lack of social licence to operate (SLO) can become a barrier for industry development. Transparency and communication have been suggested as two of the potential drivers for the industry to achieve SLO. This study explores the role of transparency and communication in the achievement of SLO in the salmon aquaculture industry by contrasting the perceptions of relevant stakeholders (researchers, managers/regulators, NGOs/community groups, and industry). The comparison was carried out in two distinct jurisdictions where salmon aquaculture occurs: an industry pioneer, Norway, having national ocean policies incorporating SLO, with a younger industry of Nova Scotia, Canada, that has adopted new aquaculture regulations in 2015. These regulations follow a moratorium of four to five years on new lease and licenses that was prompted by the public. Results reinforce the importance of meaningful engagement, reporting of environmental and social standards, as well as the need for industry (with government support) to take on a leadership role in transparency and communication in both jurisdictions. Comparison of these two areas helps to understand the role of transparency and communication in achieving SLO, which may be key to promoting the development and sustainability of the salmon aquaculture industry worldwide.

Keywords: aquaculture; Atlantic salmon; Nova Scotia; Norway; transparency; communication; social licence to operate; Q methodology

Acknowledgements

Introduction

Aquaculture, or the cultivation of seafood, is a rapidly growing industry as it continues to support the growing demand for food from the ocean (FAO, 2018). Globally, over 300 species of finfish are produced through aquaculture (FAO, 2014), dominating annual seafood production at around 80 million tonnes worldwide (Lindland et al., 2019; FAO, 2018). The finfish aquaculture industry has the potential to provide relief to wild fisheries, aid in protein production, and revenue generation (FAO, 2018; Current world finfish production from marine and coastal aquaculture is visualized in Appendix i). Drawbacks to these benefits are the broad range of effects, including conflicted use of the marine space (Sanchez-Jerez et al., 2016), potential effects on other industries such as the lobster fishery (Milewski et al., 2018; Grant, Simone, & Daggett, 2019), and cultural/indigenous impacts (Hunter, 2018). Both the benefits and drawbacks depend on the type of aquaculture operations present, as well as local context (Froehlich et al., 2017b).

Regardless, potential effects of the finfish aquaculture industry have been a main driver of discussion for years (Stickney, 1994; FAO, 2002; Weir & Grant, 2005; Dean, Shimmield & Black, 2007; Burridge et al., 2010; Trudeau, 2018; FAO, 2018). Sustainable Development Goal (SDG) 14, life below water, asserts the global need to advance the sustainable use and conservation of the oceans. Negative impacts of unmanaged aquaculture expansion have also been recognized by SDG 14 (FAO, 2019; United Nations, 2019). The environmental burden of finfish aquaculture is variable worldwide, depending on the scale, site selection, and the management practices that a nation chooses to implement (White, Philips, and Beveridge, 2013; Froehlich et al., 2017b). This variability allows for opinions to have a place in the discussion of aquaculture operations (The Huddle, 2019; Castle, 2017; Willick, 2018). Local-scale protests against aquaculture developments have gained traction, with concerns of environmental effects, but more recently from a social and community benefits perspective (Young & Matthews, 2010). This has manifested itself worldwide, including extremes like mass protests in Chile disrupting logistics and operations of salmon farming (Evans, 2019; Cherry, 2019).

Opposition to the development of the industry is most prevalent in Western countries including Canada and Norway (Bacher, 2015; Young & Matthews, 2010), despite the majority of finfish aquaculture production occurring in Asia (FAO, 2018). Development of the finfish aquaculture in Nova Scotia (Canada) and Norway is dominated by Atlantic salmon, and public perception is becoming increasingly relevant for the expansion and continued operation of the industry (Tiller et al., 2017; Terpenning, 2018; Doelle & Lahey, 2014). Norwegian and Nova Scotian priorities, as outlined by their respective governments and industry organizations include food security, maintaining low levels of sea lice, reduced use of antibiotics, community engagement, as well as fish health and welfare (Government of Norway, n.d.; Fisheries and Oceans Canada, 2017; Aquaculture Association of Nova Scotia, 2018). These concerns are balanced with the potential benefits of Atlantic salmon aquaculture for economic development to rural and coastal communities, relief to wild fisheries, and protein production for a growing population (Fisheries and Oceans Canada, 2013; Huddle, 2019; Mowi, 2019). Atlantic salmon aquaculture has gained political traction through the Canadian Prime Minister (Trudeau, 2018), as well as Norwegian Prime Minister (Solberg, 2019), supporting the responsible and sustainable development of the sector.

Political will, combined with legislation supporting social wellbeing and resilience put forward in the 1970s is representative of the growing concerns of the public (Carroll, 1991). In this context, corporations became subjected to considering the public as a stakeholder in their operation alongside of their traditional shareholders (Carroll, 1991). Social licence to operate (SLO) grew with the increased expectations from industries operating in public space. Expectations of industry to fulfil corporate responsibilities (Carroll, 1991) influence the way in which these companies conduct business as they have begun to directly affect profitability and operations of a company (Moffat et al., 2015; Graafland, 2002). Norway prides itself on its transparent industry, and their companies tend to use this as a mitigation tool for social licencing issues (Mowi, 2019; Grieg, 2019). Transparency, as a principle that is increasingly embraced in aquaculture management, can help lead to accountability of an industry (Issing, 2005; Hale, 2008). Generally, transparency initiatives are supported by regulation and management efforts, as is the case of salmon aquaculture in Nova Scotia and Norway

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(Fisheries and Aquaculture, 2015; Hersoug, 2015; examples of data transparency in both regions can be found in Appendix iv). However, the power of transparency in regulation of the aquaculture industry depends on the way in which actors respond to transparency, rather than transparency on its own (Fox, 2007). Part of the effectiveness outlined by Fox (2007) is linked to the way in which information is released, and with what context information is communicated to minimize confusion and prevent recipients from becoming overwhelmed (Issing, 2005). Communication, the multidirectional flow of information between parties, allows for perspectives to be exchanged among relevant stakeholders (Thackeray & Neiger, 2009). This multidirectional flow is crucial for meaningful engagement (Sayce et al., 2013; Thackeray & Neiger, 2009), in contrast to a unidirectional flow of information that may have been prioritized in the past (Rogers & Shoemaker, 1971). Transparent and clear communication could more accurately prepare the industry for future sustainable growth (Froehlich et al., 2017a).

Management Problem

The Nova Scotian aquaculture industry has potential for food production and economic development – particularly in rural and coastal communities (Flaherty et al., 2019). However, a lack of social licencing provides a barrier for the development of the industry (Doelle & Lahey, 2014). Canadian stakeholders including public groups, media, some NGOs, and First Nations communities scrutinize the industry based on the way that transparency and environmental protection are being regulated in the context of finfish aquaculture (Terpenning, 2018; Flaherty et al., 2019). Although new aquaculture regulations in Nova Scotia released in 2015 (Nova Scotia Legislature, 2015) have begun to promote transparency, this does not seem to be enough for certain stakeholders (Terpenning, 2018). In Norway, their multinational corporations seem to be focusing efforts for SLO globally, causing issues with social licence at the local scale (Carson & Rønningen, 2016; FAO, 2018). In both regions, the aquaculture stakeholder network is complex, with industry proponents competing with the fishing industry, recreation, and tourism (Mather & Fanning, 2019) for use of the marine space.

Norwegian policy makers have incorporated statements in their National Ocean Policy supporting social licensing, including intentions for social cost-benefit assessment (UNESCO, 2007), representing transparency and communication as part of their plans for the industry (Royal Ministry of the Environment, 2002). Norway, with the contemporary floating pen design in operation since the 1960s (Knapp, Roheim, & Anderson, 2007), has relative seniority over the Nova Scotian context, with Nova Scotia harvesting its first farmed salmon in 1984 (Chang, 1998). Comparison of Norwegian perspectives of transparency and communication, with the Nova Scotian industry, an area in which there is now potential to expand into the costal zone following a recently lifted moratorium in 2015, could increase the understanding of the role of transparency and communication in achieving genuine social licence.

Research Aims and Objectives

The understanding of the role of transparency and communication has the potential to promote the social licence of the salmon aquaculture industry in Norway and Nova Scotia by identifying the most likely bottlenecks in allowing SLO. This understanding may also bring numerous benefits to a sustainable salmon aquaculture industry and thereby society by promoting environmental, economic, and social sustainability. This research explores the existing perceptions of transparency and communication of key stakeholders from the salmon aquaculture in the different regulatory and social climates of Nova Scotia and Norway. This study is intended to allow for the identification of overlaps of stakeholder groups' priorities, as well as where there is expected (or existing) areas of conflict. This was accomplished by answering the following research question through a collection of three sub-questions:

- *Main Research Question:* What is the role of transparency and communication in the Social Licence to Operate of Norwegian and Nova Scotian Atlantic salmon aquaculture industries?
    - o *SubQ1:* What are the main drivers of social licence in the Norwegian and Nova Scotian aquaculture industries?

- *SubQ2:* What is the role of transparency in the social licencing and development of Norwegian and Nova Scotian aquaculture industries?
- *SubQ3:* What is the role of communication (and accessibility to information) in the social licencing and development of the Norwegian and Nova Scotian aquaculture industries?

These questions were answered through the completion of a Q methodology study in Nova Scotia and Norway, as a way of gauging stakeholder perception of the role of transparency and communication in the salmon aquaculture industries. The use of Q methodology, a mixed-methods tool, was used to generate broad perspectives, and allows for the identification of similarities between participants across stakeholder groups (Brown, 1993). These perceptions were compared to one another statistically to find patterns in the participants' opinions. The Q methodology study was complemented with a semi-structured interview component, allowing for participants to explain their decisions more deeply. By gaining insight into how a range of stakeholders view the role of transparency and communication as components to SLO, regulations and industry performance may be strengthened to develop more socially acceptable aquaculture.

Theoretical Background

Social licence to operate (SLO) can be defined as the 'demands on and expectations for a business enterprise that emerge from neighbourhoods, environmental groups, community members, and other elements of the surrounding civil society' (Gunningham et al., 2004). In this way, SLO is dynamically "granted" by the community in which it operates, constantly changing with new information (Thomson & Boutilier, 2011). Managers, with the role of defining rules and regulations that any industry must operate under, play an important role in shaping the reality of SLO in an area (e.g. Terpenning, 2018; Prno & Slocombe, 2012; Zhang & Moffat, 2015; Mather & Fanning, 2019). As implied by the definition of SLO, the degree to which social licence is granted changes depending on the place, the relevant stakeholders in the area, and the way in which these stakeholders are engaged. This pressure is separate from formal legal

licensing and regulation processes, as mitigation of SLO threats to an industry operation involves the ongoing, dynamic involvement of a range of stakeholders (Gunningham et al., 2004; Moffat et al, 2015).

Social licencing as a process has traditionally involved transparency as a way to generate accountability (Issing, 2005; Fox, 2007; Hale, 2008). Transparency is a principle of growing acceptability, seeing uptake from the environmental movement for assessment of natural impacts. Since the collapse of the American energy company, Enron (and its systemic accounting fraud), accountability is also seen as an organizational requirement (Hall et al., 2007). The intended role of transparency in this context is that operations subjected to transparency (e.g. NGOs, government, or industry), whether voluntarily in social licencing campaigns or through regulation, must consider the consequences of their actions to avoid negative impacts on their public perception (Fox, 2007). However, the assumption that transparency and accountability are directly linked has been challenged, with few researchers capable of explaining how openness changes the decisions made by actors (Fox, 2007; Hale, 2008). The basis of varying qualities of transparency is that if information is communicated in a way that is challenging to interpret or access, the utility of releasing that information is affected. As explained by Fox (2007), 'opaque' transparency is information that is communicated in an unclear way, divulged partially, or that is unreliable. This is contrasted with 'clear' transparency practices that explain institutional behaviour, are explicit with where funds go, and that allow for productive change based in accountability. In this way, freely flowing communication is directly connected to the type of transparency, and therefore the accountability that is taking place (Fox, 2007). In this study, transparency and communication are made distinct as a means for developing the accountability and therefore SLO of the Atlantic salmon aquaculture industry.

Methods

Q methodology (henceforth "Q") is a combination of qualitative and quantitative methods that can allow researchers to find patterns in the subjectivity of its participants

(Brown, 1993). Originating in psychology, Q has been applied to a range of disciplines, including ecological economics (Barry & Proops, 1999), forest management (Steelman & Maguire, 1999), program evaluation in nursing (Akhtar-Danesh et al., 2007), and aquaculture (Rudell & Miller, 2012; Bacher, Gordoa, & Mikkelsen, 2014; Weitzman & Bailey, 2018). Results allow for the identification of thematic perspectives on a topic, grouping participants based on similarities in their answers (Cross, 2005). Using Q allows researchers to capture perceptions through structured sorting rather than relying on large sample sizes (McKeown & Thomas, 2013). This makes for a major logistical advantage to Q methodology, allowing for smaller sample sizes to produce statistically significant results (Brown, 1993). Though this combination of semi-structured interviews and Q-methodology, there is the potential to provide an effective, easily understood output that may inform policy decisions (Barry and Proops, 1999).

Concourse survey and selecting statements

A Q study begins with the development of the 'concourse' survey where a broad, well-represented understanding of the opinions and existing knowledge surrounding the study topic is developed (Du Plessis, 2005; Weitzman & Bailey, 2018). From this survey, all statements are inspired by media, literature, or other existing documents (see Appendix ii for more information). In the context of transparency, communication, and public trust/SLO, scientific and grey literature were surveyed. From these documents, statements were compiled, and then tailored to ensure that each statement was standalone, with its meaning not repeated in a similar wording, and ensuring that only the most relevant statements were included. This is done to ensure that there is a manageable number for participants to read through, as well as balanced to ensure there is pro, neutral, and con opinions about the topic. These statements were sorted into categories by topic: 1) Drivers of Social Licence, 2) Transparency, 3) Communication, 4) Who Should Take the Lead?, and 5) Other Benefits and Challenges. This final grouping of statements is called the Q-Sort, containing 40 statements in this study (Table 1).

Study area

Interviews were completed across NS and Norway (see Figures 1 and 2) with the approval of the Marine Affairs Program Ethics Review Standing Committee under application #MAP2019-01. Norway, a Scandinavian country located on the Atlantic Ocean, has a population of 5.3 million, with a GDP per capita of 72,185 USD (Statistics Norway, 2018). Norway produces around 1.3 million metric tonnes of finfish per year (FAO, 2018), valued at 7.4 billion USD with 94.6% of this being Atlantic salmon (Statistics Norway, 2019). Canada has a GDP per capita of 45,032 USD, and Nova Scotia, a coastal Atlantic province of Canada has a population of 950,680 individuals (Statistics Canada, 2018). In 2018, Nova Scotia produced 8,228 metric tonnes of Atlantic salmon, valued at over 57 million USD. This constituted 83% of the total provincial aquaculture production (finfish, shellfish, and other seafoods combined) in 2018 (Nova Scotia, 2019).

Figure 1: Map of Nova Scotia, indicating approximate interview locations under red pins (Produced in Esri/ArcGISonline).Map of Nova Scotia, indicating approximate interview locations under red pins (Produced in Esri/ArcGISonline).

Figure 2: Map of Norway, indicating approximate interview locations under red pins (Produced in Esri/ArcGISonline).

Survey participants

Norwegian interviews were completed between mid-April and the end of June 2019, and Canadian interviews were completed from the start of July to the end of August 2019. 16 interviews were completed in each region (N=32), with 4 participants in each stakeholder group: i) managers/regulators, ii) industry, iii) ENGO/community groups, iv) academia/researchers. These stakeholder groups were chosen to be a combination of familiarity with the Atlantic salmon aquaculture and those that possess legitimate interest in the issue (de Bussy & Kelly, 2010). Participants were chosen across categories that were linked within the Atlantic salmon and finfish aquaculture industries. In the context of this study, a stakeholder is defined as: 1) a person impacted, 2) with knowledge about, or 3) with interest in the salmon aquaculture industry.

Semi-structured interviews

This study combines the quantitative approach of Q with the qualitative perspectives of semi-structured interviews in an effort to address the research purpose, primary research question, and all research sub-questions (Table 2). During the interviews, participants were provided 40 numbered statements to ensure the same order, in the categories described in Table 1. Participants would then sort these statements with the help of a grid (Figure 3) based on how much they agree, disagree, or feel neutrally/do not know about an issue. This was completed either in-person or online through the use of QSortWare software when an in-person interview was not possible. Q is designed in a way that forces a quasi-normal distribution, where participants were asked to sort only three statements in the category they felt most strongly about (+4 / -4), and up to six statements for the neutral/do not know category (this inverted parabola shape is shown in Figure 3). The number of statements intended for each rank is illustrated by the number of rectangles below each column. Once participants completed placing all 40 statements on the board, there was the opportunity for them to discuss their choices. This was done in person, through Skype, or over the phone. These interviews allowed for participants to explain the way in which they interpreted the statements and to explain why they may have chosen to sort the statements the way they did rather than an alternative.

Table 1: Q-sort statements (n=40) used in the Q methodology interview, organized by corresponding categories.

Category	Statement
Drivers of Social Licence	Reducing the use of pesticides and antibiotics is not important to achieving social licence.
	Meaningful engagement with communities affected by aquaculture operations is important to achieving social licence.
	Communication among stakeholders (e.g. industry, public and government) is not important to achieving social licence.
	Public education is important to achieving social licence.
	Minimizing the effects on benthic species (e.g. lobster) is not important to achieving social licence.
	Preventing effects on wild salmon populations is important to achieving social licence.
	Reduced reliance on fishmeal is not important to achieving social licence.
	Monitoring, reporting, and enforcement of environmental and social standards is important to achieving social licence.
	Transparency is not important to achieving social licence.
	Independent certification of environmental and social standards is important to achieving social licence.
Transparency	Transparent aquaculture operations generate a higher value product.
	Transparent aquaculture operations are a pre-requisite for entry into some markets.
	Regulations that promote transparency can compromise industry development.
	Transparency leads to accountability of the industry.
	Existing regulations sufficiently encourage transparency.
	Current capacity (e.g. infrastructure, personnel, resources) does not prevent farmers from operating in a transparent way.
Communication	Sharing technical information without proper public education does not cause confusion.
	Polarization of views regarding salmon aquaculture is caused by a lack of effective communication.
	Government does not have the capacity to effectively communicate to the public.
	Government communication initiatives do not reach the majority of the public.
	Communication strategies have failed to show changes in aquaculture operations over time.
	Effective record-keeping systems provide the potential for effective communication of aquaculture practices.
	The information that industry is currently communicating is accessible to the public.
	Without communicating information in a way that is easily understood, transparency is not useful to the public.
Who should take the lead?	Promoting transparency is not a role for NGOs.
	Promoting communication is not a role for NGOs.
	Promoting transparency is a role for the government.

Promoting communication is a role for the government.

Promoting transparency is not a role for industry.

Promoting communication is not a role for industry.

Promoting transparency is a role for an independent ecolabel.

Promoting communication is a role for an independent ecolabel.

Promoting transparency is a role for media (e.g. newspapers, television coverage, etc.).

Promoting communication is a role for media (e.g. newspapers, television coverage, etc.).

Other Benefits and Challenges	Transparent aquaculture practices do not promote sustainable aquaculture. Conflict resolution in the marine space is a process of transparency. Conflict resolution in the marine space is not a process of communication. Current transparency policies set by the government are not effective. Current communication policies set by the government are effective. There is no reluctance for salmon aquaculture companies to communicate environmental parameters (e.g. disease occurrence, escapees, etc.) to the public.

Table 2: Methods used in this study to address research purpose and research questions.

(Step 1) Research Purpose	Allow for the identification of overlaps of stakeholder groups' priorities, as well as where there is expected (or existing) areas of conflict.		
(Step 2) Primary Research Question	What is the role of transparency and communication in the Social Licence to Operate of Norwegian and Nova Scotian Atlantic salmon aquaculture industries?		
(Step 3) Research Sub-Questions	What are the main drivers of social licence in the Norwegian and Nova Scotian aquaculture industries?	What is the role of transparency in the social licencing and development of Norwegian and Nova Scotian aquaculture industries?	What is the role of communication (and accessibility to information) in the social licencing and development of the Norwegian and Nova Scotian aquaculture industries?
(Step 4) Methodology	Q methodology	Semi-structured interview	
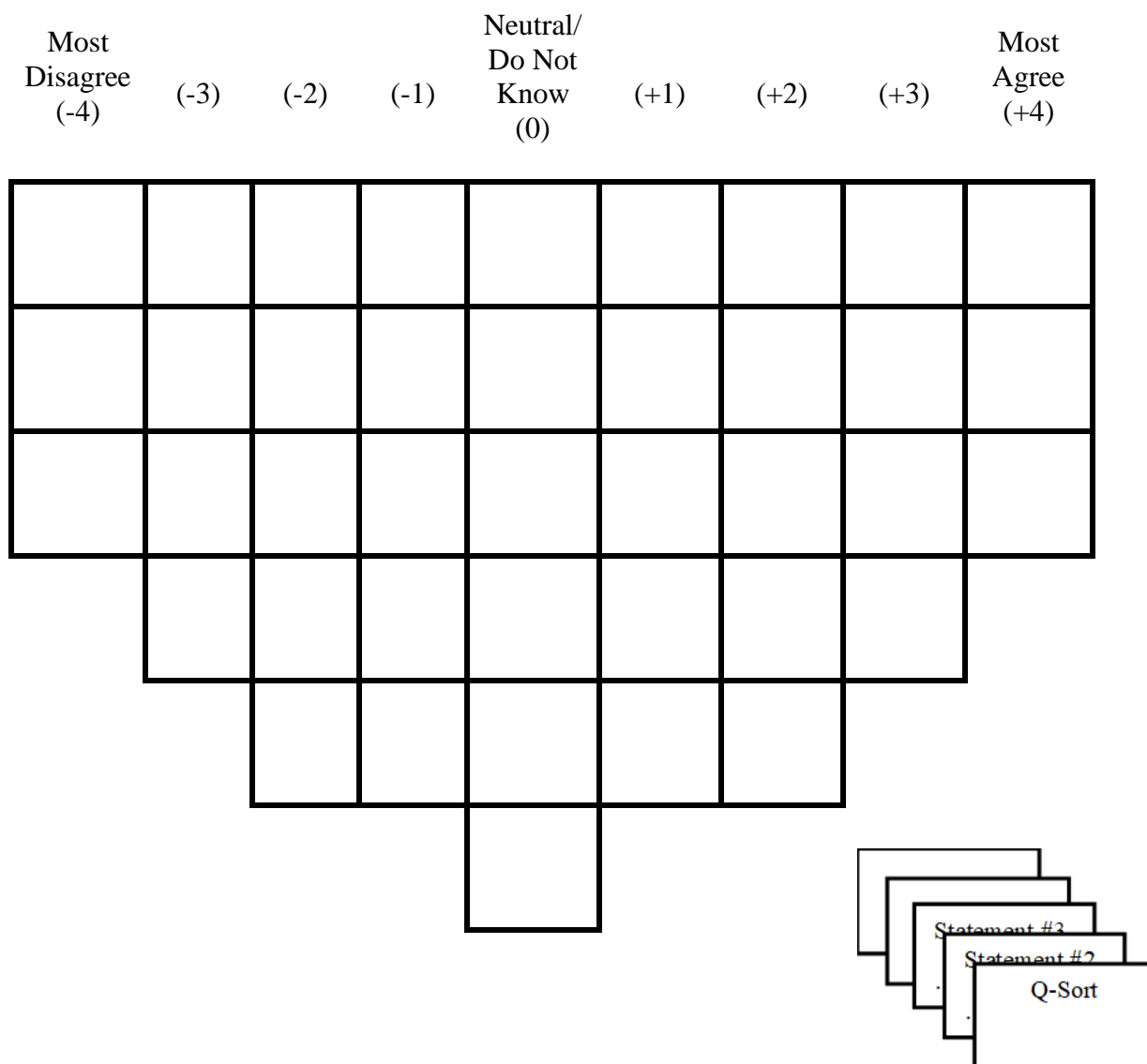
Figure 3: Q methodology interview setup. Participants read through 40 statements (Q-sort), sorting first based on "agree," "disagree," and "neutral." Piles were then subdivided onto the matrix, based upon subjective rankings perceived by the participant.

Statistical analysis

Analysis was completed with the use of the PQMethod software version 2.35 (Schmolk, 2002) to find patterns in the way participants sorted all 40 statements within and between stakeholder groups. Once imported to PQMethod software, a factor analysis

was performed (Schmolk, 2002). For each individual Q-sort, a correlation matrix was created to compare to all other Q-sorts, where a correlation of 1 represents a Q-sort that is completely identical. Principal component analysis (PCA) is then used to group similar Q-sorts based on the correlation matrix (see a visualization of this in Appendix iii). Because Q requires participants to decide what is meaningful and valuable, these groups, or "perspectives" represent individuals that share similar values and understanding surrounding transparency and communication in Atlantic salmon aquaculture (Watts & Stenner, 2005). To determine which perspectives explained the most variability in the system, and which will be further analyzed, a perspective had to explain >10% of the variation, with eigenvalues >2. These values are determined via varimax orthogonal rotation, providing explained variability and eigenvalues for each perspective. In this case, an eigenvalue that exceeds 2 means that at least two Q-sorts correlate significantly with each other.

Factor analysis for Q methodology begins with creating an idealized Q-sort for each perspective, meaning an average of all Q-sorts that were loaded significantly for that perspective (Watts & Stenner, 2005). This can be thought of as a fake participant generated by the software that would be an idealized sort for the perspective. From this analysis, another correlation matrix is developed between each Q-sort and the perspective with which they correlated most closely. Determining if the factors were loaded significantly relative to its closest perspective, the below equation was used:

$$s = 2.58 \times \left(\frac{1}{\sqrt{N}} \right)$$

Where N = the number of statements (Curry et al., 2013), producing s = 0.408 at p = 0.10 (Brown, 1980). The original level of s = 0.4 (rounded to one decimal place) has also been raised by other researchers to create more conservative statistics (i.e. Weitzman & Bailey, 2018 to s = 0.5). In this case, the coefficient was raised to s = 0.55. Once completed, perspectives were then grouped qualitatively based on what makes sense based on perceived patterns. Confounding sorts were those where participants sorted significantly in both of the factors that were used or none of them.

Results

From the analysis of the Q-sorts, two significant perspectives emerged, explaining 63% of the variance (P1 = 33 % and P2 = 30%). All participants interviewed (except for two) can be grouped into one of these two perspectives as a result of their perceptions about Atlantic salmon aquaculture, transparency, communication, and their role in the social licencing of the industry. 14 participants aligned significantly with *Perspective 1*, 10 participants aligned significantly with *Perspective 2*, 6 participants aligned significantly with both (confounding sorts), and 2 participants aligned significantly with neither (also confounding sorts) (Table 3). Each of the two perspectives is defined by an idealized sort (Table 4) that represents the perception of a participant who fits perfectly into that perspective. The following sections explore areas of consensus among the 32 participants, as well as analyze each perspective based on the idealized sort (Table 4). To ensure only the most relevant statements are interpreted, only significantly distinguishing statements ($p < 0.05$), and well as extremely ranked statements (-4, -3, +3, +4) will be analyzed. The corresponding number of Q-statements are indicated in brackets in the text (i.e. (#)). Perspectives were labelled based on the statistically significant statements of the idealized sorts as follows: *Perspective 1 – Public Trust Starts with Industry*; *Perspective 2 – Transparency Starts with Government*.

Table 3: Overview of factor loadings for each Q-sort ranging from -1 to 1 (complete disagreement to complete agreement) compared to model factor score. Bolded values represent participants who scored significantly for that factor (absolute value of coefficient above 0.55).

Participant	P1	P2
Perspective 1 (P1)		
Norwegian Industry	**0.794**	0.0779
Norwegian Industry	**0.676**	0.284
Norwegian Industry	**0.728**	0.128
Norwegian Manager/Regulator	**0.768**	0.402
Norwegian Academia/Researcher	**0.574**	0.355
Norwegian Academia/Researcher	**0.742**	0.239
Norwegian ENGO/Comm. Group	**0.562**	0.451
Norwegian ENGO/Comm. Group	**0.568**	0.522
Canadian Industry	**0.655**	0.316
Canadian Industry	**0.702**	0.537
Canadian Industry	**0.558**	0.502
Canadian Industry	**0.872**	0.0668
Canadian Academia/Researcher	**0.674**	0.303
Canadian Academia/Researcher	**0.643**	0.533
Perspective 2 (P2)		
Norwegian Manager/Regulator	0.470	**0.674**
Norwegian Manager/Regulator	0.262	**0.804**
Norwegian Academia/Researcher	0.0689	**0.755**
Norwegian Academia/Researcher	0.502	**0.597**
Norwegian ENGO/Comm. Group	0.294	**0.705**
Canadian ENGO/Comm. Group	0.491	**0.698**
Canadian ENGO/Comm. Group	0.0660	**0.715**
Canadian ENGO/Comm. Group	0.144	**0.818**
Canadian Academia/Researcher	0.453	**0.776**
Canadian Manager/Regulator	0.519	**0.597**
Confounded Sorts		
Norwegian Industry	**0.620**	**0.628**
Norwegian Manager/Regulator	**0.637**	**0.601**
Norwegian ENGO/Comm. Group	0.378	0.149
Canadian Academia	**0.606**	**0.591**
Canadian Manager/Regulator	0.533	0.503
Canadian Manager/Regulator	**0.710**	**0.555**
Canadian Manager/Regulator	**0.595**	**0.679**
Canadian ENGO/Comm. Group	**0.559**	**0.552**
Explained Variance (%)	33	30
Defining Q-Sorts	14	10
Total Q-Sorts	20	16

Table 4: Idealized sort for each perspective described by each category of Q-statements. * indicates significant difference between perspectives at p < 0.05 and ** indicates significance at p < 0.01. Statements without significant difference are consensus statements.

Category	P1	P2
Drivers of Social Licence		
24. Reducing the use of pesticides and antibiotics is not important to achieving social licence.	-4	-3
10. Meaningful engagement with communities affected by aquaculture operations is important to achieving social licence.	4	4
31. Communication among stakeholders (e.g. industry, public and government) is not important to achieving social licence.	-3	-3
**16. Public education is important to achieving social licence.	4	2
**38. Minimizing the effects on benthic species (e.g. lobster) is not important to achieving social licence.	-2	-4
**6. Preventing effects on wild salmon populations is important to achieving social licence.	2	4
*12. Reduced reliance on fishmeal is not important to achieving social licence.	-2	-1
**20. Monitoring, reporting, and enforcement of environmental and social standards is important to achieving social licence.	3	4
11. Transparency is not important to achieving social licence.	-4	-4
**13. Independent certification of environmental and social standards is important to achieving social licence.	2	3
Transparency		
7. Transparent aquaculture operations generate a higher value product.	1	2
**1. Transparent aquaculture operations are a pre-requisite for entry into some markets.	3	2
26. Regulations that promote transparency can compromise industry development.	-2	-2
**40. Transparency leads to accountability of the industry.	3	3
**34. Existing regulations sufficiently encourage transparency.	0	-3
37. Current capacity (e.g. infrastructure, personnel, resources) does not prevent farmers from operating in a transparent way.	2	2
Communication		
33. Sharing technical information without proper public education does not cause confusion.	-2	-1
**4. Polarization of views regarding salmon aquaculture is caused by a lack of effective communication.	3	0
**25. Government does not have the capacity to effectively communicate to the public.	-2	0
**18. Government communication initiatives do not reach the majority of the public.	-1	1
**23. Communication strategies have failed to show changes in aquaculture operations over time.	1	0
15. Effective record-keeping systems provide the potential for effective communication of aquaculture practices.	2	3
**3. The information that industry is currently communicating is accessible to the public.	1	-1

**14. Without communicating information in a way that is easily understood, transparency is not useful to the public.	4	2
Who Should Take the Lead?		
30. Promoting transparency is not a role for NGOs.	-1	-2
21. Promoting communication is not a role for NGOs.	-1	-1
**19. Promoting transparency is a role for the government.	1	3
5. Promoting communication is a role for the government.	0	1
**27. Promoting transparency is not a role for industry.	-4	-2
**36. Promoting communication is not a role for industry.	-3	-2
39. Promoting transparency is a role for an independent ecolabel.	1	1
35. Promoting communication is a role for an independent ecolabel.	0	0
22. Promoting transparency is a role for media (e.g. newspapers, television coverage, etc.).	0	0
29. Promoting communication is a role for media (e.g. newspapers, television coverage, etc.).	0	1
Other Benefits and Challenges		
*2. Transparent aquaculture practices do not promote sustainable aquaculture.	-3	-3
**9. Conflict resolution in the marine space is a process of transparency.	2	0
**28. Conflict resolution in the marine space is not a process of communication.	-3	-2
**8. Current transparency policies set by the government are not effective.	0	1
32. Current communication policies set by the government are effective.	-1	-1
**17. There is no reluctance for salmon aquaculture companies to communicate environmental parameters (e.g. disease occurrence, escapees, etc.) to the public.	-1	-4

Areas of consensus

Statements that were not ranked differently between *Perspective 1* and *2* meant that there was no major disagreement in how participants decided to sort them (Table 5). 17 statements were non-significant for both perspectives at p > 0.05, and could not be used to define either perspective. In particular, both perspectives strongly believed (-4, -3, 3, or 4) that the following were important to achieving social licence: i) meaningful engagement with communities affected by aquaculture operations; ii) communication among stakeholders; iii) reducing the use of pesticides and antibiotics; and iv) transparency. In addition, participants believed that transparency promotes sustainable aquaculture. This is explained by a Canadian academic participant whereby "everyone knows that sustainability is important, environmentally and economically. So, if you have a reason to hide your practices, then perhaps they aren't environmentally sustainable, maybe at the expense of your own economic sustainability." One Canadian

ENGO/Community group participant suggests that "I definitely think that it's important for any and all regulations around aquaculture to be transparent… but I don't think that transparency necessarily leads to social licence." Both perspectives generated an apathetic or unsure response (-1, 0, or 1); i) promoting communication is a role for the government; ii) promoting transparency is a role for media; iii) promoting communication is a role for an independent ecolabel; and iv) promoting communication is a role for media.

Table 5: Consensus statements (p > 0.05) for *Perspective 1* and *Perspective 2*. Statements with an absolute ranking value of at least 3 in both perspectives in bold. Statements with an absolute rating of 2 or less in both perspectives starred.

Statement No.	Statement	*Perspective 1* Ranking	*Perspective 2* Ranking
10	**Meaningful engagement with communities affected by aquaculture operations is important to achieving social licence.**	**4**	**4**
15	Effective record-keeping systems provide the potential for effective communication of aquaculture practices.	2	3
37*	Current capacity (e.g. infrastructure, personnel, resources) does not prevent farmers from operating in a transparent way.	2	2
7*	Transparent aquaculture operations generate a higher value product.	1	2
39*	Promoting transparency is a role for an independent ecolabel.	1	1
5*	Promoting communication is a role for the government.	0	1
22*	Promoting transparency is a role for media (e.g. newspapers, television coverage, etc.).	0	0
35*	Promoting communication is a role for an independent ecolabel.	0	0
29*	Promoting communication is a role for media (e.g. newspapers, television coverage, etc.).	0	1
21*	Promoting communication is not a role for NGOs.	-1	-1

32*	Current communication policies set by the government are effective.	-1	-1
30*	Promoting transparency is not a role for NGOs.	-1	-2
33*	Sharing technical information without proper public education does not cause confusion.	-2	-1
26*	Regulations that promote transparency can compromise industry development.	-2	-2
31	**Communication among stakeholders (e.g. industry, public and government) is not important to achieving social licence.**	**-3**	**-3**
24	**Reducing the use of pesticides and antibiotics is not important to achieving social licence.**	**-4**	**-3**
11	**Transparency is not important to achieving social licence.**	**-4**	**-4**

Perspective 1 – Public Trust Starts with Industry

The 'Public Trust Starts with Industry' perspective was composed of 14 participants that only sorted significantly with this perspective. These participants were 7 industry representatives (50%), 4 academia/researcher representatives (29%), 2 ENGO/community group representatives (14%), and 1 manager/regulator representative (7%). This perspective had 8 Norwegian participants (57%) and 6 Canadian participants (43%) (Figure 4). The participants sorted in this perspective shared the common idea that promoting both transparency (27) and communication (36) must come from industry, acknowledging that entry into some markets requires transparency (1). Participants in this perspective have a strong belief that transparency and communication should be coming from industry. One Norwegian industry representative states "transparency is a role for industry, because we do it all of the time… industry is promoting transparency all of the time, every day."

This perspective believes that polarization of views is largely because of a lack of communication (4), which also compromises conflict resolution in the marine space (28). Public education is important (16), which is emphasized by the belief that transparency is not useful to the public if the information is not communicated properly (14). Lastly, this

group did not hold strong opinions on how effective current transparency policies are, or if existing regulations sufficiently encourage transparency (8, 34). However, one Canadian academic explains that "I would like to see – and have seen – more growth of aquaculture in Canada… my sorting of these statements [has] to do with my interest in seeing the industry grow and understanding what might be preventing that. And social licence has a huge thing to do with that."
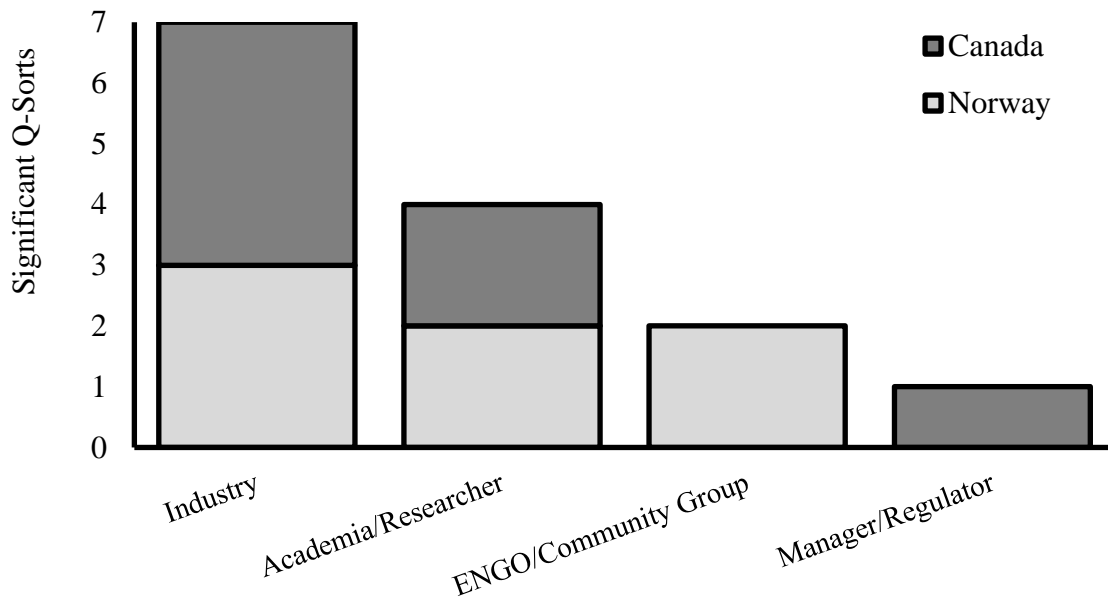
Figure 4: Number of Q-sorts that were significantly associated with *Perspective 1 – Public Trust Starts with Industry*, divided into their relevant stakeholder groups. Canadian participants are indicated in dark grey and Norwegian participants are indicated in light grey.

Perspective 2 – Transparency Starts with Government

The 'Transparency Starts with Government' perspective was composed of 10 participants that sorted significantly with only Perspective 2. Within this perspective, there were 4 ENGO/community group representatives (40%), 3 academia/researcher representatives (30%), 3 manager/regulator representatives (30%), and 0 industry representatives (0%). This perspective had 5 Norwegian participants (50%) and 5

Canadian participants (50%) (Figure 5). The participants sorted in this perspective shared the belief that transparency should begin with the government (19), and an emphasis on how record-keeping (i.e. having foundational baseline information) is required for information to be communicated (15). One Canadian ENGO/Community group participant explains that "… having access to information and data and transparency around criteria for decision making means that the public and everybody can hold people accountable for what is being done … existing regulations are not encouraging transparency…" Perspective 2 holds a respect for independent certification of environmental and social standards (13), and emphasized the importance of minimizing the effects on benthic species and wild salmon (38, 6). In the context of conflict resolution, however, participants felt as though communication was more important than transparency (9, 28), and that industry held great reluctance to communicate environmental parameters (17). Complementary with this perceived reluctance to communicate the information is a link to the belief that existing regulations must be changed in order to effectively promote transparency (34), as transparency and communication work together to generate SLO. Participants in this perspective tended to be unsure or feel neutrally about communication as the cause for polarization of views regarding Atlantic salmon aquaculture (4), and the capacity that government has to communicate to the public as well (25).
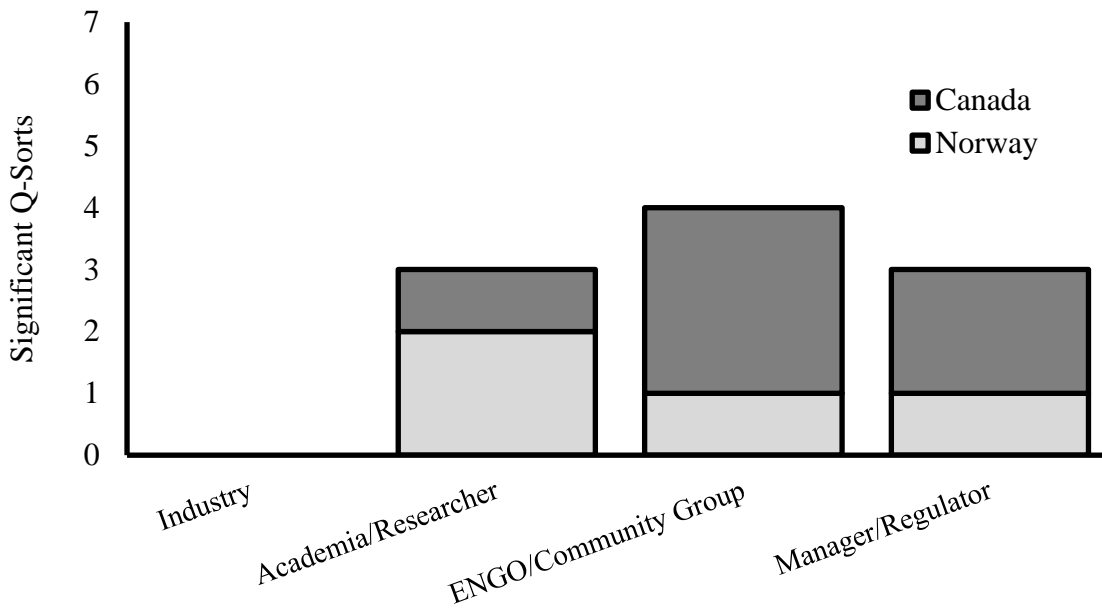
Figure 5: Number of Q-sorts that were significantly associated with *Perspective 2 – Transparency Starts with Government*, divided into their relevant stakeholder groups. Canadian participants are indicated in dark grey and Norwegian participants are indicated in light grey.

Confounding sorts

Some participants were significantly sorted into either both perspectives (n = 6), or neither (n = 2). These sorts are called confounding sorts (Table 3). Stakeholders not sorting significantly with either were a Norwegian ENGO/Community Group member and a Canadian Manager/Regulator representative. In both cases of confounding sorts, it was not consistent based on stakeholder group or the region that they identified most closely with (Norway or Nova Scotia), however, all Canadian manager/regulators participants sorted significantly with both perspectives.

Discussion

In the creation of policy and management strategies, stakeholder perspectives are important to understand (Sevaly, 2001). Globally, there is a need for increased understanding of how perceptions of the public can influence the management of the aquaculture industry for the benefit of as many stakeholders as possible (Froehlich et al., 2017a; Krøvel et al., 2019). This research investigated stakeholder perceptions of the role of transparency and communication in the social licence of the Atlantic salmon aquaculture industry in Nova Scotia, Canada, and Norway. Many studies surrounding the perceptions of aquaculture have been completed using more traditional approaches including survey-based methods (Mazur & Curtis, 2008; Whitmarsh & Palmieri, 2009) and interviews (Mazur & Curtis, 2006; Wingenbach, Gartin, & Lawrence, 1999). However, Q methodology provides researchers and managers with a tool that explores stakeholder groups together across geographic areas and their perceptions on a topic (Brown, 1993), and allows for an added qualitative resolution through semi-structured interviews. By comparing Nova Scotia, a relatively smaller and younger industry with Norway, a global leader in the production of Atlantic salmon, a better understanding of the roles of transparency and communication in social licence to operate for this industry can be established. The findings of this research show that perceptions did not differ between these two countries, as well as the identification of two different perspectives, representing two views on how to better manage the aquaculture industry in these countries as well as Atlantic salmon aquaculture globally.

Nova Scotia-Norway uniformity

This research has revealed a substantial overlap between the perceptions of Atlantic salmon aquaculture industry stakeholders of Nova Scotia and Norway. *Perspective 1: Public Trust Starts with Industry* contained the most stakeholders (n = 14), and had 57% Norwegians and 43% Nova Scotians. *Perspective 2: Transparency Starts with Government* (n = 10) had 50% Norwegians and 50% Nova Scotians. As pointed out by a Norwegian researcher,

"Here, [in Norway, Atlantic salmon aquaculture] started out innocently. It started out where it had to be local owner-operator, right? And you had to be responsible to your neighbours, and that kind of social traction really made a difference. But as the ownership structure changed, and the regulation around ownership structure went towards big business benefits … immediate local responsibility changed."

These results indicate that there is no difference in the stakeholder perceptions between Norway and Nova Scotia despite historical, economic, or geographical differences. The conclusion that there is no difference between Norwegian and Nova Scotian attitudes is drawn qualitatively from the overlap found in the two perspectives rather than a statistical comparison between countries. These results may reflect similarities between Nova Scotia and Norway's industry commitment to sustainably expand their salmon aquaculture industry (Hersoug et al., 2017; Nova Scotia, 1996). In addition, Norwegian salmon aquaculture companies are currently considering expansion to Nova Scotia, perhaps indicating similar opportunities, culture, and values for salmon farming (Withers, 2019a; Withers 2019b). For example, Norwegians and Nova Scotians both value the potential for the Atlantic salmon aquaculture industry to save coastal communities from outmigration (Tiller & Richards, 2015; Flaherty et al., 2019) and similarly, to provide economic benefits at the local level (Krøvel et al., 2019). However, some studies have indicated that within Canada, there are significantly different perceptions from coast to coast, with more favourable perceptions in Atlantic Canada, where Nova Scotia is situated (Flaherty et al., 2019). This suggests that while there are potential similarities in values between Nova Scotia and Norway, stakeholders in neighboring areas may not share the same degree of homogeneity. However, regardless of industry development and geographical location, stakeholders from this study hold similar priorities for what must be done to improve the social licence of the Atlantic salmon aquaculture industry in the context of transparency and communication, reinforcing the potential for similarity in values from Norway to Nova Scotia. This allows for the findings in this study to have broad application in either region, and in other parts of the world with similar contexts.

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Main drivers of social licence to operate

Generally, participants agreed that monitoring, reporting, and enforcement of environmental and social standards is important to achieving social licence (Table 4; 20). Atlantic salmon aquaculture management has a focus on sustainability in both Norway and Nova Scotia (Government of Norway, n.d.; Fisheries and Oceans Canada, 2017; Nova Scotia, 2015). However, within sustainability, there is generally a focus on environmental risks rather than on social and economic impacts (Olsen & Osmundsen, 2017). The emphasis from participants on the importance of environmental standards is not surprising, given that they are well established in both Norwegian and Nova Scotian impact assessments (Government of Norway, n.d.; Fisheries and Oceans Canada, 2017; Nova Scotia, 2015). However, monitoring of social standards can be more nuanced, where social standards attempt to address questions beyond profit maximization and environmental health (Beschorner & Müller, 2007). Given that social standards are not considered in current monitoring protocol of Nova Scotia (Fisheries and Oceans Canada, 2018) or Norway (Norwegian Fisheries Directorate, 2005), adding social standards into monitoring, reporting, and enforcement practices may promote an empirical understanding of social licencing. This would allow Atlantic salmon aquaculture proponents to respond to claims made regarding their social licencing (Bice & Moffat, 2014). The development of these social standards must be done through the engagement with communities affected by aquaculture operations (10), to identify indicators of social performance, as well as enabling multidirectional communication among stakeholders (31). By drawing on the mining industry, companies in New South Wales (NSW) have developed their own 'Communities Standard' where socio-economic baseline studies are required in all of their operational areas (Mitchell & McManus, 2013). Despite this being an example of a voluntary approach, with certain limitations to accountability (Bice, 2013), mining operations in NSW have taken steps to recognize the social impacts of their industry by collecting baseline socio-economic data that could be incorporated into the management of the aquaculture industry. By explicitly incorporating monitoring, reporting, and enforcement of social standards into the management regime of the Atlantic salmon aquaculture industry, a more mutually beneficial SLO may be able to be attained in all regions.

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Another major driver of social licence includes the reduction of the use of pesticides and antibiotics (24). This aligns with the report by Doelle and Lahey (2014), reinforcing the notion that the use of antibiotics is one of the significant issues of controversy in finfish aquaculture in Nova Scotia. The use of antibiotics in finfish aquaculture has been well documented to have unintended impacts in the context of finfish aquaculture, including the potential for antibiotic resistance to develop in microbes and to affect non-target species (Burridge et al., 2010; Buschmann et al., 2012; Park, et al., 2012). Further, there are concerns that overuse of antibiotics in aquaculture will have impacts on human healthcare, potentially causing antibiotic resistance in some human pathogens (Done et al., 2015). However with the reality of risks present with antibiotic use, recent years have seen substantial reduction in antibiotic use due to the advent of vaccination for furunculosis and other diseases, combined with better fish care in both Norway and Nova Scotia (Midtlyng et al., 2011; Lulijwa et al., 2019; Doelle & Lahey, 2014). Now, antibiotics are used only under veterinarian supervision in Nova Scotia and Norway (ACFFA, n.d.; Government of Norway, 2017). Similarly, further reducing pesticide use will be important in advancing SLO in the Atlantic salmon aquaculture industry (24). Among other reasons, they are used in the Atlantic salmon aquaculture industry because they are fairly easy to apply, generally cost-effective, and in certain circumstances, the only feasible way of controlling a situation (Helfrich et al., 2009). However, these benefits come at the cost of negative impacts to non-target species (Willis & Ling, 2003), sublethal effects on fish (e.g. weight loss, sterility, low disease resistance; Helfrich et al., 2009), bioaccumulation in Atlantic salmon for human consumption (Jacobs et al., 2002), and others. Grasping how stakeholders perceive the trade-offs associated with pesticides and antibiotics is important to understanding the SLO, and to improve the management of the Atlantic salmon aquaculture industry in a meaningful way.

Across all perspectives, geographic regions, and stakeholder groups, participants agreed that transparency is critical in achieving the social licence of the Atlantic salmon aquaculture industry. This reinforces suggestions by the Nova Scotian Doelle-Lahey report (2014), as well well-supported research on the importance of transparency (Issing, 2005; Fox, 2007; Hale, 2008). Since all stakeholders, including industry proponents,

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believe that transparency is imperative to social licence (11), yet there are still social licencing issues, this research reveals the importance of ongoing and improved implementation of regulation to promote transparency. Taking into consideration the role that communication has to complement transparency will also be important, ensuring that multidirectional communication among all stakeholders occurs (31). Perhaps then, by considering communication in parallel with transparency regulations, the relationship between transparency and accountability will be strengthened (Fox, 2007). Newly implemented regulations, combined with a recently lifted moratorium in Nova Scotia seem to favour the development of the industry, suggesting that more stringent regulations on transparency including those suggested by the Doelle-Lahey report (2014) have no major impact on industry expansion. This is reinforced by Cermaq Canada's potential expansion on Nova Scotia's coastline (Withers, 2019a; Withers, 2019b) as well as Norway's considerable and ongoing Atlantic salmon production. Transparency is an important principle in fostering SLO, and does not impact industry development in a major way.

Identifying the leaders

Identifying a champion for the leadership of transparency was a major driver in defining the two key perspectives found in this research. Seemingly, there is overlap in the drivers of social licence, but major disagreements on who should operationalize them. *Perspective 1* placed the most emphasis on the importance of industry being a leader in both transparency and communication. As a perspective made up of 50% industry representation, they understood the importance of having information come directly from the source. This could indicate that the industry feels that they are doing an effective enough job as is, and should not need to be held accountable by government. As put by a Norwegian industry representative,

> "[w]hat you say has to be founded in reality. If you're in a company and you can't communicate the decision you want to make to your stakeholders in a way that will not decrease the trust in of your company for example, you can't make the decision."

Although, perhaps industry proponents have concerns about releasing existing information produced prior to potential new regulations, or that industry would prefer to keep the control they already have. Alternatively, the strong representation from industry could also indicate a strong willingness to cooperate with government in relation to promoting transparency and communication in the form of regulation. As it is put by a Canadian industry representative,

> "to say that transparency does not promote public trust, I disagree with that. I think transparency promotes industry support, it promotes – it is tantamount to industry growth, because without transparent operations and transparent *regulations*, you can't have industry growth."

Conversely, Perspective 2 placed government as the leader of transparency initiatives, and uncertainty surrounding a leader for communication. This perspective is made up of 0% industry representation, and fairly evenly distributed between ENGO/community groups (40%), managers/regulators (30%), and academia/researchers (30%). This could suggest that Perspective 2 believes more transparency and communication regulation would be beneficial, but that industry cannot be trusted with the power to regulate themselves. According to a Canadian ENGO/community group representative,

> "[i]t's the government's job to hold companies accountable for their actions and to make sure they are operating in a transparent way … although you have to promote the industry for economic reasons, and promote your GDP and that sort of stuff, another aspect of that is that [managers/regulators] are the stewards on behalf of the people for the resource and therefore they have to make sure that resource is being used effectively."

There is a discrepancy in this research between who people feel should take the lead in transparency and communication regulation, but relative similarity in the prioritization of the objectives that need to be met.

Statements that participants rated low (+/- 1 and 0) could be areas of uncertainty they lean towards the "neutral/do not know" column. These areas are where stakeholder

do not have enough information to make a decision about the statement, or did not feel strongly about (Weitzman & Bailey, 2018; Cross, 2005). For example, stakeholders feel particularly neutral about media's role in transparency and communication (22, 29; Table 5). Media is a form of communication that virtually everyone is familiar with, although participants consistently suggest that promoting transparency is not a role for media (22). As suggested by Olsen & Osmundsen (2017), perhaps because of the perceived potential bias that exists in media outlets, focus should be taken away from media as a potential champion for the transparency of the industry. This aligns with the work of Tibor Koltay (2011), who notes that information is now available in incredible quantity, but with uncertain quality. Conversely, findings conflict with the work of Maxwell (2018) based in Newfoundland, Canada, where it was found that media were the second most trusted stakeholder group. Participants also generally ranked the role of ecolabels in communication and transparency low (35, 39). In this case, however, it could be because at the product-related level, the concern for issues diminishes, limiting the efficacy of ecolabels (Grunert, Hieke, & Wills, 2014), or that participants are confused about how communication and transparency could be linked to ecolabelling. Values outlined in *Perspective 2* suggest there is a strong belief that social licence is rooted in the way that government manages Atlantic salmon aquaculture. Promoting agency of local communities affected by aquaculture in determining dialogue around benefits and impacts will be one of the key roles of government in ensuring meaningful engagement (Mather & Fanning, 2019). This is consistent with the literature that suggests managers have a major role in shaping SLO of an industry (e.g. Terpenning, 2018; Prno & Slocombe, 2012; Zhang & Moffat, 2015; Mather & Fanning, 2019). However, this is contrasted with the values in *Perspective 1*, where it is believed that transparency and communication must both propagate from the industry itself. Perhaps then, if industry associations and proponents were outspoken about the positives surrounding current transparency regulations of the industry, it would simultaneously communicate information to the public about what the industry is actually up to, as well as show that the industry acknowledges that transparency is in their best interest. If this strategy was implemented in collaboration with regulatory departments, it would convey that the information being released is legitimate and verified, as well as show other stakeholders

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that both of the leaders they identified are willing and ready to take part in multidirectional communication.

Management Recommendations

Although all stakeholders must work together to work towards building a network of communication that allows effective flow of information, this research shows that industry leadership (with government support) on transparency will be strongly respected by stakeholders. In addition, consideration of all realms of sustainability (social, environmental, economic) in monitoring reporting, and enforcement will aide in the improvement of SLO in the Atlantic salmon aquaculture industry. Based on considering all realms of sustainability, in combination with industry-led transparency initiatives, I recommend the application of previously established tools like the ecosystems approach to aquaculture (EAA) and marine spatial planning (MSP), which require social, environmental, and economic considerations. EAA is also consistent with the finding that communities must be more meaningfully engaged, and considered on a case-to-case basis (Brugère et al., 2019). Employing the management tool of MSP may be an alternate approach for achieving a more meaningful engagement with communities (Stelzenmuller et al., 2017). In addition, adaptive management could reduce the number of conflicts occurring in Atlantic salmon aquaculture, as well as improve communication by conveying information more effectively (Govan et al, 2008; Holling, 1978). This combination of multiple management tools may create a more resilient industry (DeSilva & Soto, 2009).

Conclusions

Stakeholders of Atlantic salmon aquaculture in Nova Scotia and Norway feel similarly about the role of transparency and communication in the social licencing of the industry. Two main perspectives were found that defined most stakeholders: *Perspective 1: Public Trust Starts with Industry* and *Perspective 2: Transparency Starts with Government*. *Perspective 2* had no industry representation, and otherwise, both

perspectives had representation from every stakeholder group and both countries. These different perspectives helped to describe the role of transparency and communication in the Social Licence to Operate of Norwegian and Nova Scotian Atlantic salmon aquaculture industries. These differences, attributed to the separate roles of transparency and communication as a means of achieving genuine social licence (Terpenning, 2018), mean that both have to be considered in the management of the industry. More broadly adopting communication as a principle is essential to realize the full potential of the information provided through the principle of transparency. Participants felt that monitoring, reporting, and enforcement of *both* environmental and social standards is important (20), and that meaningful engagement with communities affected by aquaculture operations is critical (10). Multidirectional communication within the stakeholder network is critical (31). In addition, reducing the use of pesticides and antibiotics is something that participants emphasized as being important (24). Considering transparency and communication separately in the context of social licence is relevant to more precisely understanding the perceived issues of the public and all relevant stakeholders. This proposed public availability and clarity of information from government and industry may be a way to guide Atlantic salmon aquaculture towards better implementation of the standards and best practices in place for the sector.

References

ACFFA. (2019). Media statement: salmon farmers are already transparent about escapes. Retrieved November 20, 2019, from https://www.atlanticfishfarmers.com/media-releases-all/2019/9/13/media-statement-salmon-farmers-are-already-transparent-about-escapes

ACFFA. (n.d.). The highest quality. *Growing our Fish*. Retrieved November 8, 2019, from https://www.atlanticfishfarmers.com/growing-our-fish

Akhtar-Danesh, N., Brown, B., Rideout, E., Brown, M, & Gaspar, L. (2007). Use of Q-methodology to identify nursing faculty viewpoints of a collaborative BScN program experience. *Canadian Journal of Nursing Leadership, 20*(3), 67-85.

Aquaculture Association of Nova Scotia (2018). Seafarmers conference – Making waves 2018. Retrieved August 26, 2019, from http://seafarmers.ca/seafarmers-conference-making-waves-2018/

Asche, F., Hansen, H., Tveterås, R., & Tveterås, S. (2009). Thalassorama: The salmon disease crisis in Chile. *Marine Resource Economics, 24*(4), 405-411. https://doi.org/10.5950/0738-1360-24.4.405

Asche, F. & Khatun, F. (2006). Aquaculture: issues and opportunities for sustainable production and trade. Geneva: International Centre for Trade and Sustainable Development (ICTSD), 2006. Retrieved November 1, 2019, from http://www.ictsd.org/sites/default/files/research/2008/06/asche_khatun_2006.pdf

Bacher, K., Gordoa, A., & Mikkelsen, E. (2014). Stakeholders' perceptions of marine fish farming in Catolina (Spain): A Q-methodology approach. *Aquaculture*, *424-425*(20), 78-85. http://doi.org/10.1016/j.aquaculture.2013.12.028

Bacher, K. (2015). *Perceptions and misconceptions of aquaculture: a global review*. Rome: FAO Globefish Research Programme.

Barry, J., & Proops, J. (1999). Seeking sustainability discourses with Q methodology. *Ecological Economics*, *28*(3), 337–345. https://doi.org/10.1016/S0921-8009(98)00053-6

Beschorner, T. & Müller, M. (2007). Social standards: Toward an active ethical involvement of businesses in developing countries. *Journal of Business Ethics, 73*, 11-20. https://doi.org/10.1007/s10551-006-9193-3

Bice, S. (2013). No more sun shades, please: Experiences of corporate social responsibility in remote Australian mining communities. *Rural Society, 22*(2), 138-152. https://doi.org/10.5172/rsj.2013.22.2.138

Bice, S. & Moffat, K. (2014). Social licence to operate and impact assessment. *Impact Assessment and Project Appraisal, 32*(4): 257-262. https://doi.org/10.1080/14615517.2014.950122

Brown, S.R. (1993). A primer on Q Methodology. *Operant subjectivity*: *16*(3), 91-138.

Brown, S. R. (1980). *Political subjectivity: applications of Q methodology in political science,*

New Haven: Yale University Press.

Brugère, C., Aguilar-Manjarrez, J., Beveridgem M. C. M., & Soto, D. (2019). The ecosystem approach to aquaculture 10 years on – a critical review and consideration of its future role in blue growth. *Reviews in Aquaculture. 11*(3), 493-514. https://doi.org/10.1111/raq.12242

Burka, J. F., Hammell, K. L., Horsberg, T. E., Johnson, G. R., Rainnie, D. J., & Speare, D. J. (1997). Drugs in salmonid aquaculture--a review. *Journal of Veterinary Pharmacology and Therapeutics, 20*(5), 333–349. https://doi.org/10.1046/j.1365-2885.1997.00094.x

Burridge, L., Weis, J. S., Cabello, F., Pizarro, J., & Bostick, K. (2010). Chemical use in salmon aquaculture: A review of current practices and possible environmental effects. *Aquaculture*, *306*(1), 7–23. https://doi.org/10.1016/j.aquaculture.2010.05.020

Buschmann, A. H., Tomova, A., López, A., Maldonado, M. A., Henríquez, L. A., Ivanova, L., … Cabello, F. C. (2012). Salmon aquaculture and antimicrobial resistance in the marine environment. *PLOS One, 7*(8), e42724. https://doi.org/10.1371/journal.pone.0042724

Carroll, A. B. (1991). The pyramid of corporate social responsibility: Toward the moral management of organizational stakeholders. *Business Horizons*, *34*(4) 39-48.

Carson, S.G. & Rønningen, K. (2016). Norwegian salmon farming and the chase for social legitimacy. *Food Futures: Ethics, Science, and Culture,* 123-144. https://doi.org/10.3920/978-90-8686-834-6

Castle, S. (2017). As wild salmon decline, Norway pressures its giant fish farms. *The New York Times*. Retrieved October 2, 2019, from https://www.nytimes.com/2017/11/06/world/europe/salmon-norway-fish-farms.html

CCFAM. (2016). Aquaculture development strategy 2016-2019. *Fisheries and Oceans Canada.* Retrieved August 21, 2019, from http://publications.gc.ca/site/eng/9.816360/publication.html

Chang, B. D. (1998). The salmon aquaculture industry in the maritime provinces. *Fisheries and Oceans Canada*. Retrieved July 31, 2019, from http://www.dfo-mpo.gc.ca/Library/234569.pdf

Cherry, D. (2019). Was I wrong about salmon farming? *IntraFish Commentary*. Retrieved November 20, 2019, from https://www.intrafish.com/commentary/was-i-wrong-about-salmon-farming-/2-1-708899

Chu, J., Anderson, J. L., Asche, F., & Tudur, L. (2010). Stakeholders' perceptions of aquaculture and implications for its future: A comparison of the U.S.A. and Norway. *Marine Resource Economics, 25*(1), 61-76. https://doi.org/10.5950/0738-1360-25.1.61

Costen, S. (2018). New study: Port Mouton fish farming harming lobster fishery. *Lighthouse Now*. Retrieved July 19, 2019, from

https://www.lighthousenow.ca/article.php?title=New_study_Port_Mouton_fish_farming_harming_lobster

Cross, R. M. (2005). Exploring attitudes: the case for Q methodology. *Health Education Research, 20*(2), 206–213. https://doi.org/10.1093/her/cyg121

Curry, R., Barry, J., & McClenaghan, A. (2013). Northern visions? Applying Q methodology to understand stakeholder views on the environmental and resource dimensions of sustainability. *Journal of Environmental Planning and Management, 56*, 624-649. http://dx.doi.org/10.1080/09640568.2012.693453

Dean, R. J., Shimmield, T. M., & Black, K. D. (2007). Copper, zinc and cadmium in marine cage fish farm sediments: An extensive survey. *Environmental Pollution*, *145*(1), 84–95. https://doi.org/10.1016/j.envpol.2006.03.050

de Bussy, N. & Kelly, L. (2010). Stakeholders, politics, and power. *Journal of Communication Management, 14*(4), 289-305. https://doi.org/10.1108/13632541011090419

DeSilva, S.S., & Soto, D. (2009). Climate change and aquaculture: Potential impacts, adaptation and mitigation. *Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. FAO Fisheries and Aquaculture Technical Paper* 530, 151-212.

Doelle, M., & Lahey, W. (2014). A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_ 04Dec 14.pdf

Done, H. Y., Venkatesan, A. K., & Halden, R. U. (2015). Does the recent growth of aquaculture create antibiotic resistance treats different from those associated with land animal production in agriculture? *AAPS Journal, 17*(3), 513-524. https://doi.org/10.1208/s12248-015-9722-z

Du Plessis, T. C. (2005). *A theoretical framework of corporate online communication: A marketing public relations (MPR) perspective. University of South Africa, Pretoria.* Retrieved August 13, 2019, from http://hdl.handle.net/10500/2271

Ecology Action Centre. (2019). Sustainable fisheries and aquaculture. *Our Work.* Retrieved November 20, 2019, from https://ecologyaction.ca/marine/sustainable-fisheries-and-aquaculture

Evans, J. (2019). SalmonChile: Six salmon plants paralyzed by protests. *IntraFish Processor.* Retrieved November 20, 2019, from https://www.intrafish.com/processor/salmonchile-six-salmon-plants-paralyzed-by-protests/2-1-697703

FAO. (2002). SOFIA 2002 – State of World Fisheries and Aquaculture – 2002. Retrieved July 31, 2019, from http://www.fao.org/fishery/sofia/en

FAO. (2014). SOFIA 2014 – State of world fisheries and aquaculture: Opportunities and challenges. Retrieved June 5, 2019, from http://www.fao.org/fishery/sofia/en

FAO. (2018). SOFIA 2018 - State of World Fisheries and Aquaculture – 2018. Retrieved December 14, 2018, from http://www.fao.org/state-of-fisheries-aquaculture/en/

FAO. (2019). Sustainable Development Goals. Retrieved October 2, 2019, from http://www.fao.org/sustainable-development-goals/goals/goal-14/en/

Fisheries and Oceans Canada. (2013). Aquaculture statistics: Employment contribution to Canada. Retrieved August 21, 2019, from http://www.dfo-mpo.gc.ca/aquaculture/sector-secteur/stats-eng.htm

Fisheries and Oceans Canada. (2018). Aquaculture Monitoring Standard – AAR Monitoring Standard 2018. Retrieved November 17, 2019, from https://www.dfo-mpo.gc.ca/aquaculture/management-gestion/aar-raa-ann7-eng.htm

Fisheries and Oceans Canada. (2015). Canada's Sustainable Aquaculture Program. Retrieved August 21, 2019, from http://www.dfo-mpo.gc.ca/aquaculture/programs-programmes/sustainable-durable/index-eng.htm

Fisheries and Oceans Canada. (2017). Farmed salmon. Retrieved August 26, 2019, from
http://www.dfo-mpo.gc.ca/aquaculture/sector-secteur/species-especes/salmon-
saumon-eng.htm

Fisheries and Oceans Canada. (2005). Overview: Qualitative research exploring
Canadians' perceptions, attitudes and concerns towards aquaculture. *Reports and
Publications.* Retrieved July 2, 2019, from http://www.dfo-mpo.gc.ca/por-
rop/focus-aquaculture-eng.htm

Flaherty, M., Reid, G., Chopin, T., & Latham, E. (2019). Public attitudes towards marine
aquaculture in Canada: insights from the Pacific and Atlantic coasts. *Aquaculture
International*, *27*(1), 9-32. https://doi.org/10.1007/s10499-018-0312-9

Froehlich, H. E., Gentry, R. R., & Halpern, B. S. (2017a). Conservation aquaculture:
Shifting the narrative and paradigm of aquaculture's role in resource management.
Biological Conservation, *215*, 162–168.
https://doi.org/10.1016/j.biocon.2017.09.012

Froehlich, H. E., Gentry, R. R., Rust, M. B., Grimm, D., & Halpern, B. S. (2017b). Public
perceptions of aquaculture: evaluating spatiotemporal patterns of sentiment
around the world. *PLOS One.* 1-18. https://doi.org/10.1371/journal.pone.0169281

Flurey, C. A., Hwelett, S., Rodham, K., White, A., Noddings, R., & Kirwan, J. R. (2016).
Identifying different typologies of experiences and coping strategies in men with
rheumatoid arthritis: a Q-methodology study. *BMJ Open, 6*(10).
https://doi.org/10.1136/bmjopen-2016-012051

Fox, J. (2007). The uncertain relationship between transparency and accountability.
Development in Practice, *17(*4-5). 663-671.
https://doi.org/10.1080/09614520701469955

Føre, M., Frank, K., Norton, T., Svendsen, E., Alfredsen, J. A., Dempster, T. …
Berckmans, D. (2018). Precision fish farming: A new framework to improve
production in aquaculture. *Biosystems Engineering, 173,* 176-193.
https://doi.org/10.1016/j.biosystemseng.2017.10.014

George Washington University's Elliot School for International Affairs. (2009). The contribution of government communication capacity to achieving good governance outcomes. *CommGAP.* Retrieved November 20, 2019, from http://documents.worldbank.org/curated/en/511591468331052544/The-contribution-of-government-communication-capacity-to-achieving-good-governance-outcomes

Government of Norway. (n.d.). Norway's battle against antimicrobial resistance in the agricultural sector. *Government.no.* Retrieved November 8, 2019, from https://www.regjeringen.no/en/aktuelt/norways-battle-against-antimicrobial-resistance-in-the-agricultural-sector/id2554750/

Govan, H., Aalbersberg, W., Tawake, A., & Parks, J. (2008). Locally managed marine areas: A guide to supporting community-based adaptive management. *Locally-Managed Marine Area Network.* Retrieved November 11, 2019, from http://agris.fao.org/agris-search/search.do?recordID=GB2013203237

Government of Norway. (n.d.). Farmed salmon. *Government.no.* Retrieved August 26, 2019, from https://www.regjeringen.no/en/topics/food-fisheries-and-agriculture/fishing-and-aquaculture/rad-1/farmed-salmon/id495344/

Graafland, J. J. (2002). Profits and Principles: Four Perspectives. *Journal of Business Ethics*, *35*(4), 293–305. https://doi.org/10.1023/A:1013805111691

Grant, J., Simone, M., Daggett, T. (2019). Long-term studies of lobster abundance at a salmon aquaculture site, eastern Canada. *Canadian Journal of Fisheries and Aquaculture, 76*(7). 1096-1102. https://doi-org.ezproxy.library.dal.ca/10.1139/cjfas-2017-0547

Grieg Seafood. (2019). Rooted in nature – Annual report 2018. Retrieved August 8, 2019, from https://www.griegseafood.no/inverstors/annual-reports/

Grunert, K. G., Hieke, S., & Wills, J. (2014). Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy*, *44*, 177-189. https://doi.org/10.1016/j.foodpol.2013.12.001

Gunningham, N., Kagan, R. A., & Thornton, D. (2004). Social license and environmental protection: Why businesses go beyond compliance. *Law & Social Inquiry*, *29*(2), 307-341. https://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&arti cle=1674&context=facpubs

Hale, T. N. (2008) Transparency, accountability, and global governance. *Global Governance, 14*(1). 73-94. https://doi.org/10.2307/27800692

Hall, A. T., Bowen, M. G., Ferris, G. R., Royle, M. T., Fitzgibbons, D. E. (2007). The accountability lens: A new way to view management issues. *Business Horizons. 50*(5). 405-413. https://doi.org/10.1016/j.bushor.2007.04.005

Helfrich, L. A., Weigmann, D. L., Hipkins, P., & Stinson, E. R. (2009). Pesticides and aquatic animals: A guide to reducing impacts on aquatic systems. *Virginia State University*. Retrieved from http://hdl.handle.net/10919/48060

Hersoug, B. (2015). The greening of Norwegian salmon production. *Maritime Studies*, *14*(1), 16. https://doi.org/10.1186/s40152-015-0034-9

Hersoug, B., Karlsen, K.M, Solås, A. M., Kvalik, I., Johnsen, J. P., Young, N. … Thorarensen, H. (2017). Intensive aquaculture and sustainable regional development in the Arctic region – from controversy to dialogue (AquaLog). *Nofima.* Retrieved November 11, 2019, from https://nofimaas.sharepoint.com/sites/public/Cristin/Rapport%2013-2017.pdf?&originalPath=aHR0cHM6Ly9ub2ZpbWFhcy5zaGFyZXBvaW50LmN vbS86Yjovcy9wdWJsaWMvRWR6azJYa0NCRGRQdFVoaHJLUXNvTGtCdjA wNF9TYmpttck5OVUNINjdLRkZSdz9ydGltZT0wbDR6OGRwbTEwZw

Hersoug, B., Mikkelsen, E., & Karlsen, K. M. (2019). "Great expectations" – Allocating licences with special requirements in Norwegian salmon farming. *Marine Policy*, *100*, 152-162. https://doi.org/10.1016/j.marpol.2018.11.019

Holling, C. S. (1978). Adaptive environmental assessment and management. *John Wiley & Sons.* http://pure.iiasa.ac.at/id/eprint/823/

The Huddle. (2019). Aquaculture industry may be the saving grace for Nova Scotia's rural communities. Retrieved August 21, 2019, from https://huddle.today/aquaculture-industry-may-be-the-saving-grace-for-nova-scotias-rural-communities/

Hunter, J. (2018). Fish farms opposed by First Nations will be phased out. *The Globe and Mail*. Retrieved August 19, 2019, from https://www.theglobeandmail.com/canada/british-columbia/article-fish-farms-opposed-by-first-nations-will-be-phased-out/

Issing, O. (2005). Communication, transparency, accountability: monetary policy in the twenty-first century. *Federal Reserve Bank of St. Louis Review, 87*(2), 65-83.

Jacobs, M. N., Covaci, A., & Schepens, P. (2002). Investigation of selected persistent organic pollutants in farmed Atlantic salmon (*Salmo salar*), salmon aquaculture feed, and fish oil components of the feed. *Environmental Science & Technology, 36*(13), 2797-2805. https://doi.org/10.1021/es011287i

Jentoft, S. & Chuenpagdee, R. (2009). Fisheries and coastal governance as a wicked problem. *Marine Policy, 33*(4), 553-560. https://doi.org/10.1016/j.marpol.2008.12.002

Johansen, R. (Ed.) (2013). Fish Health Report 2012. Oslo: Norwegian Veterinary Institute.

Knapp, G., Roheim, C. A., & Anderson, J. L. (2007). The great salmon run: competition between wild and farmed salmon. *TRAFFIC North America. Washington, DC.* Retrieved September 1, 2019, from https://www.traffic.org/site/assets/files/3637/great-salmon-run.pdf

Koltay, T. (2011). The media and the literacies: media literacy, information literacy, digital literacy. *Media, Culture & Society, 33*(2), 211-221. https://doi.org/10.1177/0163443710393382

Krøvel, A. V., Gjerstad, B., Skoland, K., Lindland, K. M., Hynes, S., & Ravagnan, E.
 (2019). Exploring attitudes toward aquaculture in Norway – Is there a difference
 between the Norwegian general public and local communities where the industry
 is established? *Marine Policy, 108*. https://doi.org/10.1016/j.marpol.2019.103648

Latimer, E. (2019). Fish farm on Cape Breton reserve pairs up with Cooke Aquaculture.
 Retrieved August 21, 2019, from https://www.cbc.ca/news/canada/nova-
 scotia/first-nation-cooke-aquaculture-trout-1.5216362

Lindland, K. M., Gjerstad, B., Krøvel, A. V., & Ravagnan, E. (2019). Governing for
 sustainability in the Norwegian aquaculture industry. *Ocean & Coastal
 Management. 179*(1). doi: 10.1016/j.ocecoaman.2019.104827

Lulijwa, R., Rupia, E. J., & Alfaro, A. C. (2019). Antibiotic use in aquaculture, policies
 and regulation, health and environmental risks: a review of the top 15 major
 producers. *Reviews in Aquaculture,* 1-24. https://doi.org/10.1111/raq.12344

Lusedata. (2019). Sogn og Fjordane key figures. Retrieved from
 http://statistikk.lusedata.no/default.aspx?FylkeID=14

Marko, H. (1973). The Bidirectional Communication Theory - A Generalization of
 Information Theory. *IEEE Transactions on Communications*, *21*(12), 1345–1351.
 https://doi.org/10.1109/TCOM.1973.1091610

Mather, C. & Fanning, L. (2019). Social licence and aquaculture: Towards a research
 agenda. *Marine Policy, 99,* 275-282. https://doi.org/10.1016/j.marpol.2018.10.049

Mazur, N. A., & Curtis, A. L. (2006). Risk perceptions, aquaculture, and issues of trust:
 lessons from Australia. *Society & Natural Resources, 19*(9), 791-808.
 https://doi.org/10.1080/08941920600835551

Mazur, N. A., & Curtis, A. L. (2008). Understanding community perceptions of
 aquaculture:
 lessons from Australia. *Aquaculture International*, *16*(6), 601–621.
 https://doi.org/10.1007/s10499-008-9171-0

Maxwell, R. (2018). Key players in the Grieg NL Placentia Bay Atlantic salmon
    aquaculture project: a social network analysis. *Master of Marine Management
    Graduate Project*. Marine Affairs Program, Dalhousie University, Halifax, N.S.
    Retrieved from http://hdl.handle.net/10222/75162

McKeown, B., and Thomas D. (2013). Q Methodology, 2nd ed, Sage Publications,
    Newbury Park, Ca.

McLeod, S. (2018). BC's aquaculture, the most transparent food-industry. *SeaWestNews.*
    Retrieved August 14, 2019, from https://seawestnews.com/bcs-aquaculture-the-
    most-transparent-food-industry/

Mercer-Mapstone, L., Rifkin, W., Louis, W., & Moffat, K. (2017). Meaningful dialogue
    outcomes contribute to laying a foundation for social licence to operate.
    Resources Policy, 53, 347-355. https://doi.org/10.1016/j.resourpol.2017.07.004

Midtlyng, P.J., Grave, K., Horsberg, T.E. (2011). What has been done to minimize the
    use of antibacterial and antiparasitic drugs in Norwegian aquaculture?
    Aquaculture Research, 42, 28–34. https://doi.org/10.1111/j.1365-
    2109.2010.02726.x

Milewski, I., Loucks, R. H., Fisher, B., Smith, R. E., McCain, J. S. P., & Lotze, H. K.
    (2018). Sea-cage aquaculture impacts market and berried lobster (*Homarus
    americanus*) catches. *Marine Ecology Progress Series*, *598*, 85–97.
    https://doi.org/10.3354/meps12623

Miljure, B. (2016). Genetically-modified fish could cause 'consumer confusion'. *CTV
    News Vancouver.* Retrieved July 2, 2019, from https://bc.ctvnews.ca/genetically-
    modified-fish-could-cause-consumer-confusion-1.2912422

Miller, P. (2019). Queens Municipality passes motion against Liverpool aquaculture
    project. *CBC Nova Scotia*. Retrieved July 19, 2019, from
    https://www.cbc.ca/news/canada/nova-scotia/queens-declines-aquaculture-
    expansion-liverpool-bay-1.5109423

Mitchell, G. & McManus, P. (2013). Engaging communities for success: Social impact assessment and social licence to operate at Northparkes Mines, NSW. *Australian Geographer, 44*(4): 435-459. https://doi.org/10.1080/00049182.2013.852502

Moffat, K., Lacey, J., Zhang, A., & Leipold, S. (2015). The social licence to operate: a critical review. *Forestry*, *89*(5), 477-488. https://doi.org/10.1093/forestry/cpv044

Mowi. (2019). Mowi integrated annual report 2018. Retrieved August 7, 2019, from https://mowi.com/blog/2019/04/07/mowis-2018-annual-report/

Mowi. (n.d.) Targets and policies. *Corporate Governance.* Retrieved November 20, 2019, from https://mowi.com/investors/corporate-governance/targets-and-policies/

Müller, F. H., & Kals, E. (2004). The Q method. An innovative method for collecting subjective attitudes and opinions. *Forum: Qualitative Social Research, 5*(2), Art. 34. http://nbn-resolving.de/urn:nbn:de:0114-fqs0402347

Mulligan, P. (2019). Queens municipality passes motion against Liverpool aquaculture project. *CBC News Nova Scotia*. Retrieved August 8, 2019, from https://www.cbc.ca/news/canada/nova-scotia/queens-declines-aquaculture-expansion-liverpool-bay-1.5109423

Naylor, R. L., Goldburg, R. J., Primavera, J. H., Kautsky, N., Beveridge, M. C. M., Clay, J., … Troell, M. (2000). Effect of aquaculture on world fish supplies. *Nature*, *405*(2000), 1017–1024. https://doi.org/10.1038/35016500

Nelsen, J. & Scoble, M. (2006). Social license to operate mines: Issues of situational analysis and process. *Department of Mining Engineering, University of British Columbia, Vancouver.*

Norwegian Fisheries Directorate. (2005). The Aquaculture Act. Retrieved November 17, 2019, from https://www.fiskeridir.no/Akvakultur/Akvakulturloven-og-forskrifter

Nova Scotia (2019). Aquaculture statistics – Aquaculture production and sales. *Department of Fisheries & Aquaculture*. Retrieved October 28, 2019, from https://novascotia.ca/fish/aquaculture/economic-impact/

Nova Scotia Legislature (2015). Fisheries and coastal resources act – Chapter 25 of the
acts of 1996. Accessed August 26, 2019, from
https://novascotia.ca/fish/aquaculture/laws-regs/

Nova Scotia. (1996). Chapter 25 of the Acts of 1996 – Fisheries and Coastal Resources
Act. Accessed November 11, 2019, from
https://novascotia.ca/fish/aquaculture/laws-regs/

Nova Scotia. (2015). Nova Scotia Department of Fisheries and Aquaculture –
Environmental Monitoring Program Summary. Retrieved November 8, 2019 from
https://novascotia.ca/fish/aquaculture/environmental-monitoring/

Park, Y. H., Hwang, S. Y., Hong, M. K., Kwon, K. H. (2012). Use of antimicrobial
agents in aquaculture. *Revue Scientifique et Technique, 31*(1): 189-197.
https://doi.org/10.20506/rst.31.1.2105

Royal Ministry of the Environment (2002). Report no. 12 to the storting (2001-2002):
Protecting the riches of the seas. Retrieved October 29, 2019, from
https://www.regjeringen.no/en/dokumenter/report-no.-12-to-the-storting-2001-
2002/id195387/

Rogers, E. M., & Shoemaker, F. F. (1971). *Communication of innovations: a cross-
cultural approach.* New York: The Free Press.

Rudell, P. N., & Miller, M. L. (2012). Human perceptions and attitudes regarding
geoduck aqua- culture in Puget Sound, Washington: a Q-method approach.
Journal of Shellfish Research, *31*, 342–343.

Sanchez-Jerez, P., Karakassis, I., Massa, F., Fezzardi, D., Aguilar-Manjarrez, J., Soto, D.
… Dempster, T. (2016). 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. *Aquaculture Environment
Interactions, 8*, 41-54. https://doi.org/10.3354/aei00161/

Sayce, K., Shuman, C., Connor, D., Reisewitz, A., Pope, E., Miller-Henson, M., …
Owens, B. (2013). *Ocean & Coastal Management, 74*, 57-66.
http://dx.doi.org/10.1016/j.ocecoaman.2012.06.012

Schmolck, P. (2002). PQMethod (version 2.35). Retrieved January 6, 2019, from:
http://schmolck.org/qmethod/

Sevaly, S. (2001). Involving stakeholders in aquaculture policy-making, planning and
management. *Aquaculture in the Third Millennium.* Technical Proceedings of the
Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20-25
February 2000. 83-93. NACA, Bangkok and FAO, Rome.

Solberg, E. (2019). Opening of the salmon. *Government of Norway.* retrieved October 2,
2019, from https://www.regjeringen.no/en/aktuelt/opening-of-the-
salmon/id2630496/

Statistics Canada (2018). Gross domestic product, expenditure-based, provincial and
territorial, annual (x 1,000,000). Retrieved August 15, 2019, from
https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3610022201

Statistics Norway (2018). Key figures for the population & National accounts. Retrieved
August 15, 2019, from https://www.ssb.no/en

Statistics Norway (2019). Aquaculture. Retrieved October 28, 2019, from
https://www.ssb.no/en/fiskeoppdrett/

Steelman, T. A., & Maguire, L. A. (1999). Understanding participant perspectives: Q-
methodology in national forest management. *Journal of Policy Analysis and
Management*, *18*(3), 361–388. https://doi.org/10.1002/(SICI)1520-
6688(199922)18:3<361::AID-PAM3>3.0.CO;2-K

Stelzenmüller, V, Gimpel, A., Gopnik, M., & Gee, K. (2017). Aquaculture site-selection
and marine spatial planning: The roles of GIS-based tools and models.
Aquaculture Perspective of Multi-Use Sites in the Open Ocean. 131-148.

Stickney, R. R. (1994). Principles of aquaculture. *Technology & Engineering*. University
of California.

T. Buck Suzuki Environmental Foundation. (n.d.). Fish feed. *Salmon Farming Impacts.* Retrieved August 12, 2019, from http://www.bucksuzuki.org/current-projects/salmon-farming-campaign/salmon-farming-impacts/fish-feed/

Tang, J. (2018). New environmental assessment process a compromise between industry, activists. *National Post.* Retrieved November 20, 2019, from https://nationalpost.com/news/politics/government-reveals-far-reaching-new-review-process-for-major-resource-projects

Terpenning, M. S. (2018). Stakeholder perceptions of the Nova Scotia aquaculture regulations implemented in 2015 – a foundation for social licence? *Master of Marine Management Graduate Project*. Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/75158

Thackeray, R. & Neiger, B. L. (2009). A multidirectional communication model: Implications for social marketing practice. *Health Promotion Practice*, *10*(2), 171-175. https://doi.org/10.1177/1524839908330729

Thomson, I. & Boutilier, R. G. (2011). Social license to operate. In Darling, P. (Eds), *SME*

Mining Engineering Handbook (pp 1779-1796). Littleton, Colorado: Society of Mining

Metallurgy and Exploration.

Tiller, R. G., De Kok, J.-L., Vermeiren, K., & Thorvaldsen, T. (2017). Accountability as a governance paradox in the Norwegian salmon aquaculture industry. *Frontiers in Marine Science*, *4*(71). https://doi.org/10.3389/fmars.2017.00071

Tomasso, J. R. (2012). Environmental nitrite and aquaculture: a perspective. *Aquaculture International, 20*(6), 1107-1116. https://doi.org/10.1007/s10499-012-9532-6

Trudeau, Rt. Hon. J. (2018). Minister of Fisheries, Oceans and the Canadian Coast Guard Mandate Letter. *Justin Trudeau, Prime Minister of Canada.* Retrieved July 10, 2019 from https://pm.gc.ca/eng/minister-fisheries-oceans-and-canadian-coast-guard-mandate-letter-august-28-2018UNESCO. (2007). National ocean policy.

The basic texts from: Australia, Brazil, Canada, China, Colombia, Japan, Norway, Portugal, Russian Federation, United States of America. *IOC Technical Series, 75. Law of the Sea Dossier 1: Intergovernmental Oceanographic Commission.* Retrieved January 6th, 2019, from http://www.ioc-unesco.org/index.php?option=com_content&view=article&id=362&Itemid=100036

United Nations. (2019). The Sustainable Development Goals Report 2019. *United Nations.* Retrieved August 19, 2019, from https://unstats.un.org/sdgs/report/2019/

van Amstel, M., Driessen, P. P. J., Glasbergen, P. (2008). Eco-labeling and information asymmetry: a comparison of five eco-labels in the Netherlands. *Journal of Cleaner Production, 16*(3), 263-276. https://doi.org/10.1016/j.jclepro.2006.07.039

Watts, D. S., & Stenner, D. P. (2005). Doing Q methodology: Theory, method and interpretation. *Qualitative Research in Psychology*, *2*(1), 67–91. https://doi.org/10.1191/1478088705qp022oa

Weir, L. K., & Grant, J. W. A. (2005). Effects of aquaculture on wild fish populations: a synthesis of data. *Environmental Reviews, 13*(4): 145-168. https://doi.org/10.1139/a05-012

Weitzman, J. (2016). Assessing the potential of ecolabels to improve social acceptance within Nova Scotia's finfish aquaculture industry: A stakeholder approach. *Master of Marine Management Graduate Project*. Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/72681

Weitzman, J., & Bailey, M. (2018). Perceptions of aquaculture ecolabels: A multi-stakeholder approach in Nova Scotia, Canada. *Marine Policy*, *87*, 12-22. https://doi.org/10.1016/j.marpol.2017.09.037

Willick, F. (2018). Residents concerned about salmon farm expansion near Liverpool. *CBC News.* Retrieved October 2, 2019, from

https://www.cbc.ca/news/canada/nova-scotia/cooke-aquaculture-salmon-farm-expansion-liverpool-1.4881177

Willis, K. J. & Ling, N. (2003). The toxicity of emamectin benzoate, an aquaculture pesticide, to planktonic marine copepods. *Aquaculture, 221*(1-4), 289-297. https://doi.org/10.1016/S0044-8486(03)00066-8

Wingenbach, G. J., Gartin, S. A., & Lawrence, L. D. (1999). Students' perceptions of aquaculture education in the Northeast region. *Journal of Agricultural Education, 40*, 14-22. https://doi.org/10.5032/jae.1999.01014

Withers, P. (2015). Aquaculture regulations criticized for a lack of transparency in report. *CBC Nova Scotia.* Retrieved July, 17, 2019, from https://www.cbc.ca/news/canada/nova-scotia/aquaculture-regs-less-transparent-says-report-1.3316911

Withers, P. (2019a). Global salmon farming company eyes $500M expansion along Nova Scotia coast. *CBC Nova Scotia.* Retrieved November 9, 2019, from https://www.cbc.ca/news/canada/nova-scotia/nova-scotia-fish-farms-mitsubishi-cermaq-1.5083342

Withers, P. (2019b). Why open-pen salmon farms could be coming to St. Margarets Bay, Mahone Bay. *CBC Nova Scotia.* Retrieved November 9, 2019, from https://www.cbc.ca/news/canada/nova-scotia/open-pen-salmon-farms-mahone-bay-st-margarets-bay-1.5353452

White, P., Phillips, M. J., & Beveridge, M. C. M. (2013). Environmental impact, site selection, and carrying capacity estimation for small-scale aquaculture in Asia. *FAO Fisheries and Aquaculture Proceedings, 21*, 231-251.

Whitmarsh, D., & Palmieri, M. G. (2009). Social acceptability of marine aquaculture: The use of Survey-based methods for eliciting public and stakeholder preferences. *Marine Policy*, *33*(3), 452–457. https://doi.org/10.1016/j.marpol.2008.10.003

WHO. (2015). Vaccinating salmon: How Norway avoids antibiotics in fish farming. *Features 2015.* Retrieved November 20, 2019, from https://www.who.int/features/2015/antibiotics-norway/en/

Young, N., & Matthews, R. (2010). The aquaculture controversy in Canada: Activism, policy, and contested science. *Vancouver: UBC Press.*

Zander, K. & Feucht, Y. (2018). Consumers' willingness to pay for sustainable seafood made in Europe. *Journal of International Food & Agribusiness Marketing, 30*(3), 251-275. https://doi-org.ezproxy.library.dal.ca/10.1080/08974438.2017.1413611

Appendices

Appendix i – Worldwide finfish production
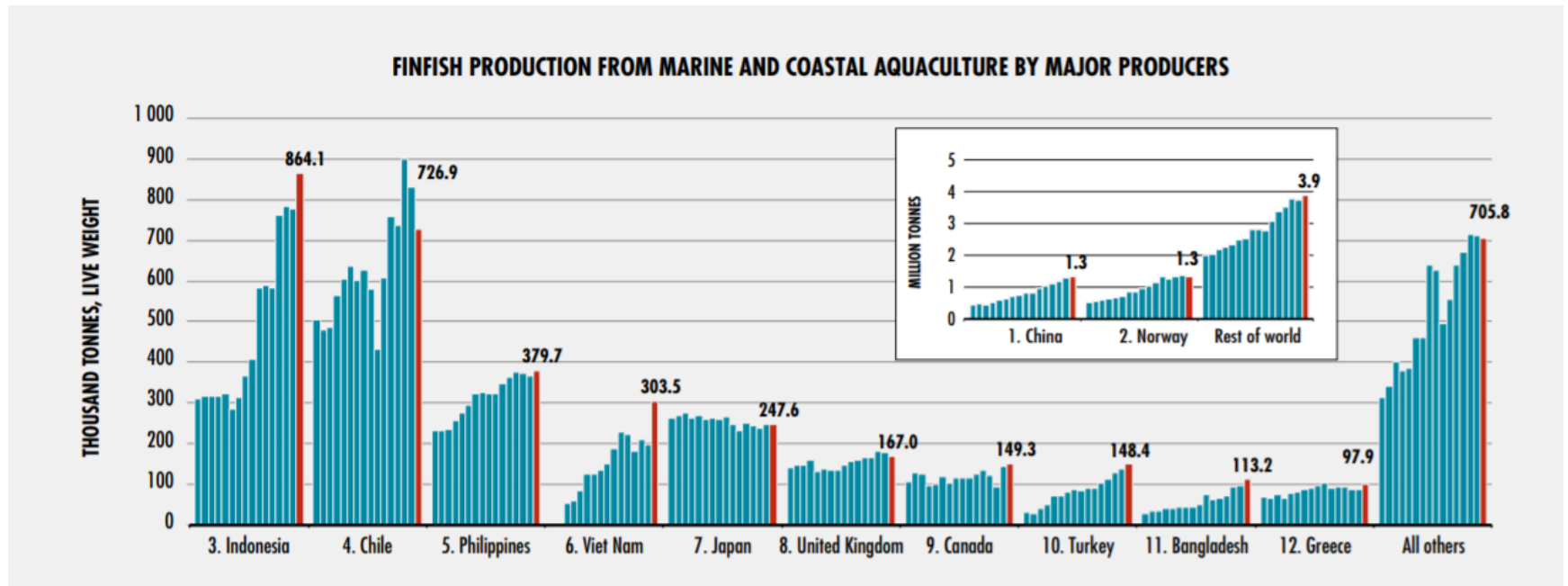
Figure 6A: Finfish production from marine and coastal aquaculture by major producers. Taken from the FAO's The State of World Fisheries and Aquaculture: Meeting the Sustainable Development Goals 2018.

Appendix ii – Concourse survey and final statement selections

Table 6A

(#)	Statement	Source
1	Transparent aquaculture operations are a pre-requisite for entry into some markets.	Asche, F. & Khatun, F. (2006). Aquaculture: issues and opportunities for sustainable production and trade. Geneva: International Centre for Trade and Sustainable Development (ICTSD), 2006. Retrieved November 1, 2019, from http://www.ictsd.org/sites/default/files/research/2008/06/asche_khatun_2006.pdf
2	Transparent aquaculture practices do not promote sustainable aquaculture.	Fisheries and Oceans Canada. (2015). Canada's Sustainable Aquaculture Program. Retrieved August 21, 2019, from http://www.dfo-mpo.gc.ca/aquaculture/programs-programmes/sustainable-durable/index-eng.htm
3	The information that industry is currently communicating is accessible to the public.	Doelle, M., & Lahey, W. (2014). A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf
4	Polarization of views regarding salmon aquaculture is caused by a lack of effective communication.	Flaherty, M., Reid, G., Chopin, T., & Latham, E. (2019). Public attitudes towards marine aquaculture in Canada: insights from the Pacific and Atlantic coasts. *Aquaculture International*, *27*(1), 9-32. https://doi.org/10.1007/s10499-018-0312-9
5	Promoting communication is a	Chu, J., Anderson, J. L., Asche, F., & Tudur, L. (2010). Stakeholders' perceptions of aquaculture and implications for its future: A comparison of the U.S.A. and Norway. *Marine Resource Economics, 25*(1), 61-76. https://doi.org/10.5950/0738-1360-25.1.61

role for the
government.

6	Preventing effects on wild salmon populations is important to achieving social licence.	Mather, C. & Fanning, L. (2019). Social licence and aquaculture: Towards a research agenda. *Marine Policy, 99,* 275-282. https://doi.org/10.1016/j.marpol.2018.10.049
7	Transparent aquaculture operations generate a higher value product.	Zander, K. & Feucht, Y. (2018). Consumers' willingness to pay for sustainable seafood made in Europe. *Journal of International Food & Agribusiness Marketing, 30*(3), 251-275. https://doi-org.ezproxy.library.dal.ca/10.1080/08974438.2017.1413611
8	Current transparency policies set by the government are not effective.	Doelle, M., & Lahey, W. (2014). A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec 14.pdf
9	Conflict resolution in the marine space is a process of transparency.	Jentoft, S. & Chuenpagdee, R. (2009). Fisheries and coastal governance as a wicked problem. *Marine Policy, 33*(4), 553-560. https://doi.org/10.1016/j.marpol.2008.12.002
10	Meaningful engagement with communities affected by aquaculture operations is important to	Mercer-Mapstone, L., Rifkin, W., Louis, W., & Moffat, K. (2017). Meaningful dialogue outcomes contribute to laying a foundation for social licence to operate. *Resources Policy, 53,* 347-355. https://doi.org/10.1016/j.resourpol.2017.07.004

achieving social
licence.

11	Transparency is not important to achieving social licence.	Withers, P. (2015). Aquaculture regulations criticized for a lack of transparency in report. *CBC Nova Scotia.* Retrieved July, 17, 2019, from https://www.cbc.ca/news/canada/nova-scotia/aquaculture-regs-less-transparent-says-report-1.3316911
12	Reduced reliance on fishmeal is not important to achieving social licence.	T. Buck Suzuki Environmental Foundation. (n.d.). Fish feed. *Salmon Farming Impacts.* Retrieved August 12, 2019, from http://www.bucksuzuki.org/current-projects/salmon-farming-campaign/salmon-farming-impacts/fish-feed/
13	Independent certification of environmental and social standards is important to achieving social licence.	Weitzman, J., & Bailey, M. (2018). Perceptions of aquaculture ecolabels: A multi-stakeholder approach in Nova Scotia, Canada. *Marine Policy*, *87*, 12-22. https://doi.org/10.1016/j.marpol.2017.09.037
14	Without communicating information in a way that is easily understood, transparency is not useful to the public.	Fox, J. (2007). The uncertain relationship between transparency and accountability. *Development in Practice*, *17(*4-5). 663-671. https://doi.org/10.1080/09614520701469955
15	Effective record-keeping systems	Weitzman, J. (2016). Assessing the potential of ecolabels to improve social acceptance within Nova Scotia's finfish aquaculture industry: A stakeholder approach. *Master of Marine Management*

	provide the potential for effective communication of aquaculture practices.	*Graduate Project*. Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/72681
16	Public education is important to achieving social licence.	Fisheries and Oceans Canada. (2005). Overview: Qualitative research exploring Canadians' perceptions, attitudes and concerns towards aquaculture. *Reports and Publications.* Retrieved July 2, 2019, from http://www.dfo-mpo.gc.ca/por-rop/focus-aquaculture-eng.htm
17	There is no reluctance for salmon aquaculture companies to communicate environmental parameters (e.g. disease occurrence, escapees, etc.) to the public.	Asche, F., Hansen, H., Tveterås, R., & Tveterås, S. (2009). Thalassorama: The salmon disease crisis in Chile. *Marine Resource Economics, 24*(4), 405-411. https://doi.org/10.5950/0738-1360-24.4.405
18	Government communication initiatives do not reach the majority of the public.	Chu, J., Anderson, J. L., Asche, F., & Tudur, L. (2010). Stakeholders' perceptions of aquaculture and implications for its future: A comparison of the U.S.A. and Norway. *Marine Resource Economics, 25*(1), 61-76. https://doi.org/10.5950/0738-1360-25.1.61
19	Promoting transparency is a role for the government.	McLeod, S. (2018). BC's aquaculture, the most transparent food-industry. *SeaWestNews.* Retrieved August 14, 2019, from https://seawestnews.com/bcs-aquaculture-the-most-transparent-food-industry/

| 20	Monitoring, reporting, and enforcement of environmental and social standards is important to achieving social licence.	Føre, M., Frank, K., Norton, T., Svendsen, E., Alfredsen, J. A., Dempster, T. … Berckmans, D. (2018). Precision fish farming: A new framework to improve production in aquaculture. *Biosystems Engineering, 173,* 176-193. https://doi.org/10.1016/j.biosystemseng.2017.10.014
21	Promoting communication is not a role for NGOs.	Froehlich, H. E., Gentry, R. R., Rust, M. B., Grimm, D., & Halpern, B. S. (2017b). Public perceptions of aquaculture: evaluating spatiotemporal patterns of sentiment around the world. *PLOS One.* 1-18. https://doi.org/10.1371/journal.pone.0169281
22	Promoting transparency is a role for media (e.g. newspapers, television coverage, etc.).	Flaherty, M., Reid, G., Chopin, T., & Latham, E. (2019). Public attitudes towards marine aquaculture in Canada: insights from the Pacific and Atlantic coasts. *Aquaculture International*, *27*(1), 9-32. https://doi.org/10.1007/s10499-018-0312-9
23	Communication strategies have failed to show changes in aquaculture operations over time.	ACFFA. (2019). Media statement: salmon farmers are already transparent about escapes. Retrieved November 20, 2019, from https://www.atlanticfishfarmers.com/media-releases-all/2019/9/13/media-statement-salmon-farmers-are-already-transparent-about-escapes
24	Reducing the use of pesticides and antibiotics is not important to achieving social licence.	WHO. (2015). Vaccinating salmon: How Norway avoids antibiotics in fish farming. *Features 2015.* Retrieved November 20, 2019, from https://www.who.int/features/2015/antibiotics-norway/en/

25	Government does not have the capacity to effectively communicate to the public.	George Washington University's Elliot School for International Affairs. (2009). The contribution of government communication capacity to achieving good governance outcomes. *CommGAP*. Retrieved November 20, 2019, from http://documents.worldbank.org/curated/en/511591468331052544/The-contribution-of-government-communication-capacity-to-achieving-good-governance-outcomes
26	Regulations that promote transparency can compromise industry development.	Tang, J. (2018). New environmental assessment process a compromise between industry, activists. *National Post*. Retrieved November 20, 2019, from https://nationalpost.com/news/politics/government-reveals-far-reaching-new-review-process-for-major-resource-projects
27	Promoting transparency is not a role for industry.	Mowi. (n.d.) Targets and policies. *Corporate Governance*. Retrieved November 20, 2019, from https://mowi.com/investors/corporate-governance/targets-and-policies/
28	Conflict resolution in the marine space is not a process of communication.	Jentoft, S. & Chuenpagdee, R. (2009). Fisheries and coastal governance as a wicked problem. *Marine Policy, 33*(4), 553-560. https://doi.org/10.1016/j.marpol.2008.12.002
29	Promoting communication is a role for media (e.g. newspapers, television coverage, etc.).	Flaherty, M., Reid, G., Chopin, T., & Latham, E. (2019). Public attitudes towards marine aquaculture in Canada: insights from the Pacific and Atlantic coasts. *Aquaculture International*, *27*(1), 9-32. https://doi.org/10.1007/s10499-018-0312-9
30	Promoting transparency is not a role for NGOs.	Ecology Action Centre. (2019). Sustainable fisheries and aquaculture. *Our Work*. Retrieved November 20, 2019, from https://ecologyaction.ca/marine/sustainable-fisheries-and-aquaculture

| 31	Communication among stakeholders (e.g. industry, public and government) is not important to achieving social licence.	Thackeray, R. & Neiger, B. L. (2009). A multidirectional communication model: Implications for social marketing practice. *Health Promotion Practice*, *10*(2), 171-175. https://doi.org/10.1177/1524839908330729
32	Current communication policies set by the government are effective.	Doelle, M., & Lahey, W. (2014). A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf
33	Sharing technical information without proper public education does not cause confusion.	Miljure, B. (2016). Genetically-modified fish could cause 'consumer confusion'. *CTV News Vancouver*. Retrieved July 2, 2019, from https://bc.ctvnews.ca/genetically-modified-fish-could-cause-consumer-confusion-1.2912422
34	Existing regulations sufficiently encourage transparency.	Doelle, M., & Lahey, W. (2014). A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec 14.pdf
35	Promoting communication is a role for an independent ecolabel.	van Amstel, M., Driessen, P. P. J., Glasbergen, P. (2008). Eco-labeling and information asymmetry: a comparison of five eco-labels in the Netherlands. *Journal of Cleaner Production, 16*(3), 263-276. https://doi.org/10.1016/j.jclepro.2006.07.039

36	Promoting communication is not a role for industry.	Terpenning, M. S. (2018). Stakeholder perceptions of the Nova Scotia aquaculture regulations implemented in 2015 – a foundation for social licence? *Master of Marine Management Graduate Project*. Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/75158
37	Current capacity (e.g. infrastructure, personnel, resources) does not prevent farmers from operating in a transparent way.	Terpenning, M. S. (2018). Stakeholder perceptions of the Nova Scotia aquaculture regulations implemented in 2015 – a foundation for social licence? *Master of Marine Management Graduate Project*. Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/75158
38	Minimizing the effects on benthic species (e.g. lobster) is not important to achieving social licence.	Tomasso, J. R. (2012). Environmental nitrite and aquaculture: a perspective. *Aquaculture International, 20*(6), 1107-1116. https://doi.org/10.1007/s10499-012-9532-6
39	Promoting transparency is a role for an independent ecolabel.	Weitzman, J., & Bailey, M. (2018). Perceptions of aquaculture ecolabels: A multi-stakeholder approach in Nova Scotia, Canada. *Marine Policy*, *87*, 12-22. https://doi.org/10.1016/j.marpol.2017.09.037
40	Transparency leads to accountability of the industry.	Terpenning, M. S. (2018). Stakeholder perceptions of the Nova Scotia aquaculture regulations implemented in 2015 – a foundation for social licence? *Master of Marine Management Graduate Project*. Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/75158

Appendix iii: PQMethodology Rotation Output
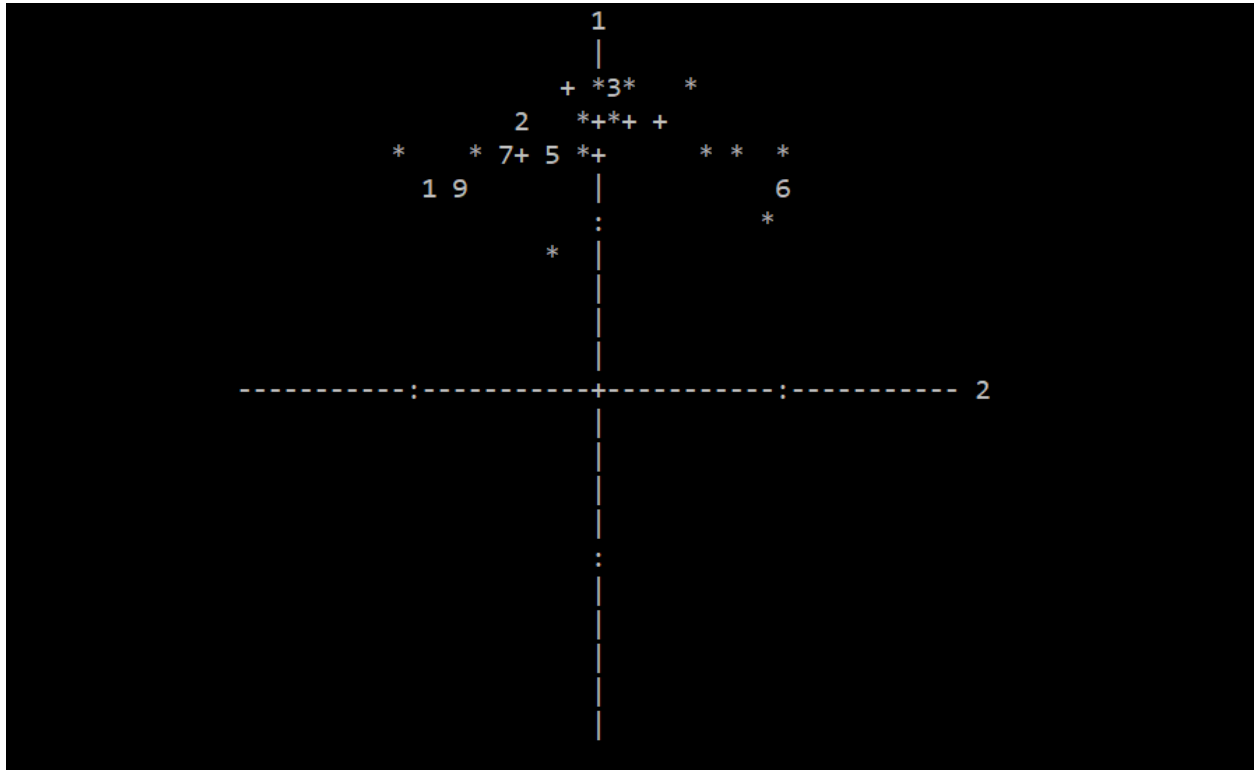
Figure A7: PQMethodology rotation output with an angle of 0° rotation from default. Y-axis represents factor/perspective 1 (56% of variation) and X-axis represents factor/perspective 2 (7% of variation). Asterisks, plus-signs, and numbers indicate where a participant's sort falls on the cartesian plane. There are 24 symbols on the plane, corresponding with the 24 non-confounding sorts.

Appendix iv – Open access finfish aquaculture information available in Norway and Nova Scotia
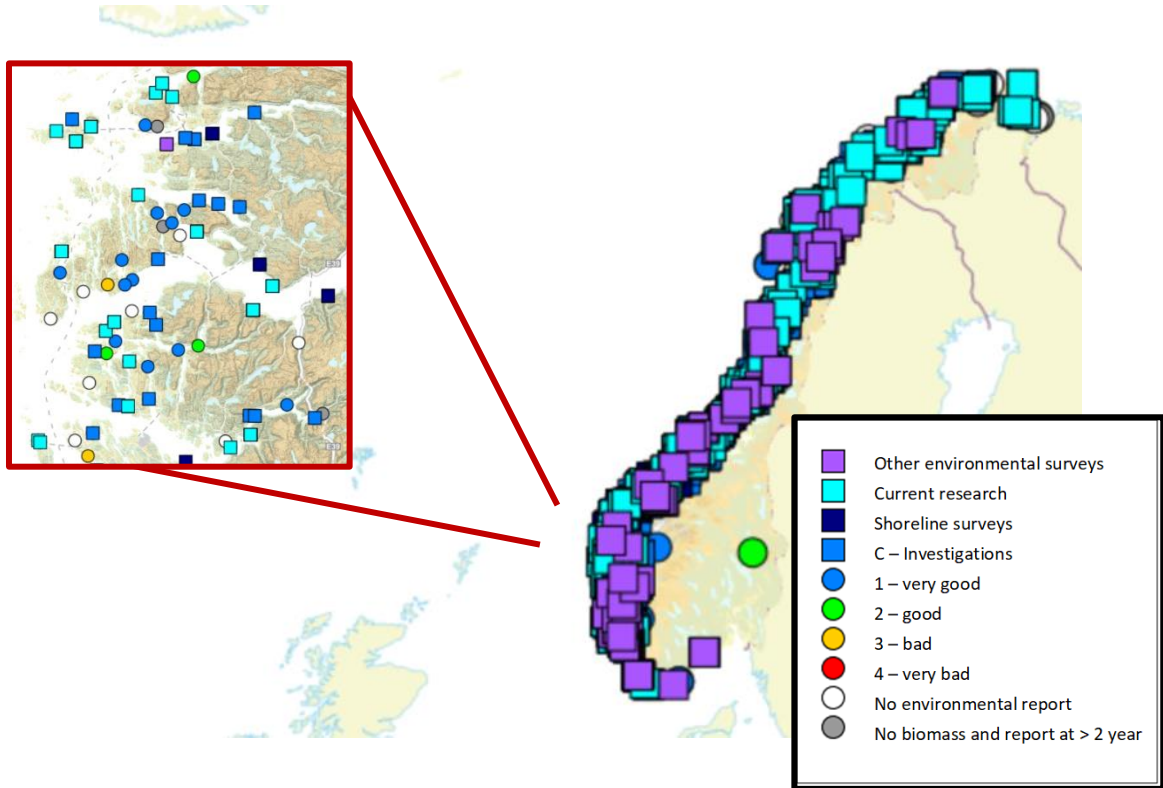
Figure A8: Publicly available interface of the locations of all aquaculture sites in Norway. In red is a pop-out of an area near Bergen, Hordaland (retrieved from Barentswatch June 5, 2019).
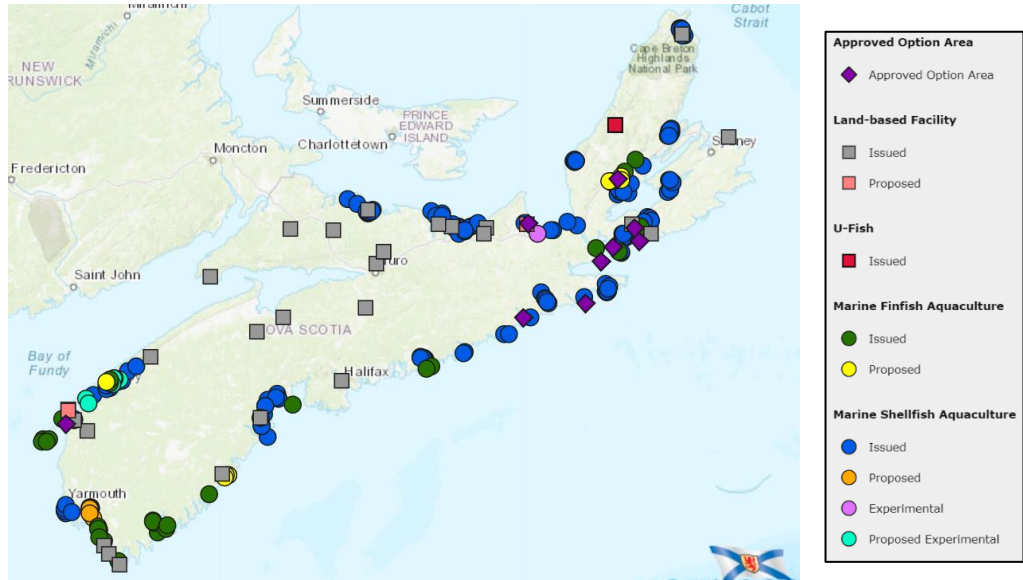
Figure A9: Publicly available interface of the locations of all aquaculture sites in Nova Scotia (retrieved from Nova Scotia's Aquaculture Site Mapping Tool June 5, 2019).