On the influence of private stakeholders in the governance of international tuna fisheries

by

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For Cous—who shared this journey with me from start to end—and who everyday reminds me of our responsibility as humans to do right by all creatures with whom we share this planet.

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ABSTRACT

Twenty-three populations of tuna are globally distributed across national waters and the high seas. These fish are caught by hundreds of fishing fleets, which operate in a complex governance system, influenced by national regulations, intergovernmental negotiations, non-governmental organization (NGO) agendas, and international seafood market conditions. Regional Fisheries Management Organizations (RFMOs) are the primary fora where management decisions for tuna fisheries are made, yet their effectiveness is complicated by the transboundary nature of both fish and fisheries, the socio-economic circumstances of each member state, and geopolitical relations between states. Since the early 2000s, demand for sustainably-caught seafood has increased, and fishing companies now seek third-party eco-certifications to market their catch. To obtain and retain this certification, tuna fisheries must demonstrate effective management—which creates incentives for RFMO reform. Given these trends, I ask: (i) how is this changing private governance landscape influencing decisions made through RFMOs? and (ii) is this beneficial or detrimental for the long-term conservation and management of tuna? To address these questions, this thesis includes four research chapters, which are first introduced by an overview of tuna fisheries and associated public and private governance mechanisms. Subsequently, each chapter analyzes how decisions made at RFMOs are (or could be) affected by different governance mechanisms: Chapter 3 measures the contribution of tuna and other high seas fisheries to global food security, Chapter 4 analyzes trends in eco-certifications for tuna fishing companies, Chapter 5 synthesizes two decades of tuna advocacy by NGOs, and Chapter 6 assesses the influence of different attendees at annual Western and Central Pacific Fisheries Commission (WCPFC) meetings. My concluding chapter synthesizes these findings and provides reflection on improved tuna fisheries governance and open research questions around the role of the private sector. I suggest that pressure from MSC-certified fishing companies and other supply chain actors, combined with increasingly diverse and proactive engagement by NGOs, has affected RFMO decisions for the betterment of tuna fisheries management. Still, many improvements remain preliminary, and these influences will only be beneficial long-term if RFMO policymakers, seafood companies, and NGOs hold each other accountable in their commitments to ensure the sustainability of global tuna populations.

LIST OF ABBREVIATIONS USED

ABNJ	Areas Beyond National Jurisdiction
ABT	Atlantic bluefin tuna
ADV	Advisor
ALB	Albacore tuna
AO	Atlantic Ocean
BB	Bait boat
BET	Bigeye tuna
BFT	Bluefin tuna (not species specific)
B	Biomass
B_0	Unfished (virgin) stock biomass
B_{MSY}	Biomass at Maximum Sustainable Yield
BBNJ	Biodiversity Beyond National Jurisdiction
CCBST	Commission for the Conservation of Southern Bluefin Tuna
CCM/CPC	Commission Cooperating Non-Members and participating Territories
CMM	Conservation and Management Measure
CMS	Compliance and Monitoring Scheme/Convention on Migratory Species (context specific)
CONS	Consultant
CSR	Corporate Social Responsibility
DEL	Delegate
DWF	Distant water fleet
EEZ	Exclusive Economic Zone
EII	Earth Island Institute
ENGO	Environmental Non-governmental Organization
EPO	Eastern Pacific Ocean
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAD	Fish Aggregating Device
FFA	Pacific Islands Forum Fisheries Agency
FIP	Fishery Improvement Project
F	Fishing Mortality
F_{MSY}	Fishing Mortality at Maximum Sustainable Yield
FSM	Federated States of Micronesia
GOV	Government
HCR	Harvest control rule(s)
HS	High seas
IATTC	Inter-American Tropical Tuna Committee
ICCAT	International Commission for the Conservation of Atlantic Tunas
IGO	Intergovernmental Organization
IO	Indian Ocean

IOTC	Indian Ocean Tuna Commission
IGFA	International Game Fishing Association
IGO	Intergovernmental organization
INGO	Industry non-governmental organization
IPNLF	International Pole and Line Foundation
ISSF	International Seafood Sustainability Foundation
IUCN	International Union for the Conservation of Nature
IUU	Illegal, Unreported and Unregulated fishing
LL	Longline
LRP	Limit reference point(s)
MED	Mediterranean
MCS	Monitoring, control, and surveillance
MSC	Marine Stewardship Council
MHLC	Multilateral High Level Conference
MSY	Maximum Sustainable Yield
NAO	North Atlantic Ocean
NGO	Non-governmental Organization
NPO	North Pacific Ocean
NSMD	Non-state market-driven
OBS	Observer
OPAGAC	Organización de Productores de Atún Congelado
PBT	Pacific bluefin tuna
PICTs	Pacific Island Countries and Territories
PNA	Parties to the Nauru Agreement
PNG	Papua New Guinea
PS	Purse seine
RFMO	Regional Fisheries Management Organization
SAO	South Atlantic Ocean
SBT	Southern bluefin tuna
SFP	Sustainable Fisheries Partnership
SIDS	Small Island Developing States
SKJ	Skipjack tuna
SPO	South Pacific Ocean
SSB	Spawning stock biomass
SSB_0	Unfished (virgin) spawning stock biomass
TAC	Total Allowable Catch
TRP	Target reference point(s)
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNFSA	United Nations Fish Stocks Agreement
UNGA	United Nations General Assembly

UoA	Unit of Assessment
UoC	Unit of Certification
UK	United Kingdom
US	United States of America
VDS	Vessel Day Scheme
VMS	Vessel Monitoring Scheme
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean
WWF	World Wildlife Fund for Nature
YFT	Yellowfin tuna

STATEMENT

Every researcher brings their unique worldview to their work. We all strive to make our findings reproducible by being systematic and transparent during data collection and analysis. Yet, I am aware that the very questions I ask as a researcher, who I engage with during fieldwork (and how we interact), the analytical methods I choose, and how I interpret my results are all fundamentally linked to my history, beliefs, abilities, and personality. The purpose of this positionality statement is to disclose the underlying motivations and perspectives I bring to my research. This allows me to reflect on who I am as a researcher *today* while acknowledging that this perspective will change over the course of my career, as it already has. My hope is this additional context can help readers identify my strengths and weaknesses, as well as any nuances in interpretation related my social, cultural, or experiential biases.

I am a white Canadian woman who grew up in Vancouver. I am an only child and was parented by a single Mom until age 12. Animals were my first love, and my curiosity of marine life began at the Vancouver Aquarium; by kindergarten I had decided on a career in marine biology. My Mom, a high-school French teacher, saw value in educating from life experience as well as textbooks and, from a young age, I joined her on trips abroad with her students. Travels on six continents have exposed me to humanity in all its forms, and have been fundamental in shaping my understanding of human relationships and our relationship with nature.

I was originally interested in marine physiology but reading about the overexploitation of bluefin tuna in *Song for the Blue Ocean* transformed my outlook on how we interact with fish. During my BSc (Marine & Freshwater Biology; Guelph), I considered fishing a destructive practice that was devastating populations of wildlife. Fortunately, over the last decade, this perspective has widened and become more nuanced. I was fortunate to live in a rural fishing village in Madagascar prior to my MSc (Zoology; University of British Columbia), which led me to appreciate the critical importance of fish for food and livelihood security. Near the end of my MSc—which focused on quantifying unreported bycatch in the world's tuna fisheries—I attended my first tuna RFMO meeting. Here, I witnessed first-hand the complexities inherent to reaching consensus on international fishing measures across disparate social, political, cultural, and economic circumstances. Working for a sustainable seafood NGO further shaped my view on the need for diverse strategies to address marine conservation challenges.

I recognize fisheries continue to have negative impacts on marine ecosystems. And, as with all economic ventures, some fishing companies are corrupt, and some people in positions of power exploit society's most vulnerable. Bearing these challenges in mind, I aim to conduct solutions-focused research. I try to ask questions that can shed light on incentives for systemic reform in light of uncertain ecological conditions, as well as socio-political and economic pressures. I approach problems pragmatically yet usually bring an optimistic outlook to most situations, appreciating that there is no quick fix but, equally, that access points for positive progress do exist. My research combines theory and methods from marine ecology, fisheries science, environmental politics, and natural resource governance. I am interested in who gets a voice in decision-making and while I cannot speak for any specific group of stakeholders, I seek to synthesize the knowledge people entrust to me as accurately as my worldview enables with the hope that the results of my work can benefit both people and nature.

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For my lab mates and Dal colleagues (past and present), and especially my tuna-focused friends, Sinan and Helen: thank you for being a sounding board, for sharing the highs and lows. Spending time with all of you has made me a better scientist and a better human.

I am additionally indebted to my enthusiastic and resourceful Ocean Wise colleagues. I am constantly inspired by your commitment to encourage others to protect our ocean.

Thank you, Wilf, for your encouragement and enthusiasm toward my work from Day One. Happy to have done it for Booush.

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Last but not least: thank you, Boris, for listening with patience and care to all my ideas.

1 INTRODUCTION[1]

In 2017, with the support of six governments and 21 environmental groups, 66 seafood companies committed to the Tuna 2020 Traceability Initiative: a partnership designed to improve the environmental and social responsibility of tuna fishing practices and supply chains (Waughray 2017). In 2018, 118 seafood supply chain companies signed a letter calling on the world's tuna management organizations to—as soon as possible—"implement comprehensive, precautionary harvest strategies with specific timelines for all tuna stocks…" (NGO Tuna Forum 2018). The following year, the Traceability Initiative was formalized as the Global Tuna Alliance. These contemporary initiatives show the unified public-facing voice the seafood industry has developed to highlight their commitment to produce sustainable and traceable tuna and their desire to push public policymakers to adopt stronger science-based management frameworks for the world's largest transboundary fisheries. These pledges are aligned with the key mission of the United Nations Global Compact for Ocean Stewardship, which explicitly calls on leadership from businesses to help governments meet the UN Sustainable Development Goals (UN 2020). However, for fisheries, unification between these sectors has not always been the case. Only two decades ago, the fishing industry was highly skeptical of novel 'sustainable seafood' programs and messaging by environmental organizations (Broad 1999), depicting these groups as 'greenies' who should be avoided (Ish and Osterblom 2019) while environmental groups actively campaigned against tuna fishing, insinuating corruption in both fishing practices and management decisions (WWF 2006; Greenpeace 2007).

1.1 Problem statement and research questions

Today, tuna and tuna fisheries exist in a complex social-ecological system, influenced by marine environmental conditions, national regulation, international negotiations (processes and agreements), market demands, and private interest groups (Figure 1.1). Much of the fishing effort in offshore waters is directed at tuna, yet small-scale coastal fisheries also target

[1]Abridged version of doctoral comprehensive exam, *From Cat food to Cult Food: A review of the ecology, fisheries, and governance of the world's tuna* (submitted 29 June 2018; unpublished).

these fish and contribute significantly to the global catch; more than 80 countries currently fish for tuna and reported landings increased from 698,000 mt in 1960 to over five million mt in 2018 (FAO 2020b). Since the distribution of tuna stocks straddles national waters as well as international waters (the high seas), all fishing states must adhere to collective management measures to ensure fishing is sustainable and stocks remain healthy across their range. These measures are negotiated annually and the multi-lateral frameworks through which management decisions are made are called Regional Fishery Management Organizations (RFMOs) (Lodge *et al.* 2007). Despite their overarching mandates for stock conservation and mutual fishing benefit, several systemic and logistical challenges have affected the tuna RFMOs over the years (Szigeti and Lugten 2015; Haas *et al.* 2020b) and biological indicators suggest multiple tuna stocks have been (and continue to be) fished unsustainably (ISSF 2020).

In response to concerns over the overexploitation of fish stocks, poor fisheries management, and destructive fishing practices, the last two decades have seen the emergence and proliferation of private governing strategies—namely eco-certifications and sustainable seafood campaigns led by environmental non-governmental organizations (ENGOs) (Roheim *et al.* 2018). Market-based tools, such as eco-certification programs, were designed to target consumers and businesses as a way of generating a market for more sustainable products. From there, they use incentives of market access and price premiums incurred from their certifications to entice fishing companies to adopt more sustainable fishing practices (Wessels *et al.* 2001). The most ubiquitous of all seafood eco-certification programs is the Marine Stewardship Council (MSC), which has developed an assessment standard with criteria used to evaluate the ecological sustainability of a given fishery (MSC 2014). Increasingly, tuna fishing companies are seeking MSC certification directly, or through entry into a Fishery Improvement Project (FIP), on-water initiatives that are seen as a gateway to MSC assessment (Sampson *et al.* 2015). Even two fisheries for Atlantic bluefin tuna—a fish typically viewed as the poster species of overexploitation—have met the MSC Standard since 2019 (Jones *et al.* 2019; Sieben *et al.* 2020).

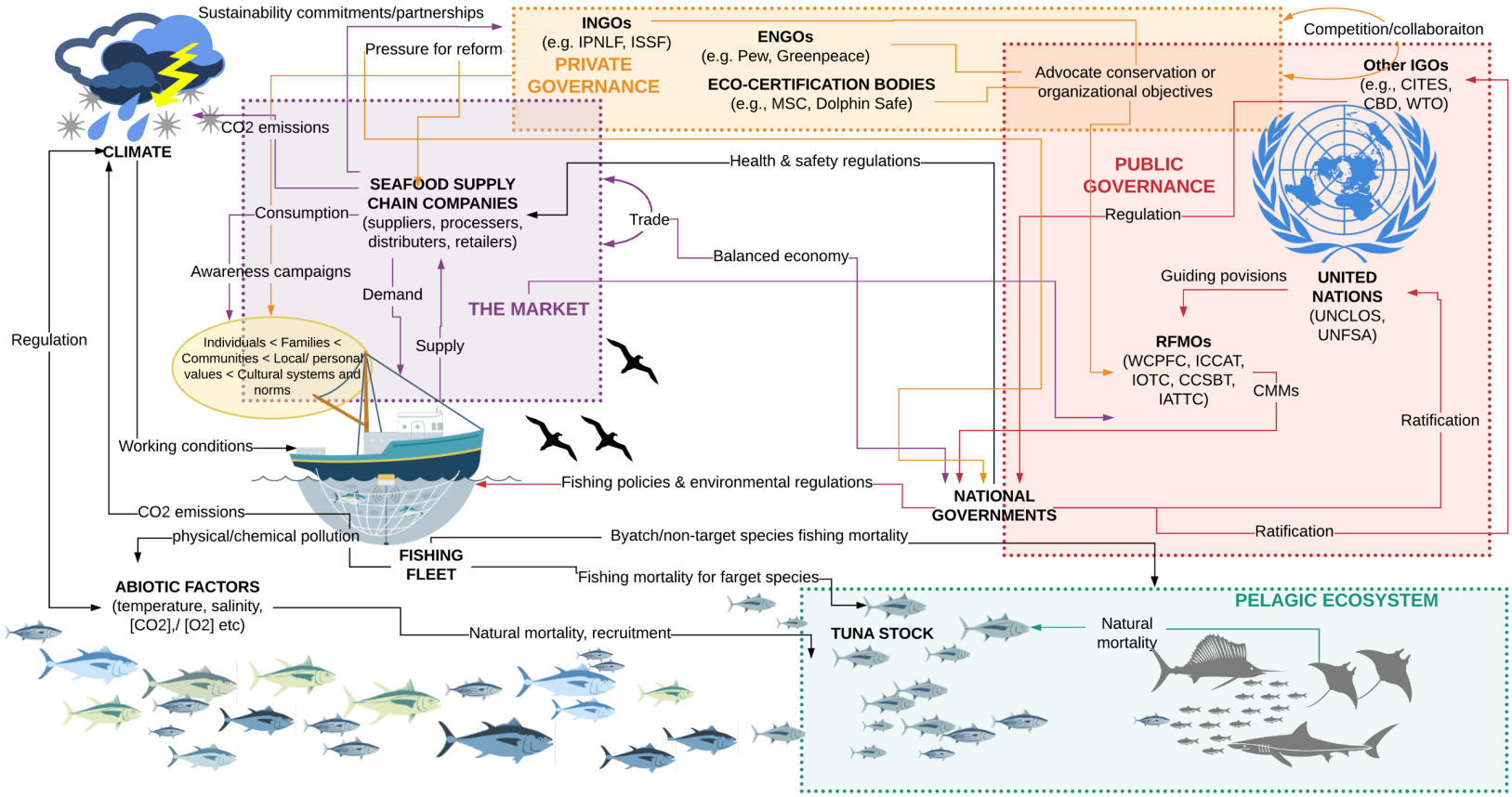

Figure 1.1 Interactions and influences in the social-ecological system for tuna. Tuna stocks are subject to fishing pressure from multiple fleets, which are under the oversight and subject to regulation developed by national governments and intergovernmental organizations. Private actors, including NGOs, eco-certification organizations, and industry members also influence fisheries through both market-based commitments, advocacy at RFMO meetings, and partnerships with governments.

Eco-certifications and other private governance initiatives are disadvantaged relative to intergovernmental institutions such as RFMOs because they must build legitimacy and authority from the bottom up but their autonomy from intergovernmental processes allows them to tap into emerging norms more quickly (Bernstein and Cashore 2007). Seafood eco-certifications signify sustainable fisheries, but certifying bodies—such as the MSC—are not responsible for the management of these fisheries: this is ultimately the role of governments (Sainsbury 2010). Still, to obtain and retain MSC-certification, fishing companies must demonstrate that effective management exists for their target species—which, in the case of tuna, remains dependent on decisions made through RFMOs. Notably, an emerging global governance regime endorsed by the United Nations and focused on biodiversity beyond national jurisdiction (BBNJ) may further complicate the jurisdictional oversight of tuna stocks through RFMOs. In light of this evolving relationship between public and private stakeholders—whereby MSC tuna companies are dependent on the decisions made by RFMOs and RFMOs themselves are subject to the outcomes of decisions made through higher levels of international governing fora, I ask the following overarching research questions:

(i) what is the contribution and significance of tuna and other species caught on the high seas in the context of global fisheries and food security?

(ii) how are private actors influencing the governance of tuna fisheries through RFMOs? And

(iii) in what ways is the engagement of private actors beneficial or detrimental for the long-term conservation and management of tuna?

The following introductory sections provide an overview of the fish, fisheries, and governance frameworks discussed throughout this thesis and lay a more detailed foundation for how I arrived at this problem statement and associated questions. Chapter 1 concludes with an overview of the specific research questions I ask for each subsequent research chapter and the associated methodologies I use to answer each.

1.2 Fast Fish

The word *Thunnus* is derived from the Greek verb *thynō*—meaning 'to rush' or 'to dart' (Ellis 2008), making it an appropriate genus name for some of the world's fastest and most agile fish. All tunas possess unique anatomical features for optimal hydrodynamic movement. These adaptations include a deep yet streamlined body profile that almost completely eliminates drag (Hertel 1963), long, slender pectoral fins and caudal keels for vertical lift (Magnuson 1978), rows of finlets to increase water flow longitudinally down the body (Nauen and Lauder 1999) and a lunate caudal fin with a high aspect ratio to enable powerful forward thrust (Lighthill 1970; Shadwick *et al.* 2012). The lymphatic system controls the movement of their pectoral and dorsal fins, including fine motor adjustments during swimming, as well as fin retraction during rapid acceleration, further minimizing drag (Pavlov *et al.* 2017). Unlike many fishes, the tunas carry the bulk of their muscle near the middle of their bodies and their swimming style appears rigid compared to other teleosts (Graham *et al.* 1983). However, this layout allows for more powerful lateral movements of the caudal fin, which is beneficial for both burst and long-distance swimming (Fierstine and Walters 1968); yellowfin can execute rapid accelerations to speeds exceeding 70 $km \cdot h^{-1}$, and the bluefins can swim at sustained speeds of 30 $km \cdot h^{-1}$ over hundreds of kilometres.

In addition to these biomechanical adaptations, the tunas are some of only a few marine fishes capable of endothermy—the ability to elevate internal body temperature above that of the ambient environment (Graham *et al.* 1983; Block *et al.* 1993; Wegner *et al.* 2015). An Atlantic bluefin, for example, can have a core temperature up to 21°C higher than the surrounding water (Block *et al.* 2001). The expression of endothermy in tunas varies (Blank *et al.* 2004); yet, in all species, it is made possible by vascular heat exchangers (i.e. networks of arterioles) called *retia mirabilia* that recover heat from venous blood flowing to the gills (Carey and Gibson 1983). This heat is then transferred to cooler arteries running counter-current, delivering oxygenated blood to muscles and other tissues. Yet, only muscles and organs with arteries connected to these heat exchangers can be heated and the tuna heart is not included in this network (Korsmeyer and Dewar 2001).

The bright red flesh of larger tuna species that has become desirable to sushi patrons globally and the warm visceral muscles that power aerobic swimming are one and the same. This highly

metabolic tissue is located deep within the body and the surrounding white anaerobic muscle provides substantial insulation, thereby helping to meet an additional requisite for endothermy (Shadwick *et al.* 2012). Sustained swimming is further enabled by a large heart (Bushnell and Jones 1994), ram ventilation, and high concentrations of hemoglobin in the blood such that its oxygen carrying capacity is similar to that of humans (*Homo sapiens*) and other mammals (Stevens and Carey 1981; Brill and Bushnell 1991).

However, endothermy is a double-edged sword. On one hand, it confers a substantial benefit in terms of mobility and hunting, yet it also incurs a heavy metabolic cost such that warm-bodied fish must consume substantially more calories than their ectothermic counterparts. The pelagic environment is lower in biological productivity compared to coastal areas but it is a critical habitat for tunas, sharks, and other highly migratory species (Ortuño Crespo and Dunn 2017). It has been suggested that the global distribution of the tunas was a function of their ability to expand into areas thermally intolerable to other fishes (i.e. colder water at both higher latitudes and at depth) in order to exploit populations of prey (Block *et al.* 1993).

Today, 23 discrete populations of seven principal commercial species of tuna (*Thunnus* spp. and *Katsuwonus pelamis*) are distributed globally in both temperate and tropical waters (Table 1.1). Although the range expansion of the tunas likely occurred over millennia, expansion of humans into the ocean occurred much more rapidly (Swartz *et al.* 2010). Satellite imagery shows that industrial commercial fisheries are now operating in over half of the global ocean, with the highest concentration in the northern hemisphere (23-68ºN) (Kroodsma *et al.* 2018). Humans have always had a disproportionately large influence on the composition and well-being of other species and ecosystems (Darimont, Fox, Bryan, & Reimchen, 2015) and our primary interaction with tuna (and most other marine fish) occurs through their capture and consumption.

1.3 International fisheries

Official national values suggest the world's current industrial and artisanal fisheries catch for all marine species just exceeds 80 million metric tonnes (mt) (FAO 2020b). This value refers to the total reported catch, but when unreported bycatch and discarded catch, recreational

landings, and subsistence landings are quantified, the current capture fisheries total may be closer to 100 million mt (Pauly and Zeller 2016). Based on reported data, just over five million mt of tuna are landed annually to support a global market of fresh, frozen, and canned products and fishing for tuna occurs using both industrial and artisanal gears, for commercial purposes (including sport fishing), and for subsistence (Figure 1.2). In total, the Pacific Ocean currently supplies two-thirds of the world's tuna (54.2% from the west and 14.8% from the east), followed by the Indian (20.4%) and the Atlantic (10.6%) and the relative species composition varies with each (Figure 1.3).

Table 1.1 Commercially targeted tuna species of the world. All life history characteristics excluding age at maturity obtained from FishBase (Froese and Pauly 2019).

Common name	Latin name	Trophic level	Common length (cm)	Age at maturity[a] (years)	Distribution	Commercial stocks
Albacore	*Thunnus alalunga*	4.3 ±0.2	100	6	Global subtropical (59°N-46°S)	6 (N. Pacific, S. Pacific, N. Atlantic, S. Atlantic, Med., Indian)
Atlantic bluefin	*Thunnus thynnus*	4.5 ±0.8	200	5[b]	Atlantic subtropical (76°N-58°S)	2 (Med., W. Atlantic)
Bigeye	*Thunnus obesus*	4.5 ±0.0	180	4	Global subtropical (45°N-43°S)	4 (E. Pacific, W. Pacific, Atlantic, Indian)
Pacific bluefin	*Thunnus orientalis*	4.5 ±0.3	200	5	Pacific subtropical (52°N-50°S)	1 (species range)
Skipjack	*Katsuwonus pelamis*	4.4 ±0.5	80	1.2	Global tropical (63°N-47°S)	5 (E. Pacific, W. Pacific, E. Atlantic, W. Atlantic, Indian)
Southern bluefin	*Thunnus maccoyii*	3.9 ±0.3	160	8[c]	S. hemisphere temperate (8°S - 60°S)	1 (species range)
Yellowfin	*Thunnus albacares*	4.4 ±0.4	150	2.5	Global tropical (59°N - 48°S)	4 (E. Pacific, W. Pacific, Atlantic, Indian)

[a]when 50% of individuals in an age class have reached sexual maturity; values from (or referenced in) most recent species stock assessments; [b]there is a high degree of uncertainty around this value, with suggestions of a much higher age (i.e. 13 years) possible for the Western stock; [c]may actually be upward of 13 years as there is a high degree of uncertainty in the data

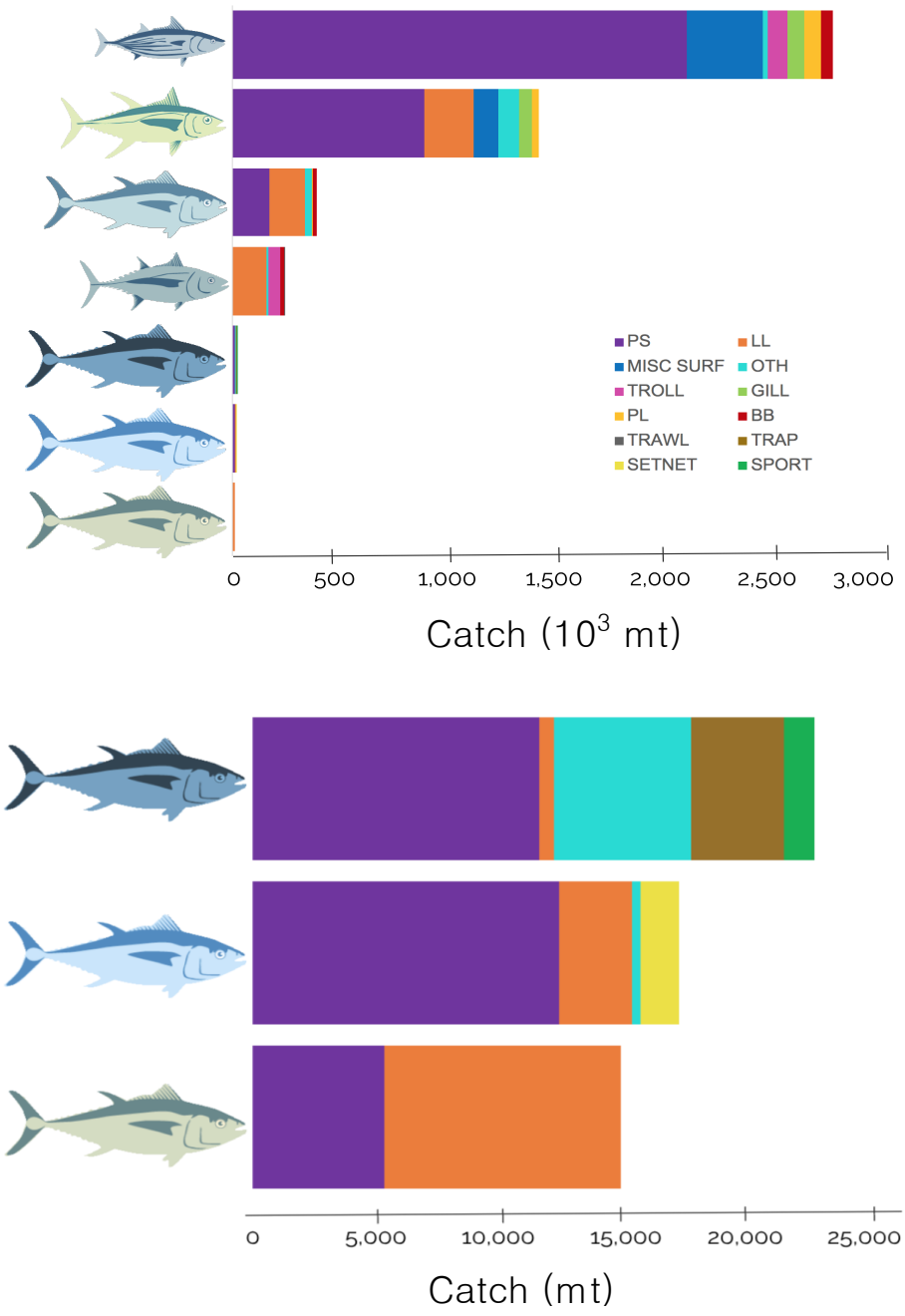

Figure 1.2 Current global catch composition (by gear) of primary tunas. Species from top: skipjack, yellowfin, bigeye, albacore, Atlantic bluefin, Pacific bluefin, southern bluefin; b) Recent catch composition (by gear) of bluefin tunas. Species from top: Atlantic, Pacific, southern. (Gears: PS = purse seine (all methods combined), LL= longline, MISC SURF= assorted small-scale surface (e.g. handline), OTH = other, TROLL = troll, GILL = small-scale surface gillnet, PL = pole-and-line, BB = bait boat, TRAWL = trawl, TRAP = trap, SETNET = Japanese coastal set net, SPORT = recreational.) Data originally from sources listed in Table S4.

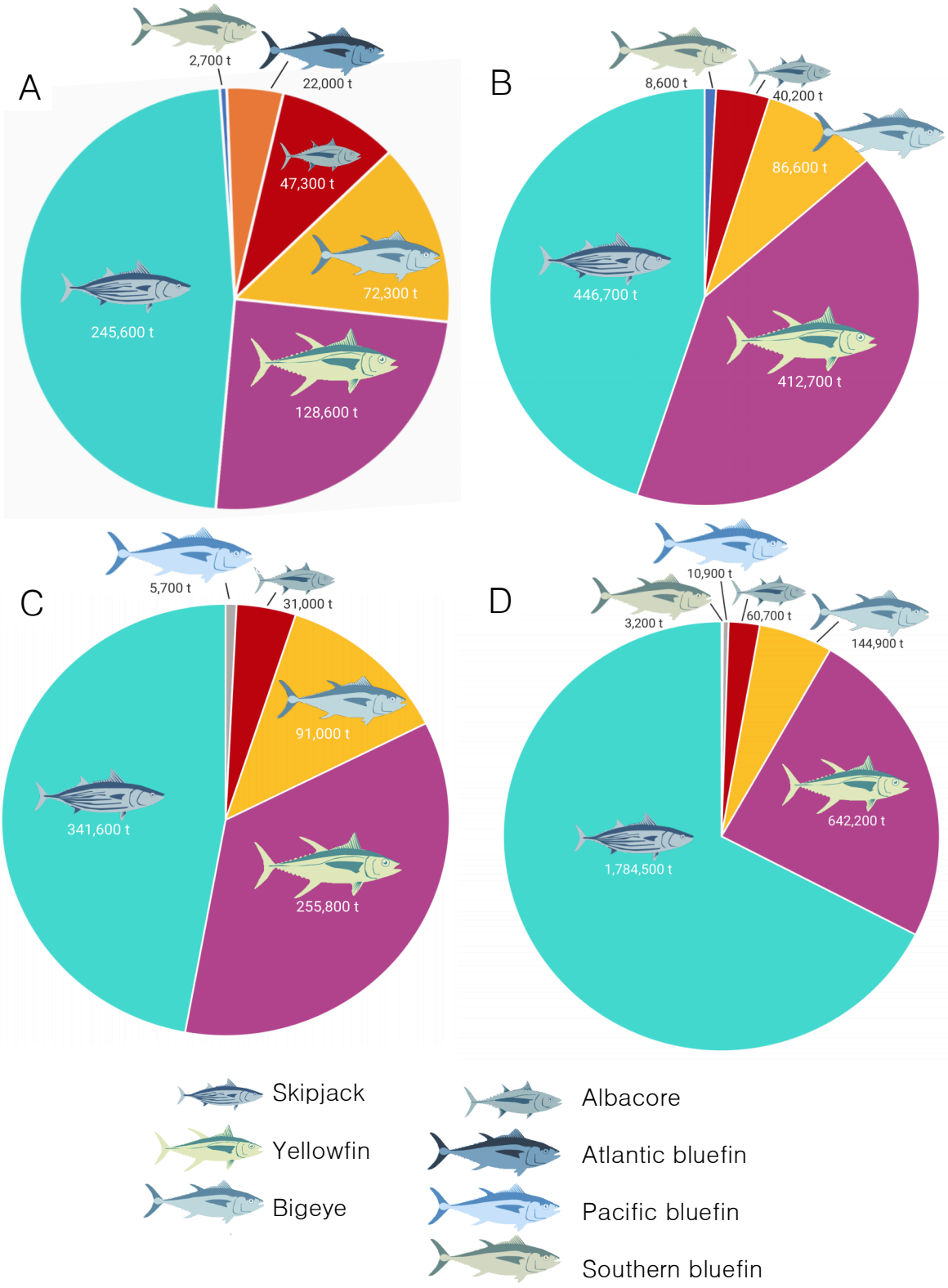

Figure 1.3 Volume (mt) of global tuna catch. Proportional breakdown of recent catch by species in each ocean: A) Atlantic; B) Indian; C) Eastern Pacific; D) Western and Central Pacific. Data originally from sources listed in Table S4.

1.3.1 Western and Central Pacific Ocean

Tuna have been a target of subsistence fishing in the Pacific Islands for centuries; the first commercial pole-and-line fleets began operating in the 1920s (Gillet 1997; Gillett and Tauati 2018). Following World War II, industrial fishing efforts intensified and landings in the early 1950s ranged from 259,000-348,000 mt·year^{-1} (WCPFC 2017).[1] The main target species were smaller tunas (skipjack and albacore) sought for canning and dried export by United States (US) and Japanese fleets based in the Pacific Islands (Gillett and Tauati 2018). Improvements in vessel technology and shipping—including the development of on-board flash freezing capabilities—combined with demands from the global market resulted in the diversification of fleets with more fishing countries, different gears, and new target species.

Today, roughly 2.7 million mt of tuna are caught annually in the Western and Central Pacific, making it the world's largest regional supplier of these fish. Skipjack is the primary target of all WCPO purse seiners and, in 2015, this species accounted for 67% of the total regional catch (Figure 1.4). Currently just over 70% of the purse seine catch comes from free school sets, 20% is from fish aggregating device (FAD) sets and the remainder is caught using natural log sets, which have been decreasing in number in recent years (Peatman *et al.* 2017). Longliners currently take 10-13% of the catch (WCPFC 2017). Despite their relative contribution to overall removals, the number of longliners in the WCPO is tenfold greater than purse seiners (i.e. 3,200 v. 300 vessels). Most longliners are either large (>250 GRT) distant water fleet (DWF) vessels with freeze capabilities that partake in trips to sea longer than a month, or small (< 150 GRT), domestically-based offshore vessels that undertake shorter trips (Williams *et al.* 2017). In 2015, the majority of the longline catch consisted of bigeye, yellowfin, and albacore (WCPFC 2017) although changes in the profitability of fishing for bigeye and yellowfin over the last decade may be impacting the relative proportions of species caught by this gear type (Kate Barclay, personal communication)[2].

[1]There is no universal definition of 'industrial fishing'. However, here it is defined as commercial fishing activity off-shore with large engine-powered vessels (> 15 m in length). This type of fishing typically includes the use of extensive technological assistance (e.g. satellite-based navigation, sonar, hydraulics, automatic rail rollers, etc.) to locate and/or catch the targeted fish.

[2]Kate Barclay (Professor, University of Technology Sydney) studies Pacific Ocean tuna fisheries in the context of different governance systems and global markets.

WCPO pole-and-line effort peaked in the mid-1970s, but has decreased substantially over the last four decades, largely due to the expansion of purse seining (Williams *et al.* 2017). Nonetheless, this type of surface fishing remains a seasonal venture for Australia, Fiji, and the US (Hawaii, Guam, American Samoa), as well as Japan, and a year-round fishery for domestic vessels from Indonesia, the Solomon Islands, and French Polynesia (WCPFC 2017). In 2015, the total pole-and-line catch was 228,000 mt—making it almost comparable to the longline catch at present. Currently, a small industrial troll fishery of six American and 137 New Zealand vessels targets albacore in New Zealand coastal waters (Williams *et al.* 2017). Although landings from this fishery were upward of 8,000 mt in the 1990s, present day catch has been reduced to 2,000 mt (WCPFC 2017).

1.3.2 Eastern Pacific Ocean

With an annual landed catch of approximately 725,000 mt in 2015, commercial tuna fishing in the Eastern Pacific contributes less to the global market than in the WCPO (Figure 1.5). Industrial purse seiners (281 active in 2018) are responsible for 82% of the EPO tuna catch and, as in the WCPO, dominance by this gear began in the 1950s when technological innovations enabled a switch from pole-and-lining. Currently, Ecuador takes 41% of the total tuna annual EPO catch—mostly yellowfin and bigeye—and Mexico has the second largest catch (18%). Other South American countries including Panama (9%), Columbia (5%), Venezuela (5%), and Nicaragua (1%) all use purse seines in the EPO, as does the US (5%). In addition to FAD and free school purse seining, catch using this gear also occurs on 'dolphin sets'. Certain dolphin species aggregate and travel with yellowfin in the eastern Pacific, a behavioural trait that has been exploited by fisheries for decades (Scott *et al.* 2012). Today, two-thirds of the EPO yellowfin purse seine catch comes from purse seines set on mixed dolphin-tuna schools, with 30% from floating object sets (including FADs) and 10% from free school sets (IATTC 2018a). As with the WCPO, the number of FAD sets in the EPO has increased dramatically: from approximately 2,000 sets in the early 1990s to roughly 14,000 in 2013 (Gershman *et al.* 2015).

Distant water fleets from Japan, Korea, Taiwan, and China have always been (and remain) the primary longlining countries in the EPO, and the main targets of these fleets is yellowfin and bigeye. As of 2018, there are 1,216 authorized industrial longliners fishing in the Eastern

Pacific (IATTC 2018b). Catches of northern and southern stocks of albacore are divided by gear type based on the hemisphere in which they are fished: in the north Pacific, about 57% of the fish are taken in pole-and-line and troll fisheries that catch smaller, younger fish, while about 95% of the albacore in the south Pacific are adults caught with longlines (IATTC 2018a).

1.3.3 Indian Ocean

The 2015 catch of Indian Ocean tuna was 935,000 mt, most of which was skipjack and yellowfin (42% and 39%, respectively; (Figure 1.6). Small-scale and artisanal gears are more prevalent in this ocean than elsewhere, accounting for about half of the total catch. Indonesia is the top fishing country and uses a combination of five main gear types to land 15% of the Indian Ocean catch. When combined with its catch in the WCPO, Indonesia is responsible for around 16% of the total global tuna catch—more than any other nation. The Maldives, which operates a domestic pole-and-line fishery for skipjack within its domestic waters, has the second highest catch (125,000 mt) of tuna in the Indian Ocean, followed closely by the Spanish distant water fleet (122,000 mt).

Industrial longlining has been ongoing in the Indian Ocean since the early 1950s, but has historically been less prevalent in the Indian than in other oceans (Allen 2010). By contrast, purse seining did not begin until the late 1970s. Today, distant water fleets from the European Union (EU), and a local fleet from the Seychelles, fish almost exclusively with purse seines. While high seas driftnets are banned globally, coastal gillnets are still commonly employed by countries fishing in the Indian Ocean; at least 3,000 vessels use this gear, making it one of the most prevalent (Ardill *et al.* 2012).

1.3.4 Atlantic Ocean

The Spanish fleet catches 20% of the 482,000 mt of tuna currently landed in the Atlantic Ocean and is followed closely by Ghana, which takes 18% (Figure 1.7). Both of these countries fish primarily with purse seines, yet about 20% of their catch is also made with bait boats (poles-and-line). A lesser known output of the Atlantic purse seine industry is the catch of *faux poisson* ('fake fish'), which are smaller or damaged tunas that would be rejected by the regular canning market because of their condition (Hall and Roman 2013). Since the 1980s these fish

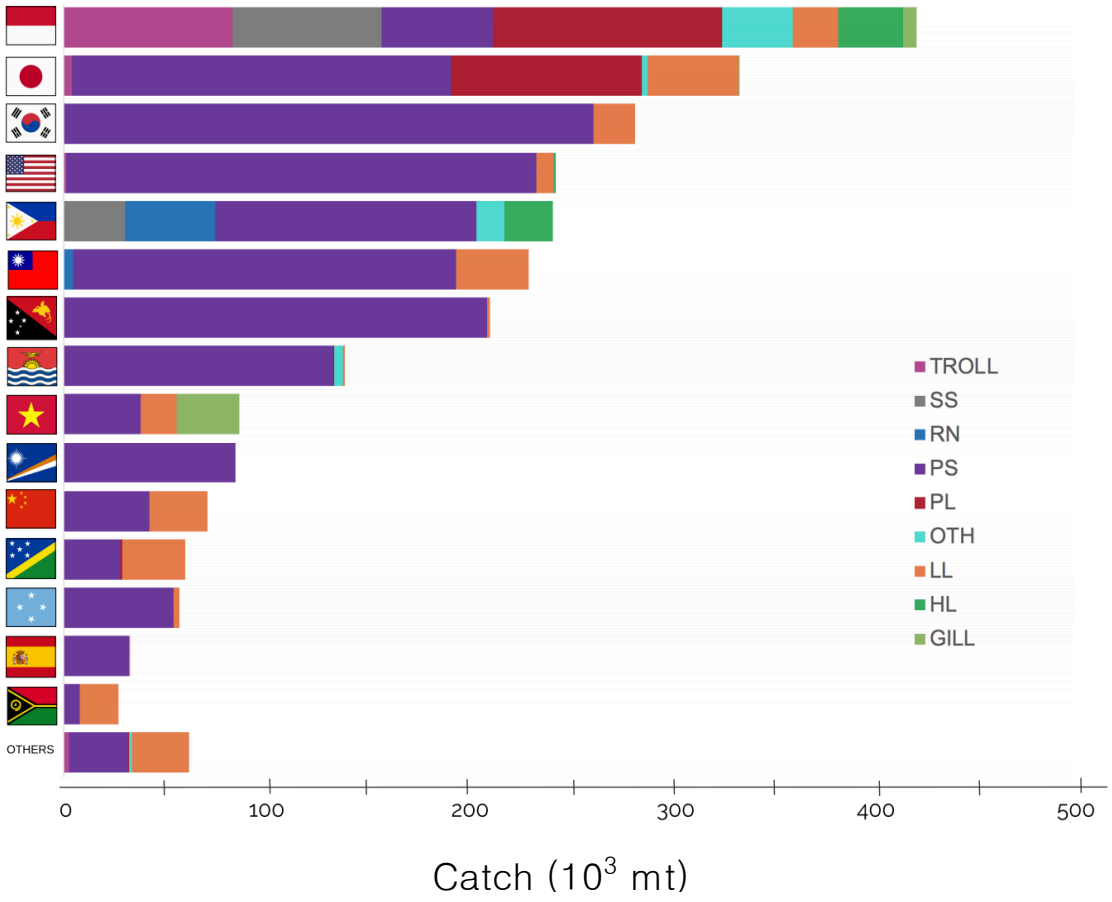

Figure 1.4 Reported catch (mt) of primary tunas by fishing country based on gear type in the western and central Pacific Ocean, 2015. Raw data downloaded from WCPFC Tuna Fishery Yearbook (2016) on 30 May 2018. (Gears: TROLL = troll, SS = miscellaneous small-scale, RN = ring net, PS = purse seine (all methods combined), PL = pole-and-line, OTH = other, LL = longline, HL = handline, GILL = gillnet.)

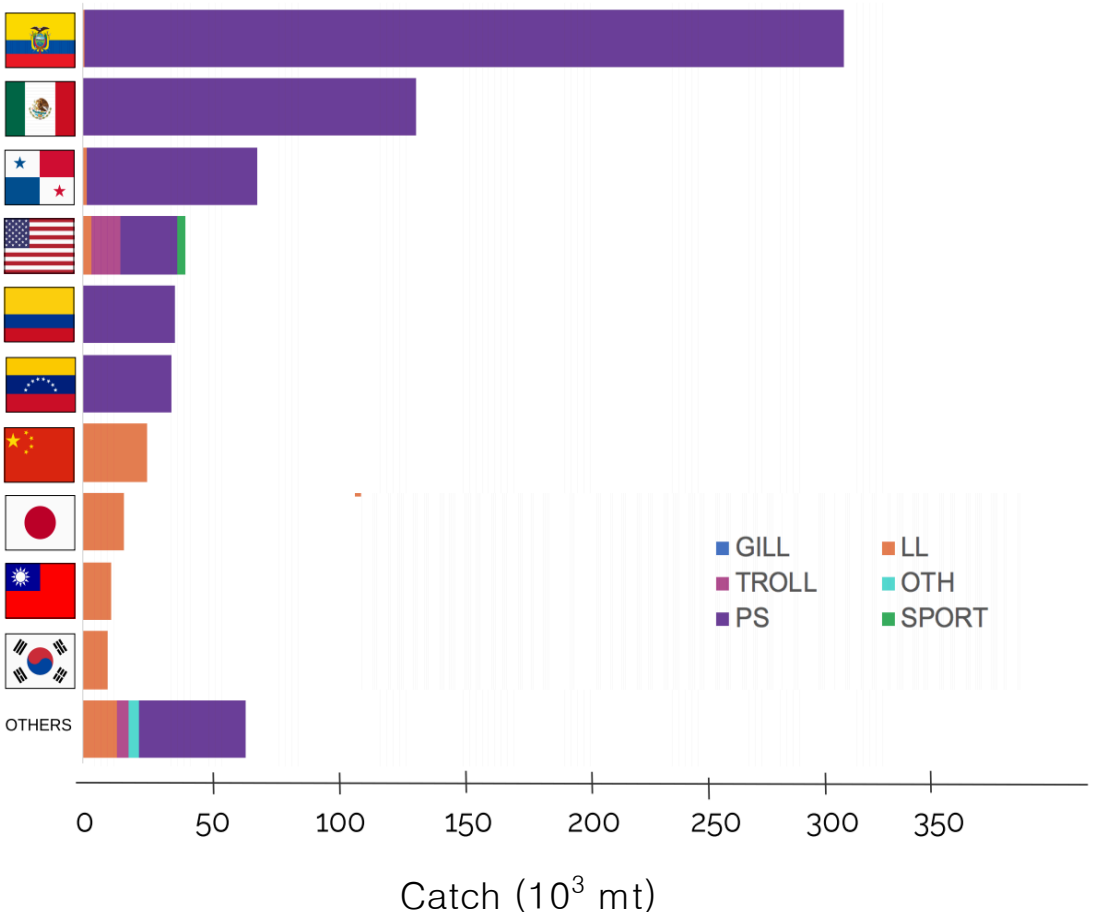

Figure 1.5 Reported catch (mt) of primary tunas by fishing country based on gear type in the eastern Pacific Ocean, 2015. Raw data downloaded from IATTC Public Domain Data on 30 May 2018 (last database update October 2017). (Gears: GILL = gillnet, TROLL = troll, PS = purse seine (all methods combined), LL = longline, OTH = other, SPORT = recreational.) Note: catch attributed to Panama is likely not reflective of the fishing activity of this country, which a common Flag of Convenience.

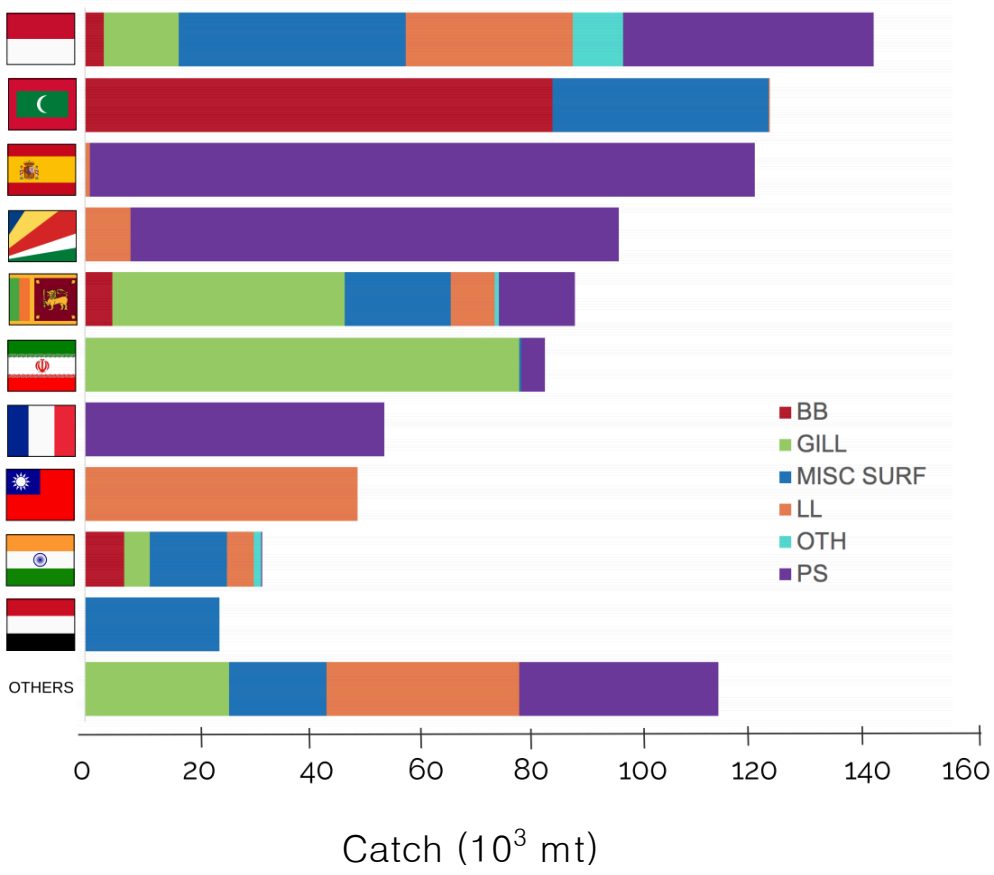

Figure 1.6 Reported catch (mt) of primary tunas by fishing country based on gear type in the Indian Ocean, 2015. Raw data downloaded from IOTC Statistical database on 30 May 2018 (last database update 30 April 2018). (Gears: BB = bait boat, GILL = gillnet, MISC SURF = other small-scale surface gears (e.g. handline, ring net), LL = longline, OTH = other, PS = purse seine (all methods combined).

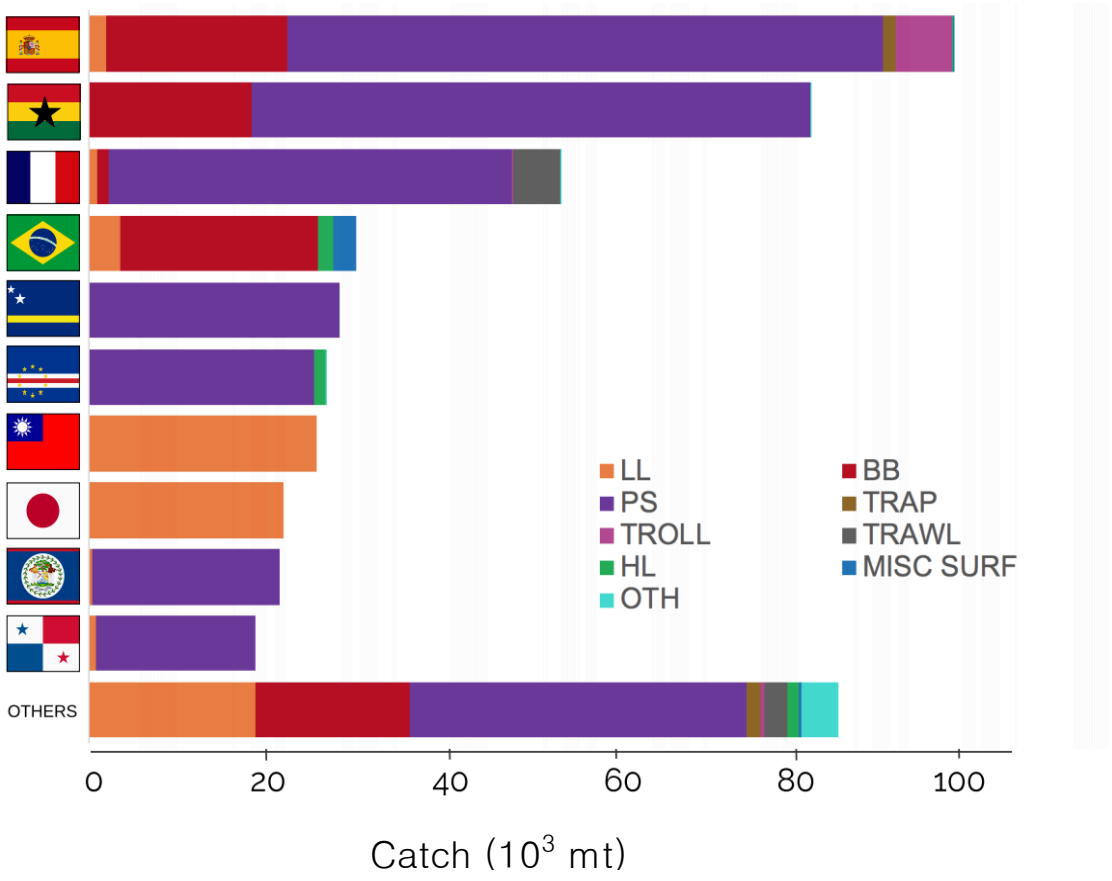

Figure 1.7 Reported catch (mt) of primary tunas by fishing country based on gear type in the Atlantic Ocean, 2015. Raw data downloaded from ICCAT Statistical Bulletin, Volume 43(II) on 30 May 2018 (v. June 2017). (Gears: LL= longline, PS = purse seine (all methods combined), TROLL = troll, HL = handline, OTH = other, BB = bait boat, TRAP = trap, TRAWL = trawl, MISC SURF = other surface gears (e.g. ring net). Note: catch attributed to Panama, Belize, and Curaçao may not be reflective of the fishing activity of those countries, which are common Flags of Convenience.

have been sold to local buyers, primarily in Côte d'Ivoire, where they play an important role in assuring local food security (Romagny *et al.* 2000). Until recently, the scale of these landings was largely unknown, yet recent estimates suggest that from 1990-2005, around 6,000 mt of target tunas (mostly skipjack) and an additional 6,000 mt of minor tuna species (i.e. frigate tunas) were sold annually as *faux poisson* by EU purse seiners (yet almost all of the smaller tuna catch was unreported) (Fonteneau and Dewals 2017). Much of the data for Ghana was also substantially under-estimated from the 1970s to the mid-2000s, yet these data have now been corrected to account for these catches (ICCAT 2017c). A similar situation (i.e. 'salt fish') gained traction in the Western Pacific in the mid 2000s (Toito'ona 2020), suggesting local market and food security connections to foreign industrial fisheries that are only now beginning to be observed in markets and adequately captured in fisheries landings databases.

While most of the fishing effort in the Atlantic is dominated by EU countries, both Guatemala and El Salvador operate sizeable purse seine fleets in the western Atlantic, landing a combined total of 22,000 mt annually. Distant water fleets from Taiwan and Japan both fish exclusively with longlines in the AO, and combined account for 10% of the total catch—most of their landings are bigeye (16,000 mt and 12,000 mt), although Taiwan also catches a notable amount of yellowfin with this gear (10,000 mt).

1.4 Ecosystem impacts of tuna fisheries

In addition to target tunas, these fleets also catch other marine animals (i.e. 'bycatch') (Figure 1.1). The volume and composition of a fishing fleet's bycatch is most directly related to the gear employed: active gears such as poles-and-line and purse seines) usually have lower bycatch rates (<5% of total catch) than passive gears such as longlines and gillnets (upward of 30-40%) (Ardill *et al.* 2012). Catch and retention rates vary by fleet and region but, for Pacific Ocean tuna fisheries, an estimated 60% of the catch of non-target finfish and sharks was discarded at sea between 1950-2010 (Schiller 2014). For distant-water vessels, which can spend months offshore, the primary aim is to maximize the value of their catch given their limited storage capacity, so these vessels have some of the highest discard rates in the industry. Small-scale tuna fisheries can be highly selective but there is a high variability in the scale of bycatch they generate even within the same gear type based on the geographic region in which they are

fishing (Gillett 2011). In the mid-2000s, small-scale and artisanal tuna fisheries had reported landings of 681,000 mt of tuna with an additional 753,000 mt of non-tuna bycatch (Gillett 2011). Still, almost all of this non-target catch caught was finfish that was likely retained for local consumption rather than discarded at sea.

By volume, sharks are the most commonly caught bycatch species in tuna fisheries. Silky sharks (*Carcharhinus falciformis*) are the most prevalent (85%) species for purse seiners (Peatman *et al.* 2017) and blue sharks (*Prionace glauca*) account for >70% of total longline bycatch (Campana *et al.* 2009; Schiller 2014). Bycatch volumes of sharks are notably different between fishing trips with and without on-board observers, and challenges in recording data at the level of species remains a key challenge—especially for species with a similar appearance, such as the threshers (Family Alopiidae). Purse seines that employ FADs have high bycatch of juvenile tunas, as well as other finfish, sharks, marine mammals and seabirds, all of which use FADs for protection and shelter (Fromentin and Fonteneau 2001; Dagorn *et al.* 2013; Fonteneau *et al.* 2013. It is estimated that FAD-purse seining has bycatch 2.8–6.7 times higher than purse seining fishing on free schools (Dagorn *et al.* 2013). As discussed above, purse seiners traditionally targeted yellowfin associating with dolphin pods; bycatch associated with this practice was as high as 500,000 dolphins·year^{-1} in the 1960s (Hall and Roman 2013). Improved fishing technique to decrease the kill-per-set rather than decreasing the number of sets, protective legislation led by the US government, and improved observer coverage combined to reduce dolphin mortality significantly (IATTC 2018a), and populations of dolphins in this region are not threatened by current levels of mortality (~250 dolphins·year^{-1}).

Turtles and seabirds are also susceptible to entanglement in longline gears (Hall and Roman 2013). In their meta-analysis of fisheries-induced sea turtle mortality, Wallace *et al.* (2010b) found records of 55,964 turtle interactions in longline fisheries (based on observer data) between 1990-2008. Globally, albatrosses (Diomedeidae) are the most threatened group of birds, and fisheries-induced mortality is the primary driver of their decline in recent decades (Croxall *et al.* 2012). Along with other pelagic birds—such as petrels (Procellariidae)—albatrosses are commonly caught as bycatch in gillnets and longlines. Given that many seabird breeding colonies are found in the southern hemisphere, bycatch of this group is highest in the southwest Atlantic and southern Indian Oceans (Croxall *et al.* 2012).

1.5 The global tuna market

Tuna have been a staple food for coastal communities in Europe, Asia, and Oceania for millennia (Gillett and Tauati 2018; Sun *et al.* 2019), with some historians suggesting that dried bluefin even sustained the Roman Legions in battle (Ellis 2008). As is reflected by the globalized nature of almost all of the world's food systems, current trade and consumption demographics of tuna have changed dramatically, even relative the start of the 20th century. Prior to the advancement of industrial refrigeration and flash freezing, fish had to be dried or canned if it was to be shipped across an ocean or continent—the distribution of fresh fish was limited to within a few hundred kilometers because of the rate of decomposition (Pitcher and Lam 2014).

Improved refrigeration capabilities combined with the onset of regular intercontinental air travel in the 1970s, enabled the transport of recently-caught bluefin from one side of the world to another in hours. Issenberg (2007) notes that tuna was prepared as sashimi in Japan as far back as the 1800s, yet only lean meat was desirable—fattier cuts were seen as low quality and were reserved for cat food. Not until the 1960s did consumer preferences in Japan start to shift toward greasier foods, a transition that was largely driven by the introduction of steak during the American occupation. Today, *toro-keru* ("melting on the tongue") is the most desirable—and most expensive—cut of tuna available.

1.5.1 Fresh and frozen tuna

Japan has historically dominated the global market for fresh and flash-frozen tuna, specifically the three bluefins and bigeye. Each January, the first tuna sale at Tsukiji Market makes international headlines, with a record US$1.7 million paid for a 222 kg fish in 2013 (Anonymous 2013).[1] This fish is always a domestically-caught Pacific bluefin, yet the price is an anomaly, driven by cultural belief of good economic fortune associated with the New Year, and—in recent years—a bidding war between two local chefs as part of a marketing scheme. Thus, it is not reflective of the normal price of these fish which, in 2017, was US$33/kg at

[1]Tsukiji was the largest fish market in the world. In 2017, 385,000 mt (US$3.9 billion) of seafood (all species) was sold there (Tokyo Metropolitan Government 2017). Tsukiji closed in 2018 and has since been replaced by Toyosu.

Tsukiji Market in Tokyo (Tokyo Metropolitan Government 2017). Changes in market demand have been influenced by economic recession in Japan combined with shifts in sushi consumption habits in the last two decades (such as increasing preferences for salmon) have resulted in supermarkets and restaurants selling upward of 80% of the country's frozen tuna, compared to the more traditional auction system (FAO 2016a, 2019). It is believed this transition is related to an increasing trend in Japan toward lower cost food, increases in imported food in their diet (Hamilton *et al.* 2011; FAO 2016a). Between 2016-2018, there was an overall decline in imported whole tuna to Japan, and a ten-year low in imported fresh/chilled products was observed in 2018 (FAO 2019). As a result of the COVID-19 pandemic, the trade of fresh tuna trade slowed worldwide due to limited restaurant demand and reduced international flights; seafood sales in Japan, including sashimi tuna, declined by roughly half as a result of these challenges (FAO 2021).

Prior to COVID-19, there was increasing demand for sushi-grade tuna in countries outside of Japan since the late 1990s, with the US and EU leading the way (Hamilton *et al.* 2011). Collectively, the US, EU, and Japan import three-quarters of the world's frozen filleted tuna but the popularity of sushi is growing in established seafood markets in South Korea and China, as well as emerging markets in Russia and Ecuador is increasing (FAO 2019). Mediterranean countries have always consumed larger species of tuna (and other large pelagics, such as swordfish) as part of their diets. However, in this part of the world (namely in Spain and Italy), bluefin and yellowfin is mostly consumed as steak, rather than sashimi (FAO 2016a).

In general, the current global nature of the world's seafood supply chains means the retail price of fish is often a poor feedback signal to consumers about the state of the source fish stock since declines in supply from individual fisheries (or regions) are often hidden as a result of substitution of the same (or similar) products from other fisheries (Crona *et al.* 2015). Product substitution also impacts fishers, as was observed in the case of bluefin tuna, where higher available volumes of previously over-exploited Atlantic bluefin were predicted to cause declines in revenue for fishers of the other two species (Sun *et al.* 2019).

1.5.2 Canned products

The majority of the global tuna catch is processed into cans or loins, and half of all products are imported by the US and EU collectively (FAO 2019). Skipjack, yellowfin, and (to a lesser extent) albacore are the main species used in these products. With the exception of albacore, which is mostly caught with longline, and some skipjack caught by pole-and-line, purse seiners from all four main ocean regions are responsible for supplying this industry with its fish (Hamilton *et al.* 2011). The origins of canned tuna date as far back as the late 1800s, when these products served as low-cost alternatives to other species, such salmon and sardines (Miyake *et al.* 2010). As industrialized fishing intensified, so did the production of canned tuna—from about 200,000 mt in the mid-1970s to over 1 million mt in by 2000 (Miyake *et al.* 2010). Historically, the US was the main producer of canned tuna but currently Thailand is by far the largest producer and exporter of these products, accounting for a quarter of the global supply (Hamilton *et al.* 2011; FAO 2016a). Ecuador and Spain are the second largest producers, with around 12% and 9%, respectively.

Since the 1990s, three tuna trading companies have supplied about half of the world's raw tuna for canning: Tri-Marine, Itochu, and FCF Fishery Co. Ltd. Tuna supply chains are highly complex with some larger companies (such as these three) engaged in operations that include fishing, processing, distributing, and marketing through specific brands. As of 2010, there were at least 144 tuna processing facilities in operation around the world producing canned tuna products as well as cooked (and re-frozen) loins. Most canned tuna is sold through supermarkets or chains (e.g. Walmart) and, depending on their size and location, retailers now source directly from processors (or large supply chain companies)—this linkage has enabled them to develop their own private labels for these products and sell them under their house brand (Havice and Campling 2017). The structure of global canned tuna trade is largely shaped by EU and US tariff regimes, with canneries in Africa, Latin America and PICTs supplying the EU market and those in Southeast Asia supplying primarily the US, followed by Japan and then the EU (Campling 2016).

In general, consumer demand for canned tuna has been linked to a wide array of factors including the availability of cheaper protein alternatives (e.g. canned chicken), concerns over food safety (e.g. mercury levels), environmental or sustainability considerations (e.g. dolphin

safe, tuna stock sustainability), personal health concerns (e.g. low fat diets), international trade barriers (i.e. tariff regimes), exchange rates, as well as overarching domestic and global economic conditions (Hamilton *et al.* 2011). Notably, while the sashimi tuna market suffered as a result of COVID-19, consumer demand for canned and processed tuna remained strong throughout the pandemic in both traditional and emerging markets, which was likely a result of less frequent travel, dining out, and general household reliance on staple non-perishable protein (FAO 2021).

1.6 Public governance frameworks for tuna

The world's fish stocks are common-pool resources, which means they are (i) subtractable (i.e. use by one actor diminishes the availability of the resource to others) and (ii) non-excludable (i.e. individuals cannot be prevented from access either legally or practically). This presents a key challenge: without excludability, non-cooperative users cannot be prohibited from accessing the resource, yet they can still diminish it. As Barkin and DeSombre (2013) clearly explain, "if most states in the world get together and agree to restrict their catches of fish to levels at which the species can be sustainably caught, the resource can still be depleted by the few actors that do not restrict their catches". Thus, without an effective governance regime to apply and enforce regulation of who uses these resources, how, and when, they will become overexploited (Ostrom 2002).

Governance is how society—and groups within it—organizes and makes decisions (IOG 2018). As Kooiman (2016) explains, "*governance* considers longer term trends and requirements with regard to natural resources, basing itself on an assessment of institutions and a discussion of the values to be attained. *Policy* deals with specific subjects in tighter time frames, whereas *management* grapples with the practical dimensions of its implementation" (emphasis added). Public governance refers to the legislation and processes imposed by governments through laws and regulations, including those made domestically and those required as part of a country's ratification with international agreements and membership to intergovernmental organizations (IGOs).

In the context of public tuna fisheries governance (Figure 1.1), fishing companies and fishers are subject to the specific operational guidelines and regulations (e.g. licensing conditions, catch restrictions, reporting protocols) imposed domestically through fishery management agencies and these are enforced through the application of each country's unique national policies and legislation. However, since tuna also migrate between different countries' national waters, tuna fishing fleets are additionally subject to abiding by the agreements made by their government through ratification of international treaties—such as those adopted by the United Nations General Assembly—as well as the specific fishery policies their country commits to through Regional Fisheries Management Organization (RFMO) meetings.

1.6.1 United Nations agreements

Dating back to the 1600s, a country's marine jurisdiction extended only three nautical miles offshore; ocean space beyond this limit was considered international waters and all countries were at liberty to enjoy the "freedom of the seas" (Encyclopedia Britannica 1998). However, increasing conflicts over access to fishing grounds in the mid-20th century led to certain nations asserting sovereign rights to territorial waters offshore to 12 nautical miles (nm), followed by all the ocean space to the continental shelf (around 200 nm from their coastline).

Negotiation to establish a uniform measure for all nation states began in Geneva in 1958 and concluded with the ratification of the United Nations *Law of the Sea* (UNCLOS) in 1982 (United Nations 1982). This legally-binding treaty came into force in 1994 and sets out 320 Articles pertaining to the use of the global ocean. In particular, UNCLOS endows all nation states with sovereignty over territorial seas up to 12 nm offshore, and an exclusive economic zone (EEZ), which extends from their territorial seas to 200 nm offshore. As defined in Article 56, all nations have a right to exploit the marine life within their EEZs—and a responsibility to conserve it. To date, UNCLOS has been ratified by 168 signatories (164 United Nations member states as well as the EU, Niue, Cook Islands, and Palestine.)

Since populations of tuna (and other highly migratory species) straddle several EEZs, as well as the high seas, the 1995 UN *Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* (Fish Stocks Agreement; UNFSA) was developed. This Agreement entered into force in 2001 and stipulates the requisite for precautionary

management of trans-boundary species through the application of the best available scientific information.[1] In obliging states with the long-term conservation of tunas, Article 6 of UNFSA stipulates the implementation of the precautionary approach including the delineation of stock-specific reference points and harvest control rules (HCRs). The precautionary approach refers to the implementation of management measures needed to protect a given resource even in instances of insufficient, uncertain, or unreliable scientific information (Wang 2011). A harvest control rule is a top-down tactical management approach that provides a clear guideline for output measures (e.g. total allowable catch) for the upcoming year(s) given the current state of the stock relative to target and limit reference points and pre-determined fishing objectives (e.g. maintain F/F_{MSY}, rebuild to $0.5SSB_0$, etc.) (Kvamsdal *et al.* 2016). Such science-based guidelines are important for ensuring long-term objectives are maintained or reached.

1.6.2 The tuna RFMOs

UNFSA was a key impetus for the proliferation of RFMOs, especially for tuna. Currently, there are five tuna RFMOs (sometimes referred to as t-RFMOs), each with jurisdiction over part or all of a primary ocean basin (Table 1.2): the Western and Central Pacific Fisheries Commission (WCPFC), the Inter-American Tropical Tuna Commission (IATTC), the Indian Ocean Tuna Commission (IOTC), the International Commission for the Conservation of Atlantic Tunas (ICCAT), and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT).

All RFMOs are multilateral agreements between member states (as well as participating territories and co-operating non-member states). Through their membership to a given RFMO, member countries are charged with meeting annually to negotiate and adopt fishing strategies and fleet controls for the mutual benefit of all fishing nations and long-term conservation of the stocks under their jurisdiction (Figure 1.8). RFMO members are almost always coastal states within a RFMO region, but distant water fishing nations are also permitted, and RFMO regulations apply to all members fishing within each RFMO area, which includes both EEZs and the high seas (unless otherwise defined).

[1]As of June 2021, UNFSA had been ratified by 91 signatories (including the USA and the EU).

Table 1.2 Tuna RFMOs and their associated member and co-operating non-member countries. (Note: Countries may be members of a RFMO even if their coast does not border the RFMO Convention Area, but they have identified a legitimate interest in fishing in that region. Asterisks (*) for some WCPFC members refer to overseas territories.)

RFMO	Mandate	Member countries	Co-operating non-members
Commission for the Conservation of Southern Bluefin Tuna (CCSBT)	CCSBT (1993): "The objective of this Convention is to ensure, through appropriate management, the conservation and optimum utilisation of southern bluefin tuna."	8: Australia, EU, Taiwan, Indonesia, Japan, New Zealand, South Korea, South Africa	1: Philippines
Indian Ocean Tuna Commission (IOTC)	IOTC (1993): "The Commission shall promote cooperation among its Members with a view to ensuring, through appropriate management, the conservation and optimum utilization of stocks covered by this Agreement and encouraging sustainable development of fisheries based on such stocks."	31: Australia, Bangladesh, China, Comoros, Eritrea, EU, France, India, Indonesia, Iran, Japan, Kenya, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Oman, Pakistan, Philippines, Seychelles, Sierra Leone, Somalia, South Korea, Sri Lanka, South Africa, Sudan, Tanzania, Thailand, UK, Yemen	2: Liberia, Senegal
Inter-American Tropical Tuna Commission (IATTC)	IATTC (2003): "Committed to ensuring the long-term conservation and the sustainable use of fish stocks covered by this Convention..."	21: Belize, Canada, China, Colombia, Costa Rica, Ecuador, El Salvador, EU, France, Guatemala, Japan, Kiribati, Mexico, Nicaragua, Panama, Peru, South Korea, Taiwan, USA, Vanuatu, Venezuela	5: Bolivia, Chile, Honduras, Indonesia, Liberia
International Commission for the Conservation of Atlantic Tunas (ICCAT)	ICCAT (2017a): "The Governments whose duly authorized representatives have subscribed hereto, considering their mutual interest in the populations of tuna and tuna-like fishes found in the Atlantic Ocean, and desiring to co-operate in maintaining the populations of these fishes at levels which will permit the maximum sustainable catch for food and other purposes, resolve to conclude a Convention for the conservation of the resources of tuna and tuna-like fishes of the Atlantic Ocean, and to that end agree as follows…"	52: Albania, Algeria, Angola, Barbados, Belize, Brazil, Canada, Cape Verde, China, Côte d'Ivoire, Curacao, Egypt, El Salvador, EU, Equatorial Guinea, France (St-Pierre et Miquelon), Gabon, Ghana, Grenada, Guatemala, Guinea-Bissau, Honduras, Iceland, Japan, Liberia, Libya, Morocco, Mauritania, Mexico, Namibia, Nicaragua, Nigeria, Norway, Panama, Philippines, Russia, São Tomé and Príncipe, Senegal, Sierra Leone, South Africa, South Korea, St Vincent and the Grenadines, Syria, Trinidad and Tobago, Tunisia, Turkey, UK, USA, Uruguay, Vanuatu, Venezuela	5: Bolivia, Taiwan, Suriname, Guyana, Costa Rica
Western and Central Pacific Fisheries Commission (WCPFC)	WCPFC (2001): "Determined to ensure the long-term conservation and sustainable use, in particular for human food consumption, of highly migratory fish stocks in the western and central Pacific Ocean for present and future generations…"	33: Australia, American Samoa*, China, Canada, Cook Islands, EU, Federated States of Micronesia, Fiji, France, French Polynesia*, Guam*, Indonesia, Japan, Kiribati, Marshall Islands, Nauru, New Caledonia*, New Zealand, Niue, Northern Mariana Islands*, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, South Korea, Taiwan, Tokelau*, Tonga, Tuvalu, USA, Vanuatu, Wallis and Futuna*	9: The Bahamas, Curacao, Ecuador, El Salvador, Liberia, Nicaragua, Panama, Thailand, Vietnam

Figure 1.8 View of delegations on the negotiation floor as seen from official observer section at the International Commission for the Conservation of Atlantic Tunas 21st Regular Session (Dubrovnik, Croatia; November 2018).

Despite their overarching mandate for collaborative management, multiple systemic and logistical challenges have affected the efficacy of management decisions adopted through tuna RFMOs over the years, and their subsequent domestic implementation by member countries. These challenges include, but are not limited to: competing fishing interests between member nations and fleets (Bailey *et al.* 2010, 2013; Squires 2013; Barkin *et al.* 2018), disproportionate capacities to implement measures between high- and low-income states (Hanich and Ota 2013; Hanich *et al.* 2015), low surveillance and monitoring of fishing activity (Gilman 2011; FAO 2012; Ewell *et al.* 2017), limited oversight to ensure member state compliance with management measures (Garcia and Koehler 2014; Adams 2016), an inability to address overcapacity in the global tuna fleet (Allen 2010; Aranda *et al.* 2012), and inequitable catch allocation frameworks (Seto *et al.* 2019; Sinan and Bailey 2020). For most tuna stocks, management measures have also traditionally lacked an overarching harvest strategy and have centered around setting reactionary catch limits or spatial and temporal effort controls for different gears based on results from regular stock assessments. By extension, most RFMOs also do poorly in the context of bycatch and ecosystem-based management (Gilman *et al.* 2012; Juan-Jorda *et al.* 2017) and RFMOs have been criticized for failing to apply the precautionary principle as set out through UNCLOS and UNFSA (WCPFC 2012; de Bruyn *et al.* 2013; ICCAT 2016b).

Bearing these weaknesses in mind, it is important to note that, while RFMOs are the organizations by which member states are provided a framework for cooperation, "it is the *members* that are obliged to apply the principles and measures [of UNFSA], not the [RFMO] *Commission*" (emphasis retained from original) (WCPFC 2012). As such, judgments of RFMO performance should be made in the context of these organizations' ability to facilitate effective collaboration and ensure members comply to adopted management measures, not on how well the RFMOs apply the measures toward ensuring the sustainability of the tuna and associated species under their jurisdictions. Furthermore, as Lodge *et al.* (2007) highlight, "the duty of members is not discharged by merely creating or joining an RFMO. Members have an obligation to respect conservation measures adopted by the RFMO concerned." To this end, under UNFSA, members remain under legal duty to cooperate, even if they fail to reach agreement on a specific management measure (e.g. the allocation of TAC).

Although RFMO processes and decisions exist external to the United Nations, all RFMO member states remain guided by the Articles of UNCLOS and UNFSA and are bound by international law to abide by them. Since 2015, the UN General Assembly has sought an additional legally-binding treaty to conserve biodiversity on the high seas (Res. 69/292). Fisheries management measures are currently excluded from these UN negotiations, yet area-based management tools and environmental impact assessments for high seas activities are included in discussions—and their scope of inclusion going forward will both influence and depend on decisions made through RFMOs (Marciniak 2017; De Santo 2018).

1.6.3 Other multilateral agreements

As highly migratory fishes, all tunas fall under the oversight of the Convention of Migratory Species of Wild Animals (CMS 1983), which positions itself as "the only global convention that aims to comprehensively address the conservation and sustainable use of terrestrial, avian and marine migratory species and their habitats across their entire migratory range" (CMS 2013). Currently, there are 126 contracting Parties signed on to the CMS, many of which are also member states in one or more of the tuna RFMOs. Though this linkage, CMS has been a regular attendee to RFMO meetings, and has imposed upon RFMO member states the duty to "act to avoid any migratory species becoming endangered, even when the species' range

includes areas beyond the limits of national jurisdiction (ABNJ)" (CMS 2013). Presently, no tuna are included on the CMS but 34 sharks and rays are listed (CMS 2018).

Similarly, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which entered into force in 1975, is a legally-binding—yet voluntary—agreement between governments. Originally drafted at a meeting of IUCN members, the goal of CITES is to ensure that the international trade of live wild plants and animals (or any associated products) does not threaten the long-term survival of their species (CITES 2018). While CITES has no power over the capture of a given species domestically, it has the capacity to tightly regulate, monitor or prohibit any export of those species outside of their point of capture or processing.

At the operational level, CITES is similar to CMS in that signatory states (i.e. Parties) can propose to list a species under one of the three CITES Appendices, which each pertains to a certain level of extinction risk and has unique rules dictating the degree to which international trade of that species is permitted. All Parties are allowed one vote, with the majority deciding whether a species is listed or not. CITES is legally-binding in so far as those states that have signed on to the Convention are required to ensure their own domestic laws enable the inclusion and enforcement of the CITES framework in the case of a transgression, but CITES itself does not have the power to supersede national laws or punish any wrong doing by its member Parties (CITES 2018). Atlantic bluefin is the only tuna that has been proposed for listing on Appendix I: in 1991 by Sweden and in 2009 by Monaco. Both of these proposals were rejected on the account that RFMOs, not CITES, were the most appropriate fora for decisions related to the management and conservation of tuna stocks (CITES 2010a; Webster 2011).

1.7 Non-state market driven governance and the sustainable seafood movement

The adoption of management measures for tuna fisheries has traditionally been the responsibility of national governments through their participation in RFMOs. Yet, over the last few decades, independent, self-regulated, market-focused policy instruments (e.g. eco-

certifications) have evolved in parallel to traditional public management systems, while remaining sufficiently detached such that states lack decision-making power in their existence, structure, and mandates (Cashore *et al.* 2003; Bernstein and Cashore 2007). As a whole, non-state market driven (NSMD) governance (here referred to as 'private' governance) seeks to ameliorate complex problems through the recognition and uptake of specific products by the general public through their purchasing power (Cashore 2002; Auld and Cashore 2013). Bernstein and Cashore (2007) define private governance systems as "deliberative and adaptive governance institutions designed to embed social and environmental norms in the global marketplace that derive authority directly from interested audiences, including those they seek to regulate, not from sovereign states." Therefore, the authority of these systems is granted at the level of the market by consumers, as well as businesses, operators, and like-minded NGOs at each stage in the supply chain (Figure 1.1). Companies and organizations involved in private governance initiatives choose to participate voluntarily for economic reasons such as market access or price premiums, moral beliefs (i.e. doing the right thing), and/or because it has become a social or environmental norm (Bailey *et al.* 2018) and such initiatives are typically viewed as going above and beyond what is required by law (CEC 2006).

1.7.1 Eco-certifications for fisheries

One common private governance initiative is eco-certification. Eco-certification was developed as a means of assuring consumers that a given product does not negatively impact the environment. Authentic eco-labels are awarded by an independent certifier or group, often a NGO, which has three main functions: develop an assessment standard; certify a given product as having met the standard, and market that product to consumers (D'Souza 2004). Furthermore, eco-labels are required to be voluntary, transparent, non-discriminatory, and they must not create unnecessary obstacles to trade (e.g. Technical Barriers to Trade under the WTO) (Sainsbury 2010). For companies that choose to seek eco-certification, the ability to brand their product with the associated eco-label is suggested as providing a competitive advantage in market access as well as price premiums relative to non-labelled products since consumers are (hypothetically) willing to pay more knowing they are doing good for the environment (Jacquet and Pauly 2007; Gutiérrez *et al.* 2012). Importantly, while eco-certification bodies develop standards and award eco-labels to company that meet those

standards, these organizations do not assess the company against the standard—this is the job of independent auditors and is usually paid for by the company seeking eco-certification.

In the case of seafood, the eco-labels associated with eco-certifications typically convey that a given seafood product comes from a sustainable fishery or aquaculture operation (Sainsbury 2010). The first eco-labelled seafood products were cans of 'Dolphin Safe' tuna developed and promoted by Earth Island Institute (EII) to designate tuna products coming from purse seine fisheries without dolphin bycatch. In response to increasing global awareness of overfishing, the ENGO World Wildlife Fund for Nature (WWF) and grocery corporation Unilever (which, at the time, was the largest purchaser of frozen fish in the world) partnered to form the Marine Stewardship Council (MSC) in 1996 (Gulbrandsen 2009; Auld 2014). The primary focus of the MSC is ecological sustainability. However, unlike seafood awareness campaigns such as 'Give Swordfish a Break' and 'Take a Pass on Chilean Sea Bass', the focus of the MSC is on fisheries, rather than species (Jacquet and Pauly 2007; Gutiérrez *et al.* 2012) and the MSC Standard is used to assess the sustainability of a specific fishing company (or group of companies, such as a fishing association or co-operative) (MSC 2014).

The first tuna fishery to be MSC-certified was the American Albacore Fishing Association (AAFA) North Pacific albacore troll fishery in 2007. However, by far the largest of the tuna fisheries covered by the MSC is the Pacifical purse seine fishery for skipjack, which was certified in 2011, and has an annual catch just under 800,000 mt. The certification was pursued as a partnership between the Parties to the Nauru Agreement (PNA) Secretariat and the Dutch company Sustunable BV, which led to the creation of the Pacifical brand (Kirby *et al.* 2014).[1] In addition to MSC-certified fisheries, the last few years have seen the emergence of fishery improvement projects (FIPs)—fisheries that would not at present meet the MSC Standard but which have aspirations of being MSC-certified in the future (Crona *et al.* 2019). FIPs are on-the-ground initiatives that directly focus on addressing sustainability challenges (e.g. data collection, high levels of bycatch) in a specific fishery. The modifications required are specific to each fishery and this work is overseen and/or financially supported by multiple stakeholders

[1]The PNA is sub-regional treaty that delineates the harmonized conditions for tuna purse seine fishing in the EEZs of the eight Pacific Island signatories (i.e. Parties): the Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands and Tuvalu (PNA 1982).

including national governments, NGOs, fishing companies, and seafood supply chain businesses (i.e. processors, suppliers, retailers).

1.7.2 Companies, commitments, and CSR

As the ubiquity of seafood eco-labels has increased, many consumers have become wary of greenwashing (Foley 2013), and research is inconclusive as to whether seafood eco-certification programs actually transform consumer behaviour and generate a price premium for eco-labelled products (Johnston *et al.* 2001; Roheim *et al.* 2011; Uchida *et al.* 2013; Jenny Sun *et al.* 2017) and whether they actually move the system closer to sustainability rather than just creating a market for things that were already sustainable (Ponte 2012). Nonetheless, the purchasing decisions of consumers may matter less than the engagement of relevant industry stakeholders, whose involvement gives these programs legitimacy and increases their uptake by other industry members (Gulbrandsen 2006; Barclay and Miller 2018).

In general, corporate social responsibility (CSR) refers to the operational ways in which companies voluntarily integrate social and environmental concerns in their business practices and in their interactions with stakeholders (EU Commission 2001). As a form of private governance, a company's CSR policies ensure (and publicly demonstrate) that sustainability practices are accounted for in business operations even if there are gaps in national or international legislation, and such policies are often made around social and environmental issues such as labour rights and the sustainable production of goods (Carroll 2009). CSR practices can include goal setting, reporting, philanthropy, public policy engagement, alignment with eco-certifications programs and, by extension, the sourcing of eco-labelled products (Packer *et al.* 2019).

Many companies have made ocean-related CSR commitments in recent years, such as airlines and marine cargo companies no longer permitting shipments of shark fins (Shea and To 2017), restaurants committing to the elimination of straws and other single-use plastics (Drumheller 2018; Anonymous 2018), and seafood producers addressing human rights abuses and unsafe working conditions on fishing vessels (Greenpeace 2017). Currently 75% of the world's top seafood corporations have some sort of CSR profile (Bailey *et al.* 2018) and, over the last decade, large retailers such as Walmart (global), Whole Foods (US), Sainsbury's (UK), Tesco

(UK), Aeon (Japan) and IKEA (global) have all made pledges to source upward of 100% of their products from MSC-certified fisheries (Auld and Cashore 2013; Swartz *et al.* 2017; MSC 2018).

Eco-certifications and, by extensions, CSR commitments have been integral to the sustainable seafood movement, which has evolved substantially over the last decade from a consumer-targeted approach (i.e. buy eco-labelled products) to one in which NGOs have been increasingly involved in pushing companies to meet CSR commitments (i.e. source and sell eco-labelled products) and helping fisheries improve on-water practices (Roheim *et al.* 2018). Tuna present a unique case to study in the context of the sustainable seafood movement as stocks are transboundary and fisheries are multi-national. As such, a tuna fishing company from one country is dependent on decisions adopted through consensus by all RFMO member countries. While on one hand this presents an additional—and substantial—obstacle that fisheries targeting domestic stocks avoid en route to eco-certification, it also suggests the potential for large-scale transformation in governance of the world's largest fisheries.

1.8 Thesis outline

This thesis consists of four research chapters, each of which is written as a stand-alone article, following the traditional natural sciences format of Introduction—Methods—Results—Discussion—Conclusions. Findings of all four research chapters are summarized in a concluding chapter at the end of the thesis, which synthesizes the findings in the context of literature on tuna fisheries management and public-private governance arrangements, and provides reflection on these topics with open research questions around the role of the private sector in the future.

Chapter 2 calculates the contributions of tuna and other high seas fisheries to global food security and reviews this information in light of recent negotiations at the United Nations to address the conservation and sustainable use of marine biological diversity on the high seas (United Nations 2015) and the importance of tuna fisheries to the international market. Specifically, I ask: which consumers benefit from high seas fisheries?

Chapter 3 takes a comprehensive look at the current biological status of tuna stocks exploited by MSC-certified fisheries and assesses how the uptake in certification for tuna fisheries has changed over time. In addition, I ask: do eco-certification requirements influence the harvest strategy decisions made by RFMO delegates and, if so, what role does the fishing industry play in advocating these management measures? To answer this, I analysed publicly available RFMO data, MSC eco-certification reports, and conducted 32 semi-structured interviews with attendees to RFMO annual meetings.

In Chapter 4, I assess the influence of industry and environmental NGOs on affecting improvements to tuna fisheries. By analyzing advocacy statements to RFMOs I ask: how have the tuna management priorities of NGOs changed over time? Further, by interviewing current RFMO stakeholders, I derive insights on how RFMO policymakers currently engage with NGO observers, and how these groups perceive their engagement as it relates to tuna fisheries reform.

Chapter 5 takes a comprehensive look at the Western and Central Pacific Fisheries Commission, the RFMO responsible for overseeing decisions for half of the global tuna catch. Here, through the lens of interactive governance theory, I analyze fourteen years of WCPFC meeting attendance documents and information obtained from interviews with meeting participants to answer: who governs international fisheries—and how?

My concluding thoughts in Chapter 6 synthesize the findings of each research chapter into a comprehensive overview that draws on literature from multiple disciplines to answer my overarching research questions and provide insights into potential future directions for research.

1.9 Statement of co-authorship

For all thesis chapters, I designed the research with my co-authors, conducted all data analyses, and wrote the majority of the manuscript. My co-authors contributed intellectual support and feedback throughout the conceptualization and writing process, and assisted with final

preparations for submission through content revision and editing. Published (open access) chapters are as follows:

Chapter 2: Schiller L, Bailey M, Jacquet J and Sala E. (2018) High seas fisheries play a negligible role in addressing global food security. *Science Advances* **4**, eaat8351

Chapter 3: Schiller L and Bailey M. (2021) Rapidly increasing eco-certification coverage transforming management of world's tuna fisheries. *Fish and Fisheries* **22**,592-604

Chapter 4: Schiller L, Auld G, Sinan H and Bailey M. 2021. Decadal changes in advocacy toward the conservation of highly migratory fishes. *Conservation Letters*, e12827

2 HIGH SEAS FISHERIES PLAY A NEGLIGIBLE ROLE IN ADDRESSING GLOBAL FOOD SECURITY

2.1 Introduction

To address high seas conservation and governance issues, the United Nations will start negotiations on a legally-binding instrument to protect biodiversity in marine waters beyond national jurisdiction (BBNJ) in September 2018 (UN 2018). Among the proposed conservation suggestions is the use of area-based management tools, in which fishing and other extractive activities could be prohibited. The prospect of closing any ocean area to fishing can raise many concerns, including negative impacts on food security. To understand potential trade-offs between conservation actions on the high seas and food security outcomes, it is necessary to assess the contribution of high seas fisheries to global food security.

The United Nations (UN) defines food security as "the condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (United Nations 2012). Currently, more than 800 million people remain affected by severe food insecurity, and recent increases in the prevalence of civil conflicts and the severity of natural disasters due to climate change have exacerbated this problem in certain parts of the world (FAO *et al.* 2017). Seafood (defined here as both marine and freshwater species) provides more than a third of the global population with 20% of their animal protein intake (FAO 2016b); many researchers and non-governmental organizations suggest it is especially important for assuring food security in less developed countries (Béné *et al.* 2007; Belton and Thilsted 2014; Teh and Pauly 2018), and in coastal Indigenous communities (Cisneros-Montemayor *et al.* 2016). Marine fish and invertebrates from both wild capture fisheries and aquaculture are predicted to be increasingly important protein sources as the global population grows to 9 billion by 2050 (Béné *et al.* 2007, 2015; Smith *et al.* 2010).

Between one-quarter and one-third of the world's seafood is caught by small-scale coastal fisheries (Chuenpagdee *et al.* 2006), which play a role in addressing food security at a local level. But fisheries are not just contained to the coasts. As inshore fish populations have been sequentially overfished and depleted, the development of industrial and technologically advanced fishing gears, storage, and processing capabilities has enabled vessels to travel farther offshore in pursuit of fish (Swartz *et al.* 2010) and industrial fishing currently occurs in more than half of the global ocean (Kroodsma *et al.* 2018). As fisheries have industrialized and markets have become globalized, those who rely most on fish for food are often marginalized through lack of capital as well as restrictions on accessing fishing grounds or purchasing fish (McClanahan *et al.* 2015). However, markets may allow the fish caught far offshore by industrialized fleets to feed those who are food insecure, and so it is often assumed that high-seas fisheries make an essential contribution to global food security (e.g. Poloczanska 2018). But is it true?

The 'high seas' are the area beyond national jurisdiction as defined by the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and represent almost two-thirds of the ocean surface. Areas of ocean adjacent to shore—i.e. the 200 nautical miles that extend from the coastline— are the exclusive economic zones (EEZs) of countries. While the pelagic environment is lower in biological productivity compared to nearshore areas, the high seas are habitat for migratory, high trophic fish species such as tuna and some sharks, and long-lived species such as orange roughy and toothfish. Thus, high seas fisheries can exert a high degree of top-down control in the open ocean at both the species and community level (Ortuño Crespo and Dunn 2017).

To assess the contribution of the high seas catch to global food security, we determined: i) the contribution of the high seas catch relative to other sectors of seafood production, ii) the main high seas fishing countries, iii) the species composition of the high seas catch, and iv) the primary importing countries and associated markets for those species. We used annual catch statistics from the Sea Around Us reconstructed fisheries database (v. 47), aquaculture and freshwater production estimates from the United Nations and Food and Agriculture Organization (FAO) (FAO 2016b), and import and export data from the FAO FishStat database (v. 3.01).

2.2 Methods

2.2.1 Study design

Two large, global datasets were used for these analyses: the Sea Around Us fisheries database (v. 47, obtained 13 December 2017) and the Food and Agriculture Organization of the United Nations (FAO) FishStat database (v. 3.01, obtained 11 January 2017). The Sea Around Us database includes reported and reconstructed marine fisheries catch over time since 1950 (for database rationale and methodology see Pauly 1998). FishStat is a global fisheries landings and trade database based on nationally reported figures since 1950 and it is the most comprehensive publicly available set of this kind. Data for aquaculture production and freshwater capture fisheries were obtained from most recent FAO State of World Fisheries and Aquaculture report (FAO 2016b). We defined 'seafood' as all fish and invertebrates consumed by humans, regardless of whether they originate in fresh or saltwater or are caught or farmed. Table 2.1 provides an overview of data sources and analyses.

2.2.2 Data analysis

We analyzed the relative contribution of the world's four primary seafood sectors: i) capture fisheries in national waters (EEZs); ii) capture fisheries in the high seas; iii) capture fisheries in freshwater; and iv) aquaculture (both marine and freshwater combined). Sea Around Us data of capture fisheries landings in EEZs and the high seas, and FAO data (37) were used for freshwater landings and aquaculture production values. To get a sense of the most recent trends, we used the period of 2009-2014.

Our second analysis determined i) the primary high seas fishing countries and ii) key species caught on the high seas. We identified the top fishing fleets (by catch volume) and the key species caught between 2002-2011 using the Sea Around Us database. This time frame was chosen as these were the most recent years with trade information in FishStat (v. 3.01; obtained 11 January 2017). Based on these data, a total of 395 different species (e.g. "bigeye tuna", "Atlantic cod") and taxonomic groups (e.g. "unidentified marine fishes", "deep sea crabs", "unidentified pelagic fishes") were caught on the high seas during this time. From this, we extracted the 243 species-specific entries for fish and invertebrates. Since the reconstructed

Table 2.1 Data sources and associated analyses.

Data source	Content	Years (analysis)
Sea Around Us (v. 47)	Annual catch data (country, species)	2009-2014 (total volume by sector); 2002-2011 (HS fishing countries & HS species catch/trade)
FAO FishStat (v. 3.01)	Annual trade data (imports/exports, country, product type)	2002-2011 (species catch/trade)
FAO The State of World Fisheries and Aquaculture (2016)	Annual production values (global total, sector)	2009-2014 (total volume by sector)

Sea Around Us data used in this analysis includes all forms of catch (including non-targeted species that are caught as bycatch), we assumed that not every one of the 243 species were targeted catch and that some would have been caught incidentally as bycatch in certain fisheries. To account for this, we refined this list into 'targeted species', by i) removing any species with an average annual catch ≤ 1,000 mt and ii) removing any species with a discard/total catch ≥ 10%. From these filters, 39 species remained for the subsequent analysis of trade. As the Sea Around Us data also include estimates of capture fisheries catch within EEZs, these values were used to compute the proportion of a species' total catch that is from the high seas.

Our third analysis used the FishStat database to determine the primary importing and exporting nations of the high seas species identified in the preceding analysis. Here, we defined 'primary' importers as those nations with the highest percentage (by volume) of a given species as an imported product. 'Secondary' importers are those with the second highest. Unless otherwise specified import statistics for fresh and frozen, unprocessed product forms (i.e. 'salted', 'dried', 'processed', 'prepared' products were not included) for each species were obtained from this database. We also identified which high seas fishing countries had exports of the high seas species identified in the preceding analysis. Trade data was not disaggregated between EEZs and the high seas. Therefore, it was not possible to determine what proportion of a traded species or product was originally caught on the high seas. For the purpose of this study, the assumption was no difference in the importers of EEZ or high seas products of a

given species and the data presented represent imports of the total reported catch for those species. This assumption was made on the premise that the international seafood market predominantly differentiates products based on flag state (i.e. fishing country) rather than the geographic location of the catch.

2.3 Results

2.3.1 High seas catch by volume

Between 2009-2014, the total landed catch on the high seas was an average of 4.32 million tonnes (mt) annually. This volume represents 4.2% of the annual marine catch (102 million mt), and 2.4% of all seafood production, including freshwater fisheries and aquaculture (178 million mt) (Figure 2.1).

2.3.2 High seas catch by species

Thirty-nine fish and invertebrate species accounted for 99.5% of the high seas catch identifiable to the species level during the time period sampled (Table 2.2). Only one of those

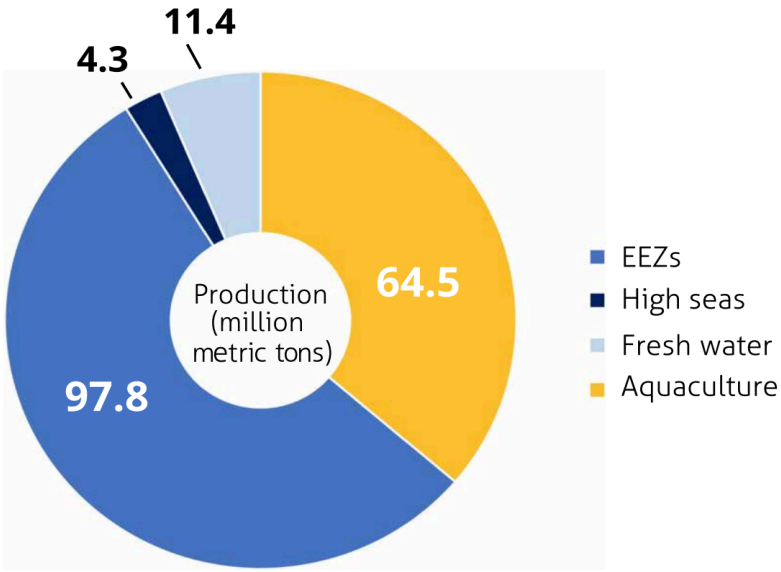

Figure 2.1 Average contribution (million mt) of seafood-producing sectors, 2009-2014. The high seas catch represents 2.4% of total global production. Data: FAO and Sea Around Us.

species, Antarctic toothfish, was caught exclusively on the high seas (3,700 mt annually) and represented 0.11% of the total high seas catch. The remaining species are 'straddling' and/or highly migratory species (i.e. caught both on the high seas and within EEZs). The top three species caught on the high seas were all tunas: skipjack (967,000 mt annually), yellowfin (563,000 mt annually) and bigeye (336,000 mt annually). The tunas (these species plus albacore and the three bluefins) collectively accounted for 61% of the total high seas catch by volume. Other main species groups were non-tuna pelagic fishes (26%), pelagic squids (7%), billfishes (3%), demersal fishes and invertebrates (2%), and krill (1%) (Table 2.2).

2.3.3 High seas catch by producers and consumers

Ten fishing countries were responsible for 72% of the total high seas catch between 2002-2011 (Table 2.3). China and Taiwan alone accounted for one-third of the world's total high seas catch, while Chile and Indonesia had the third and fourth largest catches, followed by Spain. Despite having the largest high seas catch by volume, fish from the high seas account for only 5% of China's total domestic catch. Catch from the high seas contributed to ≤ 6% of the total national catch for half of the top ten fleets: China, Japan, India, Indonesia and the Philippines; only for Ecuador and Taiwan did high seas catches account for more than one-third of their domestic landings (Table 2.3).

Current traceability standards do not allow disaggregation of imported seafood into spatial jurisdictions (i.e. caught on the high seas versus in an EEZ). However, imports of species caught on the high seas are available, and Japan was the top importer of all three globally traded bluefins (93% for southern, 58% for Atlantic and Pacific), as well as bigeye (75%), and the secondary importer of yellowfin (20%) and both toothfishes (22%). Thailand was the top importer of skipjack (63%), yellowfin (21%), and albacore (30%) and Spain was the secondary importer of albacore (19%). The United States (US) imported the majority of both toothfishes (48%) and all of the krill, and was the secondary importer of southern bluefin (2%). With the exception of South Korea importing almost all of the globally exported chub mackerel and Pacific saury, all other primary importers of species caught on the high seas were from the European Union (EU) (i.e. Denmark, France, Italy, Spain, and the Netherlands). Further details of these trade flows – and additional trade of affiliated processed products – are available in Figure 2.2, Table S1, and Table S2 and are discussed below.

Table 2.2 Species caught on the high seas (HS), 2002-2011. Data: Sea Around Us.

Species	Family	Average annual HS catch (10^3 mt)	Proportion of total catch from HS (%)
Skipjack tuna	Scombridae	966.6	35
Yellowfin tuna	Scombridae	562.5	34
Bigeye tuna	Scombridae	335.7	64
Chilean jack mackerel	Caranginidae	307	22
Argentine shortfin squid	Ommastrephidae	149.5	25
Blue whiting	Gadidae	130.8	10
Chub mackerel	Scombridae	113.1	10
Albacore tuna	Scombridae	104.5	42
Japanese anchovy	Engraulidae	96.6	6
Jumbo flying squid	Ommastrephidae	83.8	7
Pacific saury	Scomberesocidae	81.7	9
Swordfish	Xipiidae	64.7	52
Antarctic krill	Euphausiidae	37.4	24
Japanese jack mackerel	Caranginidae	28.9	9
Northern prawn	Pandalidae	27.8	8
Flathead grey mullet	Mugilidae	23.3	13
Frigate tuna	Scombridae	17.1	7
Narrowbarred Spanish mackerel	Scombridae	14.6	3
Atlantic cod	Gadidae	11.3	1
Southern bluefin tuna	Scombridae	11.1	48
Kawakawa	Scombridae	10.6	4
Greenland halibut	Pleuronectidae	7.6	7
Shortfin mako shark	Lamnidae	7.6	18
Striped marlin	Istiophoridae	6.5	53
Pacific bluefin tuna	Scombridae	5.3	21
Patagonian toothfish	Nototheniidae	4.8	17
European anchovy	Engraulidae	4.5	0
Black marlin	Istiophoridae	4	24
Indo-Pacific sailfish	Istiophoridae	4	11
Antarctic toothfish	Nototheniidae	3.7	100
Wellington flying squid	Ommastrephidae	3	39
Patagonian grenadier	Merlucciidae	2.4	1
Indo-Pacific king mackerel	Scombridae	2.1	1
Atlantic bluefin tuna	Scombridae	2	5
Silver seabream	Sparidae	2	7
Blue marlin	Istiophoridae	1.4	27
Atlantic sailfish	Istiophoridae	1.3	24
Roundnose grenadier	Macrouridae	1.2	17
Bullet tuna	Scombridae	1.1	5

Table 2.3 **Top high seas (HS) fishing fleets based on retained catch volume, 2002-2011.** Y, yes; N, no; N/A, not applicable; data: Sea Around Us, FishStat (see Table 2.1).

Fishing country	Average annual HS catch (10^3 t)	Contribution to global HS catch (%)	HS fleet contribution to total domestic catch (%)	Prevalence of severe food insecurity (% of population)[1]	Primary or secondary exporter of HS species?	HS species exported
China	714	17.0	5.3	< 0.5 ±0.07	N	N/A
Taiwan	503	12.0	42.7	0.8 ±0.62	Y	Skipjack, albacore, southern bluefin, bigeye, yellowfin, Pacific saury, marlins, swordfish
Chile	340	8.1	7.4	3.7 ±1.22	Y	Patagonian and Antarctic toothfish, jack mackerels
Indonesia	277	6.6	5.8	3.3 ±1.86	Y	Frigate tunas, kawakawa, Spanish mackerel
Spain	260	6.2	17.9	1.5 ±1.12	Y	Pacific and Atlantic bluefin, swordfish
South Korea	254	6.1	11.9	0.9 ±0.82	Y	Chub mackerel, skipjack, bigeye, squids, seabream
Japan	231	5.5	5.1	0.6 ±0.57	Y	Albacore, Pacific saury
Ecuador	185	4.4	32.3	8.7 ±2.50	N	N/A
India	128	3.0	3.6	12.4 ±2.43	Y	Spanish and king mackerel
Philippines	119	2.8	5.3	12.0 ±2.11	N	N/A
Total	**3,011**	**71.7**	**-**		**-**	

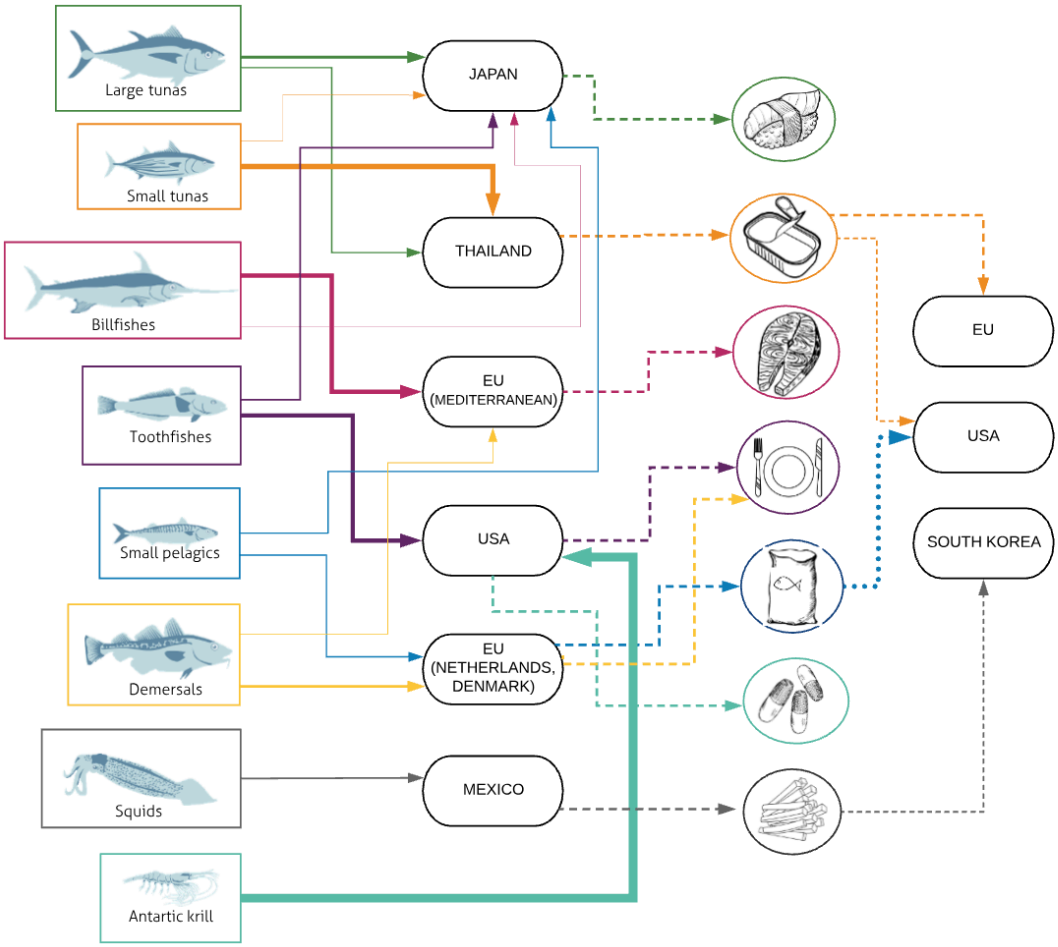

Figure 2.2 Imports of species caught on the high seas. Solid arrow width proportional to destination's share of total global imports for each species group (fresh, frozen, unprocessed form), and dashed arrows indicate likely form of consumption in primary importing country or, if applicable, processed product produced. Primary and secondary importers of processed products indicated by weighted dashed lines based on market share of imports (based on information in the literature). Data: FishStat (see Table S1and Table S2 for details).

2.4 Discussion

2.4.1 High seas fish catch and global food security

High seas fisheries contribute an estimated 4.3 million mt (2.4%) to the global seafood supply. In 2014, these fisheries were valued $7.6 billion, yet they are enabled by an estimated $4.2 billion in annual government subsidies (Sala *et al.* 2018). We found that only one species, the Antarctic toothfish, is caught on the high seas and nowhere else; the remaining species are also caught in EEZs.

Antarctic toothfish, along with its close relative, Patagonian toothfish, is usually consumed under the pseudonym 'Chilean sea bass'. Our results indicated that citizens in the US are the main consumers of these fish, which is consistent with other work that found that the US imported roughly 70,000 mt of toothfish between 2007-2012 (four times as much as the secondary importer, Japan) (Grilly *et al.* 2015). Some toothfish are certified by the Marine Stewardship Council (MSC) eco-certification program, which notes that "this fish's fine quality meat means it is considered to be luxury seafood" (MSC 2017). A 5 lb (2.3 kg) frozen portion currently retails through New York City's Fulton Fish Market website for $170 (Fulton Fish Market 2018)—an equivalent portion of fresh chicken costs $7.35.

The remaining species caught on the high seas are also caught within national waters. Japan catches Pacific bluefin tuna within its EEZ and on the high seas, and imports the majority of all three bluefin species caught by other countries (fish that were recently selling for $33/kg at Tokyo's Tsukiji Market (Tokyo Metropolitan Government 2017)). Japan is also the primary importer of bigeye tuna, which is used as an alternative to bluefin in sashimi (the fresh/frozen tuna market). Similar to the large tunas, the billfishes have relatively fatty and oily flesh and are usually sold as steaks. Italy is the world's top importer of billfish species, followed by Spain and Japan. From March 2017-2018, the average price for frozen swordfish at the Mercamadrid fish market in Madrid, Spain was $11/kg, while fresh swordfish fetched nearly triple at $31/kg (Mercamadrid 2018).

Dwarfing the fresh/frozen market, however, is canned tuna. Two-thirds of all tuna caught globally is canned; almost all of this is skipjack, although yellowfin and albacore also contribute

to this supply (Hamilton *et al.* 2011). As our analysis showed, Thailand is the main importer of these species, which is unsurprising given Thailand processes many types of seafood and is the top global exporter of canned tuna, supplying about one-quarter of all products to the market (Hamilton *et al.* 2011; FAO 2016a). Canned tuna is the least expensive form of tuna available and is heavily consumed in the EU and North America (30% and 19% respectively), while African and eastern European nations consume the least (3% and 1.6%) (Hamilton *et al.* 2011). Egypt, Australia, Japan, and Canada are the top importers after the EU and the US, but current micro-trends in the global tuna market suggest stagnation or decline in the import of canned tuna in all places, except the EU, where imports by five of the top six canned tuna consuming countries (i.e. Spain, Italy, France, UK, Germany and the Netherlands) increased in 2017 (FAO 2018).

Although canned tuna is not considered a staple item in food insecure countries, its price is comparable to other animal proteins (i.e. canned tuna and canned chicken both retail for as little as $1.50 per 5 oz tin online through Walmart), which suggests it probably does help meet the nutritional and caloric needs of some low-income households in countries where it is sold. Nearly two-thirds of the world's tuna is caught in the Western and Central Pacific Ocean, where fishing predominately occurs in the EEZs of Pacific Island countries (Seto and Hanich 2018). In this region, skipjack stocks are currently believed to be at a healthy level of abundance and the catch is considered sustainable (ISSF 2018b); yet, climate change is predicted to shift the distribution of this species (Bell *et al.* 2013; Lehodey *et al.* 2013). Furthermore, there are uncertainties around yellowfin stock structure in this ocean (Grewe *et al.* 2015). With these uncertainties in mind, ensuring the long-term health of these stocks through effective management is of paramount importance, not only because of the amount of seafood they provide but because EEZ-caught tuna plays a vital role in assuring the economic and nutritional wellbeing of Small Island Developing States (SIDS) in the Pacific Ocean (Bell *et al.* 2015b).

Not all species caught on the high seas are destined for direct human consumption. Chilean jack mackerel, blue whiting, and anchovies are common targets of directed 'reduction fisheries' (i.e. used for fishmeal)—of which almost all is used in aquaculture. About 70% of all farmed fish species require fish-based feed (Cashion *et al.* 2017b), although reduction species are also

used in the production of feeds for terrestrial livestock and domestic pets, as well as fish oils and nutritional supplements. Trade data pointed to the Netherlands as the primary global importer of blue whiting, jack, and horse mackerels, yet much of this fish is re-exported to nearby Norway (Dutch Fish 2017), where these forage fishes become inputs into the world's largest salmon aquaculture industry (approximately 1.2 million mt annually) (Ytrestøyl *et al.* 2015). Chile is the world's second largest producer of farmed Atlantic salmon (FAO 2018), and a top producer of fishmeal for aquaculture (Cashion *et al.* 2017a). Most of the fish caught by Chile are likely retained domestically for the fishmeal industry. In 2017, the US imported 24% of the fresh and frozen Atlantic salmon fillets produced by Norway (Japan and France were secondary and tertiary markets with 10% and 8%, respectively) and 30% of the fresh and frozen fillets produced by Chile (followed by Brazil and Japan, 17% and 16% each) (FAO 2018). Advances in feeds, including more plant-based proteins, may eventually reduce the reliance on fishmeal for livestock and aquaculture (Pelletier *et al.* 2018).

Norway operates the biggest fishery for Antarctic krill in the Southern Ocean (Nicol and Foster 2016). The primary destination of these invertebrates has typically been the fishmeal industry, but due to the high fatty acids in krill oil, the last decade has seen an increase in the krill supplements marketed as 'essential oils' that improve brain function (Kwantes and Grundmann 2014). Globally, there are three main manufacturers of krill oil products: Neptune (Canada), Aker Biomarine (Norway), and Enzymotec (Israel). Krill supplements are not food but "nutraceuticals" and are another product sold in developed countries (Urch 2016) and a one-month supply retails online for $20-40 in the US.

2.4.2 Additional high seas fisheries

The results presented have focused solely on catches and seafood reported in global catch and trade databases. However, some fish catches and discards may be illegal, unregulated, and/or unreported (IUU), such as documented cases in previous decades of undocumented toothfish as well as southern bluefin (Agnew 2000; Polacheck 2012). Sharks were not considered target species in this analysis (see Methods) and they are routinely discarded at sea to make space for higher value species often after removing their fins. While shark meat is of low commercial value, shark fins are one of the world's most expensive animal products, but are consumed for status, not for calories (Clarke *et al.* 2007). Spain, Taiwan, Indonesia, the United Arab Emirates,

Singapore and Japan are the biggest producers while Hong Kong has traditionally been the world's primary importer and, along with the Chinese market, the largest consumer (Shea and To 2017). After a series of conservation measures, a recent review suggested Hong Kong's imports of shark products declined by 50% since 2007, although loopholes in trade legislation and under-reported exports have potentially allowed the shark fin trade to continue (Clarke *et al.* 2012).

2.4.3 Heterogeneity of consumption within countries, indirect contributions to food security, and food waste

Most of the top countries fishing on the high seas are food secure (95% or more of their citizens are considered food secure), with the exception of Ecuador, India and the Philippines (Table 2.3). In addition, the top importers of high seas related species (in no particular order): Netherlands, USA, Japan, Spain, France, Denmark and Thailand (see Table S2) all have a low prevalence of severe food insecurity at the national level (i.e. less than 2% of the population) (Cafiero *et al.* 2016). However, data are not available to analyze the role of seafood at the household-level. Even within a food secure country, access to food is not uniform and many people may struggle to meet their caloric and nutritional needs. For example, the US is one of the top importers of multiple species in this analysis, and the second most food secure country in the world by some metrics (e.g. https://foodsecurityindex.eiu.com/Index). Yet, more than three million Americans (1.2% of the population) are severely food insecure because they cannot access food that meets their nutritional and caloric requirements and/or food preferences (Cafiero *et al.* 2016). Thus, although products derived from species caught on the high seas may be on the market, the prices of these products suggest they are not financially accessible to these Americans, in the same way that bluefin tuna is likely not accessible to the 612,000 people in Japan (0.5% of the population) considered severely food insecure (Cafiero *et al.* 2016).

There is also the notion that the high seas contribution to food security may be indirect— that sales of a relatively small quantity of high value seafood by developing countries can generate revenue to allow those countries to import lower value seafood to alleviate national food insecurity (Asche *et al.* 2015) or purchase replacement foods (Garcia and Rosenberg 2010). While we do not have the data to support or refute the notion of 'trickle down' food security,

we know that the countries catching the majority of fish on the high seas are not considered food insecure (Table 2.3), although the relatively few people doing the actual fishing on high seas fishing vessels very well might be (ILO 2013).

Lastly, the exports of high seas related species for trade revenue may have unanticipated consequences. Evidence from Pacific Island countries, which caught tuna in nearshore waters for local consumption for centuries (Bell *et al.* 2009; Gillett and Tauati 2018), shows that as tuna has become a primary export commodity (Gillett and Tauati 2018), there has been a decline in the consumption of local plants and fish in favour of less nutritious imported foods (e.g. canned meat and fish, cereal, instant noodles, and soda); these nations now have some of the highest rates of obesity in the world (Charlton *et al.* 2016). Recent local initiatives are focused on improving access to tuna for direct consumption, not only ensuring its continued supply for export (Bell *et al.* 2015a). The global problem of food insecurity is more a problem of food availability given that one-third of all food produced globally is lost or wasted, including seafood (FAO 2011). Putting this in perspective, retaining less than one-fifth of the seafood currently wasted as discards, in post-harvest handling, or in poor supply chain practices would be the equivalent of the high seas catch.

2.5 Conclusions

The discussion of access to the high seas will inevitably lead to concerns about how closing areas to fishing could impact global food security. Here we show that only one species of toothfish is caught exclusively on the high seas, that the high seas catch contributes less than 3% to the global seafood supply, and the vast majority of the marine life caught on the high seas is destined for upscale markets in food secure countries. Based on the available data, high seas fisheries do not make a direct or crucial contribution to global food security.

3 RAPIDLY INCREASING ECO-CERTIFICATION COVERAGE TRANSFORMING MANAGEMENT OF WORLD'S TUNA FISHERIES

3.1 Introduction

Transparent science-based policies are critical for sustainable fisheries management. With respect to tuna fisheries, the most recent State of World Fisheries and Aquaculture Report states that, "effective management including the implementation of harvest control rules, is needed to restore overfished stocks and to maintain others at sustainable levels" (FAO 2020b). Recent evidence from the FAO ABNJ Tuna Project further suggests that, since 2014, the number of major tuna stocks fished sustainably has nearly doubled from 10 to 18 (FAO 2020a). In this paper, we seek to better understand the mechanism behind this recent shift in management effectiveness. Specifically, we analyse how private eco-certifications can and have been used as a pressure point by private actors (e.g. fishing companies) and governments to catalyze international fisheries management bodies to implement harvest strategies for tuna.

Generally, private governance refers to situations where non-governmental actors (e.g. businesses, environmental or industry organizations, multinational corporations) define norms, rules or standards that other like-minded actors adopt (Green 2014). Such arrangements often emerge when government authority is diminished, lagging or lacking (Cashore *et al.* 2004; Berliner and Prakash 2013), and private governance schemes can be applied to certain environmental problems since companies can rapidly adapt their practices in response to incentives, independent of national legislation (Österblom *et al.* 2015). Companies that participate in such private (or 'market-based') programs do so voluntary and often as a means of enhancing brand reputation (Potoski and Prakash 2005; Thorlakson 2018; Thorlakson *et al.* 2018b), gaining a price advantage over competitors (Roheim *et al.* 2011), or addressing demands of import markets or other supply chain members (Thorlakson *et al.* 2018a). In response to growing public awareness concerning the over-exploitation of fish populations (or fish 'stocks') globally, many fishing companies, suppliers, and retailers have committed to marine resource conservation measures (GTA 2019; Packer *et al.* 2019). In part,

these assurances are tied to selling eco-certified seafood products as a means of showing customers that their purchase is 'sustainable' and is not derived from a fishery that negatively impacts the marine environment (Sainsbury 2010).

The largest seafood eco-certification organization is the Marine Stewardship Council (MSC), which, since 1997, has provided a third-party standard against which fisheries can be assessed. The MSC Standard includes three attributes: target stock health (Principle 1), impacts on the ecosystem (Principle 2), and management effectiveness (Principle 3)(MSC 2014). Assuming a fishery (or unit thereof) meets the numerical benchmarks associated with these criteria, it becomes certified and can promote its products through the use of the MSC eco-label, which visibly differentiates them from non-certified fisheries in the marketplace. As of their 2019 Annual Report, 361 fisheries (15% of the total marine catch) had obtained MSC-certification and the program has set a goal of having 30% of the global capture fisheries catch certified (or in the process of certification) by 2030 (MSC 2019b). In addition, some fisheries have entered into Fishery Improvement Projects (FIPs). Although not officially associated with the MSC, FIPs are public-private partnerships that are promoted as time-bound initiatives whereby a fishery seeks to improve in certain key areas (e.g. bycatch mitigation, refined catch documentation) (Bush *et al.* 2013). FIPs may be classified as 'Basic' or 'Comprehensive', with the explicit goal of the latter "to achieve a level of performance consistent with an unconditional pass of the [MSC] Fisheries Standard" (FisheryProgress 2020). While theoretically the MSC Standard can be used to evaluate any commercial fishery, it presents a unique challenge for those fishing companies targeting tuna given the migratory nature of these fish and the corresponding necessity for transboundary governance.

Twenty-three stocks of nine highly valuable commercial tuna species (*Thunnus* spp. and *Katsuwonus pelamis,* Scombridae) are distributed globally and straddle multiple national jurisdictions (Exclusive Economic Zones; EEZs) as well as international waters (the high seas). Targeting these fish are hundreds of fleets from over 80 countries, which collectively catch five million mt valued at US$ 40 billion annually (McKinney *et al.* 2020). Due to their trans-oceanic ranges and the geographic distribution of the countries fishing them, tuna cannot be managed domestically. To address this challenge, the 1995 UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks

(a.k.a. 'the Fish Stocks Agreement') formalized the role of multilateral Regional Fisheries Management Organizations (RFMOs). These intergovernmental bodies provide a framework for countries with an interest in fishing for tuna and other transboundary species to convene and develop conservation and management measures (CMMs, or equivalent). Their mandate is to ensure that all stocks under their jurisdiction are well-managed and the collective fishing effort and catch incurred by all fleets is sustainable.

Developing, negotiating, and adopting fishing regulations is the responsibility of RFMO member country government delegates at annual meetings, not RFMO secretariats or scientific advisors (Lodge *et al.* 2007). Each tuna RFMO includes several member countries (over 50 in the case of the International Commission for the Conservation of Atlantic Tunas; ICCAT) and all of these countries have unique incentives and influences for supporting or opposing different international regulations. The efficiency and efficacy of RFMOs is often limited by a consensus-based decision making framework (Adams 2016; ICCAT 2016b), inequality between high- and low-income member countries (Hanich *et al.* 2015), and poor allocation practices (Bailey *et al.* 2013). Thus, RFMOs have been criticized for their inability to meet the defined objectives of sustainable fishing and ecosystem-based management (Cullis-Suzuki and Pauly 2010; Gilman *et al.* 2012; Juan-Jorda *et al.* 2017; Pew 2019).

The Fish Stocks Agreement also stipulates the requisite for precautionary management through the application of the best available scientific information, including the delineation of stock-specific target and limit reference points and harvest control rules. Indicators of stock status often use Maximum Sustainable Yield (MSY) as a reference point and values typically calculated for tunas are (i) current spawning stock biomass (SSB), where $SSB/SSB_{MSY} < 1$ indicates an overfished population; (ii) current fishing mortality (F), where $F/F_{MSY} > 1$ indicates overfishing is occurring; and (iii) SSB/SSB_0, which conveys the current biomass of the stock relative to biomass at carrying capacity. A harvest control rule provides a pre-agreed specific management response (e.g. adjust annual catch) based on current abundance and fishing pressure relative to the reference points (e.g. $F=F_{MSY}$, rebuild to 25% SSB_0.) (Kvamsdal *et al.* 2016). These indicators are important for ensuring long-term management objectives are met and they provide RFMO delegates with clear parameters on how to respond independent

of political and socio-economic pressures. For the purpose of this paper, we refer to harvest control rules and their associated reference points collectively as a "harvest strategy".

In addition to their innate value as fishery management tools, harvest strategies are also included in the MSC Standard. Independent auditors use the MSC Standard on a case-by-case basis to evaluate specific fisheries (Units of Assessment) wishing to become eco-certified; as such a single tuna stock could have multiple MSC-certified fisheries (Units of Certification). Despite the aforementioned challenges, the structure and function of all five tuna RFMOs is sufficiently effective for tuna fisheries to receive a 'full pass' score for international fishery management under Principle 3 (Medley *et al.* 2020). Although privately-owned fishing companies have autonomy in addressing certain elements of their operations without direct government influence (e.g. gear modifications) since harvest strategies apply to an entire tuna stock, they can only be adopted through consensus at RFMO meetings. Thus, fishing companies remain directly dependent on decisions made by governments through these organizations. Although they are related to management, harvest strategies are assessed under Principle 1 of the MSC Standard and without them, fishing companies receive a 'conditional pass' for this Principle. Assuming all other Principle scores are high enough, tuna fishing companies with a 'conditional pass' for Principle 1 are still MSC-certified, but they must show progress toward closing these conditions within a specific timeframe (usually five years).

To provide guidance to these companies, all MSC assessments also contain workplans with action items for the client. For all tuna fisheries that have been MSC-certified, the majority of open conditions in their assessment pertained to harvest control rules and reference points (see www.fisheries.msc.org). To address this shortcoming, auditors explicitly stressed the need for clients to lobby government delegates to support RFMO management, specifically highlighting the importance of advocating for the adoption of harvest strategies. Although long-term harvest strategies are most desirable, interim or preliminary harvest strategies are sufficient to show progress toward meeting open conditions. However, decisions on these measures will require additional negotiation and consensus from RFMO members to be adopted in full (and, by extension, receive a 'full pass' score through MSC assessment).

Here, we assess the degree to which private eco-certification schemes are influencing the public governance of tuna fisheries through RFMOs by asking: (i) how does the biological status of tuna stocks with MSC-certified fisheries differ from those without certified fisheries? (ii) how has the prevalence and coverage of eco-certified tuna fisheries changed over time? (iii) do eco-certification requirements influence the harvest strategy decisions made by RFMO delegates? and (iv) what role does the fishing industry play in advocating for these management measures at RFMO meetings?

3.2 Methods

3.2.1 Study design

We assessed the current ecological status and eco-certification coverage of the world's tuna, as well as the uptake of harvest control measures that have occurred at the RFMO level over time. Specifically, we amalgamated and analyzed information from 74 publicly available sources across five data types: five independent RFMO catch databases, 23 tuna stock assessments, two websites, 31 eco-certification reports, and 15 RFMO Conservation and Management (CMM) policy documents. All of the data referred to here were current as of June 2019. In addition to our quantitative analyses, we conducted and analyzed 32 semi-structured interviews with individuals who attended RFMO Commission meetings in 2018.

3.2.2 Stock status

We obtained current estimates of abundance (i.e. SSB/SSB_{MSY}) and fishing mortality (F/F_{MSY}) for 21 of the 23 tuna stocks from the most recent stock assessment or most recent RFMO comprehensive scientific report (Table S3). In the few cases where these metrics were not directly available, they were calculated from other available reference points in these documents. Due to uncertainty around recruitment dynamics, no MSY-based reference points were provided in the stock assessment for eastern Atlantic bluefin tuna (*Thunnus thynnus*), so this stock was not included. Similarly, uncertainties in the growth and natural mortality of eastern Pacific skipjack tuna (*Katsuwonus pelamis*) result in high uncertainty and an inability to provide traditional MSY-based reference points for this stock as well.

When considering stock/fishery combinations (i.e. Units of Assessment; UoAs) that are MSC-certified (i.e. Units of Certification; UoCs), we realize that the present indicators of SSB/SSB_{MSY} and F/F_{MSY} do not necessarily reflect the state of a given stock when a fishery obtained MSC certification. However, since multiple stocks have more than one UoC and these certifications were obtained at different times, we decided that using current metrics was the most uniform approach to conveying this information. Further, since 30 of the 43 current MSC UoCs for tuna occurred between 2015-2019 (and 19 UoAs are in assessment as of June 2019), this is a near real-time depiction of the state of stocks when certification occurred, or will be the state of the stock for those fisheries seeking re-assessment within the next two years.

3.2.3 Global coverage of MSC and FIPs

The most recent publicly available data sets of reported landings were obtained from each tuna RFMO for the 23 target stocks (Table S4). The average catch of each species was calculated for the time period 2013-2017 and these values were used as the total catch upon which the following analyses of eco-certification coverage on a given species were calculated.

Since the MSC website reports landings for the certified fishery as a whole, we obtained recent volumes of annual landings of MSC-certified fisheries for each species from the publicly available final assessment report or most recent re-assessment (Table S5). In almost all cases, the values in these documents differed from what was provided on the MSC website (www.fisheries.msc.org) for each fishery. While the catch volumes presented on the MSC website referred to either 2016 or 2017, these landings pertained to the certified fishery as a whole not at the species level, which was needed for our analysis. For example, the MSC-certified 'US North Atlantic swordfish, yellowfin and albacore tuna fishery' caught a total of 982.4 mt in 2018 but it is not specified what volume of this catch was swordfish relative to yellowfin or albacore. By using the tonnages in reports rather than the website, we were also able to provide an average of the scale of the fishery rather than a point estimate. There was no uniform or consistent format for presenting catch information of the fleets within the final assessment reports and some reports did not present fleet catch data for the years directly prior to the assessment, suggesting an ad hoc approach on the part of the assessment auditor for reporting this vital fishery metric. Overall, the difference between the MSC website and

the MSC reports was negligible (<1%), with the former reporting an extra 12,720 mt total coverage.

For the 11 fisheries in MSC assessment, only eight provided an estimate of the volume to be covered by the certification (on the MSC website) so the catch volumes presented in this category are under-estimated. These fisheries were not discernable to the species level, so we assumed that the proportion of the catch to be covered if it achieves MSC certification was equivalent to the relative proportion of the catch of the species in the assessment in the given region. The scope and scale of current tuna FIPs were obtained from the Fishery Progress website (www.fisheryprogress.org; Table S6). As with fisheries in MSC assessment, only total volumes were provided for FIPs. To obtain species-level volumes, stock proportions were applied in the same manner as above.

3.2.4 Correlation analysis of RFMO measures and tuna fishery MSC-certifications

The dates and content of adopted harvest strategies were obtained from publicly available CMMs published by the applicable RFMO (Table S7). Correlation analysis (by number) of MSC-certified tuna fisheries (all regions combined, as per information above) and adopted full or interim harvest strategy CMMs (all RFMOs combined) was performed for 2007-2018, which represents the year the first tuna fishery was MSC-certified through the final complete year of our data. Unfortunately, there were too few fisheries and CMMs to conduct the analysis separately for each ocean basin.

3.2.5 RFMO interviews

The interview methodology and questions were approved by the Dalhousie Research Ethics Board prior to this study. Thirty semi-structured interviews were conducted with meeting participants (national delegates and official observers) in-person during the ICCAT General Session (Dubrovnik, Croatia; 12-19 November 2018) and the WCPFC Regular Session (Honolulu, USA; 9-14 December 2018). Two additional interviews were conducted via Skype in early January 2019 with individuals who were present at the WCPFC Regular Session but unavailable during the meeting. Of the 32 interviews conducted, 15 were with ICCAT

attendees and 17 were with WCPFC attendees; 19 were conducted with delegates and 13 with observers (Table S8).

Attempts were made to ensure equal geographic spread of interviewees, although this was more easily accomplished for policymakers than observers (Table S8), likely because the majority of observer organizations originate from North America and Europe. On average, interviewed policymakers had been attending RFMO meetings for 11.7±7.7 years and observers had been employed by their specific organization for an average of 8.2±5.9 years. Multiple interviewees at the WCPFC meeting states their experience with that RFMO exceeded the existence of the current Commission and they had attended meetings of the previous iteration, the Multilateral High Level Conference; MHLC. In addition, multiple observer interviewees stated they had worked for other similar organizations or had attended RFMO meetings in a different capacity before, and two individuals expressed they had more than twenty years of experience working with transboundary fisheries prior to their current position (where each had been employed for less than five years).

Most interviews were between 20-40 minutes in length and open-ended questions pertaining to the role of the eco-certifications were posed as part of broader questioning around the role of private actors at RFMO meetings and the management of tuna fisheries (Table S9). Regarding eco-certifications and harvest strategies, state delegates were asked if and how their decision making has been influenced by eco-certifications for tuna fisheries. Similarly, observers were asked about the relationship between eco-certifications and RFMO management and whether the recent trend in tuna fisheries seeking MSC-certification has influenced their organization's strategy at RFMO meetings.

Interviews were audio-recorded and subsequently transcribed. All interviewees were de-identified for analysis purposes and assigned an identification code based on their affiliation: DEL-GOV = national delegate employed by government (i.e. individuals representing their country in an official negotiating capacity); DEL-IND = national delegate employed by industry (i.e. individuals associated with specific company or firm sitting on a national delegation but who does not negotiate at the table), DEL-ENGO = national delegate employed by non-governmental organization (i.e. individuals associated with specific environmental advocacy organization sitting on a national delegation but who does not

negotiate at the table), DEL-ADV = advisor to specific government delegation (i.e. independent professional consultant or academic sitting with specific delegation, permitted to speak at the table on behalf of country being represented), OBS-ENGO= official observer from an environmental non-governmental organization, OBS-INGO = official observer from an industry non-governmental organization, and OBS-IGO = official observer from an intergovernmental organization. In cases where a specific country was mentioned directly in the context of the current meeting negotiations, or with regard to an ongoing (or desired) MSC assessment, the client country or company name was redacted. For broader references to specific countries where eco-certification outcomes were deemed public knowledge (e.g. MSC certifications associated with the Parties to the Nauru Agreement (PNA) free-school purse seine and the Maldives pole-and-line fisheries), the client name (or associated country) was not removed.

Interviews were uploaded to NVivo (v. 12.6.0), a qualitative data analysis program, and responses pertaining to the relationship between MSC-certifications for tuna fisheries and RFMO harvest strategy CMMs were amalgamated. This content was analyzed specifically for indications that participants observed, from their own experience, a connection between eco-certifications for tuna and harvest strategy development, as well as the underlying factors they believed were contributing to their perspective (Table S10). As depicted in Figure 3.5, these responses were grouped broadly into three categories of eco-certification influence ('Yes', 'No', 'Maybe') and the observed mechanism (or lack thereof) was also summarized.

3.3 Results

3.3.1 Tuna stock status

According to the relevant assessments, 15 tuna stocks are considered biologically healthy (i.e. no overfishing and not overfished), two are overfished, one is subject to overfishing and close to being overfished, and three are overfished and undergoing overfishing (Figure 3.1). Only five tuna stocks do not have MSC-certified fisheries or fisheries in a FIP (Table 3.1). Excluding eastern Pacific skipjack, all tuna stocks with MSC-certified fisheries are currently healthy, while three of those not MSC-certified but in FIPs are overfished and/or subject to overfishing. The most recent stock assessment states it is unlikely that eastern Atlantic bluefin is undergoing

overfishing yet there is high uncertainty regarding population dynamics and life history of fish in this stock, which is also the case for eastern Pacific skipjack, and therefore these stock assessments do not provide information on current biomass relative to SSB_{MSY}. Despite the lack of reliable abundance estimates, one fishery for eastern Pacific skipjack was MSC-certified in 2017, and two fisheries for eastern Atlantic bluefin entered into MSC assessment in 2018.

3.3.2 Eco-certification coverage of tuna

Since 2007, the total volume of MSC-certified tuna increased from 0.01-1.31 million mt, and the total volume in FIPs increased from 0.00-1.02 million mt. As result, 47% of the global annual tuna catch is now MSC-certified or in a FIP (Table 3.1). Combined, this represents a 237-fold increase in these private governing initiatives (by volume; Figure 3.2A) and a 57-fold increase (by number of fisheries involved; Figure 3.2B). In total, 42 tuna fisheries have entered the MSC program: 25 currently hold MSC certification, 6 have withdrawn or are exiting, and 11 are in assessment (Table S5).

Growth in the number of tuna fisheries involved with the MSC and FIPs occurred most rapidly between 2015-2018, and this is especially noticeable with the latter: 17 of the 21 FIPs for tuna started in this time (Table S6). This trend for FIPs is mirrored in the total volume covered by these initiatives, while the amount of tuna covered through the MSC each year has occurred in a more step-wise fashion. It is worth noting that the substantial increase in volume covered by the MSC as of 2011 is attributable to the certification of a single fishery—the PNA Pacifical yellowfin (*Thunnus albacares*) and skipjack free school purse seine—which supplies about 62% of all MSC-certified tuna.

Pacific tuna fisheries have the most eco-certification coverage, with fisheries in all stocks excluding southern bluefin (*Thunnus maccoyii*) and Pacific bluefin (*Thunnus orientalis*) currently MSC-certified and/or in a FIP (Figure 3.3). At a species level, skipjack—the tuna that constitutes the majority of the global catch—also has the largest MSC-certified catch volume (29.2 %), followed by yellowfin (19.7%), and albacore (14.2%). Bigeye (*Thunnus obesus*) has

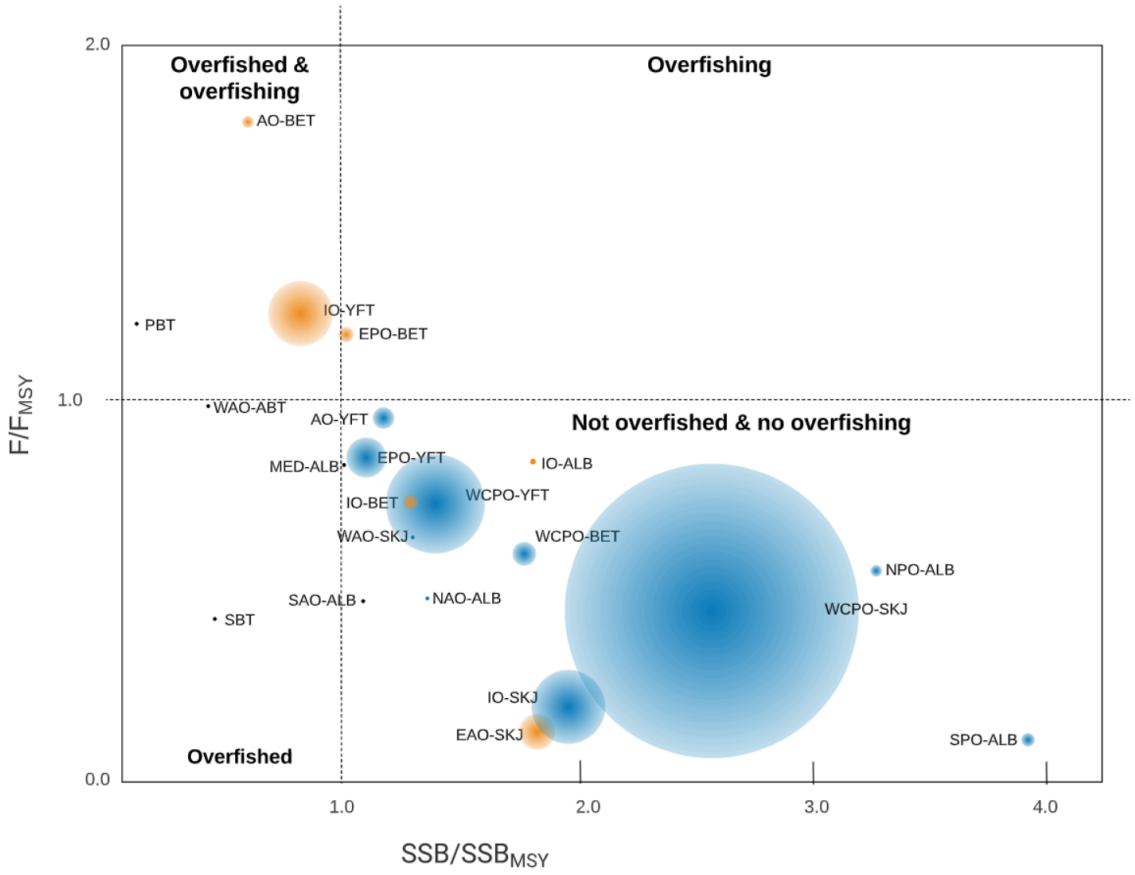

Figure 3.1 Current status of assessed tuna stocks. Most recent abundance (SSB/SSB_{MSY}) and fishing mortality (F/F_{MSY}) reference points for the world's tuna stocks with orb size indicative of contribution (%) to total global tuna catch. Tuna currently MSC-certified or in assessment are indicated in blue, tuna not currently involved with MSC-certification but in a FIP are shown in orange, and those covered by neither are shown in black. Species: PBT= Pacific bluefin; SBT= southern bluefin; ABT= Atlantic bluefin; YFT= yellowfin; SKJ= skipjack; BET = bigeye; ALB = albacore. Stocks: WCPO= western and central Pacific; EPO= eastern Pacific; NPO= north Pacific; SPO= south Pacific; IO= Indian; AO= Atlantic; EAO= east Atlantic; WAO= west Atlantic; NAO = north Atlantic, MED= Mediterranean Sea. (Recent stock assessments for WCPO SKJ and EAO ABT do not provide information on current biomass relative to SSB_{MSY}, so these stocks are not included here; see Table S1and Table S4 for data sources).

Table 3.1 MSC and FIP fishery coverage of assessed tuna stocks. (Current as of June 2019).

Species	Stock	MSC certified (mt)	MSC in assessment (mt)	FIP (mt)	No MSC or FIP (mt)	Average catch 2013-2017 (mt)
Albacore (*Thunnus alalunga*)	Mediterranean	-	-	-	2,911	2,911
	N. Atlantic	3,236	-	-	23,840	27,076
	S. Atlantic	-	-	-	15,300	15,300
	Indian	-	-	450	35,742	36,192
	N. Pacific	16,077	-	163	54,085	70,326
	S. Pacific	13,843	592	2,274	65,503	82,212
Bigeye (*Thunnus obesus*)	Atlantic	12	-	48,339	27,903	76,253
	Indian	-	-	47,870	48,097	95,967
	E. Pacific	-	-	28,737	67,287	96,024
	W. & C. Pacific	1,504	1,164	3,733	140,537	146,937
Atlantic bluefin (*Thunnus thynnus*)	E. Atlantic	-	303	-	16,788	17,090
	W. Atlantic	-	-	-	1,741	1,741
Pacific bluefin (*Thunnus orientalis*)	N. Pacific	-	-	-	10,005	10,005
Southern bluefin (*Thunnus maccoyii*)	Southern	-	-	-	13,287	13,287
Skipjack (*Katsowonus pelamis*)	E. Atlantic	166	-	140,485	80,961	221,611
	W. Atlantic	-	5,352	14,410	5,804	25,566
	Indian	82,020	-	182,457	189,572	454,048
	E. Pacific	11,675	-	92,161	204,309	308,145
	W. & C. Pacific	730,485	121,119	39,308	925,129	1,816,041
Yellowfin (*Thunnus albacares*)	Atlantic	1,835	-	81,766	45,384	128,985
	Indian	-	-	199,272	200,218	399,490
	E. Pacific	101,358	-	72,734	68,945	243,036
	W. & C. Pacific	168,594	47,522	50,494	342,572	609,182
Total (mt)		*1,130,803*	*176,051*	*1,004,652*	*2,585,920*	*4,897,426*
% global catch		*23.1*	*3.6*	*20.5**	*52.8*	

*Tuna fisheries in Basic FIPs (i.e. no stated goal of MSC-certification) account for 15,467 mt so when they are removed, this value equals 20.2 percent.

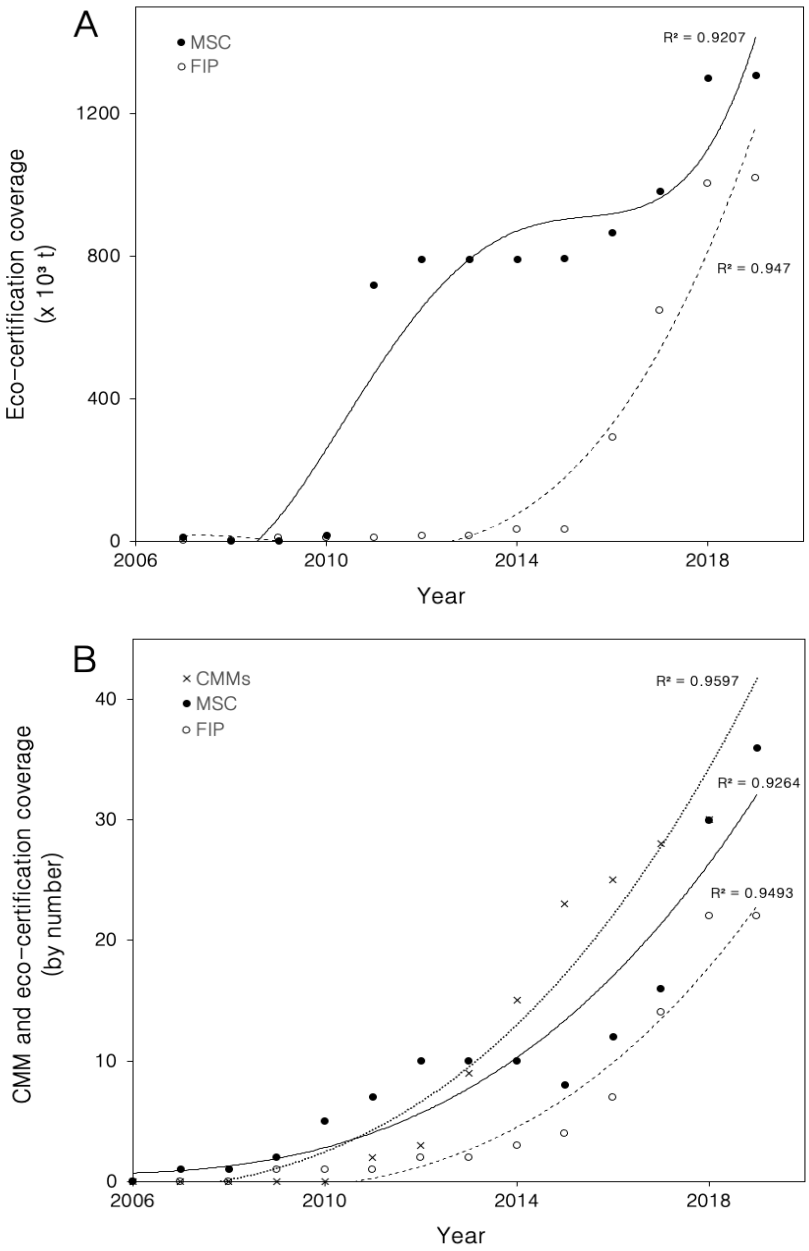

Figure 3.2 Increase in eco-certified tuna fisheries and associated measures. Shown is (A) total volume of tuna caught by MSC-certified fisheries (solid circle; solid trendline) and by fisheries in a FIP (open circle; dashed trendline); data are fitted with fourth-order (MSC) and second-order (FIP) polynomial trendlines and (B) the number of RFMO management measures (CMMs) containing harvest control rules and reference points (black *x*; dotted trendline), with number of fisheries MSC-certified or in MSC assessment (solid circle; solid trendline) and tuna fisheries in a Fishery Improvement Project (open circle; dashed trendline); data are fitted with third-order polynomial trendlines and data for CMMs and MSC were used in regression analysis. Prior to 2007, no tuna fisheries were MSC-certified or in a FIP and, prior to 2011, no management measures with explicit harvest control rules and reference points existed. (Data for 2019 are preliminary based on achievements up to June.)

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the most coverage by FIPs (31%), followed by yellowfin (29.3%), and skipjack (16.6%). The three bluefin species—historically of most conservation concern—have the lowest eco-certification coverage, with only two fisheries targeting the eastern stock of Atlantic bluefin in MSC assessment (<1%). In general, FIPs cover more stocks than MSC (16 and 12, respectively) and also appear concentrated on stocks that have no or low MSC coverage. Of the 21 FIPs for tuna, 19 are 'Comprehensive' and only two are 'Basic' (Table S6), suggesting that most tuna fisheries currently in FIPs are eventually seeking MSC-certification.

3.3.3 Adoption of harvest strategies

While RFMOs differ in age, the longest duration between RFMO establishment and the adoption of a full or interim harvest strategy for at least one stock under its jurisdiction was observed in the Inter-American Tropical Tuna Commission (IATTC; 65 years), followed by International Commission for the Conservation of Atlantic Tunas (ICCAT; 46 years). With the exception of CCSBT, which has no MSC-certified fisheries, all RFMOs adopted a full or interim harvest control rule within five years of a fishery under its jurisdiction obtaining MSC-certification (Figure 3.4). And, in each case, that harvest control rule was for the stock(s) associated with the recently certified fishery. From 2012-2018, there was a 14-fold increase in the uptake of harvest strategy measures (most of which are interim) at the RFMO level (Figure 3.2B). At present, a total of 22 reference point and 8 harvest control rule CMMs have been adopted across the RFMOs collectively, but 21 of these measures remain provisional (Table S7). We found a significant correlation between the number of MSC-certifications for tuna fisheries and the number of harvest strategy CMMs since 2007 ($r(10) = 0.81, p \leq 0.001$).

Of the 32 RFMO attendees interviewed, 22 individuals (69%) perceived the requirements of eco-certifications influenced the adoption of harvest strategy measures by RFMO members (Table S10; Figure 3.5). A further seven interviewees (22%) speculated there was a relationship between eco-certifications and RFMO management decisions, but it was weak or unspecified, and three interviewees (9%) believed there was no connection. Of the 29 respondents who had directly observed or speculated on an influence, 52% attributed the adoption of CMMs related to MSC assessment requirements to a push from the private sector (i.e. fishing companies, NGOs, supply chain stakeholders), and 19% suggested different governments had played a key role in advocating for these measures. Although they did not directly attribute the

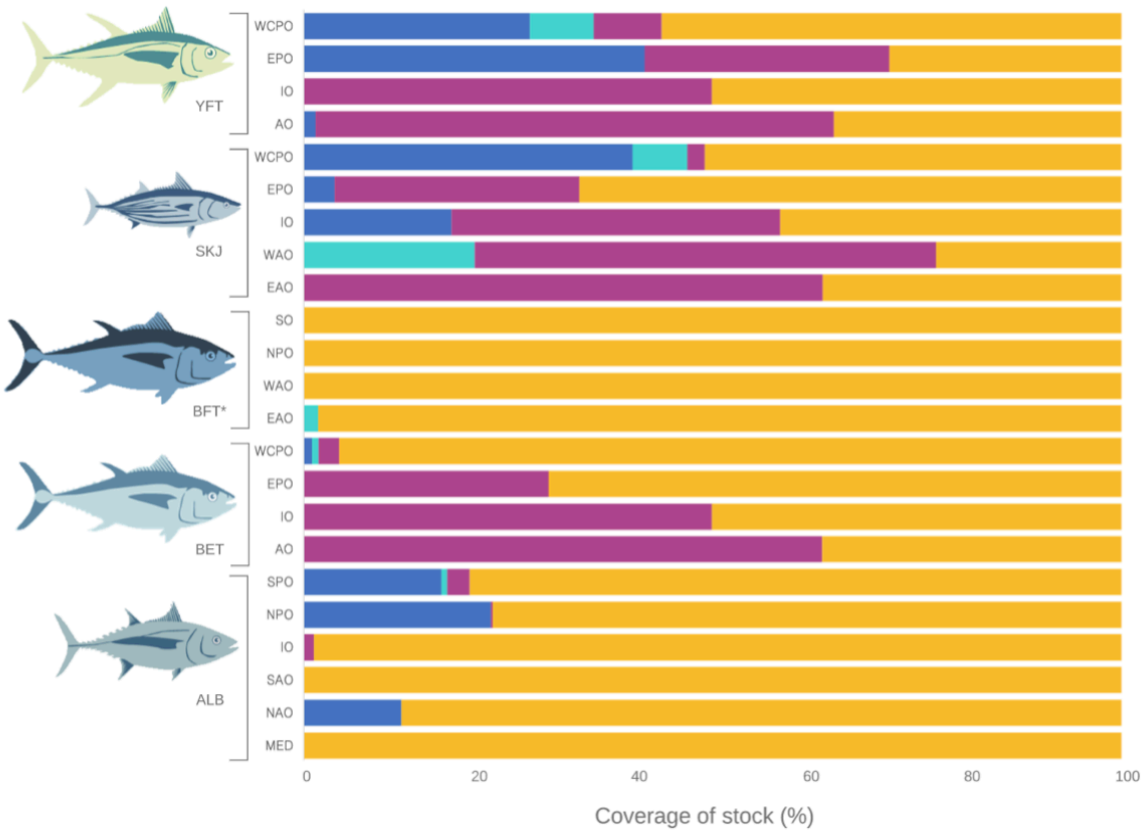

Figure 3.3 Proportion of tuna catch under eco-certification coverage. Fisheries with existing MSC certifications (dark blue), in MSC assessment (teal), in a FIP (purple) and without eco-certification coverage (orange) by stock. Species and region codes as per Figure 3.1 except BFT= bluefin (all three together where SO = southern NPO = Pacific, and WAO/EAO = Atlantic]).

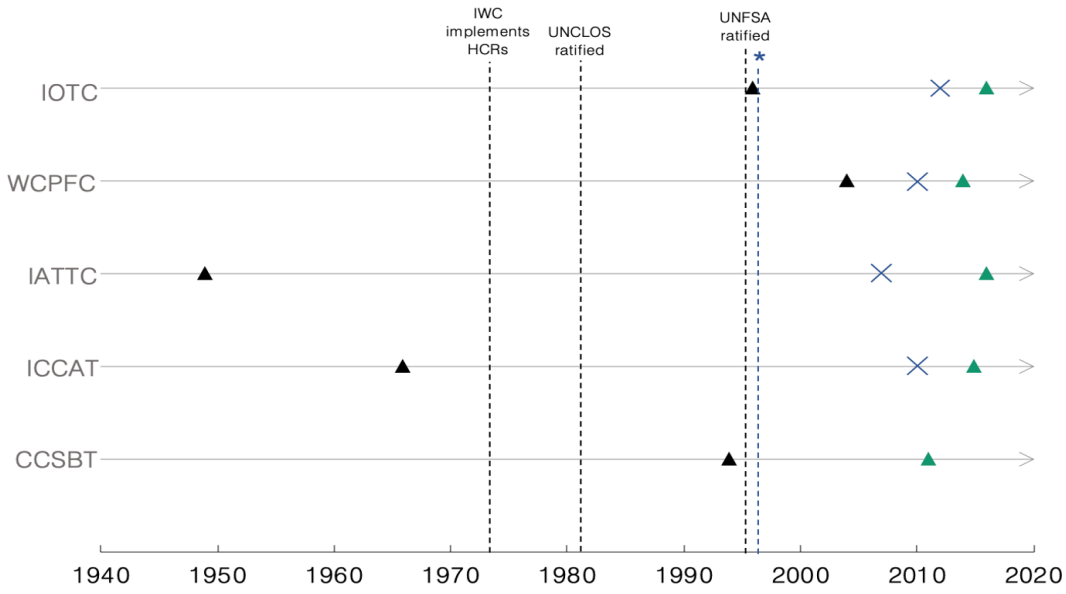

Figure 3.4 Timeline of first harvest strategy establishment by tuna RFMOs. Depictured is the year each RFMO was established (black triangle), the date of the first MSC-certification for a fishery under its jurisdiction (blue X), and the year of the establishment of its first harvest control rule (green triangle). Vertical bars show important intergovernmental treaties and legislation (black) and the establishment of the MSC (blue). Although tuna fisheries can be MSC-certified without harvest strategies in place, these fisheries must demonstrate to a certifying auditor that there is progress toward having them by the time of each MSC re-assessment, which usually occurs every five years. (See Figure S1- Figure S5 for RFMO-specific timelines.)

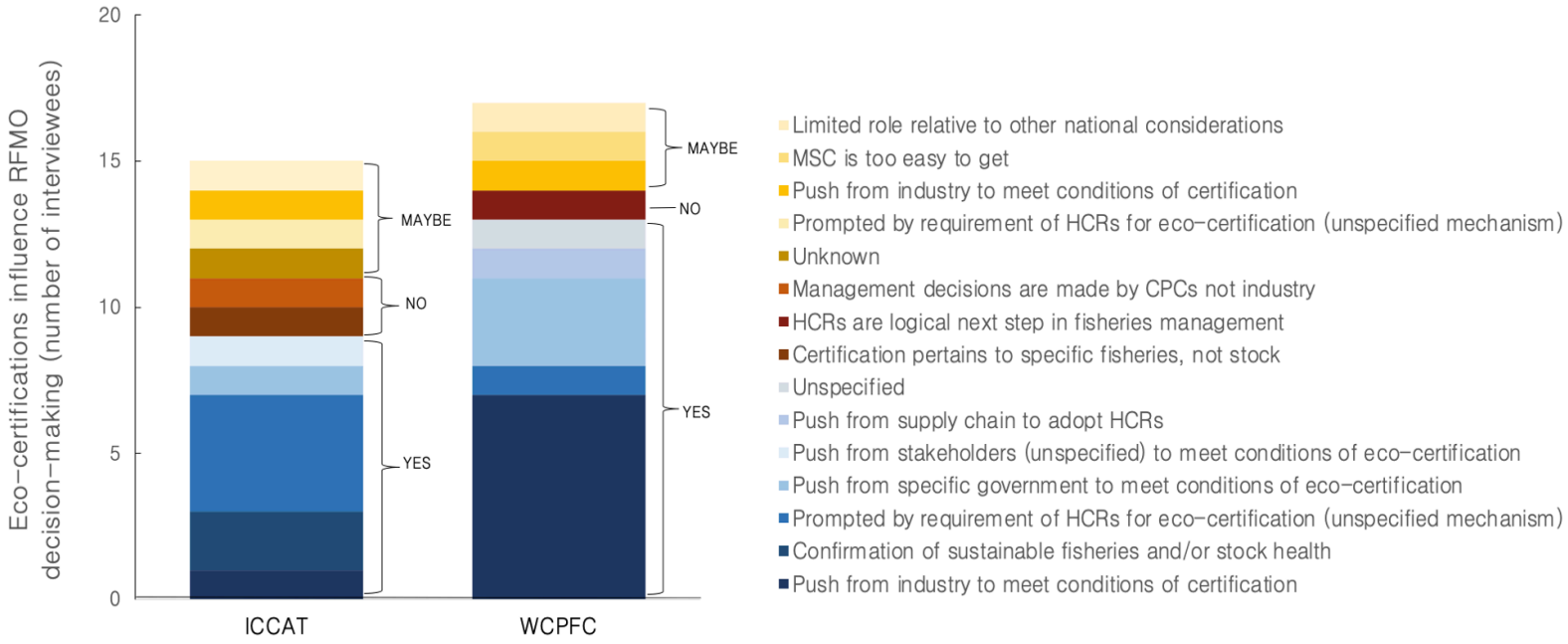

Figure 3.5 Perceptions of causal relationship between eco-certification and adoption of RFMO harvest strategies. Data were derived from interviews with 32 RFMO experts. See Table S10 for specific quotes supporting the relative grouping of each causality statement.

advocacy to a specific stakeholder, a further 29% expressed generally that recent CMMs related to harvest strategy were due to the need for these measures as part of the MSC assessment process and conditions (Figure 3.5).

3.4 Discussion

We find a tight correlation between rapidly increasing MSC-certifications for tuna fisheries and the recent uptake of associated harvest strategies at the RFMO level. Although some tuna fisheries were able to obtain MSC-certification prior to RFMO adoption of an associated harvest strategy they had to show progress toward meeting this 'open condition' to retain their certification going forward. The hypothesis that there is a causal relationship between the two trends is supported by the direct observations of RFMO attendees, of which more than two-thirds attribute recent trends in the adoption of specific harvest strategies to the requirements of MSC assessments, and the associated pressure from private stakeholders and RFMO government policymakers who perceive certification to be in their national interest. Our findings support recent observations from land-based systems, such as tropical agriculture and forestry, indicating that governments, companies, and environmental advocacy groups are increasingly working together to address environmental challenges and that businesses can play a supportive role in international governance (Lambin and Thorlakson 2018; Lambin *et al.* 2018; Thorlakson *et al.* 2018b). Here, we discuss three considerations extending from our results that pertain to the evolution of public-private relationships in tuna fishery governance.

3.4.1 Harvest control rules: good for tuna management, a key condition for MSC-certification

The concept of harvest strategies in the exploitation of transboundary marine life is not new, as this type of management framework was implemented by the International Whaling Commission over fifty years ago (Punt and Donovan 2007). Thus, there is no *a priori* reason why tuna RFMOs could not have implemented a similar approach much earlier. Regardless of the long timeline (Figure 3.4), recent progress toward implementing harvest strategies signifies substantial progress by RFMOs—a development that was especially timely for heavily

overfished stocks, such as southern bluefin. Still, for tuna fisheries seeking MSC certification, the adoption of these measures is also essential, and this prompted the private sector to take an active role in advocating for their development in recent years. As one government delegate explained, "one of the main criticisms [of] ICCAT was the lack of clear harvest control rules. I'm absolutely sure, [eco-certification] has in a way helped or has prompted or has pushed delegations towards adopting harvest control rules here. Because knowing this is one of the difficulties to get these fisheries certified of course implies an economic interest that would be better to do that."

Multiple interviewees also cited pressure from the public-private Pacifical partnership (i.e. PNA governments and Sustunable BV) as part of the reason for harvest strategies adopted at WCPFC. As one delegation advisor pointed out, "[the Pacifical fishery] pushed for target reference points and limit reference points [and] pushed for harvest control rules because it was a condition of certification. I think it has had a huge influence in the way in which the PNA had to shape this fishery to meet those conditions." This observation was echoed by two individuals in the context of the MSC-certified Maldives pole-and-line skipjack fishery, which has previously been documented as driving the adoption of harvest control rules by the Indian Ocean Tuna Commission (IOTC) (Karavias 2018). Taking a management decision to a vote is an extremely rare circumstance at RFMO meetings, but as one industry NGO representative explained, "the MSC was telling the Maldives delegation that if they didn't get a harvest control rule, they'd lose their MSC certification. I don't believe that threat has been given to any other fishery—in fact I know it hasn't—so [the Maldivian delegation] pushed for a vote and were successful."

For now, even interim harvest strategies (or workplans to develop them) for tuna stocks are viewed as positive progress from the standpoint of the MSC assessment bodies. As an environmental NGO observer asserted, "the reason [the WCPFC northern albacore measure] went through so quickly with no conversation basically was that it led to an increase in the TAC and an interim HCR in place to tick the box." Yet, until interim harvest strategies are "well defined" (i.e. not temporary or lacking specific values), this criterion remains an open condition for a given tuna fishery's MSC re-assessment and, from a fisheries management perspective, minimal progress in terms of implementing robust procedures. So, although the

trend toward adopting harvest control rules is a positive sign for RFMOs, it may also make it easier for fisheries targeting overexploited stocks to retain their MSC status or for fisheries catching tuna from recovering stocks (e.g Atlantic bluefin) to become MSC-certified since the existence of even an interim harvest strategy (or, progress toward one) allows for a 'conditional pass'. If this transpires, the adoption of, or even just commitment to adopt these measures could ultimately prove to be more beneficial for the sustainability claims of the private sector rather than for ensuring the actual sustainability of the fish stocks for which they were developed.

3.4.2 Ensuring quality not only quantity

A key criticism of the MSC has been the certification of fisheries that are already operating under best practices, suggesting there is limited incentive for them to improve once certified (Ponte 2012; Tlusty and Øistein 2016). Nonetheless, the rapid increase in tuna FIPs since 2014 suggests many fisheries with a desire to achieve MSC-certification have self-identified as needing improvement. In 2019, a Chinese-owned bigeye and yellowfin longline fleet was the first tuna FIP to become MSC-certified; this also marked the first time a bigeye fishery met the requirements of the MSC Standard (MSC 2019a).

While adhering to responsible fishing practices should be the industry's operational baseline, it should not be overlooked that companies also view FIPs and eco-certifications as key elements of corporate social responsibility claims around sustainable sourcing (Bailey *et al.* 2018). In general, outcomes of FIPs are highly varied and their applicability for different fisheries and associated effectiveness is debated (Cannon *et al.* 2018; Crona *et al.* 2019; Travaille *et al.* 2019). Questions about the FIP process have already been raised, with some suggesting it is a means for unsustainable fisheries to obtain market access through stakeholder partners and promotion by MSC (Sampson *et al.* 2015). Also, if FIPs are deemed sustainable 'enough' for market access, there exists additional risk of a fishery losing (or suspending) its MSC-certification to regress into a FIP with no negative consequences on product demand.

Three of the tuna stocks that are currently overfished and subject to overfishing have fisheries in FIPs. Part of the recent investment in tuna FIPs is likely due to the inability of these fisheries to meet the MSC Standard due to poor stock status. While the MSC promotes FIPs as a means

for small-scale fisheries to gain access to markets (MSC 2016), it appears that many companies involved in tuna FIPs remain focused on assuring they have access to a high volume of fish. For example, in December 2016, Thai Union—one of the world's leading seafood companies—announced that it would ensure that a minimum of 75% of its tuna was "sustainably sourced" (i.e. MSC-certified or from a FIP) by 2020 (WWF 2018a). To achieve this, the company invested US$90 million into establishing two FIPs and by the end of 2017, 85% of Thai Union tuna sold in the EU was already from one of them (i.e. Atlantic and Indian Ocean purse seined yellowfin, bigeye, and skipjack). Similarly, in May 2018 Italian tuna producer Bolton Group committed to sourcing 100% of its raw tuna from MSC-certified fisheries or those taking part in a "robust" FIP by 2024 (Mereghetti 2018). These findings support the assertion that the influence of eco-certifications on consumer behaviour may actually matter less than the engagement of relevant industry stakeholders, whose involvement gives these programs legitimacy and increases their uptake by other industry members (Gulbrandsen 2006; Barclay and Miller 2018).

Despite this engagement, if companies continue to make sustainable sourcing commitments mostly from large fisheries, they also marginalize small-scale fisheries that may be unable to enter a FIP or seek MSC-certification. Of the 19 'Comprehensive' tuna FIPs, nine have annual landings ≥50,000 mt, with the largest covering 243,000 mt while the two 'Basic' FIPs collectively account for less than 16,000 mt annually. Multiple interviewees raised concerns over access to certification. As one industry observer noted, "the number of retailers who say 'our sourcing policy is [fisheries] in a FIP'—but the entire Atlantic purse seine fishery is in a FIP…! [Industrial fleets] are getting preferential market access over small-scale sustainable fisheries because they're in a FIP. It's terrible."

3.4.3 RFMOs are still in charge, but still need to improve

Here, we found that, by volume, the majority of the world's tuna catch is considered sustainable when using MSY-based reference points. Tuna are, generally, a resilient group of fishes, yet differing life histories make some species more vulnerable to over-exploitation and take longer to rebuild once depleted (Juan-Jorda *et al.* 2011) and recent work has suggested that the health of individual tuna stocks is less attributable to differences in RFMO management but influenced by the life histories of target species (Pons *et al.* 2017a) and global

market demands (McCluney *et al.* 2019). Nonetheless, regardless of the driving factors behind a species' inherent vulnerability to fishing pressure, RFMO member countries are—as stipulated by UNFSA and their own convention texts—responsible for ensuring the sustainable fishing of all stocks under their jurisdiction. As such, government delegates are charged with developing applicable and effective management measures that account for the diverse biological attributes and market influences of all tunas, not only those that contribute substantially to the global market. In this regard, six stocks—or one in three—need more effective management.

When acting in parallel with effective governmental regulation, large companies can play a significant role as environmental stewards (Folke *et al.* 2019). Still, market-based measures have been criticized for promoting neoliberal ideologies including the commodification of nature and divulsion of regulatory authority, which can undermine conservation efforts and positive outcomes (Konefal 2013). In the case of the tuna RFMOs, our research suggests that recent pressure from the private sector appears to be favourable in driving more comprehensive management policies. Still, some interviewees did not see a connection and suggested the recent adoption of harvest strategies was due to a general progression of fisheries management. And, of the many interviewees that did attribute causality, many pointed out that the MSC is not the only driver of the recent trend toward these measures, rather it has been an influential catalyst in the speed at which they have been adopted. To this end, RFMO member states must maintain momentum to move beyond the many current interim measures in place and solidify science-based harvest controls for the long-term.

As highlighted by multiple interviewees, the adoption of harvest strategies should streamline the negotiation process in many ways, de-politicizing certain aspects of management and relying more on scientific advice. Still, challenges associated with responding to a harvest strategy will remain, as one ENGO representative pointed out: "there's still negotiation on how [a catch reduction] is achieved; is it achieved through [gear] closures, or longline limit reductions or handline restrictions? And then in what proportions? And then high seas versus EEZ? Even if you've got the best developed harvest control rule, you're still going to have those discussions." Bearing this in mind, it remains imperative that the socio-political complexity of these organizations is not overlooked as developing effective measures must

remain a focus for all target and bycatch species, not only those currently covered by eco-certifications.

3.5 Conclusions

We conclude that over the last decade the rise in private seafood eco-certification schemes has come to play a substantial role in driving an unprecedented adoption of public management measures at the RFMO level. This previously undocumented change was largely driven by an exponential increase in the eco-certification of tuna fisheries. While some supply chain companies and country delegations are putting substantial pressure on RFMOs to retain these certifications, the current structure of the MSC Standard means tuna fisheries remain dependent on management decisions agreed to by *all* national delegations to ensure assessment requirements can be met.

Our results corroborate the key role the private sector can play in reshaping the traditional landscape of transboundary resource management at regional to global scales, influencing national agendas and international policy making. While this case study addressed the overexploitation of fish stocks, national governments have come under increasing scrutiny from their citizens to address a wide range of other environmental concerns, such as the mitigation of climate change and plastic pollution, for example. When companies see market-driven initiatives—such as eco-certifications—as a valuable business investment there can be rapid and significant progress made by the private sector in order to meet perceived societal demands and guide international policy. Still, we stress that market measures for tuna will only be meaningful in the long-term if they support rather than undermine intergovernmental negotiation and are successful in conserving or—where necessary—rebuilding the populations of fish upon which all parties so fundamentally depend.

4 DECADAL CHANGES IN ADVOCACY TOWARD THE CONSERVATION OF HIGHLY MIGRATORY FISHES

4.1 Introduction

Tuna provide food and livelihood security for many coastal nations, especially small islands states (Gillett 2016), and have an estimated value of $40 billion globally (McKinney *et al.* 2020). These fish (*Thunnus* spp. and *Katsuwonus pelamis*) and other highly migratory pelagic species (e.g. swordfish, marlins, sharks) migrate between domestic waters (Exclusive Economic Zones; EEZs) and the high seas. They are mainly caught by industrial vessels using purse seines (i.e. nets) or longlines (i.e. baited hooks) but are also targeted by small-scale fishers using artisanal gears (Coulter *et al.* 2020). The long-term conservation of tuna stocks is the collective obligation of all fishing countries and annual Conservation and Management Measures (CMMs; here referred to as 'measures') are decided through Regional Fishery Management Organizations (RFMOs) (Lodge *et al.* 2007). As delineated through the United Nations Fish Stocks Agreement (UN General Assembly 1995) RFMOs are central to the governance of international fisheries and remain the only intergovernmental fora where member states are specifically mandated to adopt legally-binding fishery management measures for transboundary fish stocks.

Five RFMOs for highly migratory pelagic fish exist globally and collectively involve over 100 member countries and territories in the decision-making process. Approved member country delegates (here referred to as 'policymakers') are responsible for reaching consensus on measures during annual RFMO meetings. Importantly, while annual catch quotas, gear restrictions, monitoring, control and surveillance parameters or data reporting protocols are *adopted* at RFMO meetings, member countries are responsible for *implementing and enforcing* these measures domestically.

The effectiveness of RFMO measures are critical since the high economic value and high age at maturity of some larger tuna species makes these species more vulnerable to overexploitation than other fishes (Collette *et al.* 2011). Currently, only 15 of 23 key

commercial tuna stocks are considered healthy based on current fishing pressure and stock abundance (ISSF 2020). Further challenges in RFMOs exist regarding adopting effective conservation measures for sharks, billfishes, seabirds, sea turtles, and cetaceans caught incidentally in tuna fisheries (i.e. 'bycatch') (Gilman *et al.* 2017; Juan-Jorda *et al.* 2017).

Advocates are individuals who convey information in support of a specific cause, including those who recommend specific conservation actions based on scientific evidence (Parsons 2016). Advocates attend RFMO meetings as official observers and most are affiliated with a non-governmental organization (NGO) representing the interests of conservation groups (environmental NGOs; ENGOs) or fishing fleets (i.e. industry NGOs; INGOs), but representatives from intergovernmental organizations (IGOs) and academia also attend. Permitting observers access to meetings assures transparency in the negotiation process (Petersson 2020) and is consistent with the best practices of legitimate policy-making fora (Wiser 2001).

Each observer organization has a unique mission (Table S11), and although observers cannot adopt management measures, they attempt to influence RFMO policymakers by advocating measures in line with their organization's mandate. Observers may request the floor to speak during a meeting, and many interact with country delegations in private consultations as the negotiations progress. Most NGOs also submit an annual position statement (i.e. 'letter') each year to formally advocate the adoption of certain measures, and such joint letters may be signed by additional NGOs (as well as companies or academics) that are not official observers and do not attend meetings. The number of observer organizations has increased over time and, in 2017, 36 ENGOs, 22 INGOs and 20 IGOs attended annual meetings for at least one tuna RFMO (Table S11). Importantly, NGO representatives may also participate in meetings as part of specific member state delegations although in this capacity, they are more constrained in their ability to advocate their agenda to other delegations compared to when they participate as observers.

Here, we strive to understand what bearing observer agendas have on the international governance of pelagic fish species by analyzing annual RFMO letters and interviewing RFMO attendees. Dellmuth et al. (2020) found that the number of ENGOs attending RFMO

meetings is not a result of the ecological status of target stocks; rather attendance is affected by RFMO institutional factors such as RFMO size and ENGO budget. We extend this work to understand further dimensions of influence not captured by the simple total presence of ENGO observers. Observer letters offer a window into these dimensions as they represent a 'wish list' synthesizing the measures a given observer organization is asking RFMO policymakers to adopt in a given year. The letters serve as a proxy for understanding which priorities take precedence for observers and how their advocacy has changed over time. For observer agendas to influence decisions, they must be perceived as credible. Thus, interviews complement the details of the letters by providing the context for understanding if and how observer agendas are advocated and received by policymakers. We ask: i) how has the composition of letters and issues advocated by RFMO observers changed over time? ii) how do RFMO policymakers use letters and interact with observers? and iii) how are NGOs engaging most effectively to affect tuna fisheries reform?

4.2 Methods

4.2.1 Observer statement inclusion and amalgamation

We analyzed all publicly available letters submitted by ENGOs and INGOs to the annual meetings of the Western and Central Pacific Fisheries Commission (WCPFC; n= 105 letters, Table S12) and the International Commission for the Conservation of Atlantic Tunas (ICCAT; n=111 letters) through 2019. We focused on these two RFMOs since they have the most member countries (Table 1.2) and because 90% of all NGO observers attend the annual meetings of one or both (Table S11). Still, not all observer organizations submit a letter each year and some letters are signed by multiple organizations (i.e. 'joint' letters) thus annual contributions vary.

WCPFC letters were available individually as part of Regular Session meeting documents on the RFMO website (https://www.wcpfc.int/meeting-folders/regular-sessions-commission) and ICCAT letters were available as part of biennial reports for each Special or Regular Commission Session (https://www.iccat.int/en/Meetings.asp). Our time series for WCPFC starts in 2005, which is the year after it came into force, and in 1999 for ICCAT as this was

the first year for which observer letters were available (although this RFMO has existed since 1969).

Most observer groups submitted only one letter per RFMO meeting, and some observers never submitted any letters. In some cases, an observer organization would submit a letter conveying views specific to their organization, as well as a letter co-signed by multiple signatories, or on behalf of organizations not officially affiliated with the RFMO (e.g. seafood companies), which we term 'joint' letters. Both types of letters were analyzed. However, while the number of signatories for joint letters was recorded for analyses, coded letter content was attributed only to the first (or submitting) NGO and counted only once to avoid letters with dozens of signatories biasing the dataset toward specific measures. While some letters (and other materials, such as research papers or reports) are presented at optional RFMO meeting side events only those submitted specifically for the negotiations were included in our analyses. We did not review any letters submitted by RFMO member state delegations or by IGO observers.

Based on the information provided in the ICCAT biennial reports, some organizations submitted statements for specific Panels (i.e. negotiation sessions related to a specific management topic, which not all member states attend), while some submitted overarching statements to the plenary sessions as well as during one or more Panels. It was assumed that for those organizations that submitted statements to plenary, all prescient issues on their conservation agenda for a given meeting were included in that statement so no additional Panel statements were analyzed to avoid double counting. (While some Panel-specific statements elaborated on points made in a given organization's opening statement or provided specifics, the resolution of information in the original plenary statements was always of sufficient detail for analysis). Conversely, for organizations that did not submit a statement during plenary, content presented in statements to specific Panels was amalgamated to be representative of the issues they deemed to be of highest priority for the meeting as a whole (i.e. if an organization submitted two or more letters over the course of the four Panels but no letter at plenary, these statements were condensed into one entry). From the original 111 ICCAT letters reviewed, 33 were presented in Panels outside plenary and there were three

instances where letters needed to be amalgamated from multiple Panels to represent an organization's single annual position.

4.2.2 Observer letter codes

Our management measure codes were developed from a review of observer letters submitted in the first and last years of our analysis, and the ICCAT Compendium of Conservation and Management Measures (ICCAT 2018a). This review identified six overarching themes (with 16 associated measures) related to RFMO management of tuna, ecosystem conservation, and fishery practices, as well as market and trade-based governance tools (specifically sustainable seafood eco-certifications and Convention on International Trade in Endangered Species [CITES] trade controls) that can affect RFMO policymakers' decisions but are external to the RFMO process. All of these measures were then used when coding all 216 letters in our study (see Figure 4.1 for how each of these measures is related to tuna fisheries and RFMO governance). The presence ('1') or absence ('0') of measures in each letter was recorded as were notable 'other' priorities (Table 4.1). We also recorded all fish and other wildlife species mentioned in each letter.

In a given year, a single observer letter may advocate multiple management priorities based on the current state of stocks and/or the overall mission of their organization. Thus, discrete measures were coded individually (e.g. apply the precautionary approach to reduce catch of bluefin, adopt science-based limits for porbeagle sharks, implement 100% onboard observer coverage on longline vessels = 3 measures). However, in cases where a single measure was mentioned multiple times within a letter (e.g. reduce catch for bluefin, reduce catch for yellowfin, reduce catch for bigeye), we amalgamated these mentions into one data point related to the necessary objective (i.e. fishing mortality measures = 1 measure).

Although we collected species-specific information, we did not code presence of a species in a letter for generic statements associated with the observer organization platform or mission. For example, the International Game Fishing Association (IGFA) began their 2018 letter to ICCAT by stating, "Many of IGFA's members target the highly migratory species managed

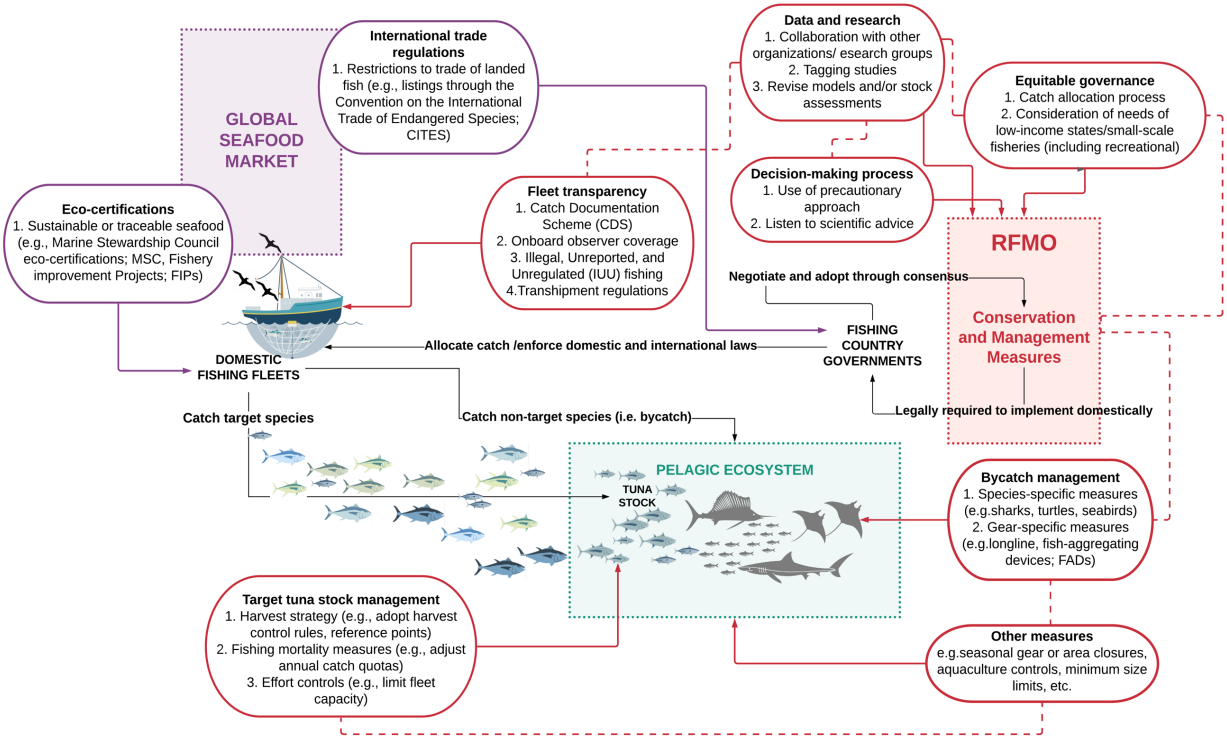

Figure 4.1 Overview of measures coded in observer letter analysis and their relationship to pelagic fisheries governance. RFMO Conservation and Management Measure (CMM) types and associated themes (red) and market-based measures (purple) are indicated. RFMO member country governments are responsible for implementing adopted CMMs, so NGO observers seek to reform tuna fisheries management by providing information to RFMO policymakers and advocating changes to CMMs. Market-based measures can also influence decisions at RFMO meetings since member country governments are affected by international trade regulations (e.g. CITES) and fishing companies can voluntarily seek private sustainable seafood eco-certifications to ensure access to supply chain companies that require these labels. Observers can leverage these measures as part of their advocacy to RFMO policymakers since domestic economies are affected by access to international markets. (Dashed lines connect all RFMO CMMs; solid red lines indicate where CMM has impact. See Table 4.1 for examples of observer letter text associated with each CMM and market measure.)

Table 4.1 Management themes included in RFMO observer letter analysis with examples of advocacy as written. (Note: text in square brackets replaces acronyms or has been inserted for clarity.)

Theme	Conservation and management priority	Letter text reflecting presence of measure advocacy
Target tuna stock management	Harvest strategy e.g. adopt harvest control rules, reference points)	"…we urge Governments to support the adoption of robust and precautionary harvest strategies, including appropriate biologically-based reference points, harvest control rules and acceptable levels of risk, for priority tuna stocks…" (FishWise *et al.*, 2015; ICCAT)
	Fishing mortality measures (e.g. adjust annual quotas)	"Reduce the total allowable catch (TAC) for bigeye tuna to stop overfishing…" (Ecology Action Centre, 2016; ICCAT)
	Effort controls (e.g. limit fleet capacity)	"…establish limited entry through closed vessel registries…" (International Seafood Sustainability Foundation, 2014; WCPFC)
Decision-making process	Use of precautionary approach	"Greenpeace urges that the Commission take into account first and foremost the precautionary approach when deliberating over new conservation and management measures for tuna and other species" (Greenpeace, 2012; WCPFC)
	Listen to scientific advice	"A seabird Conservation Measure based on the recommendation from the WCPFC Scientific Committee would be a highly constructive step to reduce seabird bycatch in the WCPFC area" (Birdlife International; WCPFC, 2006)
Bycatch	Species-specific measures (e.g. sharks, turtles, seabirds)	"The situation for mako [sharks] is now critical. We urge ICCAT to adopt measures to immediately minimize mortality on this vulnerable species…" (Defenders of Wildlife *et al.*, 2017; ICCAT)
	Gear-specific measures (e.g. longline, fish-aggregating devices; FADs)	"FAD settings should be adequately managed through strengthened restrictions [since] the deterioration of bigeye stocks is considered attributable to FAD settings that allow large catches of juvenile bigeye while the target is skipjack tuna…" (Organisation for the Promotion of Responsible Tuna Fisheries, 2018; WCPFC)
Fleet transparency (Monitoring Control and Surveillance)	Catch Documentation Scheme (CDS)	"ICCAT must remain committed to the March 2014 [electronic Bluefin Catch Documentation] implementation deadline and agree to track all catch regardless of origin or destination" (Pew, 2013; ICCAT)
	Onboard observer coverage	"The minimum levels of observer coverage for all major fishing gears should be increased to 20% based on SCRS recommendations and compliance strengthened…" (Eastern Atlantic Sustainable Tuna Initiative *et al.,* 2018; ICCAT)
	Illegal, Unreported, and Unregulated (IUU) fishing	"Oceana calls upon ICCAT to direct additional efforts towards tackling non-compliance and IUU fishing within the Convention area…" (Oceana, 2014; ICCAT)
	Transshipment regulations	"Existing prohibitions to transhipment at sea by purse seiners must be expanded to include all longline fleets" (Greenpeace, 2016; WCPFC)

by ICCAT, especially marlin, sailfish and spearfish (i.e. billfish) which are primarily caught and released…". As this statement related to the mission of the observer group, it was not used to code presence of marlin, sailfish or spearfish in the context of ICCAT measure advocacy. However, later in this letter, this INGO does mention direct asks for each of these species, i.e. "Reduce the harvest of blue marlin, white marlin/spearfish, and eastern and western Atlantic sailfish [and] institute harvest control rules for sailfish that will allow rebuilding of both eastern and western stocks.". This statement was coded for these species. As per our approach in analyzing fishery management and conservation themes, we did not double count species mentions within a given letter. We chose this approach to ensure we were adequately capturing how observer attention to different species has changed over time with as little noise as possible.

While different organizations attempt to be persuasive in their messaging and, thus, use strong verbiage or tone we chose not to analyze issue framing or language and focused objectively on letter content. We assumed that all organizations signing a letter supported its content. Therefore, to observe whether there has been increased alignment in messaging across organizations, we also collected information on the number of signatory organizations on joint letters.

4.2.3 Interviews with RFMO attendees

Transcript data used here are from the same interviews described in Section 3.2.5. However, for this study, we did not analyze industry delegate transcripts, only government policymakers (i.e. eight delegates and five advisors) and official observers (i.e. two IGO, five ENGO and six INGO representatives).

Notably, although all interviewees were asked the questions listed in Table S9, additional conversation and questions that stemmed from replies to these questions were specific to the responses of each interviewee (hence interviews were semi-structured). Therefore, while the presence of a theme in Table 4.3 indicates this was expressed by that individual, many themes also emerged from the conversation outside of the original base questions. Thus, the absence of a theme for a given interviewee does not necessarily indicate disagreement but it could also be reflective of the fact that conversation related to this theme did not arise. Although

observers have differing advocacy tactics based on their personal experience and/or organization affiliations, we (the authors) refrain from speculating on the credibility of certain individuals or organizations. RFMO policymakers were asked to comment on the role and legitimacy of observers (Table S9), thus, results on this topic are based on the feedback from those directly involved in the RFMO decision-making process and whether they perceive the information and behaviour of observers is credible.

Interview content was amalgamated and analyzed, and themes mentioned by at least one-third of all interviewees are presented in Table 4.3. Since interviewees expressed these themes in different ways, interpretation was required. For example, the following response by Delegate-5: "Those written statements don't usually make any difference in decision making but sometimes their work in between commission meetings and their fact sheets are quite useful" was coded to three separate themes: (1) Observer letters and/or interventions can be helpful to delegates but have limited impact at meetings; (2) Beneficial and/or influential observer/delegate interactions occur outside RFMO meetings and (3) Summaries or independent research in letters to RFMO delegates is useful. Similarly, the following response from ENGO-3 was also coded to aforementioned theme (2): "[on] January 2nd we're in full planning mode and reaching out to governments by February so it's all year long. We didn't used to do that, and it wasn't effective. We'd come [to ICCAT] and we'd [say], 'it's done!' and that doesn't work". Specific responses from observers that related to their engagement with the MSC, or sustainable seafood movement more broadly, were also amalgamated (Table 4.5) and additional quotes as they relate to different themes are presented in the main text of the Results.

4.3 Results

Key results related to our first question around letter content in the context of both issues and species advocated over time are presented in Section 4.3.1. We then summarize key outcomes of our interview analysis related to our second and third questions, specifically: how RFMO policymakers perceive observers as part of negotiations (Section 4.3.2), how observers and policymakers engage at RFMO and domestic meetings (Section 4.3.3.), and how observers combine RFMO advocacy with other efforts to improve tuna fishing practices (Section 4.3.4).

4.3.1 Changes in letter content over time

Non-governmental advocacy to tuna RFMOs changed over time with stable or declining numbers of letters submitted by ENGOs, while letters from INGOs to both RFMOs increased (Figure 4.2A, B). We also noted an increasing number of signatories on joint letters (Figure 4.2C, D), mostly signed by seafood supply chain companies (retailers, suppliers, processers) and other NGOs (only some of which are official RFMO observers). The largest joint letter in our analyses was submitted to WCPFC by the International Seafood Sustainability Foundation in 2018 on behalf of 181 signatories from over 100 countries (ISSF 2018a).

Target species management was the main focus in letters (24% and 22% of relative presence in letters to WCPFC and ICCAT, respectively; Figure 4.3A, B). While observer letters consistently highlighted the importance of science-based and precautionary decision-making, the type of target species management measures advocated shifted in the early-2010s. Harvest strategies—which are pre-determined science-based management actions that tell policymakers where to set the catch for a given year based on its current stock status—were only mentioned once prior to 2010 *(*n=57 letters). Since, there has been a 26-fold increase, and 58 of 74 (or 78%) of the letters in the last five years mentioned this priority (Figure 4.2E, F). With regard to market-based measures, mentions of seafood sustainability and traceability occurred in 22 of 105 (21%) letters to WCPFC but only 12 of 111 (11%) letters to ICCAT, while possible trade restrictions were mentioned in 12 letters to ICCAT but only two letters to WCPFC. Overall, sustainable seafood-related advocacy increased since 2010, whereas the inclusion of CITES declined (Figure 4.2G). Prior to 2010, all CITES mentions were related to Atlantic bluefin tuna (*T. thynnus*); since: all mentions of trade controls pertain to non-tuna species (e.g. sharks and billfish).

With regard to species advocacy, Atlantic bluefin dominated letters to ICCAT during the 2000s, while yellowfin, bigeye, skipjack and albacore (*T. albacares, T. obesus, K. pelamis* and *T. alalunga)* have always taken precedence at WCPFC. Overall, six of the 24 species (or species groups) mentioned were tunas (Table 4.2), yet other highly migratory fishes and marine megafauna consistently accounted for around half of all letter content annually (Figure 4.3

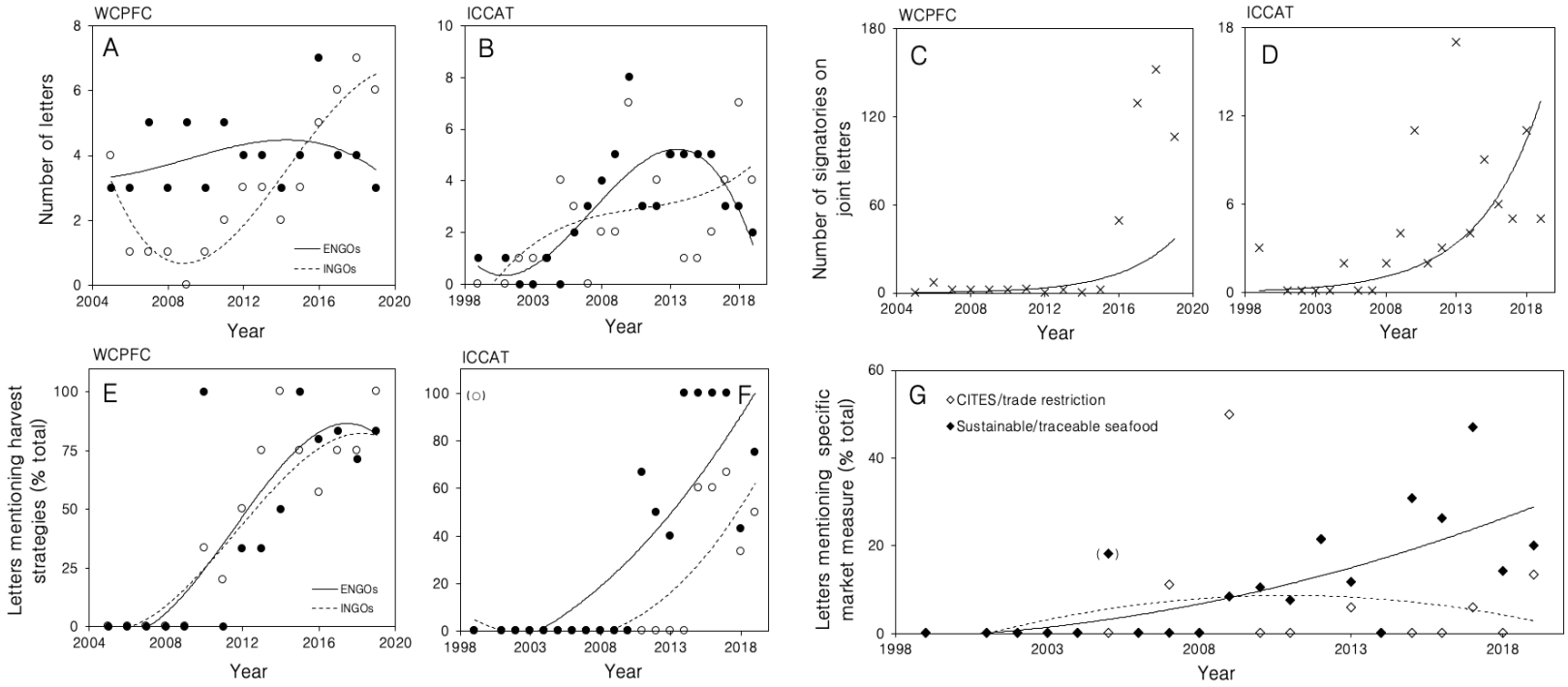

Figure 4.2 Changes in observer letter content over time. Shown are number of observer letters submitted by industry and environmental NGOs to WCPFC (A) and ICCAT (B); number of signatories on joint letters to WCPFC (C) and ICCAT (D); proportion of observer letters advocating harvest strategies for species managed by WCPFC (E) and ICCAT (F); (data point in parenthesis refers is a harvest strategy measure proposed for rebuilding swordfish while all others are specifically related to tuna or 'all stocks'); prevalence of market-based measures in observer letters for both RFMOs combined (G). Trends over time are highlighted using best-fitting second-order polynomial (A, B, G), exponential (C, D), or third-order polynomial trendlines (E, F).

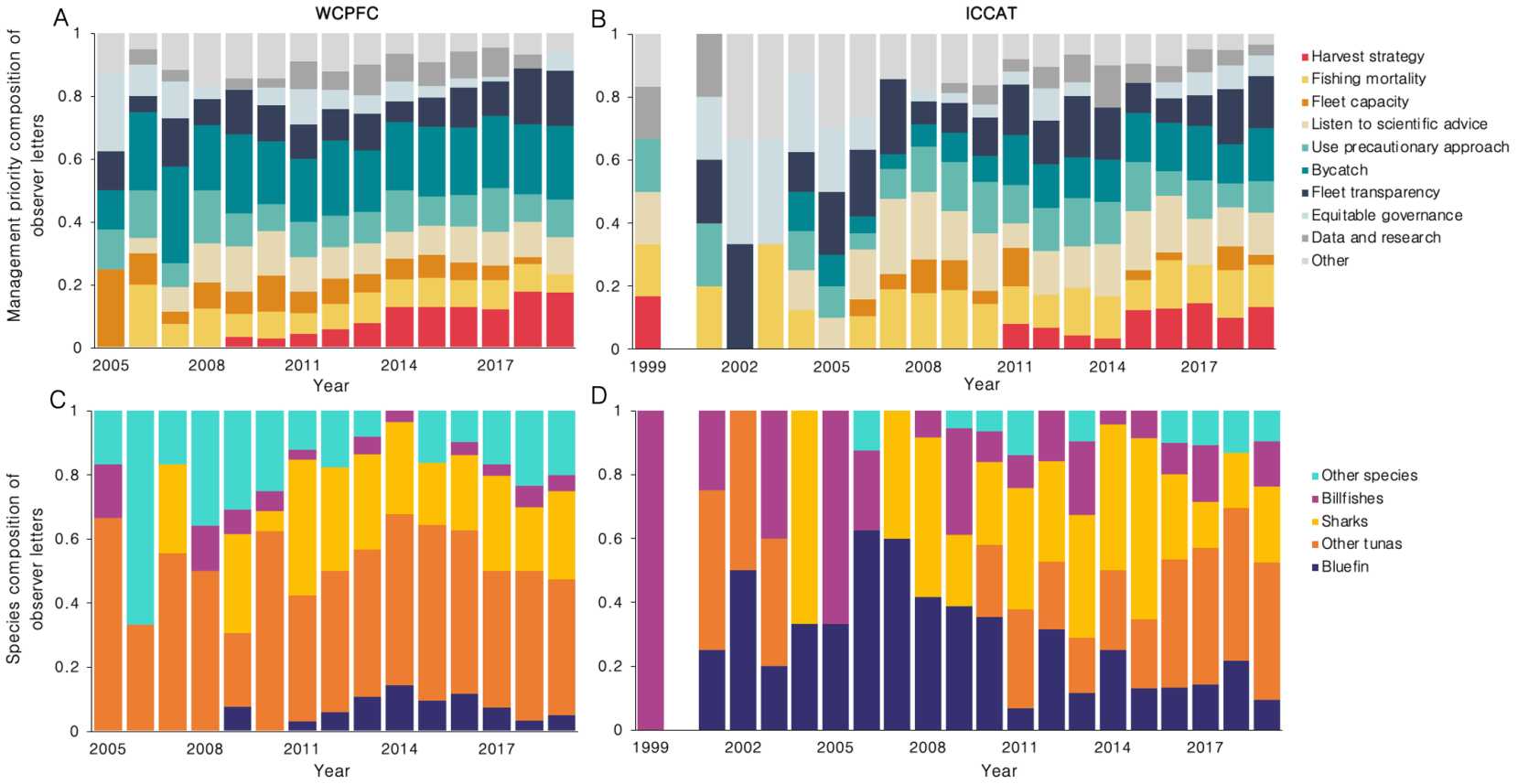

Figure 4.3 Relative proportion of letter priorities to WCPFC (left) and ICCAT (right) over time. Specifically, advocacy around management measures (A, B) and species (C, D) mentioned in ENGO and INGO observer letters submitted to WCPFC (n=105) and ICCAT (n=111) over time. Mention of harvest strategy in 1999 by ENGO was related to Atlantic swordfish; prior to 2010, no letters mentioned harvest strategies (in red) for tuna.

Table 4.2 **Species included in observer letters to tuna RFMOs.**

Common name	Latin name	ICCAT	WCPFC
Atlantic bluefin tuna	*Thunnus thynnus*	X	
Pacific bluefin tuna	*Thunnus orientalis*		X
Bigeye tuna	*Thunnus obesus*	X	X
Yellowfin tuna	*Thunnus albacares*	X	X
Skipjack tuna	*Katsuwonus pelamis*	X	X
Albacore tuna	*Thunnus alalunga*	X	X
Swordfish	*Xiphias gladius*	X	X
White marlin	*Kajikia albida*	X	X
Blue marlin	*Makaira nigricans*	X	X
Striped marlin	*Kajikia audax*		X
Sailfish	*Istiophorus* spp.	X	X
Spearfish	*Tetrapturus* spp.	X	
Silky shark	*Carcharhinus falciformis*	X	X
Mako shark	*Isurus* spp.	X	
Thresher shark	*Alopias* spp.	X	X
Blue shark	*Prionace glauca*	X	X
Porbeagle shark	*Lamna nasus*	X	
Oceanic whitetip shark	*Carcharhinus longimanus*	X	X
Whale shark	*Rhincodon typus*		X
Hammerhead shark	Sphyrnidae	X	
Mobula ray	Mobulidae		X
Seabirds	Procellariiforme	X	X
Marine turtles	Chelonioidea	X	X
Marine mammals	Cetacea	X	X

C, D). WCPFC observers advocated bycatch measures nearly as frequently as they did target species management (22%), while letters to ICCAT showed bycatch was a lower observer priority overall (11%), although relative inclusion of this topic has doubled over the last decade.

4.3.2 Policymaker perceptions of observer participation

Most (77%) RFMO policymakers reinforced that observer presence is critical for transparency and accountability in decision-making (Table 4.3). Many interviewees said current delegate-observer interactions are constructive and more relaxed relative to the past. According to Advisor-3, "[ENGO engagement] has become more professional, clearer. And more technical

also. Instead of shouting and using slogans, it's going into the real issues and sometimes also ways forward." This perspective was echoed by Advisor-1 who said, "current effective engagement by the NGOs tends to be a mixture of collaborating or funding on technical stuff and also advocacy rather than the old days where it was probably more stereotypically campaign-focused". Multiple policymakers felt observers used hyperbole in the past—with Delegate-5 calling certain tactics "emotional blackmail". Nearly three-quarters of policymakers and IGO representatives expressed countries are wary of observer involvement and/or hesitant to collaborate directly with certain groups, while others stressed that private organizations are responsible for ensuring their agendas do not undermine state sovereignty and appreciate the socio-economic considerations managers also strive to consider (Table 4.3). Delegate-3 said, "[observers are] very good at influencing public perception so I always treat them quite carefully because they are playing to an audience and, at the same time, they're holding government and industry to account. But I think sometimes their messaging is not always exactly the same as ours." Six of 13 policymakers cited a lack of transparency in observer funding sources or funder influence (Table 4.4) —both of which were linked to unclear motivations for engagement.

4.3.3 Interactions between policymakers and observers

Spoken interventions by observers have occasionally pushed policymakers through negotiation deadlocks. Delegate-6 stated, "[adopting a bluefin recovery plan in 2010] was a huge effort and a big fight on many fronts and the NGOs at that time were an important voice helping to drive our decisions in the right direction". Delegate-4 re-enforced this point: "there are times when [the observers] forced us to do something because we didn't want them to be able to say we hadn't" but emphasized that observers can also slow down or impede negotiations, especially around sensitive issues (e.g. fishing compliance). Still, observer impact at meetings is limited. As Advisor-3 said, "[policymakers] listen very carefully to some of the bycatch issues because they see emotion and sensitivity around those, but I really don't think they take anything seriously until the core tuna management issues". INGO-4 stated that letters ensure observer views are officially recorded, but 20 of 26 interviewees said letter content had little impact on negotiation outcomes (Table 4.5). Still, half of interviewees thought observers can play an important advisory role and six of 13 policymakers suggested independent research produced by observer organizations was

Table 4.3 Interview perspectives on observer influence and meeting priorities. Marker (o) indicates content related to this theme was expressed by the interviewee. Note: absence of marker does not necessarily indicate disagreement with the statement (it may be that conversation related to this theme did not arise).

	Policymakers												Official observers											
	Advisor*					Delegate								ENGO					IGO		INGO					
Interviewee perspective	1	2	3	4	5	1	2	3	4	5	6	7	8	1	2	3	4	5	1	2	1	2	3	4	5	6
Observer letters and/or interventions can be helpful to delegates but have limited impact at meetings	o	o	o	o	o	o		o	o	o	o		o		o	o	o	o	o	o	o	o			o	
Harvest strategies will improve negotiation process and/or overall management of tuna		o	o	o	o	o		o		o	o		o	o	o	o	o	o	o	o	o	o	o			
Presence of private actors at meetings is important	o	o	o	o				o	o	o	o	o	o		o	o	o	o	o	o				o		
Beneficial and/or influential observer/delegate interactions occur outside RFMO meetings	o	o	o		o				o	o						o	o	o		o	o	o	o		o	o
Interactions between observers and delegates can be constructive	o	o				o		o		o	o		o		o	o		o		o	o	o			o	
Observers can play strong advisory role to delegates	o					o		o		o	o		o	o	o	o	o				o	o			o	
Biggest challenge at RFMOs is reaching consensus on CMMs	o	o	o	o	o										o	o			o		o			o		o
MSC certifications have provided one reason for recent alignment of observer messaging around harvest strategies and/or collaboration	o			o										o	o	o		o		o		o	o	o	o	o
Observers and other private actors have differing levels of access to governments				o	o		o	o	o									o	o		o	o				o
Relationship between INGOs and ENGOs is increasingly collaborative								o							o			o	o	o	o	o	o	o		
Meeting priority given to issues is dependent primarily on economic value (key fisheries/species)		o				o		o		o	o				o	o				o	o					
INGOs and industry members can be strong influencers of management decisions	o		o				o	o		o									o	o	o		o			
Summaries or independent research in letters to RFMO delegates is useful	o		o	o	o		o			o					o	o		o								
Observer motives, interests, and/or funders not always transparent		o		o			o	o		o	o						o			o			o			

*These individuals may not be of the same nationality as the RFMO country they represent but they are employed by the that country's government to represent its interests and negotiation position during a given meeting. Examples of advisors include people who previously worked for a member country government (and are now retired from public service), academics/independent researchers, and professional consultants.

Table 4.4 Interviewee rationale for distrust or hesitation in engaging with observers. Specific responses from policymakers (and IGO representatives) on why they are resistant to observer advocacy. Content in brackets refers to de-identified affiliations or company names, or cases where acronyms were spelled out, or where words were added for clarity.

Policymaker	Quote
Advisor-2	"We've had some issues in the past that NGOs, because they have quite a lot of money—and this is particularly the philanthropic based NGOs—and have very high political profiles around the place, have direct access to political leaders, particularly in small countries. And I think they need to wield that power with a bit more responsibility because we have seen cases where leaders have been convinced to take actions that really aren't in the best interest of the economic development of their countries in order to achieve environmental outcomes…[NGOs] need to take the time to consult with the baseline government departments before walking into the President's office."
Advisor-3	"Consumer groups are not present [at meetings] but they are indirectly: the NGOs, civil society. [However] it's not always clear if they defend their members as political actors or also as consumers. And it's a bit of both of course."
Advisor-4	"Some of the [delegations] are wary [because] they see everyone coming marching in [saying] "we want to help…" and they think, "you're coming to try to tell us how to manage this?"…Some NGOs, I can understand why they're here [but] others I don't really know, I think they're just taking up space. They all have their own dynamics and politics going on amongst themselves, they're all competing and jostling for who gets attention and who gets to meet which delegates and who drinks with who [and] I think it's kind of disgraceful to see that."
Delegate-1	"The NGOs: it is quite a reasonable number of people [attending meetings] but the industry is over-represented here. They come here because they have very powerful lobbies. Especially the industrial fleets, they have very good organizations, even NGOs that are paid directly by the industry."
Delegate-2	"[ENGO A] funds Fishery Improvement Projects—and of course you've got to protect your partnership, so you better not criticize your donor. And then you've got [Tuna Fishing Company B] and they work supportively with [ENGO B] on social accountability. And then you see [ENGO B] attack other companies that just happen to be the opposition to them. So, some of these NGO groups have become tools in commercial warfare."
Delegate-3	"…the NGOs have had to moderate their message a bit because it's not about leaving [fish], it's about managing [fisheries] for the benefit of countries that really need this revenue in order to develop, and their way of life. It's easy to sit at home and agitate on an issue around conservation and sustainability while sipping on your latte, it's a bit different when you're out there in the [Pacific] Islands trying to get an education system or a hospital…"
Delegate-4	"I have always been of slightly two minds on the participation of observers are RFMOs. I think that there is a real benefit to transparency, and I think there is a true role that NGOs could play to help keep us honest, particularly when we're talking about fish on the high seas—this is the global commons, and the world deserves to know how we're managing it. On the flip side… I know that there are certain conservations [between policymakers] that won't happen unless the doors are closed. And those are important conversations from my perspective."

Delagate-5	"It is my understanding that NGOs have funders as well. So, depending on who funds you and what result they want to see from you…I think sometimes they exaggerate, you know? They exaggerate to drive their message home."
Delegate-6	Some [NGOs] exaggerate or misbehave in some ways, not conveying the facts as they should be conveyed, there is a lot of manipulation being done by the NGOs because of their own interests, I understand that. So I'm not saying it's all perfect [because] they have a lot of problems and they have created a lot of problems, particularly when they haven't conveyed information in a proper manner… But, having said that, I am grateful for their work because in the balance I think it's much more beneficial and helpful than prejudicial."
IGO-1	"There are very few people, especially from the industry [who are] just observers sitting behind their plates. These people have access to most of the delegation throughout the year, they take a position as an observer to be able to voice publicly their position, but their influence is as much, if not more important in the inter-sessional period, helping shape the brief and the position of the delegations. And it changes a lot from country to country. There would be some countries in which it is the foreign private sector who has influence."
IGO-2	"Whether [INGOs] mean to or not, [promoting their members' positions] could undermine coastal state management measures and to the extent that that is happening, then there is a tension between coastal state positions and some of those big organizations, the big multi-nationals in particular."

useful, as were infographics depicting key management priorities or stock status information. Advisor-2 emphasized that targeted messaging is key: "I think [letters] can be really useful at times, when they are specifically focused on a solution to an issue. Where I find them quite unhelpful is where you get an omnibus letter with 72 signatures underneath it". Still, despite having little impact on RFMO decisions, INGO-1 and INGO-5 expressed that joint letters represent a novel conduit between businesses and policymakers and the increasing number of signatories suggests seafood companies are increasingly engaged and aware of RFMO decisions and, by extension, the health of tuna stocks.

Notably, 57% of all interviewees said that the most effective way for NGOs to engage with policymakers was outside of RFMO meetings as most government positions are decided in advance (Table 4.3). At national multi-stakeholder advisory meetings, "the messages of the NGOs are very important because [our country] tries to take them onboard… before coming to [RFMO] meetings" said Delegate-1. ENGO-4 expressed that being included in intersessional meetings is "just part of this growing acceptance of civil society being a part of the process and being a stakeholder and having knowledge and expertise that is valid and listened to. And that's a very significant change from [my country's] perspective".

Intersessional engagement represents a deviation from past approaches by NGOs as well. As ENGO-3 explained they now meet with government officials throughout the year since, "[our message] will have no impact at all unless you've done your homework beforehand, which is all about meetings and relationship building not just at the [RFMO meeting] but before". Importantly, ENGO-4 also cautioned, "[it's] a very delicate line to walk... to maintain your transparency and [the notion] 'we're advocates, we're credible, this is what we do', gets harder the more embedded you are."

4.3.4 Observer strategies and collaboration

Observers and policymakers alike acknowledged that RFMO negotiations focus on decisions for the largest or most economically important stocks. For example, at ICCAT, Atlantic bluefin negotiations take a disproportionately large amount of time and all ENGO observers at ICCAT expressed frustration around the lack of attention to sharks and bycatch (only one WCPFC observer felt similarly). To affect change in both tuna fishing practices and fisheries management, INGO-5 indicated a comprehensive approach is needed: "We want to see the RFMOs adopt effective management measures that are based on the best available science [so] our engagement falls into a couple baskets. One is this direct engagement where [we] talk to national governments, fleets, or other NGOs, and the second is participating in technical places where we have expertise". Similarly, ENGO-3 explained, "part of what we've done is sponsor expert workshops to bring scientists, managers, stakeholders together to try to get the latest and greatest science and thinking together to develop best practices that we and others can support".

Regarding interactions with other organizations, five of six INGO observers noted more collaborative partnerships with ENGOs relative to the past. As INGO-2 explained, "through the [domestic] advisory councils, we have a much better relationship with the environmental NGOs than we had several years ago. We were able to sit around a table and discuss issues [and] sometimes we agree, sometimes we don't agree, but we have learned from them and I think also they have learned from us". All NGO observers also expressed that tuna-focused work in recent years is linked to the sustainable seafood movement—although some more directly than others (Table 4.5). Specifically, nine of 11 NGO observers discussed how their

Table 4.5 NGO interviewee perspectives on sustainable seafood advocacy and RFMOs. Specific responses on how observer organization advocacy and work is related to the sustainable seafood movement and/or MSC certification for tuna, where collaboration between different groups occurs, and how this does (or does not) relate to their advocacy at RFMOs. Content in brackets refers to de-identified affiliations or company names, or cases where acronyms were spelled out, or where words were added for clarity.

Name	Quote(s)
ENGO-1	"[Two of my colleagues] used to regularly go to the NGO Tuna Forum* and a lot of [their work with that] has been certification-orientated and based. And at the moment we are in very tight negotiations, once again playing a go-between role...between [Tuna Fishing Company A] and [Retailer B]. Because on the one hand, [Retailer B] wants to demonstrate to their consumers that they are buying sustainably-sourced products. And [Tuna Fishing Company A] would like to see a big group like [Retailer B] take more of their MSC-certified product because they can pay a premium price for it and that helps them maintain the certification."
ENGO-2	"I won't say that [MSC certification] is driving [my organization's] approach because there are a number of factors that go into how we approach any particular issue...what I will say is that MSC certification has unquestionably had an impact on [the RFMO] process." | I think [focusing effort on the supply chain] is more effective [than focusing on consumers]—and that's one of the areas where we work, and [ENGO A] and even [ENGO B] —it's about connecting the retailers with the issues in a way that encourages them to consider their own brand risk and reputation."
ENGO-3	"Our focus used to be on single-stock, ending overfishing and rebuilding whereas now through the harvest strategies work, we're trying to prevent overfishing in the first place... [MSC] hasn't impacted our strategy at the RFMOs directly but we work kind of in a parallel track to the certifications…I see the value of the MSC as a carrot. If we hit some of the stick, they provide a carrot. And on some issues, we help each other out—not on purpose necessarily—and others not so much."
ENGO-4	"I work half of my time on eco-certifications, but I don't connect them to RFMOs… at the moment I am involved in the global steering committee on trying to reform the MSC process itself…"
ENGO-5	"When we think a fishery is not prepared to go for certification, we advise the fleet... to enter a robust [Fishery Improvement Project]. You have five years to try and improve your performance, to improve the governance of the fishery. It's a powerful tool because you are joining forces [with] government authorities, private sector companies, from other NGOs…"
INGO-1	"all the groups [in the NGO Tuna Forum] are getting together twice a year, agreeing on priorities [and] most groups are interested in reforms to the highest volume fisheries… that's where a lot of the attention is [and] it is helping to get alignment and a common message." | "I think the focus of a lot of NGOs to work with retailers to work on their sourcing commitments is a good approach, except that's where the messages get so confused, and the greenwashing is dominating even the NGOs."
INGO-2	"Our main objective is to have measures that are possible to apply, that are reasonable, and that follow the objective of sustainability in the three senses: environmental, social, economic ...We want to improve the management of the stocks. [Fishery Improvement Projects] is one way, and that's why our companies are involved in FIPs. Because we believe we can always improve what we do, as companies...we are working with [ENGO A] in at least two FIPs, we are working with [ENGO B] in another FIP, we are collaborating with [ENGO C] on issues

	relating to seabirds, we are working with [ENGO D] on issues related to [illegal, unreported and unregulated fishing]…"
INGO-3	"Since fisheries have entered the MSC program, whether certified or in the full assessment process, we identify specific topics related to those specific fisheries that need to be reinforced or improved...we work a lot before [RFMO] meetings with the [fishing companies], with the partners, with the governments where those fisheries [are] so usually they can bring those topics to the [RFMO] meetings."
INGO-4	"Our main objective is to create a voice for our members in these RFMO meetings...some of our members [are] MSC-certified and one of the key principles for that certification is to have a good fisheries management framework in place...We need the MSC, like the premium price that we get from the certification, our MSC-certified fish, it helps us to cover for some of our operational expenses."
INGO-5	"We see the MSC as the gold standard with the 23 [indicators] as the elements that are necessary for achieving sustainable tuna fisheries." | "Some of the NGOs [at this RFMO meeting] have direct market partners with retailers and major buyers that they advise and so I think part of [signing letters] is making sure that the group here understands that the NGO community is paying attention."
INGO-6	"...harvest strategies for these fisheries, everybody knows that's what we need, it's just coming to agreement on them. And if you have more MSC-certified fisheries or fisheries in the program, it's just more leverage that they can apply to these delegations."

*The NGO Tuna Forum includes ENGOs and INGOs from high-income countries: ISSF, Greenpeace, Environmental Defense Fund, Monterey Bay Aquarium, Earthworm, Conservation International, Ecology Action Centre, Pew, FishWise, The Nature Conservancy, WWF, BirdLife International, Sustainable Fisheries Partnership, Ocean Outcomes, Shark Project, and the International Pole and Line Foundation. Collectively, these groups work to improve the sustainability of tuna fisheries through RFMO advocacy, seafood company sourcing commitments, and changes in on-water fishing practices.

organization collaborates with fishing and seafood supply chain companies and/or other NGOs to support tuna fisheries holding or seeking Marine Stewardship Council (MSC) eco-certification or those involved in a Fishery Improvement Project (FIP; Table 4.5). These efforts often scale up to advocacy at RFMO meetings, especially in the context of harvest strategies, which are a critical management requirement for MSC-certified fisheries. As INGO-1 explained, "there's kind of this NGO grouping that's gotten together with the support of the Packard Foundation, where all NGOs working in tuna fisheries have aligned behind common strategies and principles—harvest strategies is, quite frankly, the easiest one". Regarding the relationship between industry and environmental groups, Delegate-3 said, "I've always thought your fishermen are your greatest conservationists… they're the ones [environmental groups] need to work with. It always struck me as an obvious relationship that should be there, rather than [being] adversarial. Still, not all delegates are equally encouraging of these recent partnerships between industry and environmental NGOs and such

collaborations are one reason some policymakers are wary of current NGO advocacy (Table 4.4).

4.4 Discussion

Building on previous work by Dellmuth et al. (2020), who ask how observer participation at RFMO meetings could be extended, deepened, and enhanced, we find that proactive and sustained engagement outside official RFMO meetings is currently the most effective way for observers to influence policymaker positions. Still, retaining independence is essential for the credibility of civil society groups who view themselves as critical purveyors of information to governments, and liaise between different stakeholder groups during decision-making processes (Cadman *et al.* 2020). Based on the feedback of multiple interviewees, this may be a key challenge for observers as they work more closely with policymakers and each other.

We also find that while observers continue to advocate science-based target species management through RFMOs, they no longer see engagement in these meetings as their only mode of reforming tuna fisheries. In addition to RFMO advocacy, both environmental and industry NGOs are now also involved in work related to the sustainable seafood movement. This movement expanded in the early 2000s, when ENGOs began pressuring major seafood retailers such as Walmart, Sainsbury's, and IKEA to source only MSC-certified products (Gutiérrez and Morgan 2015; Roheim *et al.* 2018). We find ENGOs now also engage with tuna fishing companies and partner with INGOs to affect the entire seafood supply chain by facilitating sourcing of MSC-certified products or collaborating on Fishery Improvement Projects (FIPs; Table 4.5). A strong indicator of this shifting strategy is the rapid increase in the mentions of sustainable seafood and harvest strategies in RFMO letters (Figure 4.2E, F, Figure 4.3A, B). Likewise the increasing number of joint letter signatories (Figure 4.2C, D) signals increasing alignment in messaging by observer ENGOs and INGOs, as well as external supply chain companies and non-observer NGOs. This is noteworthy since, only two decades ago, the fishing industry was skeptical of sustainable seafood recommendations (Broad 1999), and viewed ENGOs as adversaries (Ish and Osterblom 2019). Equally, leading ENGOs presented an outwardly antagonistic front in their campaigns, publicly shaming the tuna fishing

industry and RFMO policymakers (Associated Press 2010) and insinuating corruption in fishing practices and policy-making (Laiviera 2010).

With regard to species advocacy, a strong focus on bluefin in ICCAT letters up to 2010 changed in the wake of an adopted bluefin recovery plan (ICCAT 2009), a shift to advocacy around harvest strategies for all target stocks, and concerns over declining bigeye (ICCAT 2018b). At the same time, ongoing challenges to address tuna fishery bycatch remain. For five decades, ICCAT policymakers were not legally mandated to manage Atlantic sharks but, since changes to the Convention Text in 2019, they are now required to do so (ICCAT 2019a). Still, the scientific community has long documented negative fishery impacts on elasmobranchs and advocated stronger management for years (Schindler *et al.* 2002; Gilman *et al.* 2008; Dulvy *et al.* 2008, 2017; Gilman 2011; Clarke *et al.* 2012; Worm *et al.* 2013). While we found similarly enduring pressure from many RFMO observers in their letters, shark populations have continued to decline (Pacoureau *et al.* 2021).

RFMO policymakers are already responding to pressure for harvest strategies as part of MSC-certification requirements (Schiller and Bailey 2021), and we suggest observer involvement in the sustainable seafood movement could similarly affect stronger measures for bycatch. Recently, the Monterey Bay Aquarium's Seafood Watch program, which assesses the environmental sustainability of fisheries, rated half of tuna fisheries globally as 'avoid', partly due to "continuing inaction on bycatch across RFMOs" (Seafood Watch 2021) and, when independently assessed against the MSC Standard 128 of 166 generic tuna fisheries (i.e. target species-gear-RFMO combinations) received failing scores on RFMO management of nearly 600 bycatch species (Medley *et al.* 2018). With recent criticism over the effectiveness of MSC's 'zero tolerance' shark finning policy (Ziegler *et al.* 2021), and ongoing scrutiny around environmental impacts of certified fisheries (Devitt *et al.* 2011; Christian *et al.* 2013a; Ramsden 2018), we anticipate increased attention toward how MSC-certified fishing fleets and their NGO partners address bycatch. We suggest that such scrutiny is both warranted and beneficial for assuring the credibility of organizations involved in the sustainable seafood movement as well as the effectiveness of their engagement with RFMO policymakers.

4.5 Conclusions

In conclusion, we find decadal changes in RFMO advocacy priorities such that harvest strategies are now the primary measure advocated to manage target species. We also observe increasing alignment in messaging to policymakers from ENGOs, INGOs, and supply chain companies. Interviews with RFMO attendees provided contextual detail on how different observer organizations influence the negotiation process and help drive efforts to reform tuna fishing practices and their management. RFMO policymakers are receptive to the contributions of NGO groups, and the relationship between delegates and observers has become more constructive over time. Yet, for observer influence to remain credible, they must communicate their motives transparently and ensure their information is factual.

5 WHO GOVERNS INTERNATIONAL FISHERIES?

5.1 Introduction

Over the last century, collective human impacts on ocean environments and marine life have rapidly intensified (McCauley *et al.* 2015; Jouffray *et al.* 2020). Reported capture fisheries landings have quadrupled since 1950 (FAO 2020b) and the global value of seafood exports surpassed other staple food products such as soy, coffee, wheat, poultry, and cocoa over a decade ago (Asche *et al.* 2015). To date, applied ecological research on global fisheries and seafood production has largely focused on evaluating the distribution and impacts of fisheries on fish populations (e.g. Myers and Worm 2003; Agnew *et al.* 2009; Worm *et al.* 2009, 2013; Swartz *et al.* 2010; Pauly *et al.* 2012; Costello *et al.* 2020), the relative environmental impacts of different fishing countries (e.g. Pauly and Zeller 2016; Sala *et al.* 2018; McCluney *et al.* 2019; Costello *et al.* 2020), and how specific management input or output controls could alleviate negative fishing impacts at large scales (e.g. Pauly *et al.* 2002; Hilborn 2007; Mora *et al.* 2009; Worm *et al.* 2009; McClanahan *et al.* 2015; Sumaila *et al.* 2016; Burgess *et al.* 2018).

Similarly, applied political science research on how fisheries management could be improved regionally or globally has investigated institutional structures that relate to the ability (or inability) of fishing countries to ensure fish stock health and sustainable fishing (Cullis-Suzuki and Pauly 2010; de Bruyn *et al.* 2013; Costello *et al.* 2016; Pons *et al.* 2017b; Juan-Jorda *et al.* 2017; Leroy and Morin 2018; Haas *et al.* 2020a; Hilborn *et al.* 2020), as well as the degree to which international governance frameworks enable managers to address equity between countries in decision-making processes and management objectives (e.g. Hanich and Ota 2013; Campbell and Hanich 2015; Yeeting *et al.* 2016; Seto *et al.* 2019; Sinan and Bailey 2020; Willis and Bailey 2020; Haas *et al.* 2020b). Unlike coastal fish stocks, where management falls under the purview of a specific national government resource management department (e.g. Fisheries and Oceans Canada, the United States' National Oceanic and Atmospheric Administration), fish such as tuna have transboundary distributions and, therefore, must be managed collectively by multiple countries (UN General Assembly 1995). Through intergovernmental institutions called Regional Fisheries Management Organizations

(RFMOs), member state delegates ('policymakers') are responsible for adopting management measures to ensure long-term tuna stock health of these species throughout their geographic ranges.

At a practical level, both cooperation and compromise in decision-making are required since RFMO management measures are almost always adopted by consensus. However, conflict is often the norm in decisions related to the environment because of severe differences in power and values across attendee groups (Kooiman and Jentoft 2005; Dietz *et al.* 2017). For RFMOs, this means that the number and geographic origin of member countries as well as the diversity of fisheries and fishing interests they oversee (i.e. different fishing gears for different tuna species, processing and trade interests) often contributes to weak, diluted, and reactionary measures rather than precautionary or proactive ecosystem-based approaches (Szigeti and Lugten 2015; Haas *et al.* 2020b). As a result, existing tensions related to national positions may be exacerbated at meetings, or non-compliance by fishing fleet vessel crew may occur. Further, data used in tuna stock assessments can be two years or more outdated relative to when scientific advisors give management recommendations to policymakers. This results in uncertainties around advice and a time lag between the status of a given stock its associated management measures (Sinan and Bailey 2020)—a problem that further compounds the inherent social and political difficulties of managing transboundary fish (Barkin and DeSombre 2013).

Recently, researchers have begun looking beyond fishing *countries* to fishing *companies* to provide a novel perspective for understanding the influence of different private actors in international fisheries governance (Crona *et al.* 2015; Österblom *et al.* 2015; Packer *et al.* 2019; Schiller and Bailey 2021; Virdin *et al.* 2021) and how this may ameliorate pervasive challenges related to global food production and resource sustainability—not only for fisheries but across sectors (e.g. Österblom *et al.* 2016; Folke *et al.* 2019; Nyström *et al.* 2019). Taking a broad global view of interconnected systems and the ways in which different groups of actors interact enables researchers to see overlapping spheres of influence and, thus, access points for reform at large spatial scales. Such approaches are intuitive given most quantifiable fisheries statistics—principally catch and effort—are attributed to countries (or their fishing fleets), seafood market data are most readily available by country and species, and fisheries management

decisions are subject to national and international political, social, and economic constraints and motivations. However, despite the many strengths of these approaches, we note that it is not countries or companies that are catching and selling seafood or developing management measures for fisheries. Rather, this is the responsibility of individual *people*.

Thus, we suggest that a focus on the individuals that attend and participate in RFMO meetings can shed new light on influences in fisheries governance that are less apparent when research focuses on countries, companies, and civil society (i.e. non-governmental) organizations. Downscaling to the individual has the potential to reveal new ways in which influence in decision-making occurs. Importantly, this view will supplement and refine, not negate, existing work by taking account of the people who participate in meetings and investigating the characteristics of their relationships, which may not be explained only by the countries and organizations they represent. To this end, we ask: *who* governs international fisheries? And—by extensions—*how*?

Below, we first present our case study for analysis: the Western and Central Pacific Fisheries Commission (WCPFC). Subsequently, we provide a conceptual framework for this paper by situating annual WCPFC meetings at the intersection of the system to be governed (the seafood supply chain), and the governance system (RFMO), and we present our hypotheses and metrics for assessing influence of different meeting attendees in Sections 5.1.2 and 5.1.3. In our Methods (Section 5.2) we detail the qualitative and quantitative datasets and procedures used to answer our research question and test our hypotheses and we present these findings sequentially in the Results (Section 5.3). In our Discussion (Section 5.4), we explain how these findings relate to the overall governability of tuna fisheries through RFMOs, and what this means for the resilience, vulnerability, and adaptive capacity of these institutions and the people they govern.

5.1.1 Case study

The Western and Central Pacific Ocean (WCPO) is unique relative to other ocean basins in that it is geographically dominated by the Exclusive Economic Zones of island states, which have small terrestrial areas but combined marine jurisdiction that exceeds 30 million km^2

(Hanich *et al.* 2010b). These waters are key fishing grounds for tropical tuna species (skipjack, yellowfin and bigeye) and prior to the UN Convention on the Law of the Sea (UNCLOS; 1982), this area was fished largely by foreign fleets from the US and Asia—the Japanese fleet accounting for upward of 75% of foreign fishing prior to the 1980s (Schurman 1998). During this time, many partnerships between local governments and foreign investors were also established particularly with regard to seafood processing facilities on more developed islands (e.g. Fiji, Solomon Islands, Papua New Guinea), and many of these companies have persisted for decades (Barclay 2010).

After the UN Convention on the Law of the Sea (UNCLOS) was signed in 1982, Pacific Island Countries and Territories (here 'Pacific Islands') began asserting their sovereign rights to control fishing within their newly defined EEZs. This resulted in conflicts with distant water fishing states—especially the US and Japan—over fishing access agreements (and associated access fees) (Schurman 1998; Aqorau 2011). Over the last thirty years, Pacific Island states have gained increasing power and autonomy in the management of their EEZs through cohesive positions as part of local sub-regional coalitions (Aqorau 2009; Hanich *et al.* 2010a; Miller *et al.* 2014).

The two most prominent Pacific Island state coalitions are the Forum Fisheries Agency (FFA) and the Parties to the Nauru Agreement (PNA). Although not a management body, the FFA provides expertise and support for its 17 member states on sovereign decisions related to the management of tuna within their EEZs and the PNA is a coalition of eight FFA countries. The Western and Central Pacific Fisheries Commission (WCPFC) is the RFMO responsible for overseeing management decisions for tuna stocks throughout their range within the western and central Pacific Ocean (Figure 5.1). This RFMO came into force in 2004 and at the time of our analysis, was composed of 27 member states, six participating territories, and ten cooperating non-members (Table 5.1). Although the WCPFC is the primary tuna fisheries management body in the western Pacific Ocean, FFA plays a strong advisory role to its members during WCPFC meetings, and the PNA has retained significant autonomy with regard to the implementation of regional management measures for tuna in the WCPFC Convention Area given that half of the global skipjack tuna catch comes from within their EEZs.

In 2007, PNA implemented the Vessel Day Scheme (VDS), which charges fishing companies a per-day vessel fee to access PNA EEZs for fishing. By controlling overall purse seine fishing effort in relation to science-based stock status indicators, the VDS ensures sustainable tuna catch while providing economic benefits to PNA countries (Aqorau 2009). Between 2007-2014, there was an observed 279% increase in revenues from foreign access agreements across PNA EEZs (Gillett 2016); the price of a fishing day increasing from $1,350 in 2004 to $7,800 in 2013 (Havice 2013). In addition to the Vessel Day Scheme, PNA countries have implemented additional requirements for fleets operating in their waters (including, but not limited to): 100% observer coverage on purse seiners, in-port transshipments, high seas pocket closures, and seasonal restrictions on the use of fish aggregating devices (FADs). All of these

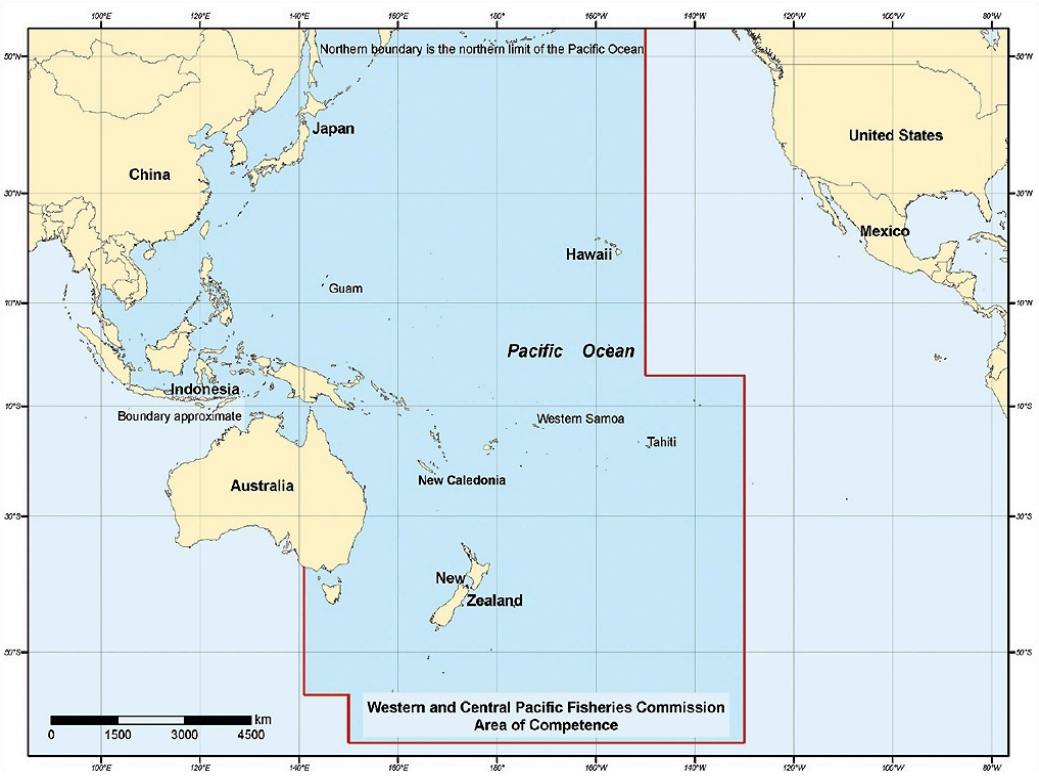

Figure 5.1 Western and Central Pacific Fisheries Commission (WCPFC) Convention Area (shaded blue). Management measures adopted by policymakers at annual WCPFC meetings apply to fisheries targeting tuna stocks throughout this area within coastal state EEZs and on the high seas. Image source: University of Wollongong.

Table 5.1 WCPFC member states as of 2018 (last year in dataset used for analysis). WCPFC member states (M) participating territories (T), and co-operating non-member states (C) may be fishing countries (i.e. flag states), access countries (i.e. coastal states), or key importers of tuna (i.e. market states). These designations are not mutually exclusive since the EEZs of all coastal states are within the WCPFC Area. Flag states fish within their EEZ (domestic; 'D'), within another country's EEZ (foreign; 'F'), and/or in the high seas ('HS'). Here, 'market state' refers to top importers of tuna from the WCPFC Area, not countries with a high local consumption. Catches volumes obtained from WCPFC (2020).

Delegation	Type	Country status	Flag state	Coastal state	Market state	FFA member	2019 catch (mt)
Am. Samoa	T	SIDS	Yes (D)	Yes	No	No	3,056
Australia	M	HIGH	Yes (D)	Yes	Yes	Yes	3,036
Belize	C	SIDS	No	No	No	No	1
Canada	M	HIGH	No	No	No	No	1
China	M	HIGH	Yes (F, HS)	Yes	No	No	72,375
Cook Is.	M	SIDS	Yes (D)	Yes	No	Yes	5,743
Ecuador	C	UP-MID	Yes (HS)	No	No	No	25,136
El Salvador	C	LOW-MID	Yes (HS)	No	No	No	2,939
EU	M	HIGH	No	No	Yes (canned)	No	10,293
Fiji	M	SIDS	Yes (D)	Yes	No	Yes	14,845
Fr. Polynesia	M	SIDS	Yes (D)	Yes	No	No	7,406
France	M	HIGH	No	No	No	No	1
FSM	M	PNA	Yes (D)	Yes	No	Yes	172,939
Guam	T	SIDS	Yes (D)	Yes	No	No	256
Indonesia	M	UP-MID	Yes (D, HS)	Yes	No	No	536,222
Japan	M	HIGH	Yes (F, D, HS)	Yes	Yes (sashimi)	No	322,590
Kiribati	M	PNA	Yes (D)	Yes	No	Yes	221,905
Korea	M	HIGH	Yes (F, HS)	Yes	No	No	344,670
Liberia	C	LOW	No	No	No	No	1
Marshall Is.	M	PNA	Yes (D)	Yes	No	Yes	98,338
Mexico	C	UP-MID	No	No	No	No	1
N. Mariana Is.	T	SIDS	Yes (D)	Yes	No	No	1,174
Nauru	M	PNA	Yes (D)	Yes	No	Yes	33,256
New Caledonia	T	SIDS	Yes (D)	Yes	No	No	2,751
New Zealand	M	HIGH	Yes (D)	Yes	Yes	Yes	11,123
Niue	M	SIDS	No	Yes	No	Yes	1
Palau	M	PNA	Yes (D)	Yes	No	Yes	3,473
Panama	C	HIGH	No	No	No	No	0
Philippines	M	LOW-MID	Yes (D, HS)	Yes	No	No	160,084
PNG	C	PNA	Yes (D)	Yes	No	Yes	267,291
Samoa	M	SIDS	Yes (D)	Yes	No	Yes	3,227
Senegal	C	LOW-MID	No	No	No	No	1
Solomon Is.	M	PNA	Yes (D)	Yes	No	Yes	68,198
St. Kitts & Nevis	C	SIDS	No	No	No	No	1
Taiwan	M	HIGH	Yes (F, HS)	Yes	No	No	289,936
Thailand	M	UP-MID	No	No	Yes*	No	0
Tokelau	T	HIGH	Yes (D)	Yes	No	Yes	67
Tonga	M	SIDS	Yes (D)	Yes	No	Yes	235
Tuvalu	M	PNA	Yes (D)	Yes	No	Yes	7,340
USA	M	HIGH	Yes (F,D)	Yes	Yes (canned)	No	172,913
Vanuatu	M	SIDS	Yes (D)	Yes	No	Yes	37,223
Vietnam	C	LOW-MID	Yes (D)	Yes	No	No	109,315
Wallis & Futuna	T	HIGH	Yes (D)	Yes	No	No	18

measures have been subsequently adopted through the WCPFC, and the Vessel Day Scheme is widely recognized as one of the most successful examples of rights-based fisheries management globally (Aqorau *et al.* 2018; Yeeting *et al.* 2018).

In 2011, the PNA obtained eco-certification through the Marine Stewardship Council (MSC), the world's largest private eco-certification organization. This certification covers all free school purse seine fisheries operating within their EEZs, making it the largest MSC-certified tuna fishery to date (Schiller and Bailey 2021). The PNA rationale for seeking MSC certification was two-fold: additional recognition for the credibility of PNA management measures and commercial opportunities for PNA countries (Yeeting *et al.* 2016). To this second point, MSC certification provided PNA with a means to capture additional market control over tuna caught in their EEZs and, in 2010, the PNA Secretariat pursued into a joint venture with Pacifical, a Dutch-based company that "promotes the catch, production, distribution, and trade" of MSC-certified PNA tuna (Pacifical 2021). Today, high-income countries in the EU are the primary markets for MSC eco-labelled tuna products (60% combined), followed by Australia and New Zealand (30% combined), and the US and Canada (8% combined)(MSC 2020b).

Notably, the ability to monitor fishing activity in PNA waters through the use of satellite monitoring has been fundamental for the enforcement of the VDS—and thus, increasing success—of their management measures (Hanich *et al.* 2010b). Still, not all WCPFC members support PNA's autonomy, suggesting it limits wider regional coherence and some foreign fishing states want WCPFC measures to be applied more consistently across WCPO high seas areas and EEZs (Miller *et al.* 2014). Further, although the Pacific Islands are often viewed in the collective, notable differences in the value of fisheries relative to other local industries differs widely across the islands, as does the abundance of tuna within their EEZs. This variation can lead to disagreements between island states around fishing measures, as well as differing perspectives on foreign investment and aid (Aqorau 2015, 2016).

5.1.2 Conceptual framework: influence and interactive governance theory in the context of RFMOs

Nearly 40% of all seafood is traded internationally and collectively humans consume over 80 million mt of seafood provided by the world's capture fisheries each year (FAO 2020b). From water to plate, seafood supply chains involve fishers, vessel operators and owners, port authorities, as well as employees of small and large seafood processing companies, domestic and international seafood suppliers and traders, regional and global brands, niche and trans-national seafood retailers and restaurants, and ultimately: seafood consumers, whose preferences for seafood products are influenced by taste, price, availability, access, as well as personal cultural or religious beliefs and morals (e.g. human and animal welfare, environmental sustainability, halal) (Olsen 2004; Johnson *et al.* 2005; Thorpe *et al.* 2005). Importantly, these people are not separate entities acting in geographic, economic, or social isolation (Kooiman and Chuenpagdee 2005). Through the lens of 'interactive governance' they are part of an integrated system with the power to address societal problems by bringing their concerns as private actors to the level of public governance institutions (Kooiman 2016).

Torfing *et al.* (2012) define interactive governance as, "the complex process through which a plurality of actors with diverging interests interact in order to formulate, promote and achieve common objectives by means of mobilizing, exchanging and deploying a range of ideas, rules and resources" (pp. 2-3). Simply put: people in the system to be governed (who we term 'stakeholders') try to influence those doing the governing (policymakers) through their participation in the governance system, while policymakers try to influence stakeholders through management efforts (Kooiman 2008). In the context of WCPFC, the common objective of the governance process (i.e. their Convention mandate) is, "to ensure the long-term conservation and sustainable use, in particular for human food consumption, of highly migratory fish stocks in the western and central Pacific Ocean for present and future generations" (WCPFC 2001, pp. 1). In economic terms, this means ensuring fish stocks are managed in such a way as the ensure they provide the maximum flow of net economic benefits to society (not only industry) over time (Lodge *et al.* 2007).

A notable defining feature of the interactive governance framework is the emphasis on different types of interactions between public and private actors. Depending on the system,

such interactions may be adaptive, collaborative, proactive, or passive (Chuenpagdee 2011). In seafood, the role of the individual has focused on the consumer, and the agency that individuals do or do not have through engaging in seafood sustainability initiatives as a means of affecting change in market-based fisheries governance. An additional arena where the influence of individuals may matter, but which has yet to be studied in-depth, is in the context of upstream supply chain actors and their interactions in transboundary fishery governance.

We define influence as the capacity or power of persons or things to be a compelling force on or produce effects on the actions, behavior, [or] opinions of others. Importantly, we acknowledge the myriad geopolitical and socio-economic factors affecting international negotiations, many of which exist outside of the RFMO process but affect policymakers' positions at RFMO meetings (Campling *et al.* 2007; Yeeting *et al.* 2016; Barkin *et al.* 2018; Pinsky *et al.* 2018; Bell *et al.* 2019; Molenaar 2019). Still, ocean-specific tuna fishery management measures for a given year are negotiated and adopted at RFMO meetings, so this venue provides an excellent opportunity to apply interactive governance theory because, while people with a vested interest in the WCPO tuna supply chain understand the relationship between profits made from tuna fishing and the need for healthy tuna stocks, these individuals may have different ideas on how to approach sustainable management in order to maximize returns to their country or company (which are not necessarily consistent with other members' approaches).

RFMO meeting attendees from the 'system to be governed' are people involved in the production, distribution, and final sale of tuna products. Stakeholders attend on behalf of seafood companies or fisher associations and represent a diversity of national and global companies within the supply chain. All individuals bring their unique views, values, and experiences to meetings in an attempt to influence policymakers on the adoption of management measures in keeping with their business needs (i.e. market demands and commitments to civil society) (Figure 5.2). Pre-registration and approval by the RFMO Secretariat are required to attend meetings (i.e. people cannot simply show up the day the meeting starts), but in keeping with best international practices around transparency, all interested individuals are permitted to attend if approved beforehand.

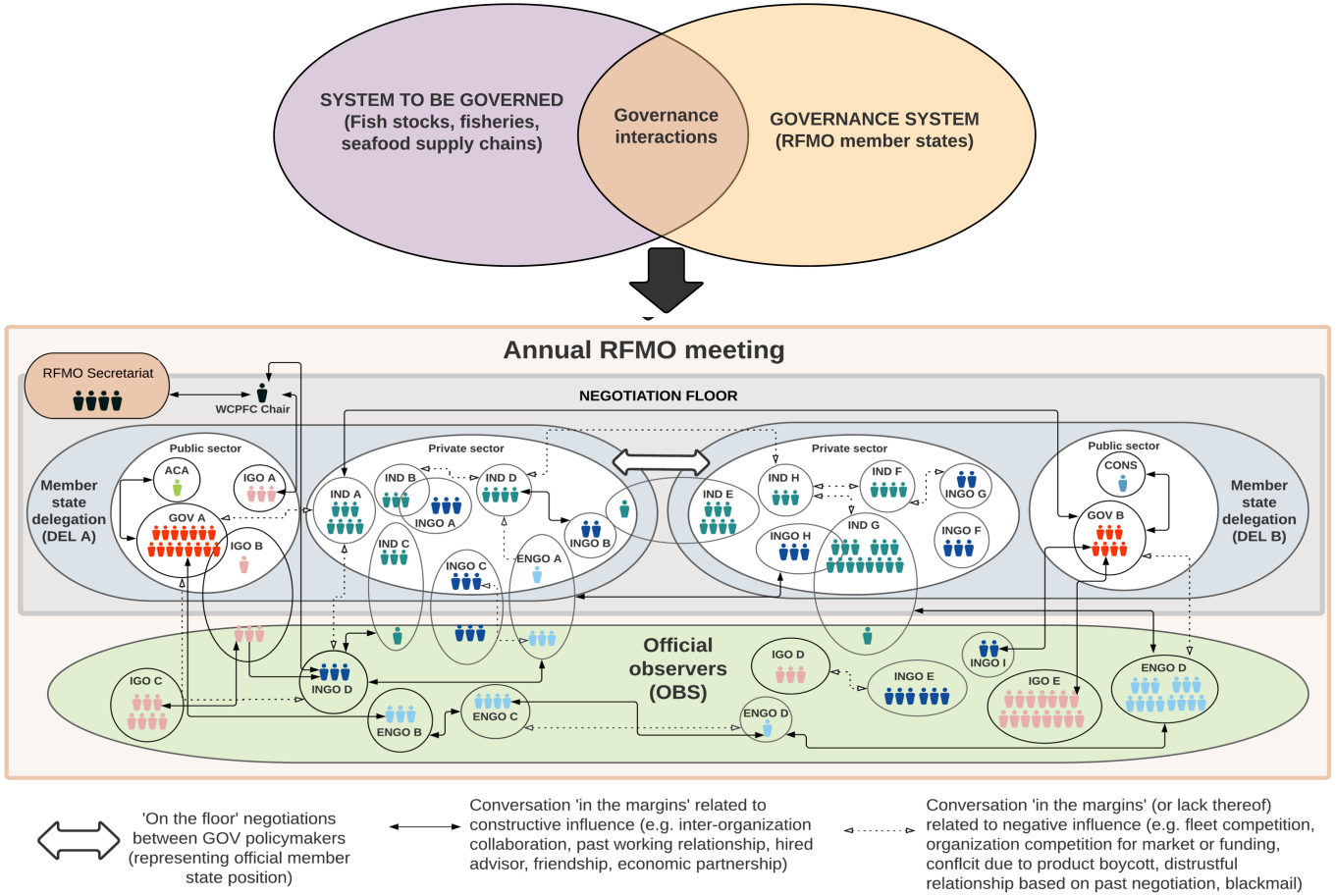

Figure 5.2 Interactive governance framework indicating RFMO meeting structure and pathways of influence. Interactive governance framework indicating RFMO meeting structure and pathways of influence. Annual RFMO meetings are one venue to observe governance interactions between the system to be governed (i.e. seafood supply chain) and the governance system (RFMO) since during these meetings RFMO member state policymakers (GOV; red) are required to adopt management measures for tuna fisheries. The negotiation positions of member state delegations are indicative of measures most beneficial for their state (taking into account social and economic factors). Thus, representatives of seafood companies (IND; teal) and fishing associations (INGO; navy) from different countries attempt to influence these decisions based on the interests of their fishing fleet or business. Other meeting attendees from the public (IGOs) and private sector (NGOs), academia support or refute the efforts of these private stakeholders as well as the positions of different governments. Academics (ACA) and consultants (CONS) may also play an additional advisory role to policymakers.

Given the direct intersection of public policymakers and private stakeholders at RFMO meetings, one way to answer our question on influence is to analyse publicly available official meeting participant lists. Here, attendee information can shed insight on the involvement of different actors over time. These lists indicate who is present at meetings and their interactions can be further deduced from the structure and layout of RFMO meetings, which follow certain rules and procedures. Within a given meeting, we distinguish two types of interactions: (i) 'on the floor' negotiations where decisions are made and measures are officially adopted, and (ii) discussions 'in the margins', which are informal conversations related to the desired outcomes of the meeting. On the floor negotiations occur primarily between government policymakers or authorized negotiators while discussions in the margins are informal private or semi-private exchanges between anyone. For this reason, our analysis focuses on analyzing the relative importance of attributes related to the *capacity* aspect of decision-making influence (as defined above).

The overarching purpose of WCPFC meetings is to provide an international forum for the negotiation of tuna fishery measures. Thus, external factors related to fishing will contribute to meeting attendance. Since fishing is an economic venture, we hypothesize: (i) there will be a significant positive relationship between delegation representation and average annual tuna catch. We further hypothesize that since specific RFMO tuna stock management measures are required for MSC eco-certification: (ii) there will be a positive correlation in the representation of MSC client groups at WCPFC meetings and the number of MSC-certified tuna fisheries in the WCPO over time. We present additional hypotheses related to our investigation of interactions that occur *within* meetings below.

5.1.3 Paring ecological concepts to social capital to assess influence

While we characterized the two avenues for attendee interactions related to the rules and procedures of RFMO annual meetings (on the floor and in the margins), the influence of individuals (and groups) is notoriously difficult to measure empirically, especially in complex dynamic systems (Tsui and Lucas 2013). As such, we turn to definitions from ecology as analogies to quantify attributes of attendee interactions deducible from the structure of RFMO meetings, our meeting lists, and our interviews. To do this, we situate RFMO meetings and

their attendees within a broader socio-ecological system (Figure 5.3). Subsequently, we pair ecological concepts with indicators of social capital. The indicators we describe below are all proxies for measuring attendee cooperation, knowledge transfer, and trust—all of which affect negotiation outcomes and overall institutional effectiveness (Ostrom *et al.* 1999; Simonin 1999; Dirks and Ferrin 2001; Hoffman 2002; Thompson *et al.* 2010; Iliopoulos and Valentinov 2018).

Taken together, composition and representation are indicators of ecosystem diversity. The *composition* of an ecosystem refers to the number of species within it, and *representation* is synonymous with relative abundance, which is the proportion of a given species within an area relative to all other species. Therefore, this concept expresses how common or rare a species is within a community. For our analyses, we determine the diversity of RFMO communities (i.e. member state delegations and observer area) and the whole RFMO ecosystem for each meeting and compare meetings over time. In biological systems, species with high abundance are often able to outcompete similar species that have lower abundance when resources (food, habitat) are limited, leading to high reproductive success and survival (Harvey 2008). We hypothesize that in RFMOs, representation is proportional to meeting influence, and that influence will be highest for people from affiliations and delegations with the highest representation since they have the same goals for meeting outcomes and will be able to propagate their priorities farther as a result.

In addition to influence related to meeting composition and representation, we return to our overarching view that the outcomes of RFMO meetings are the result of the interactions between people—not countries or companies. Thus, decisions are also related to factors beyond which delegations or companies have the most people attending, especially if people sitting on a delegation have a limited connection with policymakers. Further, all attendees go into a meeting with a desired outcome, yet their ability to influence that outcome is related to the dynamics of a given meeting as well as outcomes of past meetings (Ostrom 2005). Repeated interactions among the same individuals result in both a historical knowledge of negotiation tactics as well as future opportunities to enforce threats, keep promises, and uphold credibility among those involved, which may promote cooperation (Mccabe *et al.* 1996). Depending on circumstance, past negative interactions may be difficult to overcome,

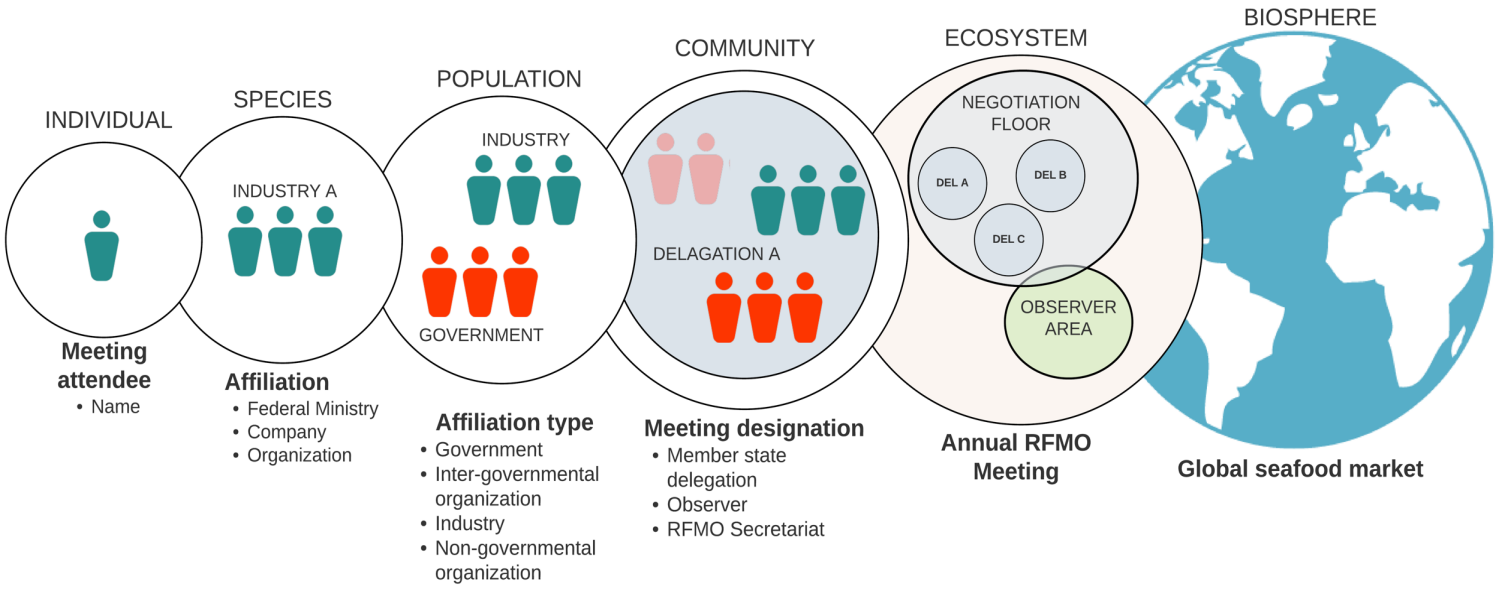

Figure 5.3 Conceptualization of annual RFMO meetings as ecosystems. Left to right: terms above each orb refer to the levels of an ecosystem (from smallest component to largest) and terms below orbs indicate the RFMO meeting equivalent (with relevant examples).

perpetuating conflict and distrust between individuals and groups (Kydd 2010; Teucher *et al.* 2013).

For repeat interactions, we suggest that one way to understand the influence of RFMO meeting attendees is in the context of social capital, which can only exist through interactions between people. Coleman (1988) first explained social capital as functional social bonds and relationships that affect societal actions. As Burt (2000) suggests, "certain people or certain groups are connected to certain others, trusting certain others, obligated to support certain others, dependent on exchange with certain others. Holding a certain position in the structure of these exchanges can be an asset in its own right. That asset is social capital." If a person has the "right" place within a network, they can help address problems faster and more effectively (Oh *et al.* 2004) and social capital plays an important role in negotiations, which are inherently social in nature (Morris and Gelfand 2004).

Social capital facilitates cooperation between people by lowering the costs of working together (Pretty 2003) and is especially valuable in repeat inter-cultural negotiation interactions (Kumar and Worm 2003; Morris and Gelfand 2004). Although social capital is difficult to measure quantitatively, it can be viewed in the context of bonding, bridging, and linking: 'bonding' describes connections between people with similar objectives and arises through their engagement in local groups (e.g. a specific fishing company), 'bridging' explains how these groups relate to other groups that may have opposing views, and 'linking' describes a group's ability to connect with external agencies, to influence policies or obtain useful resources (Pretty 2003). RFMO meeting interactions include all three forms of social capital depending on the scale observed, and we asses three attributes of WCPFC meeting attendees in relation to social capital: longevity, dispersal, and connectivity.

In biological terms, *longevity* refers to the duration of an organism's life, from birth to death. High longevity is observed in many highly social animals (e.g. whales, macaws, elephants) and has been proposed as an indicator of kinship, cooperation, leadership, and/or parental teaching within close social groups for over 40 species (including humans) across five vertebrate classes (Carey and Judge 2001; Silk *et al.* 2010; Foster *et al.* 2012). Here, we compute longevity as an individual's participation in RFMO governance interactions, measured in total

number of RFMO meetings they attend. We hypothesize that individuals with high longevity will have higher level of bonding, bridging, and linking social capital capabilities, which translates to greater influence given their institutional knowledge of past meetings, as well as the relationships they have built with other meeting attendees over time (assuming other attendees also possess longevity as an attribute to allow for repeated interactions).

Connectivity refers to how well a given landscape facilitates or impedes movement of individuals from one area to another. This is in part related to how an individual perceives and responds to their current environment, as well as the cost and ability of moving (Holyoak 2008). In nature, wildlife corridors that facilitate the connectivity of highly mobile and/or social species (e.g. bees, pelagic fish, caribou) through developed spaces are essential for ensuring species diversity and ecosystem resilience under challenging environmental conditions (e.g. climate change, urbanization) (Berger *et al.* 2008; D'Agostini *et al.* 2015; Braaker *et al.* 2017). Social network analysis models for humans have been found to successfully predict connectivity in natural landscapes for birds and insects, suggesting a linkage between the constructs of human social networks and the movement patterns of wildlife across different ecological landscapes (Fletcher *et al.* 2011). Here, we view connectivity not as a physical construct between two areas but in the context of knowledge-sharing between disparate groups of RFMO attendees. We hypothesize that supply chain companies and organizations that are represented on multiple member country delegations will have higher influence than those that do not given that their representatives interact with more people. By extension, this should mean that they have higher bonding and bridging social capital capabilities and can influence more negotiation positions and also relate more to the positions of other stakeholders and policymakers relative to if they were operating in isolation.

Lastly, *dispersal* occurs when individuals from one population move to another population. Second only to pollen transport, seed dispersal is the most important factor promoting genetic diversity in plant populations (Pijl 1982). We suggest that assuring genetic diversity within nature is akin to assuring diversity of perspectives and knowledge in human social systems. Here, we assess the degree to which attendees have changed affiliation type from one meeting to the next. We hypothesize that attendees with higher dispersal will have more influence based on the experience and perspectives obtained through working different jobs and,

therefore, they will also have an increased ability to relate to differing negotiation positions. As with longevity and connectivity, individuals with high dispersal may also have more inter-personal relationships (in this case bridging and linking social capital), enabling them to engage more knowledgably with different types of stakeholders and assume leadership roles in diverse social groups (King *et al.* 2009).

5.2 Methods

Since annual WCPFC Regular Session meetings are where tuna fishery management measures are negotiated and adopted, our quantitative analysis focuses primarily on who is present at these meetings over time, as well as their connections to each other, and tuna fisheries as a whole within the region. Interviews with WCPFC attendees provide additional perspective on interactions between attendees at meetings as well as the external influence of the market and how this shapes those interactions.

5.2.1 WCPFC attendee information and attributes for analysis

The WCPFC Secretariat was unable to provide a workable database of the people who had attended meetings over time, so we manually extracted attendee information from participant lists for WCPFC Regular Sessions 2-15 (2005-2018) from PDF documents available on the WCPFC website (see: https://www.wcpfc.int/meeting-folders/regular-sessions-commission). Attributes and associated codes for attendees and countries included in our database based on information available in these lists are summarized in Table 5.2 (bold). We supplemented these attributes with additional data based on best available information, including delegation socio-economic category (World Bank, 2021) and geographic region of delegation/private organization affiliation headquarters. Regarding affiliation type, all individuals with a government position were assigned the affiliation 'GOV', individuals associated with an intergovernmental organization were assigned the affiliation 'IGO', and individuals positions associated with the WCPFC Secretariat were assigned 'RFMO'.

Individuals associated with a fishing industry syndicate, fisher association/co-op, or non-governmental organization with a primary focus on fisheries issues and improvements rather than a broader environmental mandate were assigned 'INGO' (i.e. industry non-governmental

Table 5.2 Attributes assigned to WCPFC attendees and countries. Information in bold retained from meeting documents, country category information obtained from The World Bank (2021). For the purposes of analysis, we grouped all member states and cooperating non-member states together (DEL).

Session	Status (code)	Country category[1]	Country region
2-15	**Delegation (DEL); Co-operating non-members (DEL); Participating territories (DEL); Observer organizations (OBS); WCPFC Secretariat (RFMO)**	High; Upper-middle; Lower-middle; Low, SIDS; Parties to the Nauru Agreement (PNA)	Asia; Oceania; North America; South America; Europe; Africa

[1]Individuals representing observer organizations were assigned 'NA' (not-applicable) for this attribute and WCPFC Secretariat individuals were again assigned 'RFMO' for this attribute and for 'Country region'. For each observer and industry representative we identified 'Affiliation Country' (i.e. where their affiliation's headquarters are located), and this information was retained when assigning 'Country region' to these attendees. 'PNA' is not a category listed by The World Bank but we chose to also identify these countries separate from other SIDS given their notable importance in the WCPO for tuna fisheries.

organization) while those individuals associated with a specific corporation, company, or fishing vessel were assigned 'IND' (i.e. industry). Individuals working for an organization with a primary focus on environmental conservation or species protection were assigned the affiliation 'ENGO' (i.e. environmental non-governmental organization). Lastly, individuals with university or research institute affiliations were assigned the code 'ACA' (i.e. academia) and 'RES' (i.e. research) and individuals who identified as consultants (or appeared to be working in that capacity) were assigned the code 'CONS'. Several individuals did not have an affiliation associated with their name and so were assigned 'UNK' (i.e. unknown). We additionally amalgamated 'Affiliation country' information for all affiliations from information from each individual organization's website. Table S13 for all affiliations and associated codes.

5.2.2 Refinements

Multiple adjustments were made to the attendee list database due to perceived errors and typographical errors in source data, specifically regarding individuals' names and affiliations over time. We edited all cases where we had cause to believe these were mistakes (or nicknames) made during the original data entry, rather than separate people. Such cases for attendees' names included adjusting perceived spelling mistakes when one name and affiliation was the same, such as 'Afasene Hopi' and 'Afaseni Hopi' or 'Chris Reed' and 'Chris Reid', re-

arrangement of first and last names, such as 'Sang-doo Kim' and 'Kim Sang-doo' (assuming affiliation was the same), adjusting for hyphenated first and last names, such as 'Rhea Moss' and Rhea Moss-Christian' or 'Chi-guk Ahn' and 'Chiguk Ahn', and adjusting for nicknames, such as 'Matt Hooper' and 'Matthew Hooper'. In cases were individuals provided a middle name or middle initial, we condensed it to their first and last name. Similarly, all titles (e.g. Dr, Hon.), suffixes (e.g. Jr., III) and punctuation were also removed.

We applied similar adjustments in spelling to affiliation on account of spelling and general typographical errors, and refined punctuation (standardized commas, periods, capitalization) and acronyms to ensure consistency between individuals of the same affiliation. Originally, we collected data for WCPFC 2-14, which included 3,260 individuals and 531 affiliations. After adjustments, the refined list totalled 2,365 individuals and 522 affiliations (5,576 unique data entries). We then added the most recent year of attendance (WCPFC 15), which resulted in the dataset we used for analysis: 2,612 individuals and 595 affiliations across 6,183 unique data entries.

5.2.3 Limitations and assumptions

We assumed that everyone attending a WCPFC Regular Session meeting had a vested interest in the tuna governance process and its outcomes, and we assumed this was most closely explained by their affiliation. Understandably, these interests are highly variable between individuals. Thus, we acknowledge that not all interests are equal (or even comparable), but all are valid.

Importantly, the RFMO delegation on which a person sits is not necessarily a clear indicator of where their interests and influence lie since an individual does not have to be of the same nationality as their delegation government (i.e. a Korean citizen can sit on the Kiribati delegation). Further, government policymakers are not the only people permitted to negotiate; representatives from the private sector and consultants are permitted to negotiate on behalf of a national delegation as long as they have permission to do so from the delegation government. For this reason, it is important to view individuals in the context of both their delegation country and their affiliation country. We assume an individual's affiliation is the piece of information most closely related to their interest (both on a delegation and more

broadly), however within our dataset this information was not always accurate, or it was missing. For example, many attendees lacked affiliations for one (or more) meetings (i.e. 'UNK') and both authors note that they attended RFMO meetings affiliated to observer organizations previously accredited rather than applying as a representative of a new observer organization (thus affiliation may sometimes be chosen for ease rather than interests).

Lastly, we note that one attendee who was interviewed as part of this work did not appear on the official attendee list at the 2018 meeting where they were interviewed (although they attended all other WCPFC meetings according to attendee lists in meeting reports). Although not a significant omission in isolation, if such errors occur in aggregate, data may be biased (i.e. over or under-representation of certain affiliations or people).

5.2.4 Correlation and ANOVA analyses

To test our aforementioned hypotheses (Section 5.1.2), we performed two correlation analyses using (i) our attendee database and publicly available WCPFC catch data (WCPFC 2020) and (ii) our attendee database and the total number of certified tuna fisheries in the WCPFC region from Schiller & Bailey (2021). For the first analysis, we compared the average annual size of a country delegation with its average annual catch (2005-2018) but we did not include numbers for the host county when averaging a country's delegation size as these were often outliers relative to their normal delegation size. The extreme case of this was observed when WCPFC 9 (2012) was hosted in Manila: 144 people on the Philippines delegation compared to an average delegation size of 21 (median= 15) when meetings were held outside the Philippines. For the second analysis, we accounted for changes in total meeting attendance numbers over time by using the proportion of MSC-certified IND attendees and PNA (DEL-GOV and PNA Office) attendees relative to all attendees in a given year.

In addition, we performed two single-factor ANOVA tests to determine if there was a significant difference in (i) average delegation size based on country category, and (ii) longevity based on affiliation type. Given that, combined, there were only eight upper-middle, low-middle and low countries we grouped these together (i.e. low-middle) and compared them to high income countries, SIDS (without PNA) and PNA countries for (i).

5.2.5 Interviews with RFMO attendees

Transcript data used here are from the same interviews described in Section 3.2.5, which were approved by the Dalhousie Research Ethics Board beforehand. However, for this study, we only analyzed interviews conducted with 2018 WCPFC Regular Session meeting participants (n=17) and two individuals who were interviewed at ICCAT but who also attended the 2018 WCPFC meeting. In total, this resulted in analysis of interviews with eight government policymakers and advisors (DEL), four fishing industry members (DEL), three INGO representatives (OBS), two ENGO representatives (OBS) and two IGO representatives (OBS). Interviews were first coded to identify main themes across all meeting attendees, which resulted in 231 initial statements for further review. These statements were then paired to one of 24 overarching topics (including relationship types) at one (or more) level(s) and linked to one of four main influence types for review and comparison (Figure 5.4).

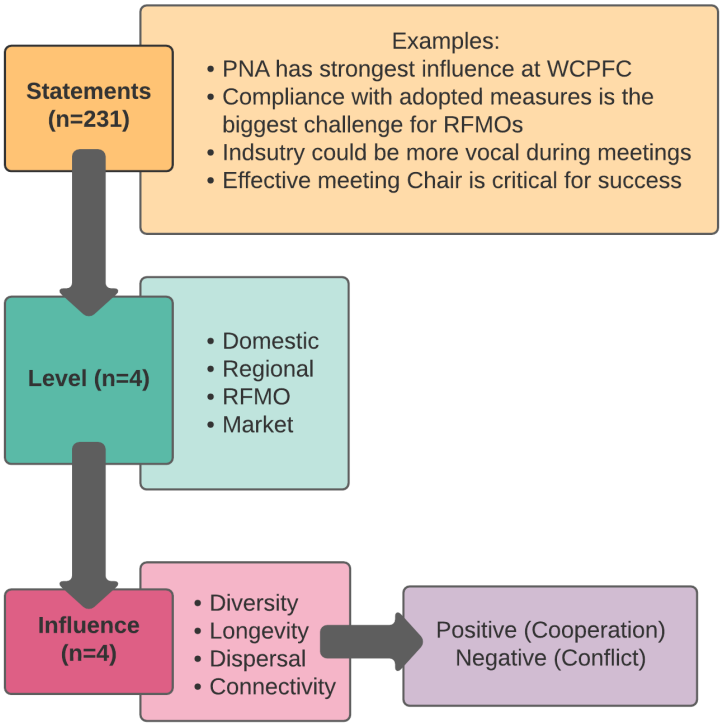

Figure 5.4 Process for categorizing interview content for analysis.

5.3 Results

Here, we present results on the five attributes we investigated: diversity (Section 5.3.1), longevity (Section 5.3.2), and connectivity and dispersal (Section 5.3.3) in the context of influences and how they manifest at RFMO meetings. In each of these sections we first present the quantitative findings from our attendee list analyses, followed by a synthesis of common and opposing views expressed by meeting interviewees.

5.3.1 Meeting diversity: composition and representation

5.3.1.1 Trends in attendance over time

Annual attendance to WCPFC meetings more than doubled between the 2nd Regular Session (2005) and the 15th Regular Session (2018) with government representatives constituting 41% of total attendance across all years, followed by industry representatives (21%), and fishery association (INGO) representatives (12%) (Figure 5.5A). The United States was represented most at meetings (13%), followed by Japan (10%) (Figure 5.5B): the average number of people attending each meeting affiliated with these countries (government positions, industry, and NGOs combined) was 56±24 and 44±17 individuals, respectively. Notably, growth in attendance was not equally distributed across countries. Rather, attendance by individuals from high income countries and the PNA increased over time, while the attendees from other country groups remained largely stable, with the exception of years in which these countries hosted the meeting (Figure 5.6A). The number of different fishing and fisheries-related companies (i.e. IND) in attendance increased substantially, especially when compared to INGOs and ENGOs (Figure 5.6B). Still, individuals from only 14 of 242 industry affiliations accounted for over 40% of all industry representation and these 14 fishing companies came from only eight countries Korea (24%), China (22%), Philippines (15%), US and Federated States of Micronesia (each 9%), Taiwan and Japan (each 8%), and Papua New Guinea (5%).

We find a significant positive correlation ($r(41)= 0.83$, $p < 0.001$) between average delegation size and average annual catch (Figure 5.7A). We further find a positive correlation in both the number of attendees affiliated with MSC-certified fisheries (i.e. MSC Client groups; $r(10)= 0.82$, p=0.001) and PNA attendees ($r(10)= 0.78$, $p =0.003$) relative to the number of MSC-

certified tuna fisheries in the WCPO over time (Figure 5.7B). There was no correlation between the number of other industry attendees and MSC certified fisheries ($r(10)= 0.40$, $p = 0.2$). With the exception of Indonesia, representation by government officials on the ten largest delegations was less than 50% (Figure 2C). The delegations with the lowest government representation were China (16%), Japan (22%), and Korea (29%). Delegations from the Philippines, Japan, and China also had the largest industry diversity, with 49, 41 and 30 different companies and/or INGOs sitting on their delegations over time (Figure 5.7C).

We found statistically significant differences in attendance based on economic status as determined by single-factor ANOVA ($F(3,39) = 3.03$, $p = 0.04$). The average delegation size for high income countries was roughly twice that of other country groups, excluding PNA countries, which have average delegation sizes above the SIDS median (Table 5.3; Figure 5.7C) and three PNA countries are among the largest delegations: Papua New Guinea, Federated States of Micronesia, and Marshall Islands. The PNG delegation is mostly represented by government, while the other two have roughly equal government to industry representation.

Nine of the top 21 private organizations in attendance were companies, seven were INGOs, and five were ENGOs (Table 5.4); the National Offshore Tuna Fisheries Association, a Japanese INGO, currently was the most represented of all NGO organizations. Notably, attendance by Greenpeace decreased substantially relative to other private organizations over the last decade and the Pew Charitable Trusts is currently the ENGO with the most representation at meetings. When focusing only on observer attendees (i.e. individuals not sitting on a specific delegation), the IGO Forum Fisheries Agency, followed by ENGO Greenpeace, had the most representation, and 11 of 73 organizations accounted for 68% of all observer attendees over time (Table 5.5).

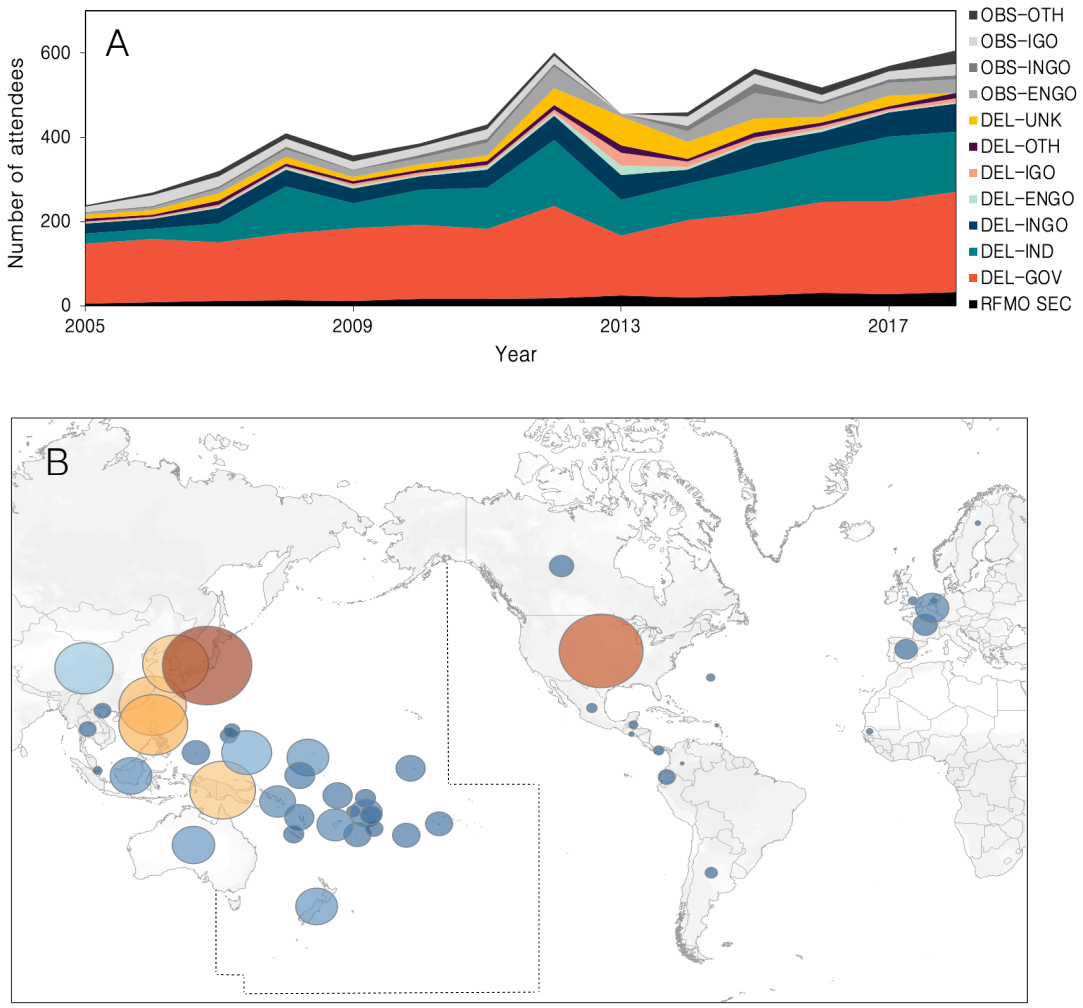

Figure 5.5 Participation (number of attendees) at WCPFC meetings over time by affiliation type (A) and country (B). Noticeable peaks in total attendance (A) are largely related to increases in number of individuals attending from the meeting host country; map (B) shows total number of individuals from each country in all years combined (2005-2018). Affiliation codes: RFMO SEC= WCPFC Secretariat; DEL-GOV= government policymaker on delegation; DEL-IND= fishing or seafood supply company representative on delegation; DEL-INGO= fishing industry association representative on delegation; DEL-ENGO= environmental NGO representative on delegation; DEL-IGO= intergovernmental organization representative on delegation; DEL-OTH= representative from other affiliation (e.g. academic, consultant) on delegation; DEL-UNK= representative without listed affiliation on delegation; OBS-ENGO= environmental NGO observer; OBS-INGO= fishing industry association observer; OBS-IGO= intergovernmental organization observer; OBS-OTH= observer from other organization (e.g. media, academic).

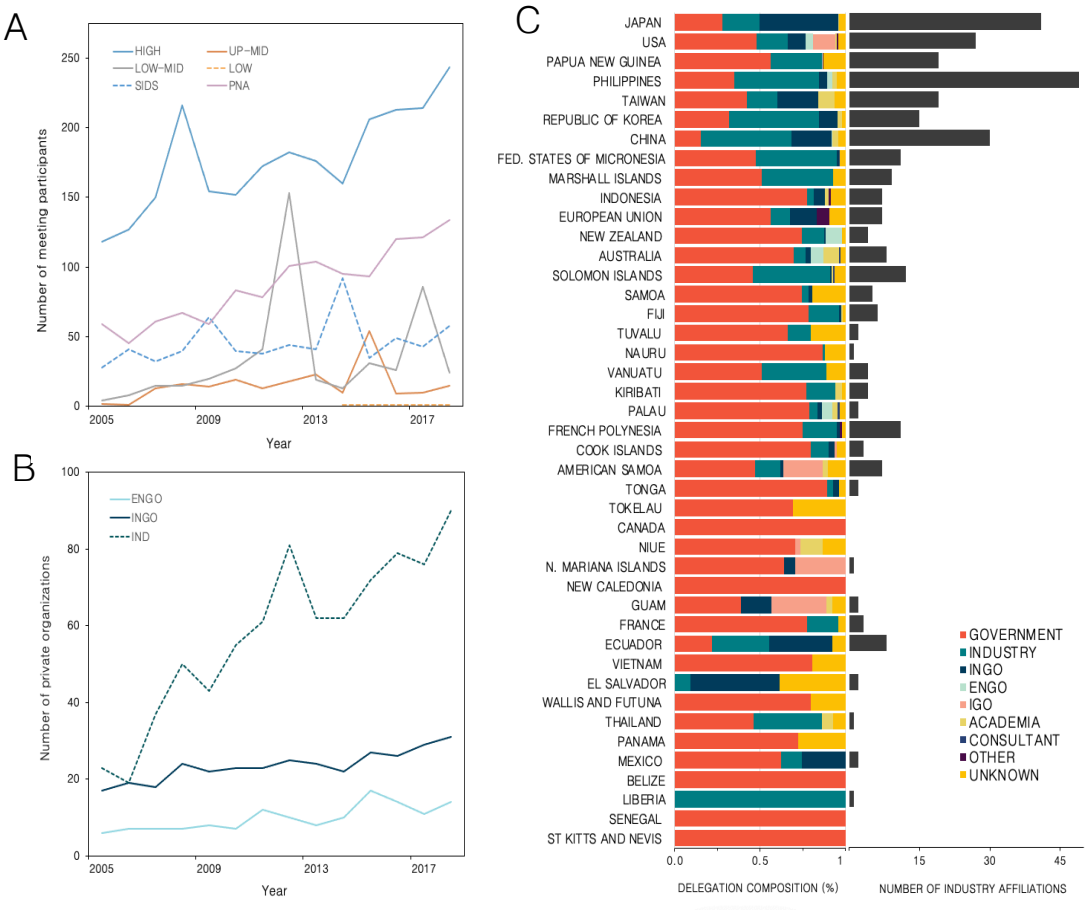

Figure 5.6 Attendance and representation of different individuals and organizations at WCPFC over time. Specifically: (A) representation of countries by economic development status and PNA; (B) representation of primary private actor group types; and (C) relative delegation composition by affiliation type (left panel) and number of different companies and INGOs on delegation (right panel); all years combined, ordered by average delegation size across all years, from largest to smallest. Note: since data are current through 2018, there are some countries listed that no longer participate in WCPFC meetings (i.e. co-operating non-members: Senegal, Belize, Mexico) and some countries that now attend meetings but are not included here.

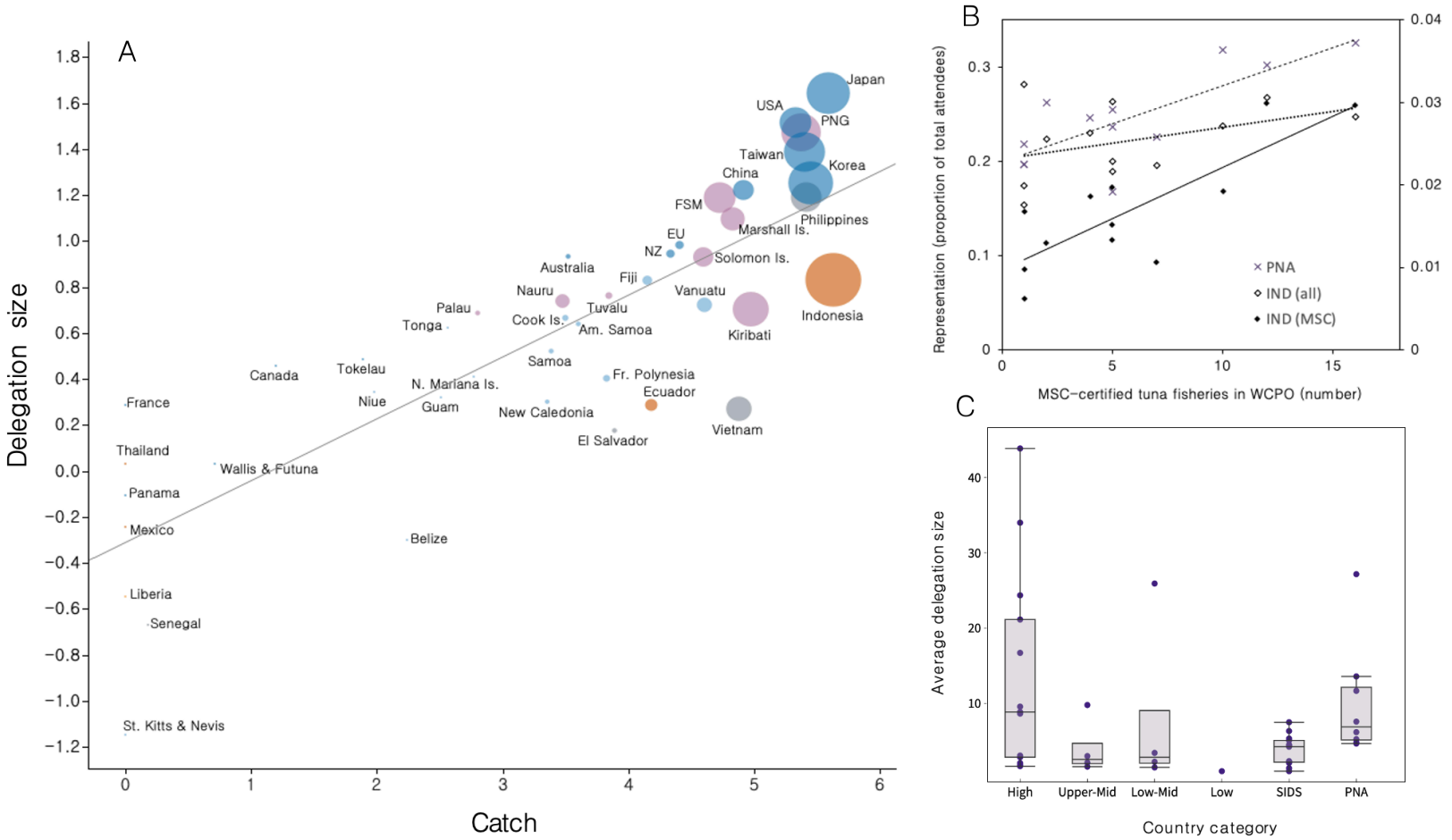

Figure 5.7 Factors affecting WCPFC delegation size. Specifically: (A) Correlation ($r(41) = 0.83$, $p < 0.001$) between average WCPFC delegation size and average annual catch (log scale). Marker colour related to economic development status for high (dark blue), upper-middle (orange), lower-middle (grey), low-income (grey), SIDS (light blue) and PNA (purple); size of marker proportional to 2019 catch (mt) of tropical (skipjack, bigeye, yellowfin) and temperate (albacore, Pacific bluefin) tuna species; (B) Correlation between PNA attendance ($r(10) = 0.78$, $p = 0.003$), MSC Client group attendance ($r(10) = 0.82$, $p = 0.001$), and all other industry attendees ($r(10) = 0.40$, $p = 0.2$) relative to the number of MSC-certified tuna fisheries in the WPCO over time (2007-2018); (C) average delegation size (all affiliations) based on economic status of member country (single-factor ANOVA: $F(3,39) = 3.03$, $p = 0.04$).

Table 5.3 WCPFC delegation attributes. See Table S2 for breakdown of all companies (i.e. 'industry') sitting on each delegation. Countries denoted with an asterisk (*) are also FFA members and those indicated with a hashtag (#) are PNA members.

Country Category	Delegation	Total delegates	Median delegation size	Delegate longevity	Foreign Industry (%)	Domestic Industry (%)
High	Japan	614	45	2.6	0	100
High	USA	476	36	3.5	20.5	79.5
PNA	PNG*#	417	22	2.4	36	64
Low-Mid	Philippines	414	15	1.8	4.9	95.1
High	Taiwan	341	24	2.3	3.3	96.7
High	Korea	296	20	1.8	0	100
High	China	234	16	2.3	8.1	91.9
PNA	FSM*#	212	14	2.3	18.0	82.0
PNA	Marshall Is.*#	175	11	3.3	43.8	56.2
Up-Mid	Indonesia	157	8	1.5	0	100
High	EU	134	10	2.3	0	100
High	New Zealand*	124	9	2.6	46.7	53.3
High	Australia*	121	9	2.0	0	100
PNA	Solomon Is.*#	119	7	2.2	17.6	82.4
SIDS	Samoa*	99	3	1.4	20	80
SIDS	Fiji*	94	7	2.0	17.6	82.4
PNA	Tuvalu*	81	3	1.9	9.1	90.9
PNA	Nauru*#	77	5	3.0	100	0
SIDS	Vanuatu*#	74	6	2.7	7.1	92.9
PNA	Kiribati*#	71	5	2.0	33.3	66.7
PNA	Palau*#	68	5	1.9	100	0
SIDS	Cook Is.*	65	4	2.3	100	0
SIDS	Fr. Polynesia	65	3	1.8	0	100
SIDS	Am. Samoa	61	4	2.0	88.9	11.1
SIDS	Tonga*	59	4	2.1	100	0
High	Tokelau*	43	3	2.3	0	0
High	Canada	40	2	2.1	0	0
SIDS	N. Mariana Is.	31	2	1.6	0	0
SIDS	Niue*	31	3	2.1	0	0
SIDS	Guam	28	2	1.6	0	0
SIDS	New Caledonia	28	2	3.1	0	0
High	France	27	2	1.7	20	80
Up-Mid	Ecuador	27	2	1.6	22.2	77.8
Low-Mid	Vietnam	26	3	1.7	0	0
Low-Mid	El Salvador	21	2	1.9	0	100
High	Wallis & Futuna	15	1	1.4	0	0
Up-Mid	Thailand	15	2	1.5	0	100
High	Panama	11	2	1.8	0	0
Up-Mid	Mexico	8	1	1.6	0	100
SIDS	Belize	7	1	1.8	0	0
Low	Liberia	4	1	1.3	100	0
Low-Mid	Senegal	3	2	1.5	0	0
SIDS	St Kitts & Nevis	1	1	1.0	0	0

Table 5.4 Top private actors represented at WCPFC over time. Of the 242 different private actor groups (IND, ENGOs, INGOs) that have attended meetings, these 21 organizations currently account for 37% of private actor representation (by number of individuals). Country of organization refers to head office except for 'Global' organizations in which case it refers to where it was founded. ('Global' organizations have offices in more than five countries on more than one continent.)

Organization	Type	Country	Representation[1]	Connectivity	Longevity[2]
National Offshore Tuna Fisheries Association*	INGO	Japan	3.7 (-0.5)	Yes (Japan)	2.5
Pew Charitable Trusts	ENGO	USA	3.3 (-0.4)	Yes (USA)	2.3
Greenpeace	ENGO	Canada (Global)	3.0 (-4.2)	Yes (Australia, China, N. Zealand)	1.9
WWF	ENGO	Switzerland (Global)	2.4 (-0.7)	No	2.1
China Overseas Fisheries Association	INGO	China	2.0 (+1.4)	Yes (China)	2.8
RD Fishing Industry	IND	China	1.9 (+0.4)	Yes (PNG, Philippines)	2.1
Tri Marine Group	IND	USA (Global)	1.9 (+0.4)	Yes (Am. Samoa, China, Marshall Is., Solomon Is., USA)	2.5
Luen Thai Fishing Venture Ltd.	IND	China	1.8 (+0.3)	Yes (Cook Is., FSM, Palau, Marshall Is.)	3.3
The Nature Conservancy	ENGO	USA	1.7 (+1.7)	Yes (N. Zealand)	1.4
Dong Won Fisheries	IND	Korea	1.6 (+0.3)	Yes (Korea, PNG)	1.6
Federation of Japan Tuna Fisheries Co-operative Associations	INGO	Japan	1.6 (-0.2)	Yes (Japan)	2.4
National Ocean Tuna Fishery Association*	INGO	Japan	1.4 (-0.5)	Yes (Japan)	2.1
Silla Co. Ltd	IND	Korea	1.4 (+0.2)	Yes (Korea)	2.2
Liancheng Overseas Fishery (Shenzhen) Co. Ltd.	IND	China	1.3 (+0.1)	Yes (China, FSM)	2.3
Japan Far Seas Purse Seine Fishing Association	INGO	Japan	1.2 (-0.5)	Yes (Japan)	4.7
Ping Tai Rong Ocean Fishery Group Co. Ltd.	IND	China	1.2 (+1.0)	Yes (China)	3.2
Sajo Industries	IND	Korea	1.2 (-0.1)	Yes (Korea)	2.2
Diving Seagull, Inc.	IND	FSM	1.1 (-1.9)	Yes (FSM)	3.2
Earth Island Institute	ENGO	USA	1.1 (+0.1)	No	2.1
International Seafood Sustainability Foundation	INGO	USA	1.1 (0.0)	No	3.4
Taiwan Tuna Association	INGO	Taiwan	1.1 (+0.7)	Yes (Taiwan)	1.8

[1]Proportion of private sector (i.e. NGO/IND) individuals at meetings between 2014-2018 (%) with change between 2014-2018 and 2009-2013, weighted by overall attendance during each period); [2]Average number of meetings attended by company or organization representatives (2005-2018).
*These organizations together form the INGO Organization for the Promotion of Responsible Tuna Fisheries (OPRT).

5.3.1.2 Influence exerted by fishing and access countries

Nearly 80% of interviewees asserted that the main tension at WCPFC is a result of the relationship between Pacific Islands countries and distant water fleets from Asia and the US, as well as the EU. As OBS-ENGO-2 described, "here, you've got island states, they're big ocean sovereignty states because they have large [ocean] territories for small specks of land [so] the political dynamics are very different [to other RFMOs]." Given the geographical configuration of the Pacific Islands and the concentration of the tuna within those waters, DEL-ADV-2 said, "coastal states are dominant here—they have a lot of power" and "the PNA countries have a massive amount of leverage in this forum, much to the annoyance of some of the other countries" (DEL-GOV-2). Multiple interviewees noted that certain Pacific Island states receive investment from distant water nations, especially Japan and the EU as part of regional development projects for fisheries and other industries (DEL-IND-4, DEL-GOV-3, OBS-IGO-1). However, "there's a culture clash in the WCPFC, which is a bit of a shame because there should be a really strong alignment of interests there…the best way to promote Pacific Island countries' development is to recognize their rights and do what you can to create rules to support those in the WCPFC, yet you're battling for every fish" (OBS-IGO-1).

Most interviewees either explicitly stated or implicitly implied the significant influence of the PNA on shaping measures adopted through the WCPFC, as well as the power this regional coalition continues to exert, and perceived conflicts related to this assertion of sovereignty. As interviewees noted, many existing WCPFC measures were first established by the PNA and then brought to the WCPFC. Despite their relative autonomy, DEL-ADV-2 suggested that PNA derives additional legitimacy from the WCPFC framework. As they explained, "the major beneficiaries of the Commission are the Pacific Island countries… especially the PNA and the Vessel Day Scheme—[which] was endorsed by the Commission. I mean, [PNA] would have done it anyway, but [having it] endorsed [by WCPFC members] has helped strengthen the management of the PNA, which they would not have been able to do without the Commission."

5.3.1.3 The influence of the market

Seventy-five percent of interviewees expressed that supply chain companies, not consumers, are the main drivers in demand for MSC-certified tuna, and traceable, socially-responsible, or "tuna with a story" (DEL-ADV-2, DEL-GOV-2, DEL-INGO-1) products are also increasingly important. DEL-IND-4 expressed that the demand for MSC is surprising given that the canned seafood market is especially price conscious while DEL-INGO-3 perceived it is worth having MSC because "you want to be able to sell your catch wherever you can". According to DEL-GOV-1, "the retailers that supply the consumers take it seriously and they want these certifications. It is not a matter of the final consumer but a matter of the company selling it".

Regarding the influence of seafood companies during meetings, OBS-INGO-2 said that in the early days of WCPFC, "[supply chain companies] certainly weren't sending people to meetings. They send people to meetings a lot now [and] I think if you have those that are purchasing the tuna and have a direct supply chain linkage to harvesters on the water, and you have [retailers] buying it from the processors and putting it on someone's plate caring about this, then they are going to drive change through that mechanism. Because everyone here who is not in those categories and is not an NGO wants to sell tuna. They all have economies, they all have vessels, and they're businessmen or women and that does have an impact". OBS-IGO-2 presented a different perspective, "probably the worst thing that could've happened for MSC was the world's big supermarkets making these grand commitments saying all of their fish will be MSC. Because I think that put a huge pressure on MSC to [have] more and more fisheries and that has led to what I think is a weakening of the Standard."

Other interviewees also felt the MSC Standard had become too weak or was not applicable to tuna (DEL-GOV-2, DEL-GOV-4, OBS-IGO-1 and DEL-IND-3) while some also highlighted how the MSC-certification of the PNA fishery further divided this group from other delegations as well as industry members at WCPFC (DEL-ADV-1, DEL-ADV-2, DEL-GOV-2, DEL-IND-5, OBS-IGO-1). As DEL-ADV-2 said, "the PNA are suspicious of the motivations of some people for harvest strategies" and OBS-IGO-1 recalled, "there have been debates—probably fair to call them 'wars'—between MSC versus Dolphin Free. These are private companies that have had huge scuffles [and] it's gone to arbitration of the highest level,

[which] just shows that there are some very strong commercial drivers behind those labelling programs that it's good to have one's eyes open to". DEL-ADV-2, DEL-ADV-3, OBS-INGO-2, OBS-INGO-3 all asserted that the demand for eco-certified stems almost entirely the EU rather than the US and Asia, and DEL-ADV-3 noted that at WCPFC, "market states can use some influence [during negotiation] but unfortunately the EU is very difficult sometimes". In the context of the 2018 meeting, DEL-ADV-2 said, "there's two tensions around the room on where the tropical tuna is now. One is coming from the EU: they want to slacken the measure [and] increase the fishing effort and put more fish into the market because it's healthy. Then you've got Japan and the Pacific Island countries who say, 'no we want to keep the catch [where it is], keep the lean on the fisheries"'.

5.3.2 Longevity

5.3.2.1 Trends in attendance over time

We find that nearly 60% of people who attended WCPFC Regular Session meetings did so only once (Figure 5.8B); only 65 of 2,612 individuals (2.5%) attended 11 or more meetings and only six people attended all 14 (Figure 5.8C; Figure 5.9). It is worth noting that in terms of representation, these 65 individuals have accounted for between 9-19% of total annual attendance (Figure 5.8D). The majority of these people attended affiliated with government or industry; only one person attended affiliated with a ENGO and one affiliated with an academic institution. These 65 people have participated primarily (75%) on delegations (although not always the same one) and as part of the WCPFC Secretariat (8%) rather than as observers (17%). Within this group, we found that 79% of all WCPFC member state and participating territory delegations were represented over time (100% when only looking at member states). Mirroring overall meeting representation, within the top 65, individuals sitting on the US delegation dominated representation, followed by Japan and Papua New Guinea (Figure 5.9A). Representation among these individuals was primarily dispersed across high-income country delegations (39%), PNA delegations (23%), and representatives affiliated with WCPFC Secretariat, IGOs, and NGOs (26% collectively) while other SIDS, and middle-income countries accounted for only 11% collectively. We find greater parity in the composition of these 65 individuals by affiliation type relative to the WCPFC as a whole, especially with regard to government, industry, INGO, and IGO attendees (Figure 5.9B).

Average dispersal (i.e. number of different affiliation types over time) among these individuals was 1.89, nearly twice that of meeting attendees as a whole (1.09). While a full analysis of gender composition across all meeting attendees was not feasible, we note here that only 14% of these 65 individuals were women.

We found statistically significant differences in longevity based on affiliation type as determined by single-factor ANOVA ($F(9,2804) = 8.60$, $p < 0.001$). Individuals affiliated with the WCPFC Secretariat attended the most meetings and consultants attended the fewest (Figure 5.8A). The delegation with the highest overall longevity (all DEL affiliation types) was the US (3.5 meetings) and only three other delegations had longevity of 3.0 meetings or more: Marshall Islands (3.3), New Caledonia (3.1) and Nauru (3.0); on average, PNA countries had higher longevity than all other country categories (Table 5.3). When looking only at DEL-GOV attendees, New Caledonia and the Marshall Islands had the highest longevity (3.1 meetings each), followed by the US (3.0), Nauru (2.8), and the Cook Islands (2.7). Of private organization attendees, the Japan Far Seas Purse Seine Fishing Association (INGO) had the highest longevity (4.7 meetings), followed by the US-based INGO, International Seafood Sustainability Foundation (3.4 meetings), and the Chinese fishing company Luen Thai Fishing Venture Ltd. (3.3 meetings; Table 5.4).

Table 5.5 Top observer organizations represented at WCPFC over time. (Note: these data refer to the total attendance of these groups (including repeat attendees) who attended in an observer capacity as per meeting attendee lists).

Name	**Type**	**Total attendance**
Pacific Islands Forum Fisheries Agency (FFA)	IGO	168
Greenpeace	ENGO	112
The Pew Charitable Trusts	ENGO	60
World Wide Fund for Nature (WWF)	ENGO	56
Parties to the Nauru Office (PNA)	IGO	42
Secretariat of the Pacific Community (SPC)	IGO	33
Earth Island Institute (EII)	ENGO	25
International Seafood Sustainability Foundation (ISSF)	INGO	24
Marine Stewardship Council (MSC)	INGO	22
Inter-American Tropical Tuna Commission (IATTC)	IGO	19
Secretariat of the Pacific Regional Environment Programme	IGO	19
Others (n=62)	n/a	267

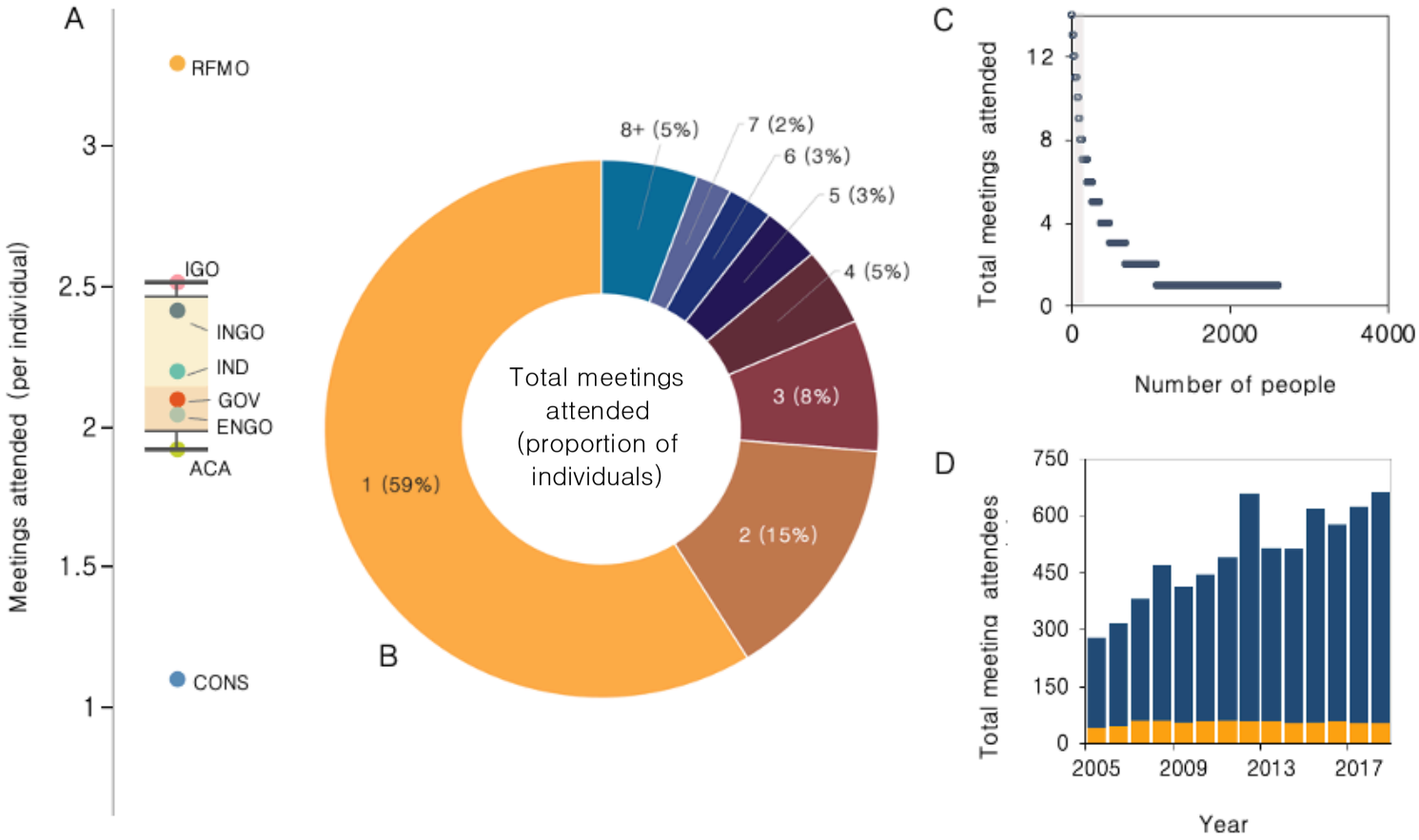

Figure 5.8 Longevity of different individuals (n=2,616) and affiliation types at WCPFC over time. Specifically: (A) average number of meetings attended by individuals of each primary affiliation type (single-factor ANOVA: $F(9,2804) = 8.60$, $p < 0.001$); (B) number of meetings attended by individual (all attendees, 2005-2018); (C) top 65 individuals (shaded grey; see Figure 5) that have attended 11 or more WCPFC meetings (these individuals represent 2.5% of all attendees over time); (D) relative representation (orange) of top 65 individuals in meetings over time.

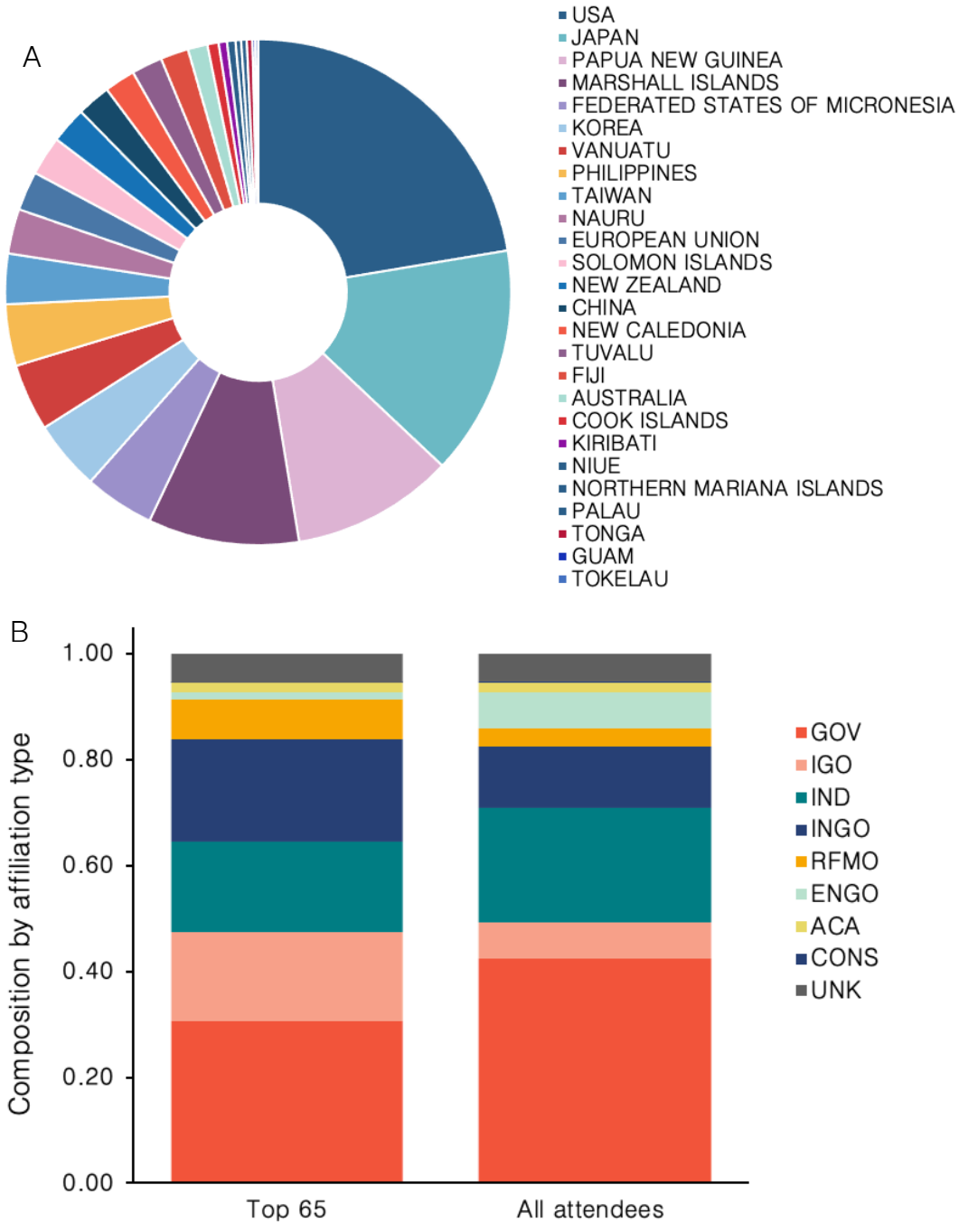

Figure 5.9. Attributes of top 65 individuals attending WCPFC, based on longevity. Specifically: (A) diversity of representation on WCPFC delegations and (B) composition of affiliation type relative to WCPFC as a whole (all meetings combined).

5.3.2.2 The influence of an evolving Commission and relationships between individuals and groups

Regarding WCPFC as a whole, both DEL-GOV-4 and DEL-IND-2 expressed that the Commission was maturing and "members are more open to discussions and dialogues and are able to agree on most points in later years" (DEL-IND-2). DEL-ADV-2 asserted that, "there are incremental gains being made through the process of decision-making and that's all you need in fisheries management…." DEL-IND-5 suggested that past successes or failures can be useful indicators of how to approach anticipated management challenges, such as an overexploited stock.

Conversely, OBS-ENGO-2 felt that many "low-hanging fruit" measures were gone and "now we've got to the point where it's all the really difficult issues, which is making decisions more challenging" (DEL-GOV-3). DEL-GOV-4 expressed a similar perspective stating, "in the early years of [WCPFC], there was much more parity when we were developing [monitoring, control, and surveillance] measures and things like that. Now that we're deep into a lot of the conservation issues, the differences are becoming starker between [the coastal states and the distant water states] and it is harder to reach compromises". DEL-IND-1 and DEL-IND-4 felt many delegations have entrenched perspectives on issues that cannot be resolved in a single meeting while others highlighted improved relationships between delegations over time. Specifically, DEL-ADV-3 explained that there were long-standing disagreements between Japan and the Pacific Island states that pre-dated WCPFC but, "the relationship has improved a lot [and] Japan is [now] sending people to FFA meetings and even PNA meetings too [because] dialogue improved the situation." Similarly, DEL-ADV-1 perceived, "the best [WCPFC] measures have generally been led by a combination of Japan and the FFA. Japan can bring in the north Asian distant water fishing states and between Japan and the FFA they can then [pressure] the US until it agrees."

To this end, over half of interviewees explicitly stated or provided examples on the importance of establishing and maintaining personal relationships over time. As OBS-ENGO-2 explained, "when you first come into this process it takes time to build the relationships and trust that you need to be able to navigate not just among the process but among the different groups in a way that you can be effective". As an example, DEL-GOV-3 explained, "I have very strong

relationships with people over a decade, 15 years probably [and] because of those friendships and relationships, [I] was able to be quite useful in [this year's] negotiation. At the end of the day, your word is as good as your bond." Similarly, DEL-ADV-1 explained that certain previously adopted measures were successful not only because of the influence of the delegations proposing them but because of the efforts made by specific individuals to keep pushing them forward over time.

In the context of relationships, some interviewees perceived that NGOs have a difficult time gaining influence at WCPFC. OBS-INGO-2 said, "it is very difficult for people in their first year, which is why if you have an NGO that turns over the staff that come, it makes the relationships not so fluid [because] you don't have that history going back, which is very important, especially to the Pacific Islanders." To this point, DEL-ADV-1 said, "Pew came in in 2010 and started off with basically an introduction strategy, contacted people to introduce them, and then built their presence up through long-term staff, built relationships and networks and understanding, and then found entry points where they could contribute". A further three interviewees (DEL-ADV-2, DEL-ADV-3, OBS-INGO-3) noted important contributions from Greenpeace over time and OBS-INGO-3 attributed their declining presence to the fact that, "just last year [Greenpeace] shifted to plastics". They also observed, "the other one that never comes anymore is Earth Island Institute. Dolphins. They used to come here all the time [but] some observers are issue oriented and so as the issue isn't happening [anymore] they might not attend".

5.3.2.3 The influence of the Chair

In addition to relationships between policymakers and other stakeholders, interviewees acknowledged that one way in which competing delegation interests are managed is through the meeting Chair. As a member of the WCPFC Secretariat, the Chair is to remain neutral to meeting outcomes, yet they have significant responsibility to ensure that negotiations progress smoothly despite decision-making constraints. DEL-GOV-3, OBS-IGO-1, and OBS-INGO-3 all stressed that an effective Chair is a critical factor contributing to the successful adoption of measures during a given annual meeting and as well as ensuring momentum is retained from one annual meeting to the next. As DEL-GOV-3 observed, "because of the nature of the business we're in, everybody is kind of tough negotiators [so] having a Chair that's decisive

and able to stamp their own authority on things when needed is really important. [But] that doesn't mean [they] ride over top of everybody. It's a fine balance between providing that guidance and a way forward when needed and backing off to let members sort things out…you need to pick [a Chair] who everybody has a degree of faith or trust in, who has integrity." Similarly, OBS-IGO-1 explained, "at last year's meeting [the member states] reached an agreement that they would agree [to adopt a measure for albacore] this year because they failed last year. It was a building up of momentum and political pressure and the Chair made it her priority."

5.3.3 Connectivity and dispersal

5.3.3.1 Trends in meeting attendance over time

IGO and ENGO individuals more commonly participated in meetings as observers rather than delegates (65% and 81%, respectively) and therefore these affiliation types had low overall connectivity (Table 5.5; Figure 5.6C). However, three of the top five ENGOs (i.e. Pew, Greenpeace, and The Nature Conservancy) have had connectivity to four high income country delegations over time: Australia, China, New Zealand, and USA (Table 5.4). Conversely, 97% of all IND attendees and 86% of all INGO attendees attended meetings as part of national delegations. Only three of the top 14 fishing companies did not show connectivity with foreign delegations: Diving Seagull Inc. (Fed. States of Micronesia), Sajo Industries (Korea), and South Seas Tuna Corp. (Papua New Guinea). Three companies had low connectivity (< 20%), four companies showed medium connectivity (20-40%), and four exhibited high connectivity (>40%). The Taiwanese company Fair Well Fishery Co. had the highest foreign connectivity (95%), followed closely by US-headquartered Tri Marine Group (94%), and Chinese company Luen Thai Fishing Venture (67%). Including their home delegation, Tri Marine and Luen Thai were connected to five different delegations (although not the same five), the most of all companies (Table S14).

These top companies were connected to 14 different delegations (including their own) and PNA counties were the main recipients of these foreign industry representatives (45%). However, despite connectivity between Korean and Japanese companies and other delegations, the Korean and Japanese delegations had no foreign industry representation (Table 5.3). While industry representation on most delegations was primarily domestic, four

delegations had industry representation from only foreign countries: Cook Islands (companies from China and Singapore), Liberia (US), Nauru (US), and Palau (China) (Table Table S14; Figure 5.10). By number of countries, China, Papua New Guinea and the Solomon Islands had the highest connectivity to foreign industry (Table S2).

Of the 1,073 individuals who attended multiple RFMO meetings, 363 (34%) changed affiliation type at least once (Figure 5.11). We find the highest dispersal between GOV-UNK (10%) and IND-UNK (8%) affiliations, followed by INGO-IND and IGO-GOV (4.8% each). GOV-IND dispersal was 3.3% and GOV-INGO dispersal was 2.5%. Over half of the top 65 individuals with high longevity changed affiliation type at least once, and 15% changed affiliation type two or more times (Figure 5.9). Within this group, nine people have been affiliated with both a private sector organization (i.e. INGO or IND) and the public sector (i.e. IGO or GOV).

5.3.3.2 The influence of industry representatives within and across delegations

Overall, 53% of interviewees gave examples of how distant water industry members exerted strong influence at WCPFC meetings. DEL-GOV-2 felt, "most of [the distant water fishing country] delegations have large numbers [and] they're not necessarily lobbying for sustainability or conservation or management, they are lobbying for their commercial interest." OBS-IGO-1 agreed that "[distant water countries] have some huge, powerful associations that can have a big impact on government positions", but they also expressed that the degree to which industry can wield power at WCPFC meetings "really comes down to what is that relationship at the national level, how strong is the governance at the national level, and how much influence industry [members] are able to wield over national positions as a result of that".

Eleven of 12 delegates, as well as OBS-IGO-1, agreed that having fishing company representatives attend meetings and sit on delegations is necessary since they are the people most affected by meeting decisions and the ones responsible for implementing adopted measures. OBS-IGO-1 said, "as long as you have the management frameworks set up, and they're sound, then the more industry involvement the better. At the end of the day, we want industry to be successful—that's why we're managing these fisheries, so they can be profitable

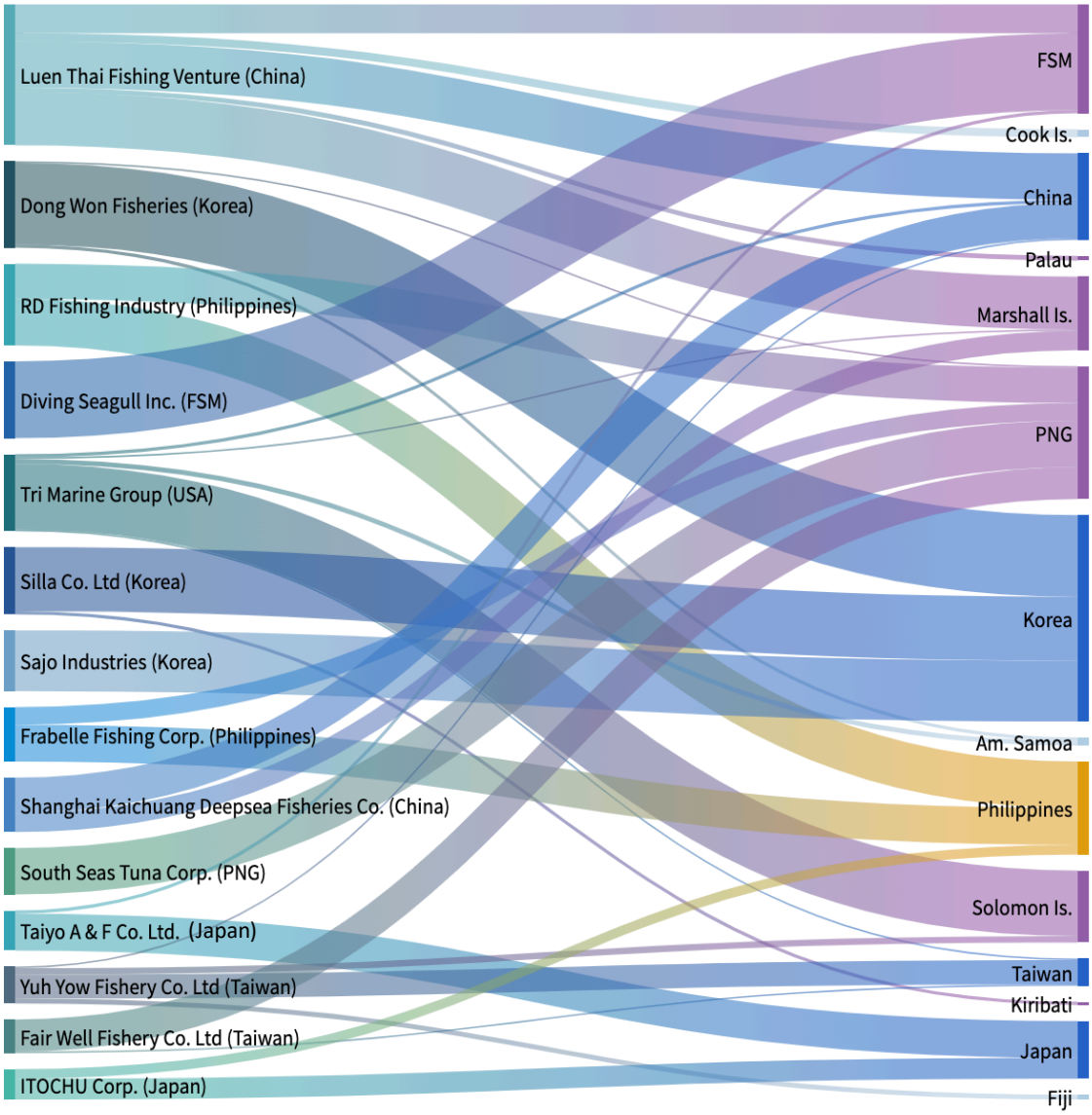

Figure 5.10 Connectivity of top 14 fishing companies (parent and subsidiary groups) in attendance at WCPFC across delegations. Flow proceeds from company (left) to delegations where represented (right); flow width proportional to magnitude of connectivity (number of individuals) based on all years combined. Delegation colour indicates high income country (blue), PNA country (purple), SIDS (light blue), and upper-middle income country (orange).

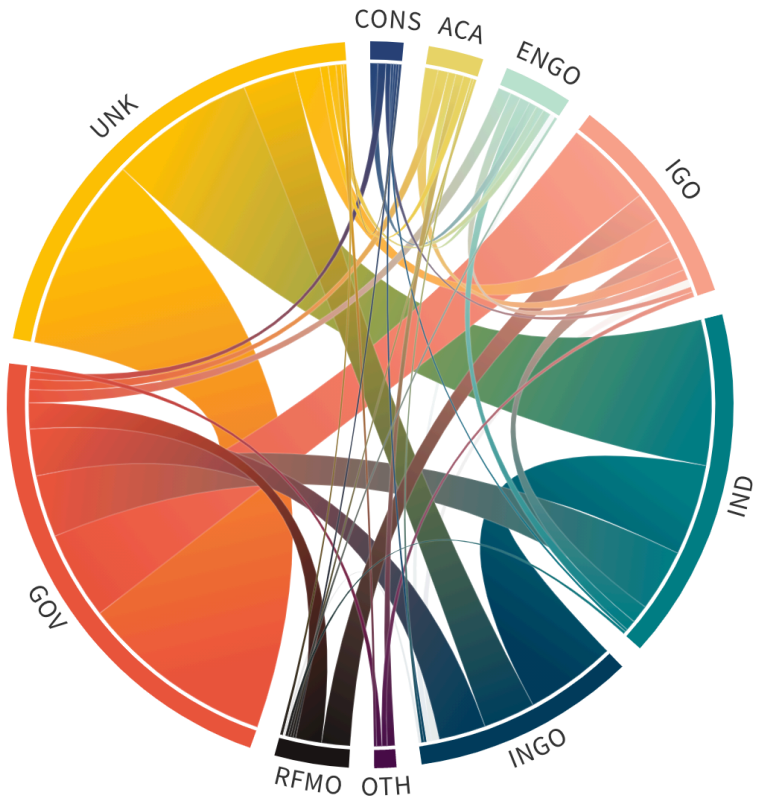

Figure 5.11 Affiliation type dispersal. Data based on individuals who attended two or more WCPFC meetings and changed affiliation type at least once (n= 363). Outer ring affiliation types: GOV = government representative, RFMO = RFMO Secretariat, INGO = industry non-governmental organization representative, IND = company representative, IGO = intergovernmental organization representative, ENGO = environmental non-governmental organization representative, ACA = representative from academia, CONS = private consultant, UNK = unknown, OTH = other. Chord width indicates overall percentage of individuals identifying with each affiliation type across all meetings (arrows are bi-directional).

and provide benefits [to people]." However, interview results suggest industry influence on policymakers within a delegation is highly heterogenous, depending on policymakers' perceptions of their country's industry as a whole, the number of different national fleets, and the power of different companies (and industry associations) on their delegation. In this regard, only three interviewees (DEL-ADV-3, DEL-GOV-4, DEL-IND-2) expressed a high level of proactive communication between industry and government delegates with DEL-GOV-1 and DEL-ADV-2 suggesting highly unbalanced relationships (Table 5.6).

Table 5.6 Heterogeneity in perspectives of relationships between industry and government within a delegation. Scores for perceived relationship where (+) indicates cooperation or positive interaction, (0) indicates neutral relationship, and (-) indicates conflict or negative interaction within delegation as a whole (i.e. namely GOV-IND but also considering IND-IND in cases where that affects GOV-IND).

Interviewee	Perceived relationship	Statement
DEL-ADV-1	GOV: + IND: +	The industry and the NGOs and the communities are all stakeholders, and they simply have a civil society right to engage in the discussions, given that they are often involved in the implementation…yes, the governments pass the regulations and legislation but it's the industry or the communities that will actually implement it.
DEL-ADV-2	GOV: 0 IND: -	The industry might be part of the [Country A] delegation, but they don't receive any briefs or anything. Most of the countries treat their industry like that. Most of the Island countries treat them with disdain actually. It's sad [because] I see that we'd be nothing without them. I mean, where I come from… all the cash flow there is tuna related. We're tuna dependant.
DEL-ADV-3	GOV: + IND: +	Every day we have a delegation meeting in the morning and before coming here we have usually two or three meetings as a whole delegation. But we have lots of dialogues and discussion before coming here.
DEL-GOV-1	GOV: - IND: +	When I come to a meeting, as a member of the government, I have the pressure of not making any decisions that the industry can complain about because the political parties are very linked to the industry in [Country B]. If you make the industry happy, they will not cause problems for you.
DEL-GOV-2	GOV: - IND: +	Who constitutes those lobbyists behind the flag? You've got industry, you've got industry associations, you've got NGOs. You see with the large industry associations that represent the brands: they pay to promote the interests of their members.
DEL-GOV-3	GOV: + IND: +	I think you have to take into account their views. Because at the end of the day, we're not just talking about species but we're talking about the humans that fish for them. So, they have a vested interest in this. They also have a large investment; these people have large investments in the fishery. I also think for issues around transparency it's good to have [industry] there. It's also good for them to see firsthand the kind of complexities that you have to face. Having said that, they don't have access in my experience to absolutely all parts of the discussions—there are still some things here that are discussed at a government level.
DEL-GOV-4	GOV: 0 IND: -	Obviously, the more industry you have in the room, the harder it is to make some of these agreements... We are taking information from all our interested stakeholders. It would be naïve to claim that different stakeholders get more play—obviously they do. But you try to find some neutral ground, you try to make sure that at least everyone feels heard. I try to work really hard on the issues that I'm engaged in, if members from outside stakeholders have input I try to really make sure they know that I've heard them and I'm trying to incorporate their comments. When I can't, I try to talk to them individually and do that so there is a sense that they are being heard even if I'm not always taking their input.

DEL-IND-1	GOV: 0 IND: 0	I think we have a cordial relationship with the government, and we work closely with them on national initiatives throughout the year. We certainly have the opportunity—if we wanted to discuss our positions with them, the opportunity is there. I would say that compared to some other delegations, whose industries are extremely active and are feeding talking points through to their delegates—we're not that involved. We want them to maintain their objectivity, if that makes sense. We don't want them to be seen as a government that is puppeteered by industry.
DEL-IND-2	GOV: + IND: +	What is important is you come to the meeting with an open mind, you meet every time there is a need to, you consult your stakeholders. In [our] case, it's always during dinner and during breakfast [and] I understand that's how other delegations are doing it as well. They have their own meeting rooms to consult each other every time there is a matter that needs to be discussed and that enables them to come up with a solid, very strong position.
DEL-IND-3	GOV: 0 IND: -	Most of the fishermen who come [to WCPFC]—maybe they're retired or they're taking time off from fishing—they're not getting paid. And yet, all these other people: government, ENGOs, are deciding their future.
DEL-IND-4	GOV: + IND: 0	It's a constant battle between longline catches and purse seine catches, as an example. There's definitely two different pieces to that. Myself, my company, what's important for our businesses—and often that aligns with other countries' delegations as well. But [all industry] is a critical part of it. If we just had government people going in [to meetings] blind, without industry involvement, it would be really bad, you'd end up with a bad result.
DEL-IND-5	GOV: 0 IND: -	At the end of the day, these discussions are about industrial competition. Because you find competition among gears that is reflected in the measures, and not only among gears but among countries. So, it's basically a clear commercial competition reflected in management measures for the benefit of the stock.
OBS-IGO-1	GOV: + IND: 0	The PNA members have such a strong basis for progressing their cooperation in the WCPFC and working together in that that any industry voices that are raised at the national level kind of get moderated against the huge amount of policy and technical work that's influencing collective positions.

Four of five industry delegates expressed that policymakers on their delegations (and meeting attendees more broadly) could benefit from having more first-hand perspectives of fishing vessel operators. DEL-IND-1 said, "I feel like industry could play a bigger role. Not necessarily in terms of negotiating per se, but just in terms of improving the understanding on operational matters [because] sometimes [policymakers'] positions are naïve and misinformed. There's quite a lot of industry representatives who are present in the room and they could be asked for an opinion". DEL-IND-6 said that when policymakers adopt measures that industry members dislike, "it's part of [industry's] fault as well, because we didn't provide all the

information that the managers require to make an evaluation". DEL- IND-1 corroborated this point saying, "industry have a propensity to sit back and be quiet and mutter under their breath that they're not happy about the misunderstanding that happens…so there's an onus on industry too, to feed back into their delegations to say 'ok let us brief you on this'. But some governments don't want to hear from industry. They just view them as being sort of bandits."

5.3.3.3 The influence of NGO representatives

Interview perspectives highlighted that the influence of NGOs within meetings is minimal. As OBS-INGO-2 said, "our ability to influence and change the course of the Titanic at these meetings is often times very limited once you're here [so] we start our advocacy and outreach and work early in the year…" Despite meeting constraints, these organizations can (and have) influenced the adoption of measures as a result of collaborations with governments in the past when priorities align. This is, in part, due to "the fact that everybody is able to understand each other's perspectives now a lot better than before" (DEL-IND-2). Still, DEL-ADV-2 said, "the PNA and FFA Secretariat have a far bigger role to play in helping to shape the fisheries [than NGOs]" but mentioned that complementary pressure from the US-based ENGO Pew had helped push forward the PNA proposal for harvest strategies. OBS-IGO-1 enforced this point, "that was a significant coming together of environmental NGO interests with PNA member country interests and FFA member country interests. [They had] slightly different objectives but worked together to get a really strong outcome".

DEL-ADV-1 felt that the most prominent NGOs at WCPFC presently are WWF, Pew, and ISSF. Still, they discussed previous work of Greenpeace, which "had an impact on IUU fishing because [Greenpeace] was able to go to sea and do tours and collect information and submit that information… and then [member states] used that information in courts" and DEL-ADV-2 highlighted the efforts of Greenpeace to engage consumers at the onset of the sustainable seafood movement, which "is now leading into the supply chain so the companies themselves are beginning to have self-regulation".

Still, OBS-IGO-2 felt NGOs could play an even bigger role in the provision of novel information given that "some of the NGOs have access to data [from fishing fleets] that governments as a whole don't necessarily have [so] they can do some pretty useful analyses of

specific potential responses to those issues [such as FAD use]". This interviewee further expressed that industry doesn't have to do everything on their own, but "going to governments and saying 'here's what we are prepared as an [industry] association to do' gives those governments quite a lot of power then when they're speaking to other delegations that they've got the backing of a quarter of the purse seine fleet—or whatever it is. These industries all talk to one another and so getting them to work together is influential."

Interviewees also mentioned that an ongoing conflict between observers and delegates is transparency and access to meetings and interviewees were divided on this situation: DEL-ADV-1, OBS-ENGO-2 presented rationale for improved access and OBS-IGO-2 and DEL-GOV-4 suggested the contrary. From the perspective of OBS-IGO-2, "I think [NGOs] need to learn where their role starts and stops and where their usefulness starts and stops…there's not an organization on the planet that gives access to all its information to anyone who asks. And for good reason. NGOs don't do that either". Conversely, OBG-ENGO-2 said, ""if [all meetings] were entirely closed door, that only government officials were allowed in the room, then I am 100% certain there would be completely industry regulatory capture and we wouldn't be in nearly as good situation as we are in the Pacific as we are today."

5.3.3.4 The influence of a changing negotiation environment

Ten of 16 interviewees expressed having changed affiliations or served on different delegations during their time attending WCPFC (or in the years previous) and six interviewees specifically expressed that these changes in affiliation had contributed to their ability to see meeting challenges or outcomes from differing perspectives and/or network to collaborate with a diversity of stakeholders as a result of past working relationships in different capacities (DEL-ADV-2, DEL-IND-2, OBS-ENGO-2, OBS-ENGO-3, OBS-INGO-2, OBS-INGO-3).

Notably, interviewees highlighted how many important discussions between stakeholders of different delegations and observers happen 'in the margins' of official meeting sessions (DEL-GOV-3, DEL-GOV-4, DEL-ADV-1, DEL-INGO-3) or during private (or semi-private) discussions over Skype. Advancements in technology relative to the first WCPFC Sessions have made the negotiation process quicker and enabled various stakeholders to coordinate joint interventions in real-time, which NGO attendees especially noted (OBS-INGO-1, OBS-

INGO-2, OBS-ENGO-2). One individual expressed that they were engaged in four simultaneous Skype conversations, which was a significant departure from communication capabilities in earlier WCPFC meetings when meeting assistants had to physically run notes around the room between delegations. Further, although Skype chats have the potential to be increasingly inclusive, DEL-ADV-2 also said that they can result in further divides between stakeholders from different affiliations due to selective inclusion. Regarding these types of semi-private digital conversations, DEL-GOV-3 said, "it has changed the way we negotiate forever. But I still think, even in this day and age, talking face to face is the most important thing… it's this human element that we're talking about, where management really lives or dies, those personal relationships between people and the trust that you build."

5.4 Discussion

We used an interactive governance theory framework paired with concepts from ecology and social network theory to examine the intersection between seafood supply chain (and associated NGO) stakeholders and government policymakers at RFMO meetings. Meeting list analyses and interviews highlight the crossover and interplay between attendees from public and private affiliations but show that interactions between these sectors are highly delegation-dependant. Whether interactions within a delegation are mutually beneficial or competitive appears to be the main determinant of the influence that private sector representatives have during meetings, especially if they are not connected to policymakers through personal relationships or to other delegations through mutually-beneficial fishing or access interests.

Assessing governability as a whole involves a three-part analysis of: (i) governing system (its diversity, complexity, dynamics, and scale); (ii) governing system capabilities; and (iii) the presence and quality of stakeholders and policymaker interactions (Bavinck and Chuenpagdee 2005). Below, we explain how our results improve the current understanding of the RFMO governing system (Section 5.4.1). Still, since interactive governance theory emphasizes the importance of 'governing-as-interaction', Kooiman and Chuenpagdee (2005) express, "it is essential not to lose sight of the actors". Thus, we subsequently focus specifically on the WCPFC ecosystem and incorporate insights from negotiation and social capital literature to explain our findings on interactions between policymakers and stakeholders at three levels of

the RFMO ecosystem (Sections 5.4.2, 5.4.3, 5.4.4). Lastly, we conclude with suggestions for best practices to ensure adaptability and resilience for WCPFC going forward.

5.4.1 Governability: Inferences based on the RFMO system

Researchers from multiple disciplines have documented challenges associated with RFMOs in light of diverse member state interests and the inherent uncertainties associated with understanding the stock status of highly migratory and transboundary fish (Song *et al.* 2017). By geographical area, the WCPFC is the largest of the five tuna RFMO Convention Areas and second largest based on number of member countries (after the International Commission for the Conservation of Atlantic Tunas; ICCAT). Our work adds to pre-existing literature on the complexity and diversity of coastal, flag, and market state interests at the resolution of annual RFMO meetings, which is one of multiple scales of analysis for this system.

We find that over the course of fourteen WCPFC meetings, 595 different public and private affiliations have been represented by 2,616 different people. Looking at this composition alone suggests high system complexity and diversity. However, we find that representation is actually relatively concentrated among a few individuals and organizations from the public and private sector. Thus, when looking at the scale and diversity of the RFMO governance system in absolute terms may not necessarily be reflective of its complexity or dynamics. Specifically: attendees from Japan, the US, and Papua New Guinea collectively accounted for over one-third of delegates at meetings. In addition, only 14 of the 242 seafood supply chain companies (5.8%) in attendance accounted for 40% of all industry representation over time and 79% of these companies had representatives sitting on at least two WCPFC member state delegations. In an analysis of the world's fishing companies, Österblom *et al.* (2015) found that 13 of the world's 130 largest fishing corporations are responsible for 11-14% of the global catch and Carmine *et al.* (2020) found that 8.9% of identifiable fishing companies represented 36% of all fishing effort in the high seas in 2018. Although we use a different metric, our findings show an even higher concentration of industry members participating in the transboundary tuna fishery governance process.

Despite comparable delegation sizes and relative rates of attendee increase (Figure 5.6A), the absolute number of attendees from high-income countries is currently twice that of PNA

countries, and five-fold greater than the number of attendees from SIDS. This finding supports that despite their relatively low numbers, the unique collective power of these small island countries allows them "to successfully assert their position within the WCPFC, whose membership includes many of the world's largest and wealthiest states" (Barclay 2007, pp. 1). Given ongoing concerns over meeting accessibility to people from small-island states (WCPFC 2016; FFA 2018), we suggest the current imbalance in meeting representation from high-income states relative to Pacific Island states is likely to increase unless meeting capacity is limited. We only assessed one RFMO so there is no benchmark for comparison but our results further the perspective that, by absolute number of stakeholders involved, transboundary governing systems for tuna are the largest and most diverse fishery governance systems in the world.

5.4.2 Ecosystem interactions: influence through representation and markets

Looking deeper at the factors contributing to attendance, we find support for our hypothesis that catch volume is a strong predictor of delegation size (Figure 5.7C). This suggests representatives from fishing countries have substantial influence in WCPFC negotiations and interviewees corroborated this finding, especially with regard to Asian fishing fleets. However, in order to have a high catch volume, these countries must also have access to fishing grounds, which is provided by coastal states in exchange for access fees. And, in order for coastal states to be able to effectively regulate access to their EEZs, they require the financial capacity to do so, which access fees enable. Therefore, foreign fishing interests and coastal country governments are mutually-dependant. Previous work detailing the strong influence of PNA member states as a coalition of access countries (see Adolf 2019 for a synthesized chronology) was further supported by interviewee observations (Section 0), and by our analyses showing that three of eight PNA countries have delegation sizes exceeding the average for high-income countries (Table 5.3; Figure 5.7C). Interview results further suggest the Japanese delegation in particular may be increasingly attuned to the aspirations of developing states and their assertion of sovereignty despite past disagreements and conflict between foreign fishing states and access states (Section 5.3.2.2). These findings are consistent with the view that relationship-building with foreign parties as a means of generating trust is highly valued by Japanese negotiators (Zhang and Kuroda 1989; Thompson *et al.* 2010).

Here, we show empirically that at WCPFC meetings, the primary observable difference in the composition of access countries and foreign fishing countries is that access countries (especially PNA delegations) are represented mostly by government policymakers (as well as IGO representatives and consultants) while foreign fishing country delegations are largely composed of industry members and fishing association representatives. In particular, Asian delegations have had the most company and INGO representation, almost all of which is domestic (Table 5.3; Figure 5.6C). Thus, the challenges for fishing and access countries are the same: cohesion in objectives and a unified negotiating position at WCPFC. For PNA, this means cooperative interactions between government policymakers across delegations, and for foreign fleets it is cooperation between policymakers and industry representatives within a delegation.

Although we did not assess fishing industry members to the level of their fleet (i.e. gear type used), we suggest that influence at WCPFC by fishing countries is greatest when there is more similarity among fishing industry members within a delegation as this will reduce internal conflict and result in a strong outward negotiating position. Notably, interviewees did not discuss American policymakers as being influential in meetings, despite the US having the second largest delegation size (and highest delegate longevity). We suggest this may be partly due to a lack of industry cohesion at the national level leading to a disjointed relationship between industry stakeholders and US policymakers. Or, since the US is primarily a fishing and market state at WCPFC, it may also be due to a lack of industry connectivity with access country delegations (both of which are circumstances we discuss in further detail in Section 5.4.3).

The EU has a low total catch in the WCPFC Area but plays a key influencing role since it is one of the top global importers of canned tuna products originating from WCPFC catch. In particular, it is a key market for eco-certified seafood. Many interviewees highlighted the importance of having eco-certified tuna to meet demands of supply chain companies (Section 5.3.1.3). From a governability perspective, when a supply chain is lengthened and more actors become involved, changes in any one aspect can have broad consequences (Kooiman and Bavinck 2005). Our findings show that PNA certification resulted in increased efforts by multiple fishing industry members to keep pace with the influence of PNA in the market

(Adolf 2019). Although it was originally developed as a market-based tool to promote sustainable fishing, in the case of the WCPFC, MSC is now being used to leverage political agendas, which has caused substantial conflict among meeting attendees. At the same time, however, this competition is contributing positively since it allows for government and industry interests to be more aligned on specific measures. Even though different stakeholder groups are competing for market access, they are all equally dependant on WCPFC measures to ensure they retain their eco-certification. Therefore, they are also dependant on each other to cooperate to make sure these measures are adopted at WCPFC meetings, which improves the governability of the system as a whole.

Currently, perceived PNA policymaker skepticism around foreign intentions may stem from the fact that many of PNA's EEZ monitoring methods, bycatch management, and traceability practices currently exceed WCPFC requirements but are not required by non-PNA fishing companies seeking MSC since auditors assess fishery management to the level of the RFMO only. Simply put: PNA Pacifical MSC products are equivalent in the market to products with a lower sustainability benchmark, which results in negative interactions between PNA policymakers and industry stakeholders. Yet, until the PNA is able to differentiate itself further from other fishing companies through marketing and branding (e.g. "fish with a story"), their MSC-certified tuna will remain equivalent to all other MSC-certified tuna in the eyes of most market actors.

5.4.3 Population interactions: influence through connectivity

The above average longevity of INGOs and industry members (Table 5.4; Figure 5.8A) suggests many people directly connected to the fishing sector perceive the necessity of being involved in (or at least aware of) decisions made through RFMOs because of their importance to business operations and livelihoods. As interviewees highlighted, the presence of industry members at meetings is beneficial since it allows fishing companies to be integrated from on-water practices to fishery management decisions. Equally, attending meetings provides industry representatives with a complementary perspective on the challenges associated with developing WCPFC measures (Section 5.3.3.2). Interviewees explained that participation from the fishing sector allows policymakers to draw directly on experience and knowledge from vessel operators and company employees to make informed management decisions in real-

time. These findings support the valuation of fisher knowledge as a complement to scientific data (Johannes *et al.* 2008), as well as the perspective of (Grafton 2000), who suggests policymakers will make fewer regulatory mistakes and be more flexible to change when they draw upon the social capital provided by fishers.

In the longer term, the inclusion of fishers in discussions on management measures can also lead to greater compliance with measures once adopted Grafton (2005). Nonetheless, we find that interactions between government policymakers and fishing company representatives are wide-ranging (Table 5.6), which suggests that industry representative influence at WCPFC is largely determined at the national level and varies substantially across WCPFC member states. These findings align with the perspective of Barkin *et al.* (2018b) who state that, "even when fisheries diplomats desire to pursue cooperative governance of sustainable international fisheries, they are faced not only with international negotiation, but also simultaneously with negotiation at domestic level with their home governments and constituents whom they have to persuade to accept any international deal pursuing sustainable cooperative governance… The domestic population acts mainly as a constraining condition over the fisheries diplomats negotiating at RFMOs."

Given this situation, we suggest that negative interactions between industry representatives and policymakers within a delegation may be offset by an industry representative's interactions with other delegation policymakers. Eleven of the top 14 fishing companies in attendance were from Asia, and all but one of these have had representatives present on at least one Pacific Island delegation over time. On the one hand, this connectivity may be viewed as an attempt by high-income states to assert dominance over lower-income nations. However, as discussed above, ability to influence a delegation is largely dependent on how receptive government policymakers are to industry presence and how much access the latter are granted for intra-delegation meetings. While multiple interviewees suggested they could not be denied participation on a delegation by a government, we were not able to comprehensively deduce how easily it is for companies to attend meetings as part of different delegations. We assume that the domestic application process specific is likely unique to each delegation and there may exist bureaucratic or logistical barriers to industry groups wishing to attend meetings in cases where their presence is not valued by national policymakers.

Given the longstanding history of foreign investment in fishing processes within the Pacific Islands (Schurman 1998; Barclay 2010), this connectivity could also signify alignment in priorities between Asian delegations and Pacific Islands based on past or recent partnerships. For example, in 2010, the Kiribati government partnered with the Chinese fishing company Shanghai Deep Sea Fishing, the Fijian processing (and exporting) company Golden Ocean Fish, and the Fijian marketer Seafood Marketing LLC founded Kiribati Fish Ltd. The goal of this investment was to "further develop Kiribati's fishing resources whilst creating economic growth and employment for the people of Kiribati" (Kiribati Fish Ltd. 2013). Although Kiribati has the largest EEZ in the WCPFC Area, it historically had low domestic catches. Through Kiribati Fish Ltd., the Kiribati government and these foreign partners have established a Fishery Improvement Project; since 2010 the Kiribati catch has increased 800% and it now has sixth highest catch among WCPFC coastal states (Table 5.1).

Similarly, other Fishery Improvement Projects between government and industry groups from different countries exist in the WCPFC Area and multiple MSC certifications for tuna cover foreign companies fishing within the EEZs of different Pacific Island countries (e.g. *MIFV RMI EEZ*, which covers longline fishing vessels flagged to a subsidiary of Luen Thai Fishing Ventures Ltd. (China) operating within the Marshall Islands EEZ; *SZLC, CSFC & FZLC Cook Islands EEZ*, which covers three Chinese longline companies fishing in the Cook Islands EEZ, *Solomon Islands Longline Tuna Fishery*, which covers Chinese, Taiwanese, and Fijian vessels fishing in Solomon Islands EEZ, and the *Solomon Islands Skipjack and Yellowfin Tuna Purse Seine and Pole-and-line Fishery*, which covers US-flagged Tri-Marine vessels fishing in the Solomon Islands EEZ). Such cross-sectoral international initiatives highlight the interdependency of the public and private sector across member countries, and provide insight into one form of collaboration that is not easily captured when looking at meeting composition in aggregate.

Lastly, we suggest that countries with low foreign industry presence on their own delegations are generally more protectionist and will face substantial difficulty influencing negotiations if they lack meeting representation on other delegations. For example, there were no American industry representatives present on Pacific Island delegations and no foreign fishing companies on the American delegation, only foreign brands. (We exclude Tri-Marine from these observations, which originated as a fishing company in the US in 1972 but is now the

world's largest vertically integrated tuna supply chain management company with offices on five continents.) This situation suggests a unilateral perspective on desired measures and minimal opportunity for compromise with other member states; the EU exhibits a similar pattern. Poor connectivity may not only limit flexibility around management measure priorities between policymakers and stakeholders from different delegations, but it also suggests there are fewer pathways for dispute settlement or conflict resolution outside of the formal negotiation process. Conversely, while we posit low influence at RFMO meetings due to low connectivity, it may also be the case that these countries have other forms of influence through connectivity that are not adequately captured through this analysis (i.e. power derived from the provision of foreign aid).

5.4.4 Individual interactions: the importance of longevity

One explanation for slow overall progress perceived in RFMOs is the high number of single-meeting attendees (Figure 5.8), especially with regard to the crucial importance many attendees give to inter-personal relationships (Section 5.3.2.2). Although we note that not all participants have the financial capacity, interest, or organizational mandate to participate each year, we suggest that this high turnover slows WCPFC progress and reduces overall governability since the adoption of measures is an iterative process that builds on work from one year to the next. An ability to engage constructively with other attendees and influence decisions requires not only knowledge of the tuna stocks and fishing fleet dynamics in the WCPFC Area, but also knowledge of meeting procedures, and relationships with people involved. Without this, knowledge gaps may compound pre-existing challenges of consensus-based decision making. Notably, multiple interviewees discussed the friendships they have built with others over time and research has shown that simply 'liking' another party leads to a stronger preference to negotiate with them again (Reb 2008).

Interviewees highlighted the challenges experienced by ENGO representatives in this regard, as these groups may have conservation campaigns that change annually or have high staff turnover. As many interviewees discussed, the influence of ENGOs instead stems largely from their supporting role outside of WCPFC meetings and interactions with policymakers throughout the year as these groups have a unique ability to provide novel information to

WCPFC member state policymakers that can then be brought to the level of the WCPFC, especially if they can obtain data directly from fishing companies. These findings corroborate the assertion of Tallberg *et al.* (2018), who conceptualize the relation between NGOs and international organizations as instrumental in nature, involving a mutually-beneficial trade of information useful for decision-making (desired by policymakers, held by NGOs) with access to the decision-making process (desired by NGOs, held by policymakers).

Many delegations and organizations with high longevity also appear to have high representation, suggesting turnover may not occur as rapidly for these groups (see Table 5.3 and Table 5.4). For delegations, we suggest that this may be indicative of junior level policymakers spending multiple years observing their head of delegation and learning the negotiation process before becoming the primary negotiator for that member state. We note that high-income countries likely have greater capacity for this type of training compared to lower income countries due to the costs of attending meetings as well as higher job security. To this end, the high representation of the FFA among observer groups (Table 5.5) suggests people from this affiliation have played a vital role in assuring Pacific Island countries have the capacity and support needed to engage in WCPFC meetings since SIDS policymakers generally have low longevity (Table 5.3).

We suggest the one upside to high attendee turnover is the possible injection of new ideas and different perspectives to persistent problems, both of which can spark learning and change if properly integrated (Dietz *et al.* 2017). However, in practice, the ability to introduce new views or knowledge is difficult without any established influence or credibility. As such, rather than having an opportunity to introduce new ways of thinking or creative solutions, new attendees may be more susceptible to inheriting dogmatic or entrenched perspectives on negotiation challenges from past attendees given their low institutional knowledge and experience. The overarching structure of the negotiation process (i.e. short meeting time frames with long agendas and mismatched science-decision timeframes) lends little flexibility in this regard. While some interviewees expressed that it is becoming easier to appreciate opposing perspectives and work collaboratively, we note that many also felt negotiations were getting more difficult. As more sensitive or conflicting issues arise, and as conflicts may increasingly arise between industry members and policymakers, having a strong foundation of people who

know each other and have experience negotiating together will be of increasing importance for the overall governability of WCPFC tuna fisheries.

For this reason, we highlight the critical importance of the 'Loyalists': the 65 people (2.5% of all attendees over time) who have the highest institutional knowledge based on their attendance at WCPFC and their experience working in different capacities for different affiliations and sitting on different delegations. We suggest this group of people is akin to a keystone species: a species within an ecosystem with low abundance but a disproportionally high impact on overall ecosystem function, resilience, and stability (Power *et al.* 1996). We find it especially noteworthy that these 65 people have collectively represented the interests of the top four public and private sector attendee types almost equally over time (Figure 5.9B), and have experience working for 80 different affiliations from 25 different countries (13% of meeting total), and have sat on all 27 RFMO member state delegations. We liken our results to the findings of Gutierrez *et al.* (2011), who identified strong leadership associated with high social capital as the most important attribute for achieving successful outcomes in co-managed fisheries. As the authors explain, "legitimate community leaders, when guided by collective interests and not self-benefits, give resilience to changes in governance, influence compliance to regulations and enhance conflict resolution" (pp. 388). This influence ensures the system as a whole remains stable in the face of challenging circumstances (e.g. situations of resource overexploitation) and explains why many interviewees also highlighted the critical importance of having an assertive and respected Chair to drive official negotiations forward.

5.4.5 Potential ways forward for the WCPFC Secretariat

This work provides novel insights into WCPFC meeting interactions. However, our analyses were limited due to missing affiliations for attendees over time (~5% of all data entries, mostly individuals sitting on delegations) and numerous spelling errors and formatting inconsistencies in source documents (some of which were likely missed by the authors when transferred to the working database). In general, we acknowledge the difficulties associated with ensuring attendees properly record their personal information when registering for meetings but suggest that record keeping by the WCPFC Secretariat should be improved to ensure transparency in keeping with best international practices. Such records would also help inform the Secretariat on how best to deal with attendance challenges and monitor trends over time.

We found significant differences in average delegation size based on national economic status (Figure 5.7C). However, a country's delegation size is often much higher when it is hosting a WCPFC meeting—especially with regard to industry attendees. This suggests participation by these individuals is constrained by the cost to travel or time away from work, a circumstance that may disproportionately affect individuals from SIDS and low or medium-income states. Increased meeting attendance has been an area of concern in recent years, especially for SIDS, which seek to host annual meetings but may not have capacity to do so given the need for high capacity venues as attendance numbers increase (FFA 2018). Although meeting location does not appear to be limiting the ability of PNA countries to assert their influence in governance interactions, this circumstance does perpetuate inequality in representation between member states, which may affect the repeat involvement of individuals long-term.

Concerns over observer participation have also been raised in recent years (WCPFC 2016), yet our results suggest that retaining diversity within meetings is key to the overall resilience and adaptability of the WCPFC. While we suggest there is not one single solution to address the challenge of increasing meeting attendance, we reiterate that single-meeting attendees dominate over time. Thus, finding a way to increase the number of meetings a given individual attends rather than decreasing the number of organizations in attendance at a given meeting could be highly beneficial for building trust and institutional knowledge between meeting attendees, which may result in the faster adoption of measures and more progress from one meeting to the next. We further highlight the valuable resource of industry members from a diversity of countries and fleets at annual meetings but who appear to be under-utilized as a source of practical information. Using the experiential knowledge of fishing company representatives to ensure management measures can be implemented with ease in-practice would likely heighten compliance with measures overall, and may help to improve relations between policymakers and stakeholders of different nationalities. Such intra-meeting brainstorming may result in creative and timely solutions to management challenges that are otherwise overlooked when relying on policymakers' knowledge alone.

5.5 Conclusions

Ecosystems are made up of complex interactions. Similarly, for international fisheries governance meetings, we observe that one attribute in isolation does not determine a country

or company's influence. Rather, combinations of factors drive the influence of individuals through their connectivity to people in different organizations and countries and their longevity. The PNA member states (collectively) and Asian fishing fleets are seen as highly influential and these groups all have high longevity and meeting representation, as well as connectivity between each other. Conversely, the US has high longevity and high overall representation, but low connectivity of individuals relative to these other delegations, which contribute to limited meeting influence.

While ENGOs collectively have low representation at meetings, and most have low organizational longevity, some ENGO representatives have substantial influence given their individual longevity and connectivity to policymakers. Industry as a whole has high representation, but delegation policymakers handle their domestic industry differently, resulting in influence that may be constrained in favour of overall national interests or a few large industry actors. Some industry members may therefore rely on high connectivity with NGOs as their main source of influence. The influence of the 'Loyalists' is due to their longevity (institutional knowledge and inter-personal relationships) which they can use to their advantage in meeting negotiations in ways most other attendees cannot.

From the perspective of interactive governance theory, high complexity and high diversity are seen as elements that lower the overall governability of a system (Kooiman 2008). On the other hand, networks with densely packed connections can suggest higher communication between individuals, which increases trust, understanding and knowledge-sharing as well as accountability (Bodin 2017). Stability and connectedness seen in natural ecosystems results from, "a long history of co-evolution, selection and mutual adjustments, rather than from an arbitrary assemblage of many species put together at random" (Young *et al.* 2006, pp. 309). Simply: elements of diversity that lead to system instability have been selected against. In a similar way, the overall strength of the WCPFC lies in having both public and private actors present at meetings, connectivity between sectors within and across delegations, and room to allow for co-evolution to occur through collaboration and competition. To this end, striving for increased attendee retention from one meeting to the next will only strengthen the governability of transboundary tuna fisheries through this process.

6 CONCLUSION

6.1 Introduction

The UN Sustainability Goals and associated Global Compact highlight an urgent need for collaboration between governments and private organizations—such as businesses, and environmental organizations—to help solve global conservation challenges (UN 2020). Since private actors often possess different resources and participate in different activities than policymakers, their efforts can be complementary (Bodin and Österblom 2013) and mutually beneficial (Tallberg *et al.* 2018). And, given that global market share in many marine sectors is concentrated among a few key transnational corporations, some companies have disproportionate power in determining the trajectory of future ocean use (Virdin *et al.* 2021).

My objective for this thesis was to study the intersection of public and private governance efforts in the context of the world's tuna fisheries. To do this, I asked three overarching questions:

(i) What is the contribution and significance of tuna and other species caught on the high seas in the context of global fisheries and food security?

(ii) How are private actors influencing the governance of tuna fisheries through RFMOs?

(iii) In what ways is the engagement of private actors beneficial or detrimental for the long-term conservation and management of tuna?

Through my engagement with Regional Fisheries Management Organizations (RFMO) attendees and relevant data sets, I found that high seas tuna fisheries contribute a limited amount to the global seafood market and what they do supply goes to high-income, food secure countries. I further found that tuna fishing companies are increasingly seeking eco-certification to demonstrate to high-income markets that their catch is sustainable. Retention

of these eco-certifications is contingent in part on the effectiveness of RFMO management. Thus, fishing companies and other private actors are positively engaging with public actors in two main ways related to the sustainable seafood movement: pushing policymakers for strong, timely RFMO stock management measures that are required for eco-certification and providing novel information to RFMO policymakers to help with decision-making. Results from Chapter 3 showed that, as of 2019, nearly half the global tuna catch was covered by Marine Stewardship Council (MSC) eco-certifications and related Fishery Improvement Projects (FIPs). A 231-fold increase in these efforts between 2007-2019 was positively correlated with a concurrent 14-fold increase in the adoption of harvest strategies by RFMOs over the same time. Many interviewees corroborated that the rapid uptake of harvest strategies was largely attributable to pressure from stakeholders needing to meet eco-certification requirements. Similarly, results from Chapter 4 showed that there has been a 26-fold increase in RFMO observer advocacy related to harvest strategies since 2010 and that NGOs are working increasingly collaboratively with fishing companies through Fishery Improvement Projects.

Tuna fishing companies and NGOs are also engaging proactively with each other to advocate the adoption of sustainable fishing practices and to propagate sustainability messaging to companies throughout the seafood supply chain, which translates to advocacy and participation by these groups at RFMO meetings as well. While the majority of policymakers indicated receptivity to observer participation in meetings, over half of RFMO interviewees perceived that the most effective way for private stakeholders to influence RFMO decisions was through engagement external to RFMO meetings. Nonetheless, results from Chapter 5 indicate that the ability of ENGOs and industry representatives to influence policymaker decisions is largely delegation-dependant.

All of my results suggest that private actor involvement in tuna fisheries governance is an increasingly dynamic topic, to which I can only provide a snapshot in time. For this concluding chapter, I first provide a high-level overview of the evolution of public and private governance for tuna over the last five years by situating the overarching results of my thesis within this landscape of real-world observations and academic literature related to the sustainable seafood movement (Section 6.2). Subsequently, I sequentially address each of my thesis questions with

a predominantly forward-looking view in Section 6.3 (Food Security), Section 6.4 (Private actor influence on RFMO decisions), and Section 6.5 (Long-term conservation and management). Future study should seek to evaluate this relationship and its outcomes over the next decade. To this end, I conclude with a summary of my research limitations and an agenda for future work (Section 6.6).

6.2 Current trends in tuna fisheries governance

In 2016, there were only 12 tuna fishing companies MSC-certified and seven tuna Fishery Improvement Projects in progress. At this time, much of the research on seafood eco-certification programs had been in the context of consumer choice and price premiums (do they exist?) (e.g. Johnston *et al.* 2001; Jaffry *et al.* 2004; Salladarré *et al.* 2011; Roheim *et al.* 2011; Brécard *et al.* 2015), and the broader credibility and legitimacy of such programs and their standards (should they exist?) (Cashore 2002; Cashore *et al.* 2004; Bernstein and Cashore 2007; Bernstein 2011; Konefal 2013). Prior to 2016, only a handful of scholars were beginning to discuss the idea that downstream seafood supply chain *companies*—not consumers—were the real drivers of the sustainable seafood movement (Auld and Cashore 2013; Auld 2014; Gutierrez and Thornton 2014; Bitzer and Glasbergen 2015).

Much has changed. Today, there are 43 tuna fisheries currently MSC-certified or in assessment (plus eight that have exited or withdrawn), and 39 ongoing tuna FIPs (plus ten that have been completed since I started). While I discussed eco-certification trends in Chapter 3, these numbers reflect an additional 34 fisheries involved in these programs relative to when I completed that analysis—a 44% increase in the last two years alone (and during a global pandemic no less). By current observation, this trend will continue. At least until all the world's industrial tuna fishing companies are MSC-certified or in a FIP. Moreover, these trends, combined with interviewee perspectives from Chapters 4 and 5, corroborate the evolution of the sustainable seafood movement proposed by Roheim *et al.* (2018) by showing the critical role seafood retailers now have in pressuring fishing companies and other supply chain actors for eco-certified products. We also see this reflected in the omnibus letters submitted to RFMO meetings by the International Seafood Sustainability Foundation (ISSF)—an INGO that represents dozens of partner seafood processing companies, traders, and brands—and by

the increasing number of tuna-specific coalitions of businesses pushing reform in both on-water fishing practices and management through RFMOs.

The two most prominent of these coalitions are the NGO Tuna Forum (12 NGOs engaging with over 100 seafood companies), and the Global Tuna Alliance (23 supply chain partners at present), both of which were established within the last five years and whose membership increases monthly (Pacifical 2020; Zboraj 2021). In December 2020, the Global Tuna Alliance announced an additional partnership with the World Economic Forum and the ENGO Friends of Ocean Action called the 2025 Pledge towards Sustainable Tuna (a.k.a. 25PST), which has set a five-year goal outlining corporate social responsibility (CSR) commitments for supply chain members related to improving traceability, environmental sustainability, and human rights. This initiative has been registered as a voluntary commitment under the UN Sustainable Development Goals, and the public commitment document outlines over two dozen action items for 25PST signatories related to RFMO advocacy as part of these three core objectives (GTA 2020).[1]

Despite ambitious private sector pledges, there is more to the evolution of tuna governance than just eco-certifications, supply chain commitments, and NGO advocacy. Since September 2016, we have also seen the rise (and stagnation) of the UN Biodiversity Beyond National Jurisdiction (BBNJ) negotiations. When I began research for Chapter 2, the degree to which fishing (and the regulation thereof) would be included in this treaty was still unclear. Although the language associated with the treaty has been subject to much debate, fisheries management measures are currently excluded from BBNJ negotiations given it should "not undermine existing relevant legal instruments and frameworks and relevant global, regional and sectoral bodies" (Scanlon 2018). Since RFMOs are the highest level of international governing bodies

[1]Regarding traceability and transparency, 25PST signatories: "commit to all tuna products in their supply chains being fully traceable to the vessel and trip dates, and that this information can be transparently shared by the end of 2025"; regarding sustainability: "commit to sourcing 100% of tuna products from fisheries with a Global Sustainable Seafood Initiative (GSSI) recognized certification, or that are in credible, comprehensive Fisheries Improvement Projects (FIPs) by the end of 2025"; regarding social sustainability: "commit to implement due diligence processes and timebound improvement targets [relative to baseline company policies on human rights] by the end of 2025 aimed at adherence to relevant [International Labour Organization] conventions".

overseeing fisheries management measures applicable to the high seas, the BBNJ treaty would likely infringe on their jurisdiction. Still, area-based management tools and environmental impact assessments for high seas activities remain, and the scope of both will influence and depend on decisions made through RFMOs (Marciniak 2017; De Santo 2018). This means that for the BBNJ treaty to be effective, transparent and constructive linkages between the UN General Assembly and the tuna RFMOs are needed (Haas *et al.* 2021). I suggest that this development is positive—at least in the context of tuna management—since to disrupt the function of RFMOs as they are finally beginning to make headway on harvest strategies and other challenging topics (such as formally integrating sharks into the ICCAT Convention Text; ICCAT, 2019), could result in a regression in the governability of tunas and other large pelagics as a whole. I further suggest that the developments around the BBNJ treaty make the results of my subsequent chapters more pertinent; if the focus is on improving fishing on the high seas—for now at least—we need to be looking deeper into what influences RFMO member state decisions and the fisheries they govern. With this knowledge, policymakers and other stakeholders can ensure continual improvement in the governability of tuna fisheries through these fora, rather than counting on a re-invention of the wheel to alleviate existing challenges.

Most recently, COVID-19 limited the functionality of all RFMO annual meetings—so much so that for two weeks in December 2020, all tuna fleets covered by the IATTC Convention were on the verge of entering 2021 as part of an unregulated fishery for the first time in the RFMO's seventy year history (Chase 2021). Understandably, this caused many prominent NGOs to release position statements describing how this would negatively impact tuna stocks. Many of these organizations also highlighted the potential market ramifications for MSC-certified and FIP tuna fisheries (as well as their retail partners) if this governance failure occurred (Pew 2021; Global Tuna Alliance 2021; Monterey Bay Aquarium 2021; WWF 2021). Results from Chapter 5 highlight that we are not yet at a point where technology can replicate the in-person interactions many RFMO policymakers and stakeholders find essential for productive negotiations. There is immense value in having a physical venue where the co-evolution of governance efforts—albeit akin to an arms race at times—between public and private actors can occur through conflict, conversation, and collaboration.

6.3 Food security

Answering my first research question, I found that fish products derived from high seas fishing grounds currently contribute a minor amount to global seafood supply (2.4% by volume) and play a limited role in assuring food security in most high-seas fishing countries (Chapter 2). All but two species caught in the high seas have transboundary distributions that include multiple nations' exclusive economic zones. Thus, the importance of these species to local food security relates largely to catch with countries' EEZs and varies widely by region. For example, as stated by Bell *et al.* (2013) of the Pacific Islands: "nowhere else do so many countries and territories depend as heavily on fish and shellfish for economic development, government revenue, food security and livelihoods" (pp. 591). The effects of climate change are anticipated to drive Pacific tuna stocks farther into the high seas over the next century (Bell *et al.* 2013; Lehodey *et al.* 2013) and these changes will affect many of these island countries that *do* depend on tuna for food security and economic benefits (such as the Parties to the Nauru Agreement member states). Below, I discuss results from Chapters 2 and 3 to explain how eco-certifications for tuna may help ensure economic benefits for these island states in the face of climate change (Section 6.3.1) and how sourcing from FIPs ensures food security challenges in high-income countries (or elsewhere the market values seafood sustainability) are addressed (Section 6.3.2). I conclude this section by discussing parallels in the shortcomings of RFMOs and MSC with regard to a lack of attention on small-scale tuna fisheries, many of which have high importance to food security but limited economic value (Section 6.3.3).

6.3.1 Retaining access agreements in light of climate change

When I wrote Chapter 3, MSC-certified tuna from PNA accounted for almost two-thirds of the global MSC-certified tuna catch. Thus, if skipjack and yellowfin stocks move father out of PNA EEZs as anticipated, companies that currently depend on PNA MSC-certified tuna to access key markets would also be impacted since skipjack caught in the high seas are not covered by the MSC Pacifical certification even though they are from the same stock. This circumstance highlights one of the peculiarities of certifying fishing companies and/or a geographical subset of a stock's distribution (such as one or multiple EEZs), rather than adhering to the stock-region-gear combination as other seafood recommendation programs

do (e.g. Monterey Bay Seafood Watch). This challenge is largely unique to transboundary tuna fisheries, since no other commercially-caught fishes have such extensive spatial distributions. Therefore, if eco-certification continues to be seen as a minimum for market access, MSC certifications specific to tuna fisheries operating within PNA waters and the EEZs of other Pacific Islands (e.g. Fiji, Cook Islands) may be able to serve as a partial buffer for these countries against changing tuna stock distributions that may otherwise impact the value of their access agreements and associated foreign partnerships. Importantly, this perspective is contingent on the PNA (and other Pacific tuna fisheries) retaining their brand novelty. Presently, however, the uniqueness of Pacifical tuna appears threatened as many foreign fishing companies have now also obtained MSC-certification in the Pacific, and others have any easier ability to do so if current trends toward harvest strategy adoption and refinement continue at WCPFC. Harvest strategies were essential for the first groups seeking to obtain (and retain) MSC, but the existence of these management measures now levels the playing field for new entrants to the eco-certification program for this assessment criterion.

6.3.2 Ensuring food security needs are met in key sustainable seafood markets

As a result of the COVID-19 pandemic, demand for canned tuna by US consumers increased by 25% (NOAA Fisheries 2021), while national food insecurity increased by 3% (~10 million people) (Feeding America 2021). As discussed in Chapter 2, canned tuna is a staple food product for many low-income families in otherwise food secure countries such as the US, Australia, and the UK. If large seafood retailers find increased demand for canned tuna products (related to a global pandemic or otherwise) they may not be able to keep their CSR commitments to source only eco-certified tuna. Alternatively, they could increase the prices of these products, which could make them financially inaccessible to those individuals who depend on them as an affordable source of protein.

We have already seen a regression in sustainability commitments from Walmart, the leading seafood retailer in the US, which committed in 2006 to souring only MSC products, but decided in 2016 that products from FIPs are also sufficiently sustainable to meet its CSR benchmark for seafood (Lubchenco *et al.* 2016). From a human rights and food security perspective: assuring people access to the calories and food preferences they require is essential. Therefore, large retailers in high-income countries that have expanded their CSR

commitments to include FIPs help ensure that need is met. However, as discussed in Chapter 3, sourcing from FIPs that have no uniform metric of assessment and may target overexploited stocks (see Figure 3.1) dilutes the overall notion of sustainability (Bailey *et al.* 2018). These programs often also have negligible benefit to small-scale fishers in low-income countries—who themselves may be food insecure—where FIPs are promoted as an incentive to meet market demands for sustainable seafood abroad (Sampson *et al.* 2015).

6.3.3 Ensuring more focus on small-scale fisheries

One parallel between the tuna RFMOs and the MSC is the continued focus on high value and high-volume fisheries, which perpetuates inequity among RFMO member states and small-scale and industrial fisheries. As one delegate at ICCAT said of MSC:

> "I think these certification schemes have been very detrimental to developing states and that's a huge problem that needs to be addressed…The system is basically rewarding those [fisheries] that are already in great condition, that don't require much improvement, and those that do require a lot of improvement won't be able to get certified because they don't have much money to run a sophisticated management system, because they don't have the money to pay for the certification process itself and that means they are being driven out of the market. Their seafood is losing value, it's getting cheaper, meaning their capacity will be even more reduced, so this is an excellent system to make the rich richer and the poor poorer.… the problem is so intrinsically embedded in the structure of the system that I really don't know how or even if they can fix it."

This perspective supports the views of multiple academics over the last decade, who have suggested MSC is often financially inaccessible for small-scale fisheries (e.g. Jacquet and Pauly 2008; Duggan and Kochen 2016; Swartz *et al.* 2017) and only covers fisheries that are already employing best practices (Ponte 2012). Further, to this interviewee's latter point: Renckens and Auld (2019) recently showed that the corporate origins, internal governance structure, as well as the design of the MSC Standard and its associated pool of assessment auditors is inherently conducive to perpetuating an imbalance in program inclusivity and accessibility of fishing companies in high versus low-income countries.

The MSC has acknowledged the disparity between large and small-scale fisheries covered by its program and also the divide in its coverage of fisheries from the Global North and South. To address this problem, they have tried developing a risk-based framework for fishery assessment as part of their Standard and currently appear to be diverting responsibility by small-scale fisheries interested in MSC should first engage in FIPs (MSC 2020a). However, the MSC continues to disproportionately advertise small-scale fisheries more than industrial fleets in its marketing materials, suggesting a disconnect between vision and practice (Le Manach *et al.* 2020). As results from Chapter 3 showed, in the case of tuna, FIPs are not necessarily small-scale (Table S6). Thus, beyond simply addressing disparities in the ability of small-scale and industrial fleets to obtain MSC certification (writ large), the diversity in the size, target species, and gears used by tuna fisheries combined with the global nature of the tuna market means this problem is amplified for small-scale tuna fleets in a way that is unlike other species groups.

Similarly, multiple interviewees expressed that RFMO policymakers must pay more attention to the management of small tuna and tuna-like species given their importance to coastal communities in low-income countries. One fishing company representative said, "there's a big chunk of bycatch species that go into the local supply for food security and you cannot imagine the amount of people that these supply—it's huge." This rejected part of the industrial catch has become an affordable source of protein in some Pacific SIDS in recent years (Toito'ona 2020); a well-documented example of this contribution are *faux poisson* ('fake fish'), small or damaged target tunas or less desirable species that would be rejected by the regular canning market because of their condition (Hall and Roman 2013). Since the 1980s these fish have been sold along the west coast of Africa to local buyers, primarily in Côte d'Ivoire, where they continue to play an important role in the economy and in assuring local food security (Romagny *et al.* 2000). Until recently, the scale of these landings was unknown, yet recent estimates suggest that between 1990-2005, around 12,000 mt of target tunas (mostly skipjack) and other minor tuna species were sold annually as *faux poisson* by EU purse seiners (Fonteneau and Dewals 2017). In general, these species are of little importance to most RFMO member states due to their low economic value. As one government policymaker said, "small tunas, frigate tunas, Spanish mackerel, and so on, are very important at a local level for food security and most of those species are either discarded or neglected by national fleets [but] we have no regulations for them in the RFMOs and there are almost no discussions in RFMOs".

The need for precautionary and ecosystem-based approaches to management by RFMOs (including measures for bycatch species) was proposed as a 'best practice' by Lodge *et al.* (2007) and has been reiterated by many academics since (see comprehensive list in Haas *et al.* 2020) as well as NGO observers (Chapter 4; Figure 4.3A). I discuss in more detail in Section 6.5.2 how the requirements of the MSC Standard may be able to help affect change in RFMO practices with regard to smaller tunas and other non-target species.

6.4 Private actor influence on RFMO decisions

Bodin (2017) suggests that effective collaboration may be the only feasible option to address regional and global environmental problems, so "which actors get involved, with whom they collaborate, and in what ways they are tied to the structures of the ecosystems have profound implications on [their] abilities to address different types of environmental problems". In this section, I relate findings from my second research question to recent literature on public-private interactions in RFMOs. First, I compare the results of Chapters 4 and 5 to those of Petersson *et al.* (2019) and Dellmuth *et al.* (2020), who assessed private actor participation across multiple tuna RFMOs (Section 6.4.1). Second, I relate my empirical findings from Chapters 3, 4 and 5 in the context of Barkin *et al.* (2018)'s framework for analysing the four pathways of private actor influence at RFMOs (Section 6.4.2). In Section 6.4.3, I discuss practical suggestions for how NGOs may be able to use their resources to bridge to divide between the UN BBNJ discussions, and RFMO negotiations in light of policymaker views on their engagement.

6.4.1 Private actor attendance and participation at RFMO meetings

Many members of the fishing industry have attended RFMO meetings for years (Chapter 5), if not decades in the case of ICCAT and IATTC. Thus, it can be inferred that these individuals have always known the status of tuna stocks and, by extension, the collective impacts of their fishing practices on resource sustainability and ecosystem health. Not until the last five years, however, have fishing and seafood companies been incentivized to take an active role in advocating the importance of sustainable seafood to RFMO policymakers, most notably in partnership with industry and environmental NGOs as part of the sustainable seafood

movement (Chapter 4). As one IGO observer said, "the biggest positive incentive is the [eco] certification because…simply put: it guarantees access to important markets."

Results on WCPFC meeting attendee composition from Chapter 5 are consistent with the findings of Petersson *et al.* (2019): high levels of industry representation and low ENGO representation at RFMOs. The strength of Petersson *et al.* (2019) is their ability to compare trends across RFMOs, and I situate results from Chapter 5 on WCFPC in that broader context to supplement their findings. The main conclusions of Petersson *et al.* (2019) are that there was no general trend toward increasing non-state actor participation across RFMOs and that considerable variation in participatory patterns requires investigation of access and other institutional influences that affect their participation. When looking at the WCPFC in isolation, I found a strong positive correlation between RFMO delegation size and annual catch in the WCPFC Area. I further found a positive correlation between MSC certification and attendance of MSC-certified fishing companies (or client groups, e.g. PNA). This latter trend was likely only observable since the time series I used extended from 2005-2018 and effects of the sustainable seafood movement may not yet have been observable in the time series used by Petersson *et al.* (2019), which ended in 2011.

Dellmuth *et al.* (2020) found no correlation between NGO attendance and the stock status of target tunas across the five tuna RFMOs (as well as two other RFMOs). When looking not at attendance but at advocacy efforts, results from the analysis of letters to ICCAT and WCPFC in Chapter 4 do show trends in ENGO advocacy over time related to the status of specific tuna stocks as well as other marine wildlife (Figure 4.3). This latter point empirically supports the conclusions of Dellmuth *et al.* (2020), who suggest ENGO groups may take an interest in bycatch and ecosystem-related topics in addition to target species. The lack of correlation between stock status and ENGO participation observed by these authors may also be indicative of ENGOs attending meetings to advocate measures around one priority species with poor stock status, the effects of which are masked when comparing aggregate attendance at the aggregate stock status of all target species covered by a RFMO. For example, as observed in letters to ICCAT, when Atlantic bluefin was heavily overfished and proposed for listing under CITES in 2010 (CITES 2010b), there was a substantial spike in letters to RFMOs around this species (Figure 4.3B). Since I found that not all observer groups submit letters

annually (and some may sign onto joint letters), advocacy efforts related to stock status may also be undetectable if total ENGO attendance at meetings remains constant.

Second, Petersson *et al.* (2019) suggests high diversity when comparing industry representation to NGOs. Results specific to WCPFC corroborate this finding at the level of overall meeting representation by number of attendees (i.e. industry vs ENGO as collectives). When looking deeper into the composition of industry actors I also find substantial diversity among industry represented at WCPFC meetings by affiliation (291 different companies from different parts of the supply chain). Observations of intra-delegation interactions between industry actors and their connection to policymakers in Chapter 5 find that representation alone is not a clear indicator of influence. WCPFC results are also consistent with those of Petersson *et al.* (2019) who suggest participation from high-income countries dominates meetings. These authors also state there have been no representatives from coastal communities or fishing vessels present at RFMO meetings, which leads partly to their conclusions around further investigating limits to meeting access. However, in the case of WCPFC, I found that WCPFC meeting location was a strong indicator of local industry attendance (and therefore, is one aspect affecting access). Again, anomalies in total meeting attendance may have been easier to pinpoint and identify given the number of years in the time series I used.

Overall, findings on WCPFC complement the work of Petersson *et al.* (2019) and Dellmuth *et al.* (2020) by expanding on their results and contextualizing their findings based on a finer resolution of data. Still, notable differences in the interpretation of results (and associated conclusions around the involvement of private actors at RFMOs) suggest that to obtain a comprehensive understanding of relationships between different actors in intergovernmental fora requires a long-term dataset, detailed attendee information, and analyses of all attendees present at meetings since it is difficult to ascertain the influence of one group when it is studied in isolation from other groups in the system. Equally, accounting for elements beyond the institution itself supports the assertion of Bodin (2017) who suggests that studying a governance system must include not only the actors involved in relation to each other, but also in context of the ecological system being governed which, in this case, is fisheries. Thus, considering external factors (e.g. meeting location and fishing fleet dynamics) and measuring

other aspects of participation (e.g. RFMO letters) can result in a more holistic picture of how and why these actors engage in the RFMO governance process during meetings and beyond.

6.4.2 Relationships between public and private actors at RFMO meetings

The complex network of public and private actors involved in the governance of tuna fisheries exemplifies a 'mixed' public-private regime (Falkner 2003) and annual RFMO meetings highlight the overlap, connectivity, and interdependency of these two sectors. Still, results from Chapter 5 support the assertion of Barkin *et al.* (2018) that, "the domestic population [of stakeholders] acts mainly as a constraining condition over the fisheries diplomats negotiating at RFMOs" (pp. 257). These authors propose four primary modes of industry influence at RFMOs based on company relationships to government domestically as well as their relationship to ENGOs, and how these relationships relate to a given member state's RFMO position around sustainability: (i) countries with higher substitutability (i.e. fleets fishing in multiple oceans) will be less willing to support sustainable fishing measures than those with low substitutability; (ii) primary market countries are less willing to support sustainable fishing measures than primary fishing countries; (iii) countries with large industry representation in RFMO delegations are less willingness to support sustainable fishing measures; and (iv) the greater the political capabilities of ENGOs in a country, the more stringent the international fisheries regulation the country is likely to support. While I did not analyze the specific position statements of different member countries, results from private actor-government interactions from Chapters 3, 4 and 5 can still be applied to these hypotheses in part by using MSC-certification as a proxy for sustainability. I discuss each of these hypotheses below in the context of my research.

Results from Chapter 5 (and much work by others, e.g. Hanich *et al.* 2010; Aqorau 2011; Yeeting *et al.* 2018) highlights the strong leadership and influence of the PNA and other Pacific Islands countries at WCPFC as a result of their control over resource access. These findings suggest that at least the inverse of the first hypothesis of Barkin *et al.* (2018) is true: countries with lower substitutability will be more likely to support sustainable fishing measures. Further, the example used by Barkin *et al.* (2018) that "the Spanish fleet, for instance, is able to fish anywhere in the world and thus cares less about protecting the long-term sustainability of any one stock" (pp. 260) may be mitigated by market demands for eco-certified products. For

example, in order for a country's tuna catch to be valued by key importing markets, it now must demonstrate it was caught sustainably regardless of what ocean its fleets were fishing in. Results from Chapter 3 showed that the Spanish purse seine syndicate OPAGAC (40 purse seiners) is currently involved with the ENGO WWF in Fishery Improvement Projects in four oceans totalling 305,000 mt (6% of the global annual tuna catch) and two Spanish albacore fisheries operating in the Atlantic (127 vessels total) are MSC-certified (Table S5). Only one year after the Spanish albacore fishery received a conditional MSC pass in 2016 (lacking harvest strategies), the EU submitted a proposal to ICCAT calling for reference points for north Atlantic albacore (EU 2016). Harvest control rules for this species entered into force in 2017. Although not analyzed to the level of the country, the correlation observed in Chapter 3 (Figure 3.3) and interview observations explain this trend at the RFMO-level. These findings support the work of Yeeting and Bush (2019) who found variability in the MSC-RFMO harvest strategy pathway across ICCAT, IOTC, and WCPFC but highlighted the importance of MSC as a catalyst in all cases. The world's industrial fisheries spent the latter half of the twentieth century expanding from national coastlines into the global ocean (Swartz *et al.* 2010). While OPAGAC's FIP involvement may represent a new form of industrial fisheries expansion that promotes itself as being more sustainability-focused, it also shows that fishing companies of all sizes are increasingly faced with the realization that there is limited capacity for substitutability in the market for eco-certified products for the largest tuna importing markets. This suggests countries with MSC-certified fleets may have less flexibility with regard to RFMO positions, especially when their largest fishing companies are involved.

Regarding the second hypothesis of Barkin *et al.* (2018), the authors explain that for the three bluefin species, which are imported primarily by Japan, "the [Japanese] post-capture sectors do not have to care about depletion of a specific stock of bluefin tuna as long as they can continue to source bluefin tuna from various seas. Therefore, it can be assumed that the government primarily represents more the interest of the post-capture sector such as traders and retailors and less that of the capture fishery sector" (pp. 260). This perspective was supported by observations by one RFMO advisor who suggested the EU (a WCPFC market country) wanted to increase total WCPFC catches while stocks are healthy, while Japan and PNA (WCPFC fishing and access countries) opposed such an approach (Section 5.3.1.3). Notably, all stocks in the WCPFC area are healthy at present and have defined or preliminary

reference points, so the degree to which a country could (or would) suggest the adoption of unsustainable fishing is increasingly limited.

Overall, I suggest the degree to which this hypothesis holds is largely species and country dependant. To this first point: a country's position on one RFMO stock may be in keeping with this hypothesis, but an 'unsustainable fishing' position must be balanced against its positions on other stocks and the connections it has with other RFMO countries around access to those stocks (i.e. a country may be a market country for one species and a fishing country for another and must account for those relationships). Second, this hypothesis may apply moreso to countries where sustainability is not an important aspect of product value (i.e. the current difference between sashimi-grade bluefin that goes to Asia and canned skipjack that goes to the EU, Oceania, and North America). Given the advocacy of dozens of seafood companies related to RFMO measures in keeping with the sustainability requirements of MSC (Chapters 3, 4, and 5) and their commitments to global initiatives like those of the Global Tuna Alliance, unilateral unsustainable approaches at RFMO meetings appear to be diminishing by default as a result of the demands of the supply chain.

Policymaker receptibility to sustainability may not always be the case, however. One attendee at WCPFC perceived that the influence of a given MSC-certified fishing company depends on how influential that company is within the delegation, even if that delegation has high overall industry representation at meetings. For example, they said, "there are MSC-certified Chinese companies [and] the Chinese delegation may listen to their concerns but their direction [at WCPFC] comes from the Communist Party." I suggest that in the case of WCPFC, high industry representation on a delegation is not necessarily indicative of an unwillingness to support sustainability measures (hypothesis 3). Rather, high industry representation may be indicative of government willing to support whatever measures its industry wants (as a collective or based on an individual company's power) or there may be a weaker relationship than expected. To this first point: if fishing companies (and other industry members) can convince policymakers that sustainability measures at RFMOs are important for their eco-certifications (Chapter 3), then RFMO positions may be aligned with more sustainable measures. To this latter point: there may be limited connection between industry demands and national positions despite high industry representation on a delegation if the member state

government has an overarching mandate from the political party in power (e.g. China). Or, in the case of PNA fishing countries (e.g. Papua New Guinea, Solomon Islands, Federated States of Micronesia, industry may have limited impact if regional intergovernmental coalitions around fishing access take precedence over national positions around fishing itself.

Multiple interviewees suggested that industry positions do shape national positions at RFMOs but, as discussed in Chapter 5, there is substantial industry diversity even within a delegation (Figure 5.6B). These observations support the third hypothesis of Barkin *et al.* (2018) that regulatory capture does exist in RFMOs. However, I also suggest that since this is the case, if industry positions are aligned with long-term sustainable management, then policymakers will respond to this as readily as they would other industry requests. While historically the goals of industry representatives at meetings might have been to pressure policymakers for measures that would help them maximize their profits (which often equates to advocating unsustainable fishing practices), the objectives of many companies are clearly changing now that they view sustainability as a requirement to operate. The transition of fishing and seafood companies to a more sustainability-focused agenda in recent years was observed in joint letters to RFMOs in the context of harvest strategies and the sustainable seafood movement (Figure 4.2 and Figure 4.3).

Regarding the fourth hypothesis proposed by Barkin *et al.* (2018), I found that most ENGOs in attendance at RFMO meetings are from high-income countries, namely the US and EU (Table S11). However, without question, the strongest measures proposed at WCPFC have come from the PNA. At the same time, the US and EU have often been opposed to the PNA's assertion of their sovereign rights to control fishing access (Aqorau 2015). As interviewees discussed in Chapter 5, PNA positions have, however, received support from US ENGOs given their sustainability focus (Section 5.3.3.3). This suggests that domestic ENGO presence may matter less than an organization's capacity to support any national positions that are aligned with their mission. Similarly, I found that partnerships between industry and environmental groups across countries as a result of the sustainable seafood movement are resulting in joint advocacy—to all RFMO member states—by these previously incompatible groups.

If stakeholders with opposing interests can agree on a common rule, their coalitions will be more successful than single-sided groups (Kahn 1988). Private actor partnerships are usually rooted in strategy for both parties, with companies entering into collaborations with non-governmental organizations out of motivations linked to compliance, risk aversion, value, or opportunity; NGO motivations are often related to issues of funding, capabilities or mission (Austin 2006). The increasing prevalence of industry-ENGO relationships as part of the sustainable seafood movement (Chapter 4; Section 4.3.4) speaks to this reciprocity-based dynamic, as well as the notion of 'Bootleggers and Baptists', which assumes stakeholders with dissimilar or incompatible interests "may advocate similar policies for different reasons; even if each has a set of preferences that does not match the other's, the point at which they have compatible interests is an important opportunity for collaboration or acquiescence in domestic politics" (Barkin *et al.* 2018, pp. 262). Results from Chapters 4 and 5 show this applies to international politics as well since industry and environmental observer organizations from multiple countries now advocate the same management measures to RFMO policymakers because of their relationship to mid-supply chain companies that seek MSC-certification. Still, most ENGOs have low connectivity to delegations within RFMO meetings and as many interviewees discussed, their influence stems largely from their supporting role outside of WCPFC meetings and interactions with policymakers throughout the year. These groups have a unique ability to provide novel information to member state policymakers that can then be brought to the level of an international organization (Tallberg *et al.* 2018). In the case of RFMOs, this is especially true when ENGOs and INGOs are able to obtain data directly from fishing companies or from campaigns at sea.

6.4.3 Bridging the divide between the BBNJ process and RFMO meetings

Lastly, while the analyses in Chapter 4 focused on issues present in observer letters to RFMOs, it is pertinent to also discuss a notable absence in these letters: NGO advocacy aligned with the BBNJ agenda. Leading up to official BBNJ meetings, NGOs played a more prominent role than policymakers in working groups (Blasiak *et al.* 2017). Nine NGOs that are official RFMO observers are also members of the High Seas Alliance, a NGO coalition that advocates high seas marine spatial management including the implementation of fully protected marine reserves (High Seas Alliance 2020). While the position of the High Seas Alliance is that the BBNJ treaty should complement existing management frameworks, our findings suggest a

potential duality in messaging to policymakers (and the public) as BBNJ was not mentioned in any observer letters to RFMOs, even when the scope of the BBNJ treaty was still undecided (c. 2012-2018) and may have had implications for the management of fisheries targeting highly migratory fishes. While spatial management measures were included in some NGO letters to ICCAT and WCPFC, especially in the early 2000s (see 'Other' in Figure 4.3A), these measures typically related to spawning area closures for Atlantic bluefin (ICCAT) and closures of the high seas pockets adjacent to PNA waters (WCPFC). No NGO advocacy letters mentioned high seas marine reserves, protected areas, or other management measures for tuna in the context of BBNJ.

Given this observation, is possible that NGO representatives discuss BBNJ in separate consultations with UN General Assembly delegates, or that the NGO representatives attending BBNJ meetings are not the same as those attending RFMO meetings. However, in either case, this would suggest a strong disconnect if policymakers attending BBNJ meetings do not also attend RFMO meetings or if NGO representatives are working separately on these tightly linked issues. It is also possible that the omission of BBNJ in RFMO letters was done intentionally by ENGOs to avoid conflict with RFMO stakeholders whose fleets depend on access to the high seas areas for fishing (namely those countries listed in Table 2.3). In Chapter 4, the key concerns highlighted by policymakers were a lack of transparency in observer agendas and past feelings of manipulation by these groups (Table 4.4). I reiterate this sentiment in the context of this apparent mismatch between NGO agendas in these two related fora and suggest that NGOs could play a key bridging role as purveyors of information between RFMO policymakers and the BBNJ negotiations if the same individuals were engaged in both.

6.5 Long-term tuna conservation and management

The overall health of world's tuna stocks appears to be improving under current RFMO frameworks, particularly since 2013 (Figure 6.1). This positive trajectory mirrors the trend seen in harvest strategy uptake (Figure 3.2B). This suggests the adoption of these management measures by RFMO policymakers has been beneficial for tuna stocks, especially with regard to reductions in fishing mortality (Figure 6.1A). The degree to which harvest strategies enable rebuilding of stocks to healthy levels of abundance (Figure 6.1B) will take longer to assess because population growth does not happen instantaneously. In consideration of my third

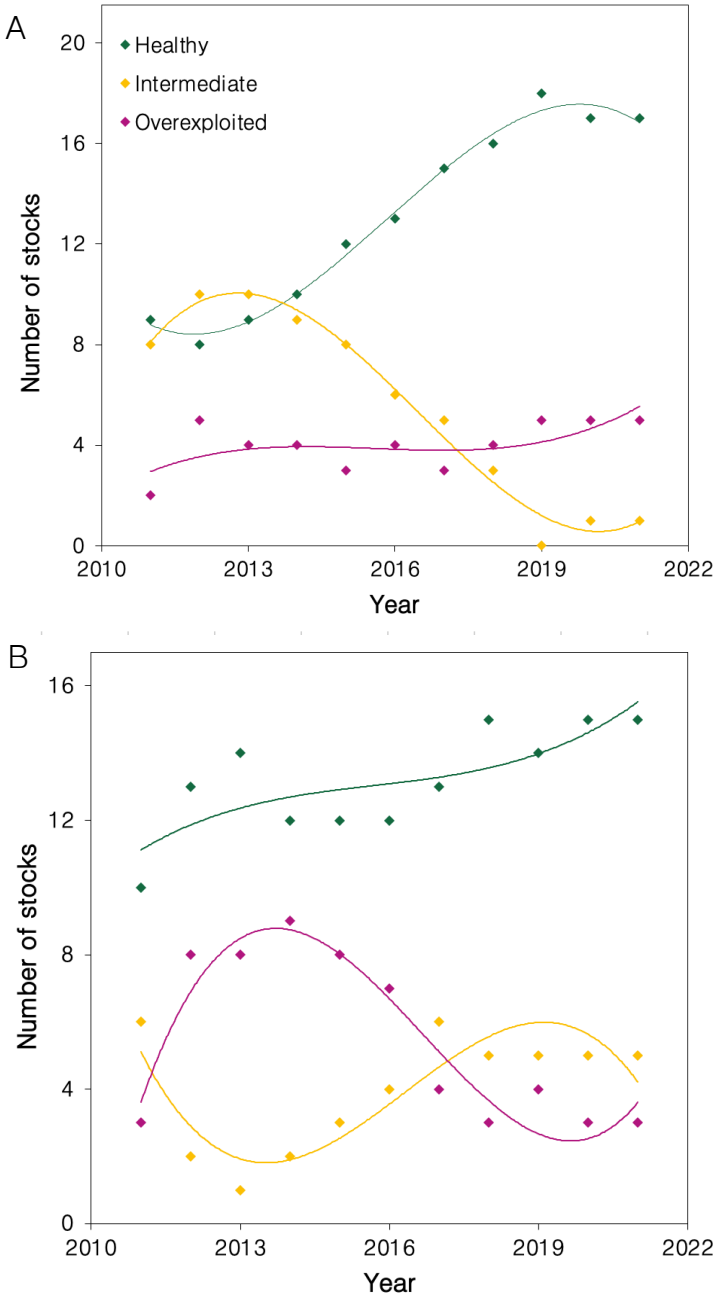

Figure 6.1 Current trajectories of the world's 23 commercial tuna stocks. Shown are trends in (A) fishing mortality (F/FMSY or equivalent stock assessment indicator) and (B) abundance (B/BMSY or equivalent) over time, all stocks combined. Data: ISSF (2021).

overarching research question, many interviewees highlighted that harvest strategies have been an increasingly important priority for RFMO policymakers in recent years (and likely an eventuality), but the rate at which they have been adopted is largely related to MSC-related stakeholder advocacy.

Despite encouraging trends, these metrics refer to the 23 tuna stocks as a collective, which means some stocks are doing better relative to 2013 while others are doing worse. For example: revised stock assessment data led to improved projections on the status of western Pacific bigeye in 2018, which is now considered healthy despite previous projections of overfishing (Ducharme-Barth *et al.* 2020). Conversely: due to overcatch of annual quotas in recent years, bigeye in the Atlantic Ocean is now considered both overfished and subject to overfishing (ICCAT 2019c) as is Indian Ocean yellowfin (IOTC 2019).

Regarding the most historically overexploited stocks: Pacific bluefin continues to be fished at less than 5% of its original stock size and has been subject to annual overcatch under its recovery plan as well as proposals to increase quotas from Japanese policymakers (McCurry 2017; Anonymous 2019). However, trends for southern bluefin are encouraging. Following a 2006 independent performance review, which "captured the CCSBT at a moment of chaos and consternation regarding its aims and their plausibility" (Szigeti and Lugten 2015), southern bluefin has been rebuilding by approximately five percent annually since its all-time low in 2009 ($SSB/SSB_0 = 4.6\%$) under strong harvest control rules adopted by CCSBT member states (CCSBT 2020). Atlantic bluefin—the original posterfish for extinction—is perceived to be doing so well that two Atlantic bluefin fisheries (annual catch of 300 mt combined) received MSC certification in 2019. Still, there remains high uncertainty in stock assessment outputs for these fish and both WWF and Pew objected to these certifications (see WWF 2020).

My work has largely highlighted the ways in which private actors have—and can continue to—improve tuna fisheries management through their engagement with RFMO policymakers and each other. Still, the success of their advocacy at RFMO meetings will always be limited by the agendas of policymakers. Therefore, the ability of fishing companies and NGOs to truly realize the goals of the sustainable seafood movement (i.e. reduce environmental impacts of fisheries on marine ecosystems) as a form of private governance, is vitally dependant on how

successfully these groups can address harmful fishing practices on the water. In the following two sections, I discuss what is required from private actors to ensure efforts thus far do not simply re-enforce the status quo (Section 6.5.1), and how industrial fishing companies in particular need to address bycatch problems in order for their sustainability claims to be genuine (Section 6.5.2).

6.5.1 Moving beyond 'sustainable enough'

Current cooperative commitments to action between companies, INGOs, and ENGOs emerged from a history of conflict and strategic opportunities. Through the sustainable seafood movement, large ENGOs such as Greenpeace and WWF began applying lessons learned in other sectors, such as forestry. These groups focused their engagement efforts on concentrated buyers of seafood, rather than relying solely on the interest of end consumers, which was the initial mechanism for market-driven change promoted by the MSC (Roheim *et al.* 2018). As stated by an attendee at ICCAT, "the retailers are much more sensitive to any perception of themselves not being supportive of sustainability because they are afraid of boycotts". To this point, although consumers themselves are not driving the sustainable movement through their purchasing power as originally envisioned, their role as the movement's "audience" cannot be overlooked or understated (Barclay and Miller 2018). As an INGO representative interviewee said, "eco-certifications are pushing the retailers, with the help of some NGOs, and the retailers are reacting because they don't want bad publicity … they are demanding these certifications in certain instances." ENGOs have successfully leveraged the concern of public perception to their advantage: at least two dozen large retailers in North America and the UK have made CSR commitments tied to the sustainable seafood movement (Roheim *et al.* 2018) and all of these groups have made pledges specific to sourcing a proportion of their products (upward of 100%) from MSC-certified fisheries (MSC 2018).

Although these efforts have the potential to affect meaningful changes in fishery practices, retailer commitments for MSC-certified products have also put substantial pressure on the supply chain—and the MSC itself—to deliver large volumes of sustainable fish to the market. As a result, multiple interviewees perceived that the MSC Standard is currently too weak to deliver real improvements to fisheries operations and management, or it gets applied by auditors in an increasingly biased way to ensure industrial-scale fisheries can retain market

access (Chapter 3). Equally, the massive recent trajectory in FIP uptake (Figure 3.3) strongly support the observation that the fishery-specific FIP model's "potential for impact will quickly plateau (against current volume-based targets)" (CEA 2020, pp. 10).

There are still no concrete standards for FIPs and evaluations on their performance are largely drawn from partners' self-reported and self-generated data that often are not robust enough to determine if there is direct on-water improvement (CEA 2020). This presents substantial concerns related to the environmentally-friendly reputation of FIP ENGO partners and greenwashing. As Tlusty and Øistein (2016) highlight, commitments based on 'sourcing sustainable seafood' are fixed—once the claim has been made, progress toward further improvement stops. Thus, the authors posit that a more adaptive goal would be to focus on 'increasing seafood sustainability'. In many regards, this was the initial goal of Fishery Improvement Projects yet their ability to achieve this goal has been hampered by retailer commitments that currently see FIPs as 'good enough' (Bailey *et al.* 2018). The interdependence of ENGOs and industry makes it challenging for ENGOs to hold their FIP and supply chain partners accountable to the sustainability commitments they make, which is a fundamental weakness of the sustainable seafood movement at present (Packer 2020).

In some cases, NGOs are working actively with companies to reduce human rights abuses in seafood supply chains (Greenpeace 2017)—a necessity for ensuring seafood is not only environmentally sustainable but also socially-responsible and ethical (Kittinger *et al.* 2017). By combining elements of social sustainability and locality, the 'fish with a story' products envisioned by some WCPFC attendees could represent the next wave of seafood sustainability efforts to reach consumers from this region. However, as Packer (2020) explains, "a broadening definition of seafood sustainability, including both social and environmental aspects, makes measuring and comparing [corporate] performance challenging" (pp. 188). In this regard, as NGOs diversify their seafood sourcing policies for business partners (see ISSF partner guidelines and recent Global Tuna Alliance 25PST commitments for examples) metrics for tracking and evaluating an individual company's performance on any one indicator become increasingly opaque.

While seafood companies can adopt their own sustainability policies and make sourcing commitments, the ultimate responsibility and authority in fisheries management rests on government policymakers (Foley 2013). As with the sustainable seafood movement, there is a growing consensus that the inclusion of socio-economic and cultural factors in decision-making are no longer seen as desirable but as essential for ensuring resource sustainability (Costello *et al.* 2020; Cisneros-Montemayor *et al.* 2021). For RFMOs, this means adopting strong, equitable allocation frameworks that ensure the rights of coastal states as they seek to develop their fisheries within the confines of adopted harvest strategies (Seto *et al.* 2019). For private actors, it means not impeding these efforts. Low-income countries have limited capacity to both influence and resist the impacts of environmental standards set by NGOs and industry (Falkner 2003). PNA represents an outlier in this regard. However, given the high concentration of NGOs representing high-income countries and philanthropic organizations at RFMO meetings, and the focus of eco-certification programs on high volume fisheries and seafood retailers, the responsibility to ensure market-based efforts do not undermine the rights of small-scale fishers, or fisheries in coastal or low-income countries, extends to all companies and NGOs involved. For example, recent calls by multiple EU and UK retailers and the ENGO Blue Marine Foundation (which is an approved IOTC observer) to boycott all yellowfin tuna coming from the Indian Ocean in response to concerns of overfishing may unnecessarily penalize small-island states that are adhering to their annual quotas, in spite of overfishing by the foreign fleets. Notably, the majority of overcatch of Indian Ocean yellowfin in recent years has come from the EU (Shah 2019), and none of the companies advocating a boycott engaged with government officials from any of the 16 IOTC small-island coastal states prior to their public announcements (Carreon 2020).

This situation speaks to RFMO policymakers' concerns over incorrect or biased advocacy and messaging by ENGOs, which now may be further amplified by misinformed supply chain partners. While retailers can take advantage of the high substitutable nature of canned tuna and source products from elsewhere if needed, countries that rely on exports from their fishing sector for national economic stability do not have this luxury and may be unnecessarily penalized by supply chain companies that lack a holistic view of a given situation. Notably, one UK retailer did offer a counter perspective by publicly acknowledging the impacts an indiscriminate boycott would have on coastal Indian Ocean fishing countries, such as the

Maldives. As expressed in their statement, Waitrose called a potential ban, "fundamentally and morally wrong" (Holmes 2020). Although this support offers a more nuanced approach to the situation, if opposing claims by retailers become the norm, they run the risk of further confusing seafood consumer and eroding the credibility of all organizations and governments involved in the sustainable seafood movement.

Similarly, by focusing on large companies—and with strong financial and strategic support from some of the world's largest private foundations (i.e. Walton, Packard, Moore) in recent years—industry and environmental NGOs have been able to scale up the impacts of their efforts. However, results from RFMO interviewees, suggest improved transparency around funder motivations and what repercussions that form of support for industrial fishing efforts may have on the sovereignty of coastal states and/or small-scale fisheries is an ongoing concern (Table 4.4). This challenge was recently acknowledged in a third-party assessment prepared for Packard and Walton on the successes and failures of the sustainable seafood movement thus far. Within, the review panel highlights that existing and future efforts may have "unintended consequences relevant to social issues and equity" (pp. 21) with regard to the costs associated with obtaining an eco-certification or joining a FIP and the lack of price premiums thus far observed by small-scale fishers (Ross Strategic *et al.* 2020). Thus, the evaluation team states that where there is the potential for negative impacts, "consider how complementary [Global Seafood Marketing strategies], or country-program investments, or partnering with development agencies or local partners could help to mitigate those impacts" (pp. 21). I suggest that further investigation of the impacts of current sustainable seafood efforts on small-scale tuna fisheries is warranted given that multiple interviewees expressed that such negative impacts are not probable but very real. And, in order to ensure any subsequent partnerships are successful, building strong relationships with low-income and coastal island state policymakers and private actor representatives through sustained RFMO attendance and the provision of credible information will be essential. Engaging transparently with policymakers is especially important for NGOs attending WCPFC, where suspicion over motives and 'western' perspectives has resulted in a reluctance for island countries to work with these groups (Barclay and Cartwright 2007a).

6.5.2 Unresolved bycatch issues

Bycatch has always been a key concern for many organizations opposed to MSC certifications of different fisheries (Christian *et al.* 2013b). The perspective of Ponte (2012) that MSC only works for fisheries that are already sustainable will be tested as more longline and FAD ('Fish Aggregating Device') purse seine fisheries seek eco-certification. FADs are floating or stationary rafts of debris (synthetic or natural materials, often including mesh) that attract fish seeking protection in the open ocean environment. While the target species of FAD purse seining are usually skipjack or yellowfin, juvenile tunas and other pelagic fishes are often caught as bycatch (see Gomez *et al.* 2020 for a comprehensive overview on current FAD literature). Similarly, pelagic longlines are a passive and indiscriminate gear primarily used to catch adult bigeye, yellowfin, albacore, and bluefin but known to catch high volumes of sharks, turtles, and seabirds as well. Unlike active gears such as free school purse seine, troll, and pole-and-line, longliners and FAD purse seines have the highest bycatch rates in the tuna fishing industry (Schiller 2014; Escalle *et al.* 2019).

Harvest strategies may have likely been the easiest target for MSC-related RFMO advocacy because these management measures are gear independent (i.e. they cover tuna stocks not fishing fleets) and no changes to fishing practices were required. In the case of bycatch, however, only some of the responsibility to address the problem can be placed to RFMOs. In this regard, private actors must also contribute to affecting bycatch reform. The INGO ISSF is actively engaged in FAD research on improvements to FAD design and RFMO advocacy and encourages its seafood supply chain partners to "conduct transactions only with those purse seine vessels whose owners develop and make public FAD Management Policies" and use non-entangling FADs (ISSF 2021). However, despite these efforts, the actual scale of FAD use is largely unknown globally (or, at least it is publicly unavailable) but it likely exceeds 120,000 individual devices (Gershman *et al.* 2015). Equally, there are currently no regulations that ensure these gears do not 'fish' (i.e. float) illegally in EEZs where a vessel itself may not be authorized to fish (Gomez *et al.* 2020), nor are there requirements stipulating fishing vessels must collect the FADs they deploy—estimates suggest only 10% of all FADs in certain ocean basins have been recovered (Escalle *et al.* 2019). Thus, the true extent of bycatch incurred by these gears is unknown and the efforts of private actors should focus not only on gear modifications to enable more FAD fishing, but also on understanding the true magnitude of

the problem; it is difficult to objectively quantify fishery 'improvement' without a baseline reference point.

By number of fisheries, tuna longline companies account for one-third of MSC certified tuna operations, and the first fishing MSC certification for a FAD-fishing company (Echebaster) occurred in 2018. The certification of the Echbaster fishery affected the credibility of the MSC and its auditors within the NGO community, not entirely because of high bycatch rates associated with this gear but because overfished yellowfin in the Indian Ocean were part of that bycatch (WWF 2018b). Currently 17 tuna longline fisheries are currently in FIPs, and the largest purse seine FIPs were led by OPAGAC, one of the original Spanish companies to use FADs for fishing. All OPAGAC FIPs were completed in 2019 and these fisheries have entered into MSC assessment. Critically, not only do these gears have high bycatch but as Gomez *et al.* (2020) suggest "market forces are failing with respect to FADs [since] tuna retailers and third-party sustainability certification programs do not treat FAD fisheries as potentially illegal, unreported and unregulated (IUU) fishing and have sent mixed messages to consumers that tend to reinforce unsustainable fishing practices" (pp. 545). These authors further state that if this is the case, then upward of 89% of all canned tuna reaching the major canned tuna markets may have been caught with IUU FADs. Since bycatch is largely related to fishing practices gears, tuna FAD fishing companies must lead on developing less-impactful FAD technologies, collect more data on FAD use and bycatch, push jointly with other national fleets for stronger RFMO regulations related to where, how and when FADs can be used, and/or reduce their use altogether. Such efforts are required *in addition to* advocating improved RFMO management measures for bycatch species.

Nonetheless, as discussed in Chapter 4, bycatch has also been an ongoing concern for many NGOs at RFMO meetings and one that has gained little traction, especially at ICCAT. Equally, as discussed above in Section 6.3.3, adopting management measures for smaller, less economically valuable tuna species is a challenge for all RFMOs despite the importance of these species for ensuring food security in many low-income coastal communities. The MSC Standard stipulates that fisheries seeking MSC also require management measures for the species they catch as bycatch, if they are caught over a certain volume threshold. If fishing companies want to avoid this requirement, at the very least, they must demonstrate that their

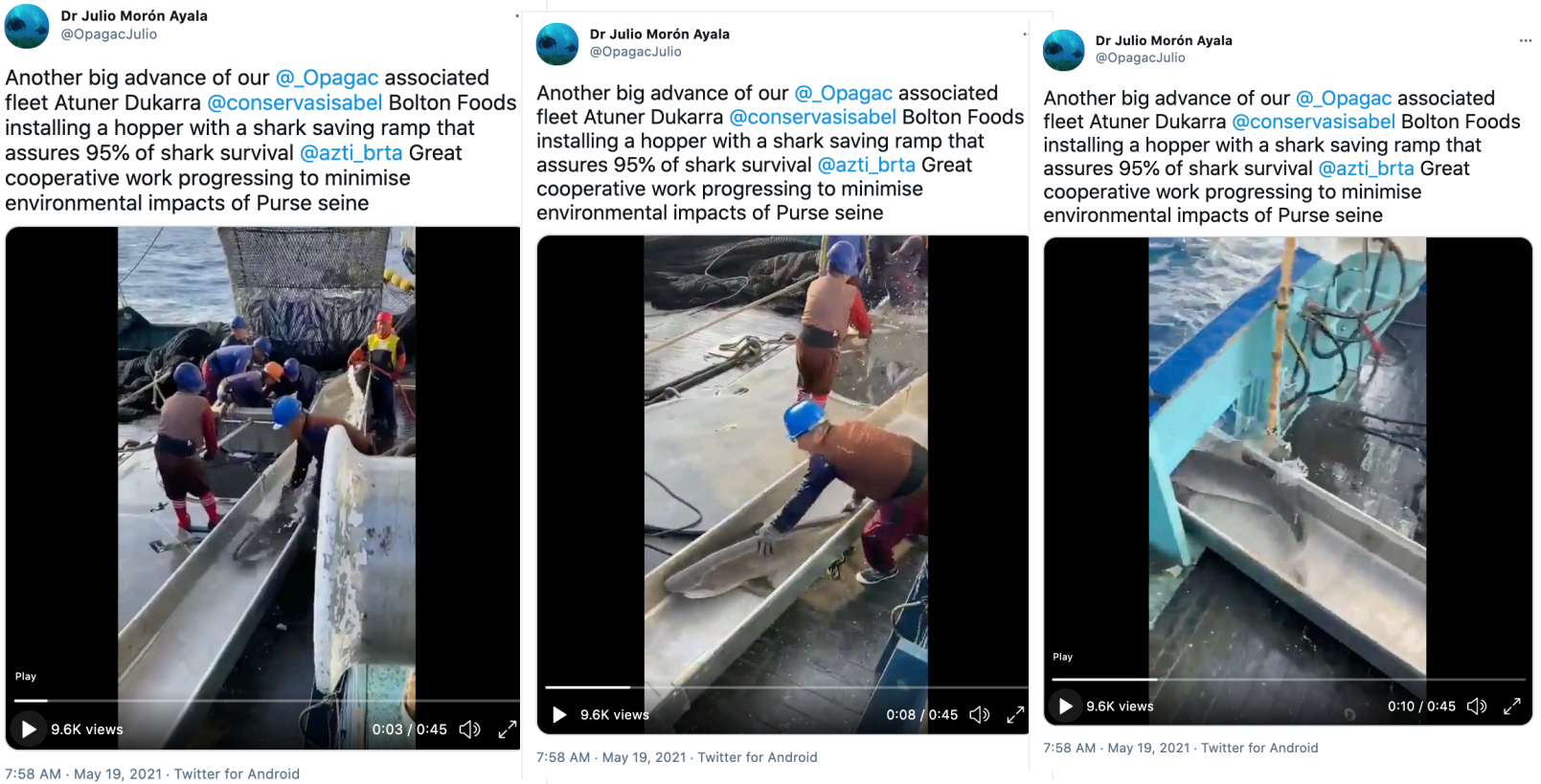

Figure 6.2 Testing new technology to reduce FAD shark bycatch. Images from video posted to Twitter (20 May 2021) showing OPAGAC fisher efforts to return a live silky shark (originally trapped in the purse seine net) back to the ocean using an onboard ramp. It is unclear how long the shark was trapped in the net prior to being brought onboard but it took less than 15 seconds to get it onto the ramp and back into the water; subsequent footage shows the process repeated for an additional silky shark in roughly the same time.

practices have no impact on the stock health of bycatch species where data are insufficient to determine otherwise (MSC 2014). Therefore, if done well (accurately), data collected by fleets could help RFMO science providers improve population estimates of smaller tuna and tuna-like species, which could help ensure their availability to coastal communities into the future. Equally, these data may also be valuable to small-scale fisheries that seek MSC-certification, since many fleets operate coastally and have high rates of bycatch of smaller tuna-like species (Ardill *et al.* 2012). Improved oversight and management of these stocks with the support of industrial fishing companies could present small-scale fisheries with the option to retain their catch for sale locally or export it, which is a choice they do not currently have given the requirement of so many supply chains for MSC-certified products.

Overall, if FAD fishing companies are serious about demonstrating 'improvement' through FIPs and not simply using them as a scapegoat for continued market access, they are directly responsible for collecting data and making on-water improvements related to their gears. Fortunately, given the size of many FAD fishing companies, they have the financial capacity and resources to address this challenge unilaterally if desired. Recent work by OPAGAC suggests on-water progress is occurring (Figure 6.2) but whether efforts are scalable remains to be seen. Equally, to retain their credibility as reputable environmental conservation organizations, NGOs participating in FIPs with FAD and longline fishing companies must be held accountable for ensuring the impacts of these fisheries are properly mitigated. Gomez *et al.* (2020) further detail responsibilities for multiple levels of the supply chain and its NGO partners with regard to the relationship between MSC and FADs, specifically emphasizing the importance of developing a FAD ownership database and company Action Plans to ensure their FAD vessels do not negatively impact endangered or threatened species. These authors acknowledge the critical role retailers have played in the sustainable seafood movement thus far—and the role they can continue to play with regard to FADs by pressuring FAD fishing companies and RFMOs for improved FAD ownership tracking protocols.

6.6 Research limitations and directions for future work

As discussed above, there has been rapid progress in the sustainable seafood movement with regard to the involvement of tuna fisheries, NGOs, and associated supply chain commitments.

And, although this thesis has helped document these trends and their impacts over the last 10-20 years, the *next* 10-20 years will yield a much clearer picture of what these types of commitments can and cannot achieve with regard to ensuring environmentally sustainable (and socially equitable) tuna fisheries and improving the management of these species and the surrounding pelagic ecosystem.

For this thesis, I took a predominantly empirical (rather than theory-driven) approach to answering my research questions. All global research is inherently subject to the constraints of scale: attempts to capture everything often means only scraping the surface of many things. In some cases, I was limited by the quantitative data sets available (the FishStat data in Chapter 2, for example, could not be refined to a resolution beyond species group in many cases). Similarly, I was limited by the assumptions I had to make for my Chapter 5 data set (i.e. corrections to typographical errors in the participant names and addition of affiliation types). Equally, interview data are only as good as the questions asked, the engagement of interviewees, and the reliability of their responses. I chose to assume all my participants shared information truthfully and I kept any information they asked to be 'off the record' out of my analyses. If I had been able to attribute certain quotes to specific countries or organizations, this too would have helped explain trends more clearly. However, ensuring participant confidentiality was a paramount concern.

While I tried to conduct interviews with a representative sample, in an ideal world, I would have been able to talk to all RFMO attendees from not only two, but all five tuna RFMOs. Most of my interviewees had participated in the RFMO process for some time so obtaining answers from people new to meetings may have resulted in different perspectives that were less contingent on past successes and failures and more representative of the current state of public-private actor dynamics. Still, I believe substantial value was obtained from having long-term perspectives as these interviewees provided important historical context to my questions and generously shared their wealth of experiential knowledge. Similarly, although Chapter 4 showcased the primary ways in which observer groups have coalesced around timely issues and their engagement in meetings, trends specific to certain issues and species advocated likely varies by RFMO—as do their interactions with policymakers—and I was unable to capture these trends for IOTC, CCSBT, and IATTC.

Looking into future directions, the results of this work point to several open and timely research opportunities. In the context of food security, specifically evaluating the impacts of eco-certifications on small-scale tuna fisheries is a much-needed body of work given the rate of uptake and volume these certifications now cover. Similarly, an assessment of the on-water contributions made by tuna FIPs, especially in the context of bycatch, has the potential to help legitimize these efforts and highlight where successes may be transferred to similar fisheries.

In addition to a person's affiliation, interpersonal relationships appear to be a key factor affecting influence at RFMO negotiations. Further evaluating the impacts of longevity, connectivity, and dispersal within and across RFMOs has the potential to shed additional light into the underlying social factors that may affect the structure and function of these fora. With five healthy tuna stocks and strong local leadership of the PNA, WCPFC is currently one of the most successful RFMOs from both an ecological and equity standpoint. However, my analysis of meeting dynamics for this RFMO remain largely context-specific since I have no other RFMO data for reference or comparison. The next step for this work is to evaluate participation and attendance at the other tuna RFMOs and analyse commonalities and differences among them.

This type of analysis may even lend insights into the activities of people affiliated with tuna fishing that technological systems cannot. For example, despite new technological capabilities to detect fishing activity thousands of kilometers offshore using satellites (McCauley *et al.* 2016; Dunn *et al.* 2018; Kroodsma *et al.* 2018), researchers are still unable to identify which companies are responsible for one-third of fishing effort in the high seas (Carmine *et al.* 2020). Yet, tuna caught by fishers working for legally authorized vessels are connected to management decisions adopted through RFMOs. Therefore, observing who partakes in annual meetings provides novel insight into understanding where interests lie in fishing and decision-making. It is my hope that this line of research will continue to grow and contribute meaningfully to improving our understanding of tuna fisheries governance. Equally, it is also my hope that this work can help ensure both public and private stakeholders contribute their perspectives constructively to the management of transboundary fishes and relate compassionately to each other.

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APPENDIX 1: SUPPLEMENTARY TABLES

Table S1 Species caught on the high seas and associated importers from 2002-2011. (USA: United States of America; N/A: not available. Trade statistics refer to species in raw or unprocessed fresh or frozen form. Data: FishStat.)

Species	Primary importer (PI)	PI proportion (%) of global imports	Secondary importer (SI)	SI proportion (%) of global imports
Skipjack tuna	Thailand	63	Japan	6
Yellowfin tuna	Thailand	21	Japan	20
Bigeye tuna	Japan	75	Ecuador	5
Chilean jack mackerel[1]	Netherlands	38	Japan	28
Argentine shortfin squid[12]	Spain	36	Italy	22
Blue whiting	Netherlands	49	Belarus	11
Chub mackerel	South Korea	98	Chile	2
Albacore tuna	Thailand	30	Spain	19
Japanese anchovy[2]	Spain	67	Turkey	17
Jumbo flying squid[12]	Spain	36	Italy	22
Pacific saury	South Korea	95	Japan	5
Swordfish	Italy	30	Spain	21
Antarctic krill[3]	USA	100	NA	NA
Japanese jack mackerel[1]	Netherlands	38	Japan	28
Northern prawn[4]	Denmark	62	Sweden	10
Flathead grey mullet	N/A	N/A	N/A	N/A
Frigate tuna[5]	Japan	13	Vietnam	8
Narrowbarred Spanish mackerel[7]	Japan	100	NA	NA
Atlantic cod	Denmark	16	Portugal	16
Southern bluefin tuna	Japan	93	USA	2
Kawakawa[5]	Japan	13	Vietnam	8
Greenland halibut	Denmark	39	China	25
Shortfin mako shark	N/A	N/A	N/A	N/A
Striped marlin[6]	Japan	78	Taiwan	20
Pacific bluefin tuna[8]	Japan	58	Spain	13
Patagonian toothfish[9]	USA	48	Japan	22
European anchovy[2]	Spain	67	Turkey	17
Black marlin[6]	Japan	78	Taiwan	20
Indo-Pacific sailfish	N/A	N/A	N/A	N/A
Antarctic toothfish[9]	USA	48	Japan	22
Wellington flying squid[12]	Spain	36	Italy	22
Patagonian grenadier[10]	France	28	Germany	18
Indo-Pacific king mackerel[7]	Netherlands	38	Japan	28
Atlantic bluefin tuna[8]	Japan	58	Spain	13
Silver seabream[11]	Spain	27	South Korea	16
Blue marlin[6]	Japan	78	Taiwan	20
Atlantic sailfish	N/A	N/A	N/A	N/A
Roundnose grenadier[10]	France	28	Germany	18
Bullet tuna[5]	Japan	13	Vietnam	8

[1]not differentiated by species in FishStat - data refer to all horse and jack mackerels collectively; [2]not differentiated by species in FishStat - data refer to all anchovies collectively; [3]given information available in primary literature, this information appears to be incomplete; [4]not differentiated by species in FishStat - data refer to all Pandalidae prawns collectively; [5]not differentiated by species in FishStat - data refer to all tunas and bonitos not otherwise specified; [6]not differentiated by species in FishStat - data refer to all marlins collectively; [7]not differentiated by species in FishStat - data refer to all Spanish mackerels collectively; [8]not differentiated by species in FishStat - data refer to Pacific and Atlantic bluefin combined; [9]not differentiated by species in FishStat - data refer to Antarctic and Patagonian toothfish combined; [10]not differentiated by species in FishStat - data refer to all grenadiers collectively; [11]not differentiated by species in FishStat - data refer to all sea breams collectively; [12]species not included in FishStat - data refer to all squids collectively

Table S2 Species caught on the high seas and associated exporters from 2002-2011. (UK: United Kingdom; N/A: not available. Trade statistics refer to species in raw or unprocessed fresh or frozen form. Data: FishStat.)

Species	Primary exporter (PE)	PE proportion (%) of global exports	Secondary exporter (SE)	SE proportion (%) of global exports
Skipjack tuna	Taiwan	20	South Korea	14
Yellowfin tuna	Taiwan	18	France	15
Bigeye tuna	Taiwan	55	South Korea	15
Chilean jack mackerel[1]	Netherlands	22	Chile	20
Argentine shortfin squid[12]	Argentina	17	South Korea	14
Blue whiting	Netherlands	39	UK	16
Chub mackerel	South Korea	54	South Africa	31
Albacore tuna	Taiwan	33	Japan	12
Japanese anchovy[2]	Italy	47	France	17
Jumbo flying squid[12]	Argentina	17	South Korea	14
Pacific saury	Taiwan	59	Japan	37
Swordfish	Spain	27	Taiwan	24
Antarctic krill[3]	Brazil	100	N/A	N/A
Japanese jack mackerel[1]	Netherlands	22	Chile	20
Northern prawn[4]	Denmark	58	Greenland	3
Flathead grey mullet	N/A	N/A	N/A	N/A
Frigate tuna[5]	Indonesia	20	Vietnam	8
Narrowbarred Spanish mackerel[7]	Indonesia	20	Vietnam	8
Atlantic cod	Norway	23	Iceland	20
Southern bluefin tuna	Australia	74	Taiwan	16
Kawakawa[5]	Indonesia	21	Vietnam	8
Greenland halibut	Greenland	24	Denmark	21
Shortfin mako shark	N/A	N/A	N/A	N/A
Striped marlin[6]	Taiwan	98	Maldives	1
Pacific bluefin tuna[8]	Spain	26	Turkey	13
Patagonian toothfish[9]	Chile	21	France	17
European anchovy[2]	Italy	47	France	17
Black marlin[6]	Taiwan	98	Maldives	1
Indo-Pacific sailfish	N/A	N/A	N/A	N/A
Antarctic toothfish[9]	Chile	21	France	17
Wellington flying squid[12]	Argentina	17	South Korea	14
Patagonian grenadier[10]	New Zealand	42	Argentina	29
Indo-Pacific king mackerel[7]	Indonesia	20	Vietnam	8
Atlantic bluefin tuna[8]	Spain	26	Turkey	13
Silver seabream[11]	Greece	32	South Korea	29
Blue marlin[6]	Taiwan	98	Maldives	1
Atlantic sailfish	N/A	N/A	N/A	N/A
Roundnose grenadier[10]	New Zealand	42	Argentina	29
Bullet tuna[5]	Indonesia	21	Vietnam	8

[1]not differentiated by species in FishStat - data refer to all horse and jack mackerels collectively; [2]not differentiated by species in FishStat - data refer to all anchovies collectively; [3]given information available in primary literature, this information appears to be incomplete; [4]not differentiated by species in FishStat - data refer to all Pandalidae prawns collectively; [5]not differentiated by species in FishStat - data refer to all tunas and bonitos not otherwise specified; [6]not differentiated by species in FishStat - data refer to all marlins collectively; [7]not differentiated by species in FishStat - data refer to all Spanish mackerels collectively; [8]not differentiated by species in FishStat - data refer to Pacific and Atlantic bluefin combined; [9]not differentiated by species in FishStat - data refer to Antarctic and Patagonian toothfish combined; [10]not differentiated by species in FishStat - data refer to all grenadiers collectively; [11]not differentiated by species in FishStat - data refer to all sea breams collectively; [12]species not included in FishStat - data refer to all squids collectively

Table S3 Abundance and fishing mortality metrics obtained from tuna stock assessments.

Stock	SSB/ SSB_{MSY}	F/ F_{MSY}	Source	Notes
NPO-ALB	3.25	0.61	ISC, 2017	Calculated from base case SB_{2015} and SB_{MSY} values in SA
SPO-ALB	3.88	0.23	Tremblay-Boyer et al., 2018	Median of 72 models: F_{recent}/F_{MSY} and SB_{latest}/SB_{MSY}
NAO-ALB	1.36	0.54	ICCAT, 2019	
SAO-ALB	1.10	0.54	ICCAT, 2019	
IO-ALB	1.8	0.85	IOTC, 2018	
MED-ALB	1.002	0.83	ICCAT, 2019	
EPO-BET	1.02	1.15	Xu et al., 2018	
WCPO-BET	1.77	0.65	McKechnie et al., 2017	Median of 18 models: F_{recent}/F_{MSY} and SB_{latest}/SB_{MSY}
IO-BET	1.29	0.76	IOTC, 2017	
AO-BET	0.59	1.63	ICCAT, 2019	
PBT	0.157	1.17	PFMC, 2018	SSB/SSB_{MSY} calculated from data provided (i.e. SSB_{2016} and SSB_{MSY})
WAO-ABT	0.401	0.985	ICCAT, 2017	Mean value of older and younger spawning estimates for F_{curr}/F_{MSY} and SSB_{curr}/SSB_{MSY}
EAO-ABT	N/A	N/A	ICCAT, 2019	Overfishing unlikely
SBT	0.49	0.50	CCSBT, 2017	
EPO-SKJ	N/A	N/A	Maunder, 2017	No reliable estimates at present
WCPO-SKJ	2.56	0.45	McKechnie et al., 2016	
EAO-SKJ	1.83	0.26	ICCAT, 2014	B/B_{MSY} (not SSB)
WAO-SKJ	1.30	0.70	ICCAT, 2019	
IO-SKJ	1.94	0.30	IOTC, 2017b	Ref case: F_{2016}/F_{MSY} and SSB_{2016}/SSB_{MSY}
EPO-YFT	1.08	0.85	Minte-Vera et al., 2017	
WCPO-YFT	1.39	0.75	Tremblay-Boyer et al., 2017	Median of 48 models: F_{recent}/F_{MSY}; SB_{latest}/SB_{MSY}
AO-YFT	1.17	0.96	ICCAT, 2019b, 2016b	Median of three models: F_{2018}/F_{MSY} and B_{2018}/B_{MSY}
IO-YFT	0.83	1.20	IOTC, 2017c	

Table S4 **RFMO catch data sources.**

RFMO	Landings data
CCSBT	SBT Global Catch data, 1952-2017
IATTC	IATTC Public Domain Catch by Species (v. Oct 2018)
ICCAT	Data extracted from species tables in ICCAT SCRS Report for biennial period, 2018-19 PART I - Vol. 2 (English)
IOTC	IOTC Nominal catch by species and gear, 1952-2017 (v. 12-06-2019)
WCPFC	WCPFC Tuna Fishery Yearbook 2017 (v. 5 November 2018)

Table S5 MSC tuna fisheries. Information obtained from webpages and publicly available final determination reports for each fishery at www.fisheries.msc.org; accessed 17 June 2019. Gear codes: TROLL = troll; PL = pole and line; PS = purse seine (FS = free school; A-FAD = anchored fish aggregating device, D-FAD = drifting fish aggregating device, DOL = dolphin set); LL = longline. MSC status codes: C = certified; E = exiting; W = withdrawn; A = in assessment [year started]. (NB: Within a given fishery there can be multiple Units of Certification depending on how many species are targeted by that fishery. For this reason, there are currently 25 MSC-certified fisheries, but 39 separate Units of Certification associated with these fisheries.)

Fishery Name	Stock	Species	Gear	Status	Year certified	Certified volume (mt)
AAFA and WFOA North Pacific albacore tuna	NPO SPO	ALB ALB	TROLL TROLL	C C	2007 2007	9,655 153.5
Canada Highly Migratory Species Foundation (CHMSF) British Columbia Albacore Tuna North Pacific	NPO	ALB	TROLL	C	2010	4,981
St Helena pole & line and rod & line yellowfin, bigeye, albacore and skipjack tuna	EAO NAO AO AO	SKJ ALB YFT BET	PL PL PL PL	E E E E	2010 2010 2010 2010	165.75 35 214.4 11.8
PNA Western and Central Pacific skipjack and yellowfin, unassociated/non-FAD set, tuna purse seine	WCPO WCPO	SKJ YFT	PS (FS) PS (FS)	C C	2011 2011	566,511 133,356
New Zealand albacore tuna troll	SPO	ALB	TROLL	C	2011	2,181
Fiji Albacore and Yellowfin Tuna longline	SPO WCPO	ALB YFT	LL LL	C C	2012 2012	3,094.65 1,317.3
Maldives pole & line skipjack tuna	IO	SKJ	PL	C	2012	68128.5
Walker Seafood Australian albacore, yellowfin tuna, and swordfish longline	SPO WCPO	ALB YFT	LL LL	C C	2015 2015	81.25 85.1
SZLC, CSFC & FZLC Cook Islands EEZ South Pacific albacore & yellowfin longline	SPO	ALB	LL	C	2015	3,753.5
Japanese Pole and Line skipjack and albacore tuna fishery	WCPO NPO	SKJ ALB	PL PL	C C	2016 2016	2,075 943

Solomon Islands skipjack and yellowfin tuna purse seine and pole and line	WCPO	SKJ	PL, PS (FS, A-FAD)	C	2016	18,710
	WCPO	YFT	PL, PS (FS, A-FAD)	C	2016	11,263
Tri Marine Western and Central Pacific Skipjack and Yellowfin Tuna	WCPO	SKJ	PS (FS, A-FAD)	C	2016	31,286
	WCPO	YFT	PS (FS, A-FAD)	C	2016	4,337
North Atlantic albacore artisanal fishery	NAO	ALB	TROLL	C	2016	3,045
Northeastern Tropical Pacific Purse Seine yellowfin and skipjack tuna fishery	EPO	SKJ	PS (FS, DOL)	C	2017	11,500
	EPO	YFT	PS (FS, DOL)	C	2017	101,019
American Samoa EEZ Albacore and Yellowfin Longline Fishery	SPO	ALB	LL	C	2017	1356
	WCPO	YFT	LL	C	2017	219.5
Talleys New Zealand Skipjack Tuna Purse Seine	WCPO	SKJ	PS	C	2017	3,433.5
SZLC CSFC & FZLC FSM EEZ Longline Yellowfin and Bigeye Tuna	WCPO	YFT	LL	C	2018	1,179
PT Citraraja Ampat, Sorong pole and line Skipjack and Yellowfin Tuna	WCPO	SKJ	PL	C	2018	2,525.5
	WCPO	YFT	PL	C	2018	497.5
French Polynesia albacore and yellowfin longline fisher	SPO	ALB	LL	C	2018	3,223
	WCPO	YFT	LL	C	2018	807
Echebastar Indian Ocean purse seine skipjack tuna	IO	SKJ	PS (FS, FAD)	C	2018	13,891
WPSTA Western and Central Pacific skipjack and yellowfin free school purse seine	WCPO	SKJ	PS (FS)	C	2018	104,513
	WCPO	YFT	PS (FS)	C	2018	14,157.5
US North Atlantic swordfish	NAO	ALB	LL	C	2018	156
	AO	YFT	LL	C	2018	N/A
SZLC, CSFC & FZLC Cook Islands EEZ South Pacific albacore & yellowfin longline	WCPO	YFT	LL	C	2018	1,376
SZLC CSFC & FZLC FSM EEZ Longline Yellowfin and Bigeye Tuna	WCPO	BET	LL	C	2019	1,503.5
Ishihara Marine Products albacore and skipjack pole and line fishery	WCPO	SKJ	PL	C	2019	1,431.48
	NPO	ALB	PL	C	2019	498.4

Sant Yago TF Unassociated purse seine Atlantic yellowfin tuna fishery	AO	YFT	PS (FS)	C	2019	1,620.1
Southeast US North Atlantic big eye tuna and yellowfin tuna	AO	YFT	LL	W	[2010-2014]	N/A
	AO	BET	LL	W	[2010-2014]	N/A
Solomon Islands skipjack and yellowfin tuna purse seine and pole and line	SPO	ALB	PL, PS (FS, A-FAD)	A	[2017]	N/A
Panama Tropical Pacific Yellowfin & Skipjack Purse Seine Tuna Fishery	EPO	SKJ	PS	W	[2018-2019]	N/A
	EPO	YFT	PS	W	[2018-2019]	N/A
MIFV RMI EEZ Longline Yellowfin and Bigeye Tuna	WCPO	YFT	LL	A	[2018]	N/A
	WCPO	BET	LL	A	[2018]	N/A
Pan Pacific yellowfin, bigeye and albacore longline fishery	SPO	ALB	LL	A	[2018]	N/A
	WCPO	YFT	LL	A	[2018]	N/A
	WCPO	BET	LL	A	[2018]	N/A
Usufuku Honten Northeast Atlantic longline bluefin tuna fishery	EAO	ABT	LL	A	[2018]	N/A
SATHOAN French Mediterranean Bluefin tuna artisanal longline and handline fishery	EAO	ABT	LL	A	[2018]	N/A
Tropical Pacific yellowfin and skipjack free-school purse seine fishery	WCPO	SKJ	PS	A	[2018]	N/A
	WCPO	YFT	PS	A	[2018]	N/A
ACTEMSA-LEAL SANTOS pole and line West Atlantic skipjack fishery	WAO	SKJ	PL	A	[2018]	N/A
Solomon Islands longline albacore and yellowfin tuna fishery	SPO	ALB	LL	A	[2019]	N/A
	WCPO	YFT	LL	A	[2019]	N/A
Kiribati albacore, bigeye and yellowfin tuna longline fishery	SPO	ALB	LL	A	[2019]	N/A
	WCPO	YFT	LL	A	[2019]	N/A
	WCPO	BET	LL	A	[2019]	N/A
PNG Fishing Industry Associations purse seine Skipjack & Yellowfin Tuna Fishery	WCPO	SKJ	PS	A	[2019]	N/A
	WCPO	YFT	PS	A	[2019]	N/A
North Buru and Maluku Fair Trade Fishing Associations, Indonesian Handline Yellowfin Tuna	WCPO	YFT	PL	A	[2019]	N/A
Tosakatsuo Suisan skipjack tuna	WCPO	SKJ	PL	W	2009 [2013]	N/A

American Western Fish Boats Owners Association (WFOA) ALB North Pacific	NPO	ALB	TROLL	W	2010 [2015]	N/A
Mexico Baja California Pole and Line	EPO	SKJ	PL	W	2012 [2015]	175
yellowfin and skipjack tuna	EPO	YFT	PL	W	2013 [2015]	339

Table S6 Fishery Improvement Projects for tuna. (Information obtained from www.fisheryprogress.org; accessed 18 June 2019; asterisk (*) indicates 'Basic' FIP, i.e. not seeking eventual MSC certification).

FIP Name	Fishing country	Stock	Species	Gear	Year started	Volume (mt)
Hawaii tuna & large pelagic longline*	USA	SPO WCPO	ALB BET, SKJ, YFT	LL	2009	9,843
Indonesia Indian Ocean tuna longline*	Indonesia	IO	ALB, BET, YFT	LL	2012	5,624
Vietnam yellowfin*	Vietnam	WCPO	YFT	HL; LL	2014	17,859
Indonesia Banda Sea yellowfin tuna handline	Indonesia	IO	YFT	HL	2015	N/A
AO tropical tuna (OPAGAC industrial PS fleet)	Spain, Curacao, El Salvador, Guatemala, Panama	AO EAO WAO	BET, YFT SKJ SKJ	PS	2016	95,000
EPO tropical tuna (TUNACONS)	Ecuador, Panama, USA, Colombia	EPO	BET, SKJ, YFT	PS	2016	113,568
WCPO tropical tuna (OPAGAC industrial PS fleet)	Cook Islands; Kiribati; Ecuador; El Salvador; Spain; Panama	WCPO	BET, SKJ, YFT	PS	2016	50,000
Cook Islands BET LL	Cook Islands	WCPO	BET	LL	2017	N/A
Eastern Pacific Ocean tuna-longline (Transmarina)	Ecuador	NPO EPO	ALB YFT, BET	LL	2017	77
EPO tropical tuna (OPAGAC industrial PS fleet)	Ecuador, El Salvador, Panama	EPO	BET, SKJ, YFT	PS	2017	80,000
Nachi Katsuura	Japan	NPO	ALB	LL	2017	150
Philippines yellowfin	Philippines	WCPO	YFT	HL	2017	500
Sustainable Indian Ocean Tuna Initiative (SIOTI)	Seychelles, Spain, France, Mauritius, Italy	IO	BET, SKJ, YFT	PS	2017	243,000
Pacific Longline Fishery	Vanuatu	SPO WCPO	ALB BET, YFT	LL	2017	5,000
Indonesia Indian Ocean skipjack pole-and-line	Indonesia	IO	SKJ	PL	2017	28,000
Indian Ocean longline (Key Traceability)	Malaysia	IO	ALB, YFT, BET	LL	2018	984
Eastern Atlantic Ocean Tuna Fishery	Spain, France	AO EAO WAO	BET, YFT SKJ SKJ	PS	2018	160,000

IO tropical tuna (OPAGAC industrial PS fleet)	Seychelles, Spain	IO	BET, SKJ, YFT	PS	2018	80,000
Ghana tuna pole-and-line	Ghana, Cote d'Ivoire, Togo, Benin	EAO AO	SKJ BET, YFT	PL	2018	30,000
Sri Lanka tuna and swordfish	Sri Lanka	IO	SWO, BET, YFT	LL	2018	77,029
Indonesia Southeast Sulawesi yellowfin tuna and skipjack purse seine	Indonesia	WCPO	SKJ, YFT	PS	2018	5,350
Indonesia Western and Central Pacific Ocean yellowfin handline	Indonesia	WCPO	YFT	HL	2018	2,100
Western and Central Pacific albacore and yellowfin longline	China, Taiwan, Fiji	WCPO SPO	YFT ALB	LL	2019	15,000

Table S7 Existing RFMO harvest control rules (HCRs) and target (TRP) and limit (LRP) reference points, including interim (I) measures. (NB: Since two RFMOs have jurisdiction in the Pacific Ocean (IATTC and WCPFC), there are a total of 26 possible harvest strategies despite there being 23 stocks.)

RFMO	Species	Year	Measure	Type	Measure
Commission for the Conservation of Southern Bluefin Tuna (CCSBT)	SBT	2011	Resolution on the Allocation of the Global Total Allowable Catch (a.k.a. 'Bali Procedure')	HCR	TAC set for 3-yr period based on specific guidelines with reference to interim rebuilding TRP
				I-TRP	Interim rebuilding TRP= 0.2 SSB_0 by 2035
Indian Ocean Tuna Commission (IOTC)	SKJ	2013	Resolution 13/10	I-TRP	$B_{target}= B_{MSY}$; $F_{target}= F_{MSY}$
				I-LRP	$B_{lim}=0.40\ B_{MSY}$; $F_{lim}= 1.50\ F_{MSY}$
		2015	Resolution 15/10	I-TRP	$B_{target}= B_{MSY}$; $F_{target}= F_{MSY}$
				I-LRP	$B_{lim}=0.40\ B_{MSY}$; $F_{lim}= 1.50\ F_{MSY}$
		2016	Resolution 16/02	HCR	TAC adjusted every 3 years in line with explicit guidelines of how to do so based on most recent stock assessment values of Bcurr, B_0, Etarg
	ALB, YFT	2013	Resolution 13/10	I-TRP	$B_{target}= B_{MSY}$; $F_{target}= F_{MSY}$
				I-LRP	$B_{lim}=0.40\ B_{MSY}$; $F_{lim}= 1.40\ F_{MSY}$
		2015	Resolution 15/10	I-TRP	$B_{target}= B_{MSY}$; $F_{target}= F_{MSY}$
				I-LRP	$B_{lim}=0.40\ B_{MSY}$; $F_{lim}= 1.40\ F_{MSY}$
	BET	2013	Resolution 13/10	I-TRP	$B_{target}= B_{MSY}$; $F_{target}= F_{MSY}$
				I-LRP	$B_{lim}=0.50\ B_{MSY}$; $F_{lim}= 1.30\ F_{MSY}$
		2015	Resolution 15/10	I-TRP	$B_{target}= B_{MSY}$; $F_{target}= F_{MSY}$
				I-LRP	$B_{lim}=0.40\ B_{MSY}$; $F_{lim}= 1.30\ F_{MSY}$
Inter-American Tropical Tuna Commission (IATTC	BET, YFT, SKJ	2014	SAC-07-07g	I-TRP	$SSB_{target}= SSB_{MSY}$; $F_{target}= F_{MSY}$
				I-LRP	Interim $F_{LIMIT}= F_{0.5R0}$ and $SSB_{TARGET} = SSB_{0.5R0}$ (i.e. spawning biomasses that corresponds to 50% reduction in recruitment; fishing mortality that causes spawning biomass to produce 50% reduction in recruitment)
		2016	Resolution C-16-02	HCR	Adopt harvest control rules based on I-TRP and I-LRP such that: if $P(F > F_{LIMIT}) > 0.10$ or $P(SSB < SSB_{LIMIT}) > 0.10$ management measures shall be established as soon as

					is practical to reduce F to F_{TARGET} and restoring SSB to SSB_{TARGET}
Western and Central Pacific Fisheries Commission (WCPFC)	BET, YFT, SKJ, SPO-ALB	2012	SC7-MI-WP-03	LRP	$SSB_{CURRENT,F=0} = .20$
	BET, YFT, SKJ, SPO-ALB, NPO-ALB, PBT	2014	CMM 2014-06	I-HCR	Commission agrees to develop and implement harvest strategy for all key stocks under its jurisdiction
	NPO-ALB	2014	WCPFC-NC10-2014	TRP	$F_{40\%SPR}$
				LRP	$SSB_{CURRENT,F=0} = .20$
				I-HCR	If $F > F_{40\%SPR}$, will reduce F to target within 2 years, if $SSB < SSB_{40\%SPR}$, adopt reasonable timeline to rebuild to LRP level
		2018	Harvest Strategy 2017-02	I-HCR	If SSB < LRP, the ISC will rebuild within 10 years to LRP level
	SKJ	2015	CMM 2015-06	I-TRP	$SB \geq 0.5\ SSB_0$
	SPO-ALB	2018	N/A	I-TRP	$SB_{F=0} = 0.56$
International Commission for the Conservation of Atlantic Tunas (ICCAT)	BET, YFT, EAO-SKJ, WAO-SKJ, EAO-ABT, WAO-ABT	2015	Recommendation 15-07	I-HCR	Commission agrees to develop and implement harvest strategies on case-by-case basis for target stocks
	NAO-ALB	2017	Recommendation 17-04	LRP	$SSB_{LIM}=0.4\ SSB_{MSY}$
				TRP	$F_{TAR}=0.8\ F_{MSY}$; $SSB_{THRESH}= SSB_{MSY}$
				HCR	3-yr TAC set based on stock assessment indicators and corresponding reference points

Table S8 **Geographic origin of RFMO interviewees.**

Affiliation	N. Am.	S. Am.	Africa	Asia	Europe	Oceana
Delegate	3	2	3	2	4	5
Observer	6	0	0	0	5	2

Table S9 Interview questions asked during RFMO meetings. The 2018 ICCAT General Session (Dubrovnik, Croatia) and the 2018 WCPFC Regular Session (Honolulu, USA) and individuals interviewed attended at least one of these meetings. (Note: all questions here were asked but additional follow-up questions were also asked based on interviewee replies.)

Questions posed to policymakers	Questions posed to observers
• How long have you been attending RFMO meetings? • How are you involved with developing and/or implementing fisheries policies for your country? • What are the biggest challenges with regard to developing conservation and management measures (CMMs) through the RFMO framework? Have these challenges changed over time? (If so, how?) • Do you think there are specific stocks or species that get more focus than others? Are there species or issues that do not receive the attention they deserve? • What is the overarching strategy of your country going in to a RFMO meeting? • How are environmental and industry NGOs and seafood companies typically involved in RFMO meetings? • Has the input of these organizations and/or companies changed over time? (If so, how?) • Many tuna stocks are currently eco-certified or in assessment by certain organizations. How has this influenced your decision-making with regard to CMMs? • Do you find the presence of observer organizations helpful or distracting? (Why?) • How do you think the recent trend toward the development of harvest control rules will impact discussions at RFMO meetings going forward?	• How long have you worked for this organization? • What is your background with regard to tuna (or fisheries more broadly)? • What are the biggest challenges with regard to managing tuna through the RFMO framework? Have these challenges changed over time? (If so, how?) • Do you think there are specific stocks or species that get more focus than others? Are there species or issues that do not receive the attention they deserve? • What are the main objectives of your organization at RFMO meetings? • What strategies does your organization use to have influence through RFMOs? • Has the input of your organization changed over time? (If so, how?) • Many tuna stocks are currently eco-certified or in assessment. Has this influenced the strategy of your organization at RFMO meetings? (If so, how?) • Many organizations have begun to push for harvest control rules and reference points. Why are these measures being increasingly advocated? • How do you think the recent trend toward the development of harvest control rules will impact discussions at RFMO meetings going forward? • What role do you see your organization as playing in the conservation and management of tuna? • Do you think private organizations are working more collaboratively or

• Do you think the management of tuna can be improved? (If yes, how? If not, what makes it successful?) • Do you think eco-certifications are effective at generating public awareness of marine issues? (Why/why not?) • Do you think eco-certifications are effective at improving tuna fisheries management? (Why/why not?) • Any final comments or additional questions you would add?	independently relative to 5 or 10 years ago? (Why?) • Do you think eco-certifications are effective at generating public awareness of marine issues? (Why/why not?) • Do you think eco-certifications are effective at improving tuna fisheries management? (Why/why not?) • If you could implement one RFMO conservation and management measure for one stock or species, what would it be and why? • Any final comments or questions you would like to add?

Table S10 **Responses from RFMO interview participants on the connection between eco-certification requirements and CMM development at RFMO meetings.** 'Mechanism' summarizes perceived causality derived from interview quotes and refers to the colours depicted in Figure 3.5.

RFMO	Affiliation	Do eco-certifications influence RFMO decisions?	Mechanism	Supporting quotes
ICCAT	DEL-ADV	Yes		Well, indirectly it must have influenced in the sense that to have the certification there are certain qualitative conditions. And we feel that the stakeholders push the decision makers to work toward certain technical agreements so they can have the certification.
	DEL-G	Maybe		I think there is a connection, but I may be wrong. Knowing that nothing happens by coincidence, it could be coordination that happens at a level that I am not aware of.
	DEL-G	Yes		One of the main criticisms [of] ICCAT was the lack of clear harvest control rules...I'm absolutely sure, [eco-certification] has in a way helped or has prompted or has pushed delegations towards adopting harvest control rules here. Because knowing this is one of the difficulties to get these fisheries certified of course implies an economic interest that would be better to do that.
	DEL-G	No		I don't think it has...Whether or not it's MSC certified is a bit of a side issue in many ways. Because a lot of the MSC certifications are probably only dealing with a small sub-set of the fishery…rather than with the stock as a whole.
	DEL-G	Yes		Yes, in principle it does influence the decisions here… Eco-certification allows good fishing practices and it allows

			guarantee of sustainable use of fishing resources.
DEL-IND	Yes		Yes, it does. Actually, not that much the certification, but the confirmation that the stocks are in good shape.
DEL-IND	Maybe		[HCRs are] the logical evolution [of RFMO management] and certifications might help in that but [they are] not actually making a great difference in the normal procedure...
DEL-ADV	Maybe		I think when you look at the growing importance of things like harvest strategies, I do attribute a lot of that to the work of the NGOs…Industry: I'm not so sure. I think they've always had a pretty tight rein on what their governments can and can't do.
OBS-INGO	Yes		I think it's closely linked to it… I'm not saying it's driven it, but it's certainly played a positive role in bringing the [Country A] government to the table and being a much more engaged participant; showing up at [RFMO] meetings, making interventions, driving their own process for developing a harvest control rule for within their archipelagic waters… players are talking together, working towards a common goal, and that common goal is the MSC.
OBS-INGO	No		We want to improve the management of the stocks: FIP is one way, and that's why our companies are involved in FIPs… we believe we can always improve what we do, as companies. But then there are several issues that don't depend on us, what we do. One of them is governance: how decisions are taken [at RFMO meetings] and what decisions are taken. That doesn't depend on us, it

			depends on the contracting parties.
OBS-INGO	Yes		It is a marriage of different interests because harvest control rules are a good tool to manage fisheries in a more planned way, but I would say that, yes, [the MSC] is part of the reason behind at least the speed on the development of these things. And it's because… the MSC requires harvest control rules in order to become certified or to achieve certification in a specific timeline.
OBS-INGO	Yes		[Tuna fisheries] share the same problems around the world: a lack of harvest control rules … the MSC isn't just a commercial tool, it's much more than that—it's a governance tool; it's a way to structure the improvement of fisheries.
OBS-ENGO	Yes		There is no doubt that a lot of the movement that the RFMOs are making on harvest strategies and FAD management… is driven by a desire of fisheries to get certified. And that is very valuable because instead of just the NGOs pushing it, you have the industry wanting it as well. And then the industry telling their representatives… [For example], the reason [the northern albacore measure] went through so quickly with no conversation basically was that it led to an increase in the TAC and an interim HCR in place to tick the box.
OBS-ENGO	Maybe		I think [MSC is] potentially influential on industry and then potentially through the industry on RFMOs. If industry is really taking their eco-certification seriously, which I think is happening less and less now, but previously,

				then it did prompt them to write letters to their government saying, "I need to have a harvest control rule" or "I need a shark measure" but unfortunately I think the time for peak influence of eco-certifications has passed due to lots of things.
	OBS-IGO	Yes		[Eco-certification] automatically could mean price differentials in some cases or, simply put, it guarantees access to important markets... And, for example, it has served as a very powerful incentive to get the Management Strategy and Evaluation Process* going forward.
WCPFC	DEL-ADV	Yes		The PNA Pacifical fishery certification has further strengthened the drive for harvest control rules… This isn't all happening just because of the eco-certification… but it would have been slower because, without it, PNA would have had less of a vested interest in making it happen.
	DEL-ADV	Yes		Very much, very much… [the PNA fishery] pushed for target reference points and limit reference points [and] pushed for harvest control rules because it was a condition of certification. I think it has had a huge influence in the way in which the PNA had to shape this fishery to meet those conditions.
	DEL-ADV	Yes		Yes, but not very much. Of course, some [tuna fisheries] are going to have MSC so there are some repercussions among CMMs.
	DEL-G	Yes		[Eco-certification] is one of the main drivers of negotiations…perhaps not so in [my country], but I can give you a specific example in the Indian Ocean with harvest control rules for tropical tunas.

			It was something that was led by the Maldives because they wanted that certification.
DEL-G	Yes		It definitely has. But I think you've got a whole heap of issues there…one of the things is that reference points and harvest control rules are coming have been coming in as the modern management measure, something we had never heard of a few years ago…
DEL-G	Maybe		[MSC] is just another element that you have to weigh up when you come up with a national position. So, all of those things feed into your national position and also feed into a regional position… But in the case of eco-branding and certification, it hasn't really entered into it so much.
DEL-G	Maybe		I don't know if [eco-certification] has impacted it that much…I would have thought it would've had more effect to be honest…I would have expected MSC to be harder to get, harder to keep, to be more of an aspirational thing. So far it seems fairly easy to get…I guess I hoped it would actually really serve that purpose, that it would really force us to do good things.
DEL-IND	Maybe		The conditions that are attached [to all tuna MSC certifications] are related to the adoption of harvest strategies and harvest control rules at WCPFC. So, this is an agenda item that [my company is] keenly interested in and we would like to see progress happening in a timely manner…But, unfortunately, these are areas that we, as an individual company, have very little influence over. All we can do is stress to our national governments, say "harvest

			strategies are really important, we'd like to see the timeframe set out in the workplan stuck to".
DEL-IND	Yes		Well of course government is about regulation to make sure everyone is able to get the benefit of the resource. At the same time, the industry wants to benefit from the resource and, of course, MSC certification provides them with the incentive… I think this kind of certification, this market influence over resource user behaviour, is working very well.
DEL-IND	Yes		There was a lot of discussion of [eco-certification] when we were trying to get to a target reference point for southern Pacific albacore, [but] that reference point is a joke, I think.
DEL-IND	Yes		There is certainly advocacy that aligns with MSC principles and meeting conditions or workplans of a FIP, like harvest control rules and target reference points… the MSC Principles are aligned with good fishery practices and the RFMOs are trying to get there anyway. It certainly does play a role in that you have companies that are in FIPs or MSC conditional certifications [by making] them advocate for those when maybe they wouldn't without the presence of MSC.
OBS-ENGO	No		[HCRs are increasingly advocated for] because they are such a logical, sensible, and responsible way to manage a fishery… And I think it's encouraging that [WCPFC members] have stopped, they're listening, they've got a commitment to best practices and they're getting there.

OBS-ENGO	Yes		MSC certification has unquestionably had an impact on this process… We wouldn't have some of the industry guys in there advocating for the passage of target reference points were it not for that potential loss of market share that comes from losing a certification.
OBS-IGO	Yes		In the past [MSC] was sort of a gold standard, now it's almost like a minimum requirement to get access to a lot of supply chains or big retailers and so forth. And to the extent that they are promoting good management practices, harvest control rules, target reference points, management strategies… I don't know if it's the certification that's driven it—but it's become part of what's driven RFMOs to much more considered management approaches for tuna stocks.
OBS-INGO	Yes		We always encourage the RFMOs during their discussions, they shouldn't look only on the science of the fisheries but try to protect the economic conditions as well inside their management framework so that they can take economic considerations when they try to put management measures in… One of the key principles for [MSC] certification is to have a good fisheries management framework in place… We have to get a TRP in this Commission meeting or it would be a commercial disaster for our members.
OBS-INGO	Yes		I think MSC certification definitely has a role in [pushing for HCRs]. You see more urgency on the part of groups that have been certified but their conditions have not been met… But I also think that

				harvest strategies themselves as an important tool has grown in prominence in the last couple years… ten years ago, it wasn't something we talked about at all.
	OBS-INGO	Yes		Oh absolutely… [For example], on the opening day [of this year's meeting]…when the first discussion for the target reference point for southern albacore came up, the delegate from [Country B] brought it up about how fisheries will lose their MSC certification if this is not passed...Which was surprising because [Country B] doesn't have any certified fisheries.
*the Management Strategy and Evaluation (MSE) is the process at ICCAT that pertains to HCRs and their associated RPs for each stock				

Table S11 Non-participating observers that attended tuna RFMO annual meetings in 2017. (Affiliation types: IGO = intergovernmental organization, INGO = industry non-governmental organization, ENGO = environmental non-governmental organization, IND = fishing or seafood supply chain company, ACA = university or research-focused program; RFMOs: IOTC = Indian Ocean Tuna Commission, WCPFC = Western and Central Pacific Fisheries Commission; IATTC = Inter-American Tropical Tuna Commission; ICCAT = International Commission for the Conservation of Atlantic Tunas; CCSBT = Commission for the Conservation of Southern Bluefin Tuna). Data amalgamated by authors from 2017 RFMO annual meeting participant lists.

Name	Type	RFMO observed	Country of origin	Year established	Campaigns/Mandate
African Union – InterAfrican Bureau for Animal Resources (AU-IBAR)	IGO	IOTC	N/A	1970	"This Africa Voice in Fisheries [is] participatory, consultative with bottom-up approach, starting at the countries level to RFMOs"
Agreement on the Conservation of Albatrosses and Petrels (ACAP)	IGO	IOTC, WCPFC	Australia	2004	"seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats to their populations"
Albino Moran y Partners Shipbrokers	IND	IATTC	Spain	N/A	international shipbroking company
American Albacore Fishing Association	INGO	WCPFC	USA	N/A	"non-profit organization representing commercial pole & line vessels...seeks to ensure responsible fishery management practices and the participation of vital fishing communities"; has MSC-certified fishery (albacore); IPNLF member
American Fisherman's Research Foundation	INGO	WCPFC	USA	1971	active participant in RFMO meetings, that seeks "to help guide this process to something fair and equitable"
American Tunaboat Association	INGO	WCPFC	USA	1917	"members of the ATA are owners of U.S. flag vessels that use purse seine nets to fish commercially for tuna. Representatives of the ATA are involved in matters that affect these vessels, including international negotiations and meetings on the conservation and management of tuna stocks"
Australian National Centre for Ocean Resources and Security (ANCORS)	ACA	WCPFC	Australia	1994	"dedicated to research, education and training on ocean law, maritime security and natural marine resource management...also provide authoritative policy development advice and other support services to

					government agencies in Australia and the wider Indo-Pacific regions, as well as to regional and international organizations and ocean-related industry"
Asociación De Pesca, Comercio Y Consumo Responsable Del Atún Rojo (APCCR)	INGO	ICCAT	Spain	N/A	N/A
Association Euroméditerranéenne des Pècheurs Professionnels de Thon (AEPPT)	INGO	ICCAT	France	N/A	N/A
Association for Professional Observers (APO)	INGO	WCPFC	USA	N/A	Represents fishery observers and advocates for their safety and fair working conditions
Bay of Bengal Large Marine Ecosystem project (BOBLME)	IGO	IOTC	N/A	N/A	Focuses on ecosystem-based management in Bay of Bengal
Beta Diversidad	ENGO	IATTC	Mexico	2004	"seek to contribute significantly to preserve and restore the ecosystems of Mexico and its biodiversity, recognizing the deep interrelation between natural and urban systems; through collaboration with companies and institutions to carry out actions both internally and externally on issues of conservation"
Birdlife International (BI)	ENGO	IOTC, WCPFC, CCSBT	UK	1922	formed the Albatross Task Force, the world's first international team of seabird bycatch mitigation instructors working at-sea on commercial fishing vessels
Blue Ocean Institute (The Safina Center)	ENGO	WCPFC	USA	2003	"We are principal advisors to Whole Foods Markets nationwide. We analyze and advise on every source of wild-caught fish that Whole Foods is considering selling. We now do this work collaboratively with Monterrey Bay Aquarium"
Blue Water Fishermen's Association (BWFA)	INGO	ICCAT	USA	1989	"representing [US] fishing and associated businesses that are involved in the harvest and sale of highly migratory species – primarily swordfish, tuna and sharks"
Center for the Blue Economy	ACA	WCPFC	USA	1999	"provides free, open-access data and analysis on ocean-

					related economic activities and resource trends to assist with policy, management, and investment decisions for ocean and coastal economies for a wide spectrum of actors"
Centre for Environmental Law and Community Rights Inc (CELCOR)	ENGO	WCPFC	Papua New Guinea	N/A	"promote and defend environmental and customary rights in Papua New Guinea through law and advocacy, to ensure sustainable resource management for the benefit of the present and future generations"
Confederation Internationale de la Pêche Sportive (CIPS)	INGO	ICCAT	Italy	1952	"has the goal to promote, coordinate and improve all the activities in touch with the fishing from a sporting point of view. "
Conférence Ministérielle sur la Coopération Halieutique entre les États Africains Riverains de l'Océan Atlantique (COMHAFAT)	IGO	ICCAT	Morocco	1989	"development, coordination and harmonization of efforts and capacities of Member States to preserve, exploit, develop and commercialize fishery resources"
Conservation International (CI)	ENGO	IOTC, WCPFC	USA	1987	"The CI Tuna Initiative will build on strong existing partnerships and engagement throughout the region to assist Pacific Island counties address [tuna conservation challenges] and help fulfill their aspirations for the use of tuna resources in the WCPO"
Convention on International Trade in Endangered Species of wild fauna and flora (CITES)	IGO	IOTC, WCPFC	Switzerland	1975	"aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival"
Convention on Migratory Species (CMS)	IGO	WCPFC	Germany	1983	"provides a global platform for the conservation and sustainable use of migratory animals and their habitats"
Defenders of Wildlife	ENGO	IATTC, ICCAT	USA	1947	advocates for better management/protection of bluefin species
Earth Island Institute (EII)	ENGO	IOTC, WCPFC	USA	1982	started Dolphin Safe eco-label, remains active in marine advocacy projects (mostly dolphins)
Ecology Action Centre (EAC)	ENGO	ICCAT	Canada	1971	pushes for stronger management of Atlantic bluefin (western stock)

Environmental Defense Fund (EDF)	ENGO	WCPFC	USA	1967	Pacific Bluefin Tuna Initiative; promotes rights-based management/catch shares in fisheries
Environment Hawaii	ENGO	WCPFC	USA	N/A	monthly newsletter that publishes information relevant to Hawaii environmental issues
European Bureau for Conservation and Development (EBCD)	ENGO	ICCAT	Belgium	1989	works closely with EU Parliament Committee and is responsible, in a co-decision procedure, for policy development of fisheries agreements and management measures
EUROPÊCHE	INGO	ICCAT	Spain	N/A	represents all recreational fishers in Europe; outspoken against IUCN Red Listing of ABT
Federation of Artisanal Fishermen of the Indian Ocean (FPAOI)	IGO	IOTC	Seychelles	2015	"an organization that will help protect the cultural values and the lifestyle of artisanal fishermen so that they can still find their place in a world that is increasingly ignoring these values"
Federation of Maltese Aquaculture Producers (FMAP)	INGO	ICCAT	Malta	N/A	represents interests of tuna ranching in Malta
Pacific Islands Forum Fisheries Agency (FFA)	IGO	IOTC, WCPFC	Solomon Islands	1979	"provides policy and services to its members to build national capacity and regional solidarity for the sustainable management of tuna in the Pacific"
FishWise	ENGO	WCPFC	USA	2002	"promotes the health and recovery of ocean ecosystems by providing innovative market-based tools to the seafood industry, supporting sustainability through environmentally and socially responsible business practices"
Food and Agriculture Organization of the United Nations (FAO)	IGO	ICCAT, WCPFC	Italy	1945	subsidiary of the United Nations, focused on issues related to food security and hunger irradiation; launched ABNJ Tuna Project in 2017 with several stakeholders
Greenpeace International (GI)	ENGO	IOTC, WCPFC	Canada	1971	advocates for sustainable tuna fisheries; provides annual canned tuna sustainability ranking guide for consumers
Hawaii Longline Association	INGO	WCPFC	USA	2000	"advance the interests of the fishermen and related industries involved in the Hawaii longline fisheries and

					to facilitate involvement in the fishery management process of Federal and State agencies"
Humane Society International	ENGO	IATTC, ICCAT, WCPFC, CCSBT	USA	1991	"we are endeavoring to create a humane and sustainable world for all animals, including people, through education, advocacy and the promotion of respect and caring"
Indian Ocean – South East Asian Marine Turtle MOU (IOSEA)	IGO	IOTC	Thailand	2003	"aims to protect, conserve, replenish and recover marine turtles and their habitats of the Indian Ocean and South-East Asian region, working in partnership with other relevant actors and organisations"
INFOPÊCHE	ENGO	ICCAT	Côte d'Ivoire	N/A	fisheries magazine
Institute for Sustainable Development and International Relations (IDDRI)	ENGO	IOTC	France	2013	protecting the marine environment and addressing equitable management in fisheries; various ocean projects established since 2013
International Environmental Law Project	ACA	WCPFC	USA	N/A	"works with governments, non-governmental organizations, and international institutions to develop, implement, and enforce international environmental law to tackle some of today's most challenging global issues"; partners and clients including other NGOs and IGOs
International Fund for Animal Welfare (IFAW)	ENGO	IOTC	Canada	1969	advocates for marine conservation issues; supports Dolphin Safe tuna
International Game Fish Association (IGFA)	INGO	IOTC, WCPFC	USA	1939	advocates for recreational fishing rights; "IGFA takes an active role in partnering in cooperative research with governmental, academic, and private organizations to benefit fisheries conservation"
International Pole & Line Foundation (IPNLF)	INGO	ICCAT, IOTC, WCPFC	UK	2013	"works to develop, support and promote socially and environmentally responsible pole-and-line and handline tuna fisheries around the world"; involved in tuna FIPs and supports fisheries with MSC certifications but also supporter of On The Hook campaign

International Seafood Sustainability Foundation (ISSF)	INGO	IATTC, ICCAT, IOTC, WCPFC	USA	2009	"to undertake and facilitate science-based initiatives for the long-term conservation and sustainable use of global tuna stocks, reducing bycatch and promoting tuna ecosystem health"; supports MSC; membership includes many purse seine companies as well as other supply chain actors
International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC)	IGO	WCPFC	N/A	1995	enhancing scientific research and cooperation for conservation and rational utilization of tuna and tuna-like species (HMS) of the North Pacific Ocean, and to establish the scientific groundwork, if at some point in the future it is decided to create a multilateral regime for the conservation and rational utilization of the HMS species in the North Pacific Ocean
Island Conservation Society (ICS)	ENGO	IOTC	Seychelles	2001	"owns and manages the Aride Island Nature Reserve, one of the finest nature reserves in the western Indian Ocean"
IUCN	IGO	WCPFC	Switzerland	1948	"provides public, private and non-governmental organisations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together"; maintains Red List, which includes extinction risk status of tuna populations
Le Drezen	IND	IATTC	France	1929	manufacturer of fishing gear (e.g. nets, floats, buoys)
Legacoop Agroalimentari	INGO	ICCAT	Italy	1957	Agriculture co-operative (214,000 members)
Marine Stewardship Council (MSC)	INGO	IOTC, WCPFC	UK	1997	"**Our mission** is to use our ecolabel and fishery certification program to contribute to the health of the world's oceans by recognising and rewarding sustainable fishing practices, influencing the choices people make when buying seafood and working with our partners to transform the seafood market to a sustainable basis"
Masyarakat dan Perkanan Indonesia (MDPI)	ENGO	WCPFC	Indonesia	2013	"focused on achieving responsible and sustainable fisheries activities and attempting to provide on-

					going care for the conservation of fisheries resources and ecosystems of Indonesia and the region"; involved in tuna FIPs and fisheries w/ FT-USA certification
Monterey Bay Aquarium	ENGO	WCPFC	USA	1984	promotes sustainable fisheries through Seafood Watch program; specific emphasis on management and conversation of PBT; affiliated with Tuna Research and Conservation Center (Stanford)
Ocean Friends Against Driftnets	ENGO	WCPFC	USA	N/A	"Our first priority is to alert the public & law enforcement of the existence of this Illegal Unidentified, & Unreported (IUU) driftnet fishing activity"; calls for a ban on US Albacore (i.e. Chicken of the Sea, Bumble Bee, Starkist); supports MSC-certified tuna and one-by-one fisheries
Oceana	ENGO	WCPFC	USA	2001	"seeks to make our oceans more biodiverse and abundant by winning policy victories in the countries that govern much of the world's marine life"
OPAGAC	INGO	WCPFC	Spain	1986	organization of producers (purse seiners) of frozen tuna that supplies canneries; active in all three primary oceans: requires all member companies to use non-entangling FADs and have a FAD management plan in place
Organization for the Promotion of Responsible Tuna Fisheries (OPRT)	INGO	ICCAT, IOTC, WCPFC	Japan	1999	organization of tuna longline producers from various countries as well as traders, distributors and Japanese public interest organizations; " striving to develop tuna fisheries in a way to fulfill international and social responsibility in cooperation with FAO and regional tuna resource management organizations responsible for each area of the world's oceans"
Pacific Islands Tuna Industry Association (PITIA)	INGO	WCPFC	Fiji	N/A	represents and advocates for the domestic industry in PICTs; represents commercial interests in policy-making for

					and encourages the economically and biologically sustainable use of tuna resources
Packard Foundation	ENGO	WCPFC	USA	1964	funds ocean conservation research with the goal of with low environmental impact fishing, promotes global markets for sustainable seafood, seeks to address IUU
Pew Charitable Trusts	ENGO	IATTC, ICCAT, IOTC, WCPFC	USA	1948	funds Global Tuna Conservation Project (i.e. tuna research, workshops and advocacy)
Parties to the Nauru Agreement (PNA)	IGO	WCPFC	Marshall Islands	1982	controls around 50% of the world's skipjack catch; PNA Pacifical fishery certified by MSC
Project AWARE Foundation	ENGO	ICCAT	USA	1989	marine conservation organization focused on engaging the general public in conservation efforts (e.g. citizen science, beach cleanups, campaigning); advocates for improved bycatch measures in tuna fisheries
Rain Forest Rescue International, Sri Lanka (RFRI)	ENGO	IOTC	Sri Lanka	N/A	conservation organization primarily focused on rainforest restoration and sustainable use
Satlink S.L.	IND	IATTC	Spain	1992	company that makes satellite communications devices (including marine buoys); emphasis on maritime and fisheries sectors
Sea Turtle Restoration Project (STRP)	ENGO	WCPFC	USA	1989	sea turtle conservation program; advocates for bycatch improvement and elimination of driftnet fisheries
Seafood Legacy	ENGO	WCPFC	Japan	2015	"supports sustainable seafood businesses and environmental organizations in Japan and around the world...formed to develop the partnerships necessary to solve the complex problems of sustainable seafood supply chains"
Secretariat of the Pacific Regional Environment Programme	IGO	WCPFC	Samoa	1993	actively promotes the understanding of the connection between Pacific island people and their natural environment and the impact that these have on their sustenance and livelihoods

Shark Advocates International (SAI)	ENGO	IOTC, WCPFC	USA	2010	"dedicated to conserving some of the ocean's most vulnerable and valuable - the sharks. Our mission is to provide leadership in advancing sound, science-based local, national, and international conservation policies through collaboration with a diverse array of organizations and decision makers"
Shark Alliance (SA)	ENGO	IOTC	USA	2006	Pew program that advocates for science-based shark management and conservation
Southeast Asian Fisheries Development Center (SEAFDEC)	IGO	IOTC	N/A	1967	"To promote and facilitate concerted actions among the Member Countries to ensure the sustainability of fisheries and aquaculture in Southeast Asia"
Stop Illegal Fishing (SIF)	ENGO	IOTC	Botswana	2007	"Dedicated to working in partnership with governments, civil society, NGOs, intergovernmental organizations and the fishing industry Stop Illegal Fishing is harnessing the necessary international support and growing African commitment to achieve positive change"
Sustainable Fisheries Partnership (SFP)	ENGO	IOTC, WCPFC	USA	2006	"SFP fills a specific gap between industry and the marine conservation community, utilizing the power of the private sector to help less well-managed fisheries meet the environmental requirements of major markets"; goal of seeing 75% of the world's seafood by volume produced in a manner that can be labeled sustainable or improving toward sustainability (i.e. in a FIP), by the end of 2020
Tautai O-Samoa Longline & Fishing Association	INGO	WCPFC	Samoa	N/A	advocates on behalf of longline fishery interests in Samoa
The Nature Conservancy	ENGO	WCPFC	USA	1951	"working with [Pacific] partners to help close the data gap by funding scientific research on longline fishing practices. In tandem, TNC is rolling out electronic monitoring technology in the

					tuna fishery to improve oversight"
The Ocean Foundation	ENGO	ICCAT	USA	2006	marine conservation funding agency
The Pacific Community (SPC)	IGO	WCPFC	Australia	1947	the principal scientific and technical organisation in the Pacific region; conducts stock assessments for WCPFC
The Shark Trust	ENGO	ICCAT	UK	1997	"dedicated to promoting the study, management and conservation of sharks, skates and rays in the UK and internationally"
The World Bank	IGO	WCPFC	USA	1944	"provide a wide array of financial products and technical assistance, and we help countries share and apply innovative knowledge and solutions to the challenges they face"
Tri-Marine	IND	IATTC	Singapore	1972	global tuna supplier; involved in FIPs and supplies MSC tuna
United Nations Development Program (UNDP)	IGO	WCPFC	USA	1966	works with other NGOs to support management of tuna in the Pacific, released a film "Saving Our Tuna"
UN Environment	IGO	WCPFC	USA	1972	started World Tuna Day in 2017, works with on the ground fishery projects in the Coral Triangle (WWF partnership)
University of the South Pacific (USP)	IGO	WCPFC	Fiji	N/A	N/A
US–Japan Research Institute	ACA	IOTC, WCPFC	USA/Japan	N/A	"Top researchers from American and Japanese universities as well as other institutions will conduct academic research in conjunction with practical research with political implications that emphasizes dealing with practical needs to resolve problems"
Western Fishboat Owners Association	INGO	WCPFC		1967	represents albacore troll fishing industry in US west coast; has MSC certification for albacore
World Tuna Purse Seine Organization (WTPO)	INGO	WCPFC	Philippines	N/A	Promote the setting up of a worldwide tuna boat registry in order to achieve freeze capacity of the global the tuna fleet
World Wildlife Fund (WWF)	ENGO	IATTC, ICCAT, IOTC,	Switzerland	1961	"WWF focuses on transforming the global tuna fisheries market and improving the way tuna

		WCPFC, CCSBT			fisheries are managed and governed...Our goal is to achieve Marine Stewardship Council (MSC) certification for healthy and well-managed tuna populations."
TRAFFIC International (IUCN/WWF Alliance)	ENGO	CCSBT	UK	1976	"Through research, analysis, guidance and influence we promote sustainable wildlife trade and combat wildlife crime and trafficking"

Table S12 WCPFC observer letters analyzed. Note: some organization names have changed over time but were kept consistent for analysis. All letters available online from the WCPFC website.

Year	Organization name	Type	Letter ID
2005	Greenpeace	ENGO	N/A
2005	International Game Fish Association	INGO	N/A
2005	Pacific Islands Tuna Industry Association	INGO	N/A
2005	World Tuna Purse Seine Organization	INGO	N/A
2005	Sea Turtle Restoration Project	ENGO	N/A
2005	World Wildlife Fund	ENGO	N/A
2005	Marine Stewardship Council	ENGO	N/A
2006	BirdLife International	ENGO	N/A
2006	World Wildlife Fund	ENGO	N/A
2006	Greenpeace	ENGO	N/A
2006	International Game Fishing Association	INGO	N/A
2007	American Fisherman's Research Foundation	ENGO	WCPFC4-2007/OP10
2007	Greenpeace	ENGO	WCPFC4-2007/OP01
2007	World Tuna Purse Seine Organization	INGO	WCPFC4-2007/OP12
2007	World Wildlife Fund	ENGO	WCPFC4-2007-OP04
2007	Oceana	ENGO	WCPFC4-2007/OP16
2007	Ocean Friends Against Driftnets	ENGO	WCPFC-TCC7-2011-OB-03
2008	Greenpeace	ENGO	WCPFC5-2008/OP01 Rev.1
2008	World Wildlife Fund	ENGO	WCPFC5-2008/OP02
2008	International Union for the Conservation of Nature	ENGO	WCPFC5-2008/OP11
2008	International Game Fishing Association	INGO	WCPFC5-2008/OP09
2009	Earth Island Institute	ENGO	WCPFC6-2009/OP08
2009	Greenpeace	ENGO	WCPFC6-2009/OP05
2009	International Union for the Conservation of Nature	ENGO	WCPFC6-2009/OP09
2009	World Wildlife Fund	ENGO	WCPFC6-2009/OP02
2009	Pew Charitable Trusts	ENGO	WCPFC6-2009/OP04
2010	Greenpeace	ENGO	WCPFC7-2010-OP-06
2010	Pew Charitable Trusts	ENGO	WCPFC7-2010-OP-02
2010	World Wildlife Fund	ENGO	WCPFC7-2010-OP-04
2010	Western Fishboat Owners Association	INGO	WCPFC7-2010-OP-05
2011	American Fisherman's Research Foundation	INGO	WCPFC8- 2011-OP-19
2011	Greenpeace	ENGO	WCPFC8-2011-OP-05
2011	The Humane Society	ENGO	WCPFC8-2011-OP-11
2011	International Seafood Sustainability Foundation	INGO	WCPFC8- 2011-OP-03
2011	Ocean Friends Against Driftnets	ENGO	WCPFC8-2011-OP-01
2011	Pew Charitable Trusts	ENGO	WCPFC8-2011-OP-04
2011	World Wildlife Fund	ENGO	WCPFC8- 2011-OP-06
2012	American Fisherman's Research Foundation	INGO	WCPFC9-2012-OP09
2012	Earth Island Institute	ENGO	WCPFC9-2012-OP10
2012	Greenpeace	ENGO	WCPFC9-2012-OP02 (Rev 1)

2012	International Seafood Sustainability Foundation	INGO	WCPFC9-2012-OP06
2012	Pew Charitable Trusts	ENGO	WCPFC9-2012-OP04
2012	World Wildlife Fund	ENGO	WCPFC9-2012-OP01
2012	Association for Professional Observers	INGO	WCPFC9-2012-OP03
2013	American Fisherman's Research Foundation	INGO	WCPFC10-2013-OP09
2013	Greenpeace	ENGO	WCPFC10-2013-OP02
2013	International Game Fishing Association	INGO	WCPFC10-2013-OP06
2013	International Seafood Sustainability Foundation	INGO	WCPFC10-2013-OP01
2013	Ocean Friends Against Driftnets	ENGO	WCPFC10-2013-OP05
2013	Pew Charitable Trusts	ENGO	WCPFC10-2013-OP03
2013	World Wildlife Fund	ENGO	WCPFC10-2013-OP04
2014	Greenpeace	ENGO	WCPFC11-2014-OP11
2014	International Seafood Sustainability Foundation	INGO	WCPFC11-2014-OP01
2014	Pew Charitable Trusts	ENGO	WCPFC11-2014-OP12
2014	World Wildlife Fund	ENGO	WCPFC11-2014-OP10
2014	International Game Fishing Association	INGO	WCPFC11-2014-OP15
2015	American Fisherman's Research Foundation	INGO	WCPFC12-2015-OP13
2015	Greenpeace	ENGO	WCPFC12-2015-OP16
2015	International Pole and Line Foundation	INGO	WCPFC12-2015-OP07
2015	International Seafood Sustainability Foundation	INGO	WCPFC12-2015-OP01
2015	Pew Charitable Trusts	ENGO	WCPFC12-2015-OP08
2015	World Wildlife Fund	ENGO	WCPFC12-2015-OP02
2015	World Wildlife Fund	ENGO	WCPFC12-2015-OP04
2016	International Seafood Sustainability Foundation	INGO	WCPFC13-2016-OP06
2016	Greenpeace	ENGO	WCPFC13-2016-OP09
2016	International Seafood Sustainability Foundation	INGO	WCPFC13-2016-OP01
2016	Pew Charitable Trusts	ENGO	WCPFC13-2016-OP02
2016	Sustainable Fisheries Partnership	ENGO	WCPFC13-2016-OP13
2016	World Tuna Purse Seine Organization	INGO	WCPFC13-2016-OP21
2016	World Wildlife Fund	ENGO	WCPFC13-2016-OP03
2016	Shark Advocates International	ENGO	WCPFC13-2016-OP16
2016	International Union for the Conservation of Nature	ENGO	WCPFC13-2016-OP12
2016	International Pole and Line Foundation	INGO	WCPFC13-2016-OP10
2016	Monterey Bay Aquarium	ENGO	WCPFC13-2016-OP11
2016	International Game Fishing Association	INGO	WCPFC13-2016-OP08
2017	Greenpeace	ENGO	WCPFC14-2017-OP09
2017	International Pole and Line Foundation	INGO	WCPFC14-2017-OP12
2017	International Seafood Sustainability Foundation	INGO	WCPFC14-2017-OP02
2017	International Seafood Sustainability Foundation	INGO	WCPFC14-2017-OP08
2017	International Seafood Sustainability Foundation	INGO	WCPFC14-2017-OP01
2017	Pew Charitable Trusts	ENGO	WCPFC14-2017-OP04
2017	World Tuna Purse Seine Organization	INGO	WCPFC14-2017-OP13

2017	World Wildlife Fund	ENGO	WCPFC14-2017-OP03
2017	International Game Fishing Association	INGO	WCPFC14-2017-OP10
2017	Greenpeace	ENGO	WCPFC14-2017-OP14
2018	International Game Fishing Association	INGO	WCPFC15-2018-OP06
2018	International Pole and Line Foundation	INGO	WCPFC15-2018-OP09
2018	International Seafood Sustainability Foundation	INGO	WCPFC15-2018-OP05
2018	International Seafood Sustainability Foundation	INGO	WCPFC15-2018-OP02
2018	Ocean Friends Against Driftnets	ENGO	WCPFC15-2018-OP16
2018	Organisation for the Promotion of Responsible Tuna Fisheries	INGO	WCPFC15-2018-OP01
2018	Pew Charitable Trusts	ENGO	WCPFC15-2018-OP04
2018	Sustainable Fisheries Partnership	INGO	WCPFC15-2018-OP21
2018	World Tuna Purse Seine Organization	INGO	WCPFC15-2018-OP22
2018	World Wildlife Fund	ENGO	WCPFC15-2018-OP14
2018	World Wildlife Fund	ENGO	WCPFC15-2018-OP07
2019	International Seafood Sustainability Foundation	INGO	WCPFC15-2019-OP01
2019	Organisation for the Promotion of Responsible Tuna Fisheries	INGO	WCPFC15-2019-OP02
2019	World Wildlife Fund	ENGO	WCPFC15-2019-OP05
2019	Pew Charitable Trusts	ENGO	WCPFC15-2019-OP09
2019	International Pole and Line Foundation	INGO	WCPFC15-2018-OP11
2019	World Wildlife Fund	ENGO	WCPFC15-2019-OP16
2019	International Game Fishing Association	INGO	WCPFC15-2019-OP17
2019	International Seafood Sustainability Foundation	INGO	WCPFC15-2019-OP18
2019	Pacific Island Tuna Industry Association	INGO	WCPFC15-2019-OP19

Table S13 Affiliations from WCPFC attendee lists (n=595) with assigned codes for type of affiliation and country of affiliation origin. Cases where GOV affiliations have 'n/a' refer to instances where the same affiliation was used by multiple governments. In these instances, the DEL country was used as the affiliation country.

AFFILIATION	CODE	COUNTRY
University of Tasmania	ACA	AUSTRALIA
ANCORS, University of Wollongong	ACA	AUSTRALIA
Kochi University	ACA	JAPAN
National Sun Yat-sen University	ACA	TAIWAN
Kasetsart University	ACA	THAILAND
Center for the Blue Economy	ACA	UNITED STATES OF AMERICA
Shanghai Ocean University	ACA	CHINA
The University of the South Pacific (USP)	ACA	FIJI
Central Police University	ACA	TAIWAN
Victoria University of Wellington	ACA	NEW ZEALAND
Center for Oceans Law and Policy	ACA	UNITED STATES OF AMERICA
University of Indonesia	ACA	INDONESIA
National Cheng Kung University	ACA	TAIWAN
James Cook University	ACA	AUSTRALIA
Bogor Agricultural University	ACA	INDONESIA
Institute for International Fisheries Cooperation	ACA	REPUBLIC OF KOREA
National Taiwan Ocean University	ACA	TAIWAN
Utrecht University	ACA	THE NETHERLANDS
Waseda University	ACA	JAPAN
Wageningen University	ACA	THE NETHERLANDS
National Taiwan University	ACA	TAIWAN
University of the Philippines	ACA	PHILIPPINES
University of Hawaii	ACA	UNITED STATES OF AMERICA
Tohoku University	ACA	JAPAN
Gakushuin University	ACA	JAPAN
Tokai University	ACA	JAPAN
University of Guam	ACA	GUAM
Pukyong National University	ACA	REPUBLIC OF KOREA
Soochow University	ACA	CHINA
Pusan National University	ACA	REPUBLIC OF KOREA
Universidad Nacional de Mar del Plata	ACA	ARGENTINA
The Australian National University	ACA	AUSTRALIA
Center for Environmental Law and Community Rights (CELCOR)	ACA	PAPUA NEW GUINEA

Korea Maritime Institute	ACA	REPUBLIC OF KOREA
Hokkaido University	ACA	JAPAN
University of Washington	ACA	UNITED STATES OF AMERICA
Pelagic Ecosystems Research Group	CONS	UNITED STATES OF AMERICA
Ajat Marketing and Services	CONS	PHILIPPINES
iTUNA Intel	CONS	SOLOMON ISLANDS
Marine Exchange	CONS	n/a
Ultramarine	CONS	n/a
Campbell Consulting	CONS	CANADA
Olsen Pacific Consulting	CONS	UNITED STATES OF AMERICA
Independent consultant	CONS	n/a
Morison Aquatic Sciences	CONS	UNITED STATES OF AMERICA
BirdLife International	ENGO	UNITED KINGDOM
Sustainable Fisheries Partnership (SFP)	ENGO	UNITED STATES OF AMERICA
The Pew Charitable Trusts	ENGO	UNITED STATES OF AMERICA
Earth Island Institute	ENGO	UNITED STATES OF AMERICA
Environmental Defense Fund	ENGO	UNITED STATES OF AMERICA
Greenpeace	ENGO	GLOBAL
Marine Stewardship Council	ENGO	UNITED KINGDOM
Ocean Friends Against Driftnets	ENGO	UNITED STATES OF AMERICA
Seafood Legacy	ENGO	JAPAN
The Nature Conservancy	ENGO	UNITED STATES OF AMERICA
World Wide Fund for Nature (WWF)	ENGO	GLOBAL
Monterey Bay Aquarium	ENGO	UNITED STATES OF AMERICA
Te Ipukarea Society	ENGO	COOK ISLANDS
Conservation International	ENGO	UNITED STATES OF AMERICA
Phoenix Islands Protected Area Conservation Trust	ENGO	KIRIBATI
Vanuatu Association of Non-Governmental Association (VANGO)	ENGO	VANUATU
Mindanao Development Authority (MinDA)	ENGO	AUSTRALIA
Environment Hawaii	ENGO	UNITED STATES OF AMERICA
Humane Society International	ENGO	UNITED STATES OF AMERICA
Fairtrade USA	ENGO	UNITED STATES OF AMERICA
David and Lucile Packard Foundation	ENGO	UNITED STATES OF AMERICA
Shark Advocates International	ENGO	UNITED KINGDOM
Ocean Outcomes	ENGO	UNITED STATES OF AMERICA
National Audubon Society	ENGO	UNITED STATES OF AMERICA
International Union for Conservation of Nature (IUCN)	ENGO	EUROPEAN UNION
AusAID	ENGO	AUSTRALIA
Blue Ocean Institute	ENGO	UNITED STATES OF AMERICA

Wildlife Trade Monitoring Network (TRAFFIC)	ENGO	UNITED KINGDOM
Sea Turtle Restoration Project	ENGO	UNITED STATES OF AMERICA
Tangaroa Blue Foundation	ENGO	AUSTRALIA
Kosrae Conservation & Safety Organization	ENGO	FEDERATED STATES OF MICRONESIA
Department of Agriculture and Water Resources	GOV	n/a
Australian Fisheries Management Authority	GOV	AUSTRALIA
Australian Bureau of Agricultural and Resource Economics and Sciences	GOV	AUSTRALIA
Department of Foreign Affairs and Trade	GOV	n/a
Fisheries and Oceans Canada	GOV	CANADA
Bureau for Fisheries, Ministry of Agriculture and Rural Affairs	GOV	n/a
Ministry of Foreign Affairs	GOV	n/a
Ministry of Marine Resources	GOV	n/a
Directorate-General for Maritime Affairs and Fisheries (DG MARE)	GOV	EUROPEAN UNION
European Union	GOV	EUROPEAN UNION
Delegation of the European Union for the Pacific	GOV	EUROPEAN UNION
National Oceanic Resource Management Authority (NORMA)	GOV	FEDERATED STATES OF MICRONESIA
FSM Congress	GOV	FEDERATED STATES OF MICRONESIA
Department of Justice	GOV	n/a
Ministry of Fisheries and Forests	GOV	n/a
Direction Polynesienne des Affaire Maritime (DPAM)	GOV	FRENCH POLYNESIA
Ministry of Maritime Affairs and Fisheries	GOV	n/a
Ministry of Agriculture, Forestry and Fisheries	GOV	n/a
National Research Institute of Fisheries Science	GOV	n/a
Kochi Prefectural Government	GOV	JAPAN
Ministry of Fisheries & Marine Resources Development	GOV	n/a
Korea International Cooperation Agency	GOV	REPUBLIC OF KOREA
Ministry of Oceans and Fisheries	GOV	n/a
National Institute of Fisheries Science	GOV	n/a
Korea Fisheries Monitoring Centre	GOV	REPUBLIC OF KOREA
Marshall Islands Marine Resources Authority (MIMRA)	GOV	REPUBLIC OF THE MARSHALL ISLANDS
Legislature of the Marshall Islands	GOV	REPUBLIC OF THE MARSHALL ISLANDS
Office of the Maritime Administrator	GOV	n/a
Nauru Fisheries and Marine Resources Authority	GOV	NAURU
Ministry for Primary Industries	GOV	n/a
Ministry of Foreign Affairs and Trade	GOV	n/a

Department of Conservation	GOV	n/a
Department of Agriculture, Forestry and Fisheries	GOV	n/a
Ministry of Natural Resources, Environment & Tourism	GOV	n/a
Papua New Guinea National Fisheries Authority	GOV	PAPUA NEW GUINEA
Investment Promotion Authority	GOV	n/a
Department of Prime Minister and National Executive Council	GOV	n/a
Department of Commerce and Industry	GOV	n/a
Department of Justice & Attorney General	GOV	n/a
Bureau of Fisheries and Aquatic Resources	GOV	n/a
Philippine Council for Agriculture and Fisheries	GOV	PHILIPPINES
Philippine Fisheries Development Authority (PFDA)	GOV	PHILIPPINES
Department of Foreign Affairs	GOV	n/a
Ministry of Agriculture and Fisheries	GOV	n/a
Ministry of Fisheries and Marine Resources	GOV	n/a
Ministry of Foreign Affairs and External Trade	GOV	n/a
Fisheries Agency, Council of Agriculture	GOV	n/a
Overseas Fisheries Development Council	GOV	n/a
Coast Guard Administration	GOV	n/a
Ministry of Agriculture and Food, Forests and Fisheries	GOV	n/a
Ministry of Natural Resources, Energy and Environment	GOV	n/a
National Oceanic and Atmospheric Administration (NOAA)	GOV	UNITED STATES OF AMERICA
United States Coast Guard	GOV	UNITED STATES OF AMERICA
United States Department of State	GOV	UNITED STATES OF AMERICA
Vanuatu Fisheries Department	GOV	VANUATU
Vanuatu Police Force	GOV	VANUATU
Department of Marine & Wildlife Resources (American Samoa)	GOV	AMERICAN SAMOA
Department of Lands and Natural Resources	GOV	n/a
Direction des Ressources Maritimes	GOV	n/a
Office of the Governor	GOV	n/a
New Caledonia Merchant Navy and Sea Fishery Department	GOV	NEW CALEDONIA
Department of Economic Development, Natural Resources & Environment	GOV	n/a
Aquatic Resources Authority of Panama	GOV	PANAMA
Vietnam Directorate of Fisheries	GOV	VIETNAM
Parties to the Nauru Office (PNAO)	GOV	PARTIES TO THE NAURU AGREEMENT (PNA)

European Parliament	GOV	EUROPEAN UNION
National Research and Development Agency, Japan Fisheries Research and Education Agency	GOV	JAPAN
Ministry of Resources & Development	GOV	n/a
Department of Fisheries and Marine Resources	GOV	n/a
Guam Bureau of Statistics and Plans	GOV	GUAM
Ministry of Agriculture and Cooperatives	GOV	n/a
Natural Resources Defense Council	GOV	n/a
Ministry of Agriculture, Fisheries and Food, Spain	GOV	SPAIN
Ministry of Economic Affairs and Climate Policy, the Netherlands	GOV	THE NETHERLANDS
Ministry for the Ecological and Inclusive Transition of France	GOV	FRANCE
Ministry of Overseas Territories	GOV	n/a
Ministry of Economy, Trade and Industry	GOV	n/a
Secretariat of Foreign Affairs	GOV	n/a
Ministry of Agriculture and Rural Development	GOV	n/a
Coastal Fisheries Development Agency	GOV	n/a
Ministry of Police	GOV	n/a
Press Secretariat Samoa	GOV	SAMOA
Office of the Attorney General	GOV	n/a
Guam Department of Agriculture	GOV	GUAM
Tokelau Apia Liaison Office	GOV	TOKELAU
National Fisheries Institute Mexico (INAPESCA)	GOV	MEXICO
Swedish Agency for Marine and Water Management	GOV	SWEDEN
Fisheries and Aquaculture Directorate (DPMA)	GOV	FRANCE
National Police	GOV	n/a
PNG Parliament	GOV	PAPUA NEW GUINEA
Milne Bay Provential Government	GOV	PAPUA NEW GUINEA
National Fisheries Research and Development Institute	GOV	n/a
Department of Commerce	GOV	n/a
Guam Department of Chamorro Affairs	GOV	GUAM
Territorial Services for Rural Economy and Fisheries	GOV	n/a
Attorney-General's Department	GOV	n/a
Ministry of Agriculture, Agrifood, and Forestry of France	GOV	n/a
Attorney General's Office	GOV	n/a
Palau Congress	GOV	PALAU
Bureau of Foreign Affairs	GOV	n/a
Madang Provential Government	GOV	PAPUA NEW GUINEA

Morobe Fisheries Management Authority	GOV	PAPUA NEW GUINEA
National Marine Fisheries Development Center (NMFDC)	GOV	PHILIPPINES
Department of Trade and Industry	GOV	n/a
City Economic Management and Cooperative Development Office	GOV	n/a
Local Government Unit of General Santos City	GOV	PHILIPPINES
National Economic and Development Authority	GOV	n/a
Philippine National Police	GOV	PHILIPPINES
Philippine Coast Guard	GOV	PHILIPPINES
Kaohsiung City Government	GOV	TAIWAN
California Department of Fish and Wildlife	GOV	UNITED STATES OF AMERICA
Office of the President	GOV	n/a
The International Merchant Marine Registry of Belize (IMMARBE)	GOV	BELIZE
Ministry of Agriculture, Fisheries, Forestry, the Environment, Sustainable Development and Immigration	GOV	n/a
La Asociacion de Atuneros del Ecuador	GOV	ECUADOR
St. Kitts & Nevis International Ship Registry	GOV	ST KITTS AND NEVIS
The Marshall Islands Registry	GOV	REPUBLIC OF THE MARSHALL ISLANDS
Parliament of Nauru	GOV	NAURU
Ministry of Foreign Commerce, Industrialization, Fisheries and Competitiveness	GOV	n/a
National Fisheries and Aquaculture Industry Chamber	GOV	n/a
Direction des Peches Maritimes (DPM)	GOV	n/a
Criminal Justice Planning Agency	GOV	n/a
Ministry of Europe and Foreign Affairs	GOV	n/a
Mindanao Economic Development Council (MEDCo)	GOV	n/a
Attorney General's Chambers	GOV	n/a
National Fisheries Institute	GOV	n/a
Foreign Affairs and International Trade Canada	GOV	CANADA
Ministry of Environment, Spain	GOV	SPAIN
Attorney-General's Chambers	GOV	n/a
Directorate of Maritime Affairs (DMA)	GOV	n/a
The French Research Institute for Exploitation of the Sea (IFREMER)	GOV	FRANCE
Office of the Premier of Niue	GOV	NIUE
Ministry of Infrastructure Tonga	GOV	TONGA
Department of Resource & Development	GOV	n/a
Ministry of Foreign Affairs and Immigration	GOV	n/a

Ministry of the Interior	GOV	n/a
US Senate	GOV	UNITED STATES OF AMERICA
Ministry of Justice	GOV	n/a
Port Authority of Guam	GOV	GUAM
Territorial Assembly	GOV	n/a
Papua New Guinea Defence Force	GOV	PAPUA NEW GUINEA
PNG National Fisheries Authority	GOV	PAPUA NEW GUINEA
Ministry of Foreign Affairs and Immigration	GOV	n/a
Secretaria General de Pesca	GOV	n/a
Ministry of Fisheries	GOV	n/a
French Maritime Affairs	GOV	n/a
Ministry of Marine Affairs and Fisheries	GOV	n/a
Fisheries Agency of Japan	GOV	JAPAN
Fisheries Chamber of Commerce and Industry Division	GOV	n/a
National Research Institute of Far Seas Fisheries	GOV	JAPAN
Fisheries Research Agency	GOV	n/a
Ministry of Natural Resources	GOV	n/a
New Ireland Provincial Government	GOV	PAPUA NEW GUINEA
National Fisheries Board	GOV	n/a
Department of Agriculture	GOV	n/a
National Fisheries Product Quality Management Service	GOV	n/a
Solomon Islands Government	GOV	SOLOMON ISLANDS
American Samoa Government	GOV	AMERICAN SAMOA
Northern Mariana Islands Senate	GOV	COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS (CNMI)
Northern Mariana Islands Government	GOV	COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS (CNMI)
Marine Resources and Mining Department	GOV	n/a
Fisheries Management Agency	GOV	n/a
Ministry of Agriculture and Fishing of Ecuador	GOV	n/a
National Chamber of Fisheries	GOV	n/a
Department of Fisheries	GOV	n/a
New Caledonia Maritime Affairs	GOV	NEW CALEDONIA
Swedish Agency for Marin and Water Management	GOV	SWEDEN
Pacific Fishery Management Council	IGO	UNITED STATES OF AMERICA
Western Pacific Fisheries Management Council	IGO	UNITED STATES OF AMERICA
Western Pacific Regional Fishery Management Council	IGO	UNITED STATES OF AMERICA
Food and Agriculture Organization of the United Nations (FAO)	IGO	EUROPEAN UNION

Pacific Islands Forum Fisheries Agency (FFA)	IGO	SOLOMON ISLANDS
Inter-American Tropical Tuna Commission (IATTC)	IGO	UNITED STATES OF AMERICA
International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC)	IGO	n/a
Secretariat of the Pacific Regional Environment Programme	IGO	SAMOA
The World Bank	IGO	UNITED STATES OF AMERICA
Secretariat of the Pacific Community	IGO	NEW CALEDONIA
ACAP	IGO	n/a
International Labour Organization	IGO	EUROPEAN UNION
Te Vaka Moana	IGO	n/a
United Nations Environment Programme	IGO	EUROPEAN UNION
CITES Secretariat	IGO	EUROPEAN UNION
United Nations Development Programme	IGO	EUROPEAN UNION
South Pacific Regional Fisheries Management Organisation	IGO	NEW ZEALAND
International Commission for the Conservation of Atlantic Tunas (ICCAT)	IGO	EUROPEAN UNION
North Pacific Anadromous Fish Commission	IGO	CANADA
ISC	IGO	n/a
ABNJ Tuna Project	IGO	EUROPEAN UNION
North Pacific Fisheries Commission	IGO	JAPAN
Pacific Islands Forum Secretariat	IGO	FIJI
Southeast Asian Fisheries Development Center	IGO	THAILAND
Walker Seafoods Australia Pty Ltd	IND	AUSTRALIA
Zhejiang Ocean Family Co., Ltd.	IND	CHINA
Liancheng Overseas Fishery (Shenzhen) Co., Ltd.	IND	CHINA
Ping Tai Rong Ocean Fishery Group Co.,Ltd.	IND	CHINA
Shanghai Kaichuang Deepsea Fisheries Co Ltd	IND	CHINA
Zhongyu Global Seafood Co., Ltd.	IND	CHINA
Tri Marine Group	IND	UNITED STATES OF AMERICA
Luen Thai Fishing Venture Ltd.	IND	CHINA
Hai Soon Diesel & Trading Pte Ltd	IND	SINGAPORE
Satlink S.L.	IND	EUROPEAN UNION
Diving Seagull, Inc.	IND	FEDERATED STATES OF MICRONESIA
Caroline Fisheries Corp.	IND	FEDERATED STATES OF MICRONESIA
Centerpac	IND	FEDERATED STATES OF MICRONESIA
Pacific Fishing Co., Ltd.	IND	FIJI
Yuh Yow Fishery Co., Ltd	IND	TAIWAN

Golden Ocean Fish Ltd	IND	FIJI
Kyokuyo Co., Ltd.	IND	JAPAN
ITOCHU Corporation	IND	JAPAN
Murata Gyogyo Co Ltd	IND	JAPAN
All Nippon Airways	IND	JAPAN
Fukuichi Fishery Co., Ltd.	IND	JAPAN
Taiyo A & F Co. Ltd	IND	JAPAN
Kazuoh Co Ltd	IND	JAPAN
Hakko Gyogyo Co., Ltd.	IND	JAPAN
Japan NUS Co., Ltd.	IND	JAPAN
Eisei Maru Co., Ltd	IND	JAPAN
Kiribati Fish Ltd	IND	KIRIBATI
Silla Co., Ltd	IND	REPUBLIC OF KOREA
Sajo Industries	IND	REPUBLIC OF KOREA
Dong Won Fisheries	IND	REPUBLIC OF KOREA
TunaQuest	IND	REPUBLIC OF KOREA
Hansung Enterprise Co.,Ltd	IND	REPUBLIC OF KOREA
Pan Pacific Foods (RMI) Inc	IND	REPUBLIC OF THE MARSHALL ISLANDS
Marshall Islands Fishing Venture, Inc	IND	REPUBLIC OF THE MARSHALL ISLANDS
Pacific International Inc.	IND	REPUBLIC OF THE MARSHALL ISLANDS
Talleys Group Limited	IND	PAPUA NEW GUINEA
Frabelle PNG Limited	IND	PAPUA NEW GUINEA
South Seas Tuna Corporation	IND	PAPUA NEW GUINEA
PNG Fishing Industry Association Inc.	IND	PAPUA NEW GUINEA
Fair Well Fishery Co., Ltd.	IND	TAIWAN
Majestic Seafood Corporation Limited	IND	PAPUA NEW GUINEA
RD Tuna Canners Ltd.	IND	PAPUA NEW GUINEA
High Energy Co., Ltd	IND	PAPUA NEW GUINEA
SOCSKSARGEN Federation of Fishing & Allied Industries, Inc	IND	PHILIPPINES
Frabelle Fishing Corporation	IND	PHILIPPINES
RD Fishing Industry	IND	PHILIPPINES
Citra Mina Group of Companies	IND	PHILIPPINES
TSP Marine Industries	IND	PHILIPPINES
Thunnidae Venture Corporation	IND	PHILIPPINES
Alliance Select Foods International, Inc.	IND	PHILIPPINES
San Andres Fishing Industries, Inc.	IND	PHILIPPINES
RBL Fishing Corporation	IND	PHILIPPINES
Marchael Sea Ventures	IND	PHILIPPINES
Trans-Pacific Journey Fishing Corp.	IND	PHILIPPINES

Euthynnus Venture Corporation	IND	PHILIPPINES
Willshine Enterprise Company	IND	PHILIPPINES
Starcki Venture Corporation	IND	PHILIPPINES
Sto. Nino Aqua Fishing Venture Corp.	IND	PHILIPPINES
RLG Fishing Company	IND	PHILIPPINES
Royal Pacific Rim Fishing Corporation	IND	PHILIPPINES
Solfish Company Limited	IND	SOLOMON ISLANDS
San Sheng Ocean Ltd.	IND	TAIWAN
Win Far Fishery Co., Ltd.	IND	TAIWAN
Fong Kuo Fishery Co.,Ltd	IND	TAIWAN
StarKist	IND	REPUBLIC OF KOREA
Gs Fisheries, Inc.	IND	UNITED STATES OF AMERICA
Chicken of the Sea International	IND	THAILAND
Tradition Mariner LLC	IND	UNITED STATES OF AMERICA
Bumble Bee Foods	IND	UNITED STATES OF AMERICA
South Pacific Tuna Corporation	IND	UNITED STATES OF AMERICA
Pacific Princess Partnership Ltd	IND	UNITED STATES OF AMERICA
Western Pacific Fisheries, Inc.	IND	UNITED STATES OF AMERICA
Tunago Fishery Co., Ltd.	IND	VANUATU
Samoa Tuna Processors	IND	AMERICAN SAMOA
Pacific Energy SWP Ltd	IND	FIJI
Liberian International Ship & Corporate Registry	IND	UNITED STATES OF AMERICA
China Transport Telecommunications & Information Center	IND	CHINA
China Southern Fishery (Shenzhen) Co., Ltd.	IND	CHINA
Dayang Ocean Fishery Co., LTD	IND	CHINA
Liaoning Pelagic Fisheries Co. Ltd	IND	CHINA
Shanghai Deep Sea Fisheries Co., Ltd.	IND	CHINA
FSM-National Fisheries Corporation	IND	FEDERATED STATES OF MICRONESIA
Kasar Fishing Corporation	IND	FEDERATED STATES OF MICRONESIA
Taiyo Micronesia Corporation	IND	FEDERATED STATES OF MICRONESIA
Sea Quest (Fiji) Limited	IND	FIJI
Golden Ocean Group	IND	BERMUDA
Green Tuna Fisheries Co., Ltd.	IND	FIJI
Ocean Pride Fisheries Ltd.	IND	CANADA
CKP Fishing Co., Ltd.	IND	FIJI
Yuh Yow Fisheries Company Ltd	IND	TAIWAN
Kaneshimeichi KK	IND	JAPAN
Suya Fishery Co., Ltd	IND	JAPAN

Nikko Suisan Co., Ltd.	IND	JAPAN
Sein Shipping Co., Ltd.	IND	REPUBLIC OF KOREA
Koo's Fishing Company	IND	REPUBLIC OF KOREA
Dongwon Industries Co., Ltd.	IND	REPUBLIC OF KOREA
Pacifical c.v.	IND	PARTIES TO THE NAURU AGREEMENT (PNA)
Nambawan Seafoods Limited	IND	PAPUA NEW GUINEA
Rell and Renn Fishing Corporation	IND	PHILIPPINES
Chl Fishing Industry, Inc	IND	PHILIPPINES
San Lorenzo Ruiz Fishing Industry Inc.	IND	PHILIPPINES
Mommy Gina Tuna Resources (MGTR)	IND	PHILIPPINES
National Fisheries Development Ltd.	IND	SOLOMON ISLANDS
Southern Seas Investment, Ltd.	IND	NEW ZEALAND
Tuvalu Tuna Fong Haur Co. Ltd.	IND	TUVALU
C & F Design Products	IND	JAPAN
Clipper Oil	IND	UNITED STATES OF AMERICA
Ming Dar Fishery (Vanuatu) Co., Ltd.	IND	VANUATU
Thai Union Group	IND	THAILAND
South Pacific Tuna Corporation	IND	UNITED STATES OF AMERICA
New England Seafood International Ltd	IND	UNITED STATES OF AMERICA
LS Holdings LLC	IND	UNITED STATES OF AMERICA
Johanna Seafoods Ltd.	IND	PHILIPPINES
Weihai Changhe Fishery Co., Ltd.	IND	CHINA
Ocean Bountiful Limited	IND	FIJI
PT. Pathemaang Raya	IND	INDONESIA
PT. Jalesveva Nusantara	IND	INDONESIA
Miyamaru Gyogyo KK	IND	JAPAN
Daishimaru Fishery Co., Ltd	IND	JAPAN
Kirikore Fisheries CO.,LTD	IND	REPUBLIC OF KOREA
National Fishery Products Quality Management Service	IND	REPUBLIC OF KOREA
Norpac Fisheries Export	IND	UNITED STATES OF AMERICA
A.V.M Bernardo Engineering	IND	PHILIPPINES
Trinity Home Industrial Development Corporation	IND	PHILIPPINES
PT. RD Pacific International	IND	INDONESIA
Global Fisheries Limited	IND	SINGAPORE
King Chou Marine Technology Co., Ltd.	IND	TAIWAN
Ming Feng Zhoushan Marine Aquatic Food Co., Ltd.	IND	CHINA
PT. Ocean Mitramas	IND	INDONESIA
Anova Foods	IND	UNITED STATES OF AMERICA
Tetra Tech	IND	UNITED STATES OF AMERICA

Shandong Zhonglu Oceanic Fisheries Co Ltd	IND	CHINA
Pohnpei Public Broadcasting Corp.	IND	FEDERATED STATES OF MICRONESIA
Asahi Gyogyo	IND	JAPAN
RMI Trust Company	IND	REPUBLIC OF THE MARSHALL ISLANDS
Sea Strong, LLC.	IND	UNITED STATES OF AMERICA
Devads Limited	IND	PAPUA NEW GUINEA
Haya No.17, Ltd	IND	REPUBLIC OF KOREA
Apia Export Fish Packers Ltd	IND	SAMOA
Tradewinds Fishing CO. Ltd	IND	SAMOA
CLS Collect Localisation Satellites	IND	FRANCE
Jih Yu Fishery Co Ltd	IND	TAIWAN
Sardinha & Cileu Management Co	IND	UNITED STATES OF AMERICA
Anova Food, LLC	IND	UNITED STATES OF AMERICA
Calvopesca El Salvador S.A.	IND	EL SALVADOR
Dalian Jinguang Fishing Co., Ltd	IND	CHINA
GS Fisheries Inc.	IND	UNITED STATES OF AMERICA
C & F Fishing LTD	IND	UNITED STATES OF AMERICA
Ocean Oils Pty Ltd	IND	AUSTRALIA
Rongcheng Yong Jin Aquatic Products Co., Ltd.	IND	CHINA
Shanghai JinYou Deep Sea Fisheries Co.,Ltd.	IND	CHINA
Shanghai Fisheries General Corporation Group	IND	CHINA
Albacora S.A	IND	SPAIN
Jalaveva Company	IND	INDONESIA
Nipponmaru Corporation	IND	JAPAN
Otoshiro Fishery Co., Ltd.	IND	JAPAN
Cubic-i Ltd.	IND	JAPAN
Agnes Fisheries Co Ltd	IND	REPUBLIC OF KOREA
Toboi Shipbuilding Co., Ltd.	IND	PAPUA NEW GUINEA
Fong Haur Fishery Co., Ltd.	IND	TAIWAN
Pesquera Ugavi S.A.	IND	ECUADOR
Samper SA	IND	SPAIN
Korea Trading and Industries Co., Ltd.	IND	REPUBLIC OF KOREA
Sanford Ltd	IND	NEW ZEALAND
Gensan Fishing Incorporated	IND	PHILIPPINES
Rugela Fishing Industries, Inc.	IND	PHILIPPINES
Damalerio Fishing Ind. Inc.	IND	PHILIPPINES
Roel Fishing Industry Inc	IND	PHILIPPINES
BSJ Fishing and Trading Inc.	IND	PHILIPPINES

Reefership Phils Inc	IND	PHILIPPINES
NH Agro Industrial Inc	IND	PHILIPPINES
Celebes Canning Corporation	IND	PHILIPPINES
Sun Warm Tuna Corporation	IND	PHILIPPINES
Propmech Corporation	IND	PHILIPPINES
Internet France Philippines Corporation	IND	PHILIPPINES
Manila Cordage Company	IND	PHILIPPINES
Seatrade Canning Corporations	IND	PHILIPPINES
Trade One Incorporated	IND	PHILIPPINES
Ihu Nui Kona Sportfishing	IND	UNITED STATES OF AMERICA
Shenzhen Shengang Ocean Industry Co	IND	CHINA
Majestic Blue Fisheries LLC	IND	REPUBLIC OF KOREA
Negocios Industriales Real Nirsa, S.A	IND	ECUADOR
Maricultura del Norte	IND	MEXICO
Liaoning Kimliner Ocean Fishing Co., LTD.	IND	CHINA
Atunera Dularra SL	IND	SPAIN
Marin Marawa Fisheries Ltd.	IND	KIRIBATI
Marshall Islands Service Corporation	IND	REPUBLIC OF THE MARSHALL ISLANDS
De Silva Sea Encounter Corp.	IND	UNITED STATES OF AMERICA
FV Jeanette	IND	AMERICAN SAMOA
Tuna Fishing (Vanuatu) Company Ltd	IND	VANUATU
Delipesca S.A.	IND	ECUADOR
GeoEye	IND	UNITED STATES OF AMERICA
Fong Seong Fishing Group	IND	TAIWAN
Vaianahoa (SC)	IND	FRANCE
Tahiti Rava'ai	IND	FRANCE
VINI VINI LONG LINE Products (EURL)	IND	FRANCE
Titaua Tautai (SC)	IND	FRANCE
Fetu Armement (SARL)	IND	FRANCE
Moorea Peche (SCA) BP 712	IND	FRANCE
AC2P –Rava'Ai Rau	IND	FRANCE
Vaeanapa (SCA)	IND	FRANCE
Mekathon –Daniella 4 (SC)	IND	FRANCE
Tahiti Island Seafood	IND	FRANCE
Guangdong GUANGYUAN Fishery Group Co. Ltd	IND	CHINA
Winfull Fishing Co Ltd.	IND	FIJI
New Eikyu	IND	JAPAN
Furuno	IND	JAPAN
Nambuk Fisheries Co., Ltd.	IND	REPUBLIC OF KOREA

Unotech Co., Ltd.	IND	REPUBLIC OF KOREA
New Development Fisheries Co. Ltd.	IND	REPUBLIC OF KOREA
Shipping-Land Co., Ltd.	IND	REPUBLIC OF KOREA
Sun Tai Fishing	IND	PHILIPPINES
Tong Seong Fishery	IND	TAIWAN
Pacific Ocean Producers, LLC	IND	UNITED STATES OF AMERICA
Diflopes S.A.	IND	ECUADOR
Pesca Azteca	IND	MEXICO
De Brett Seafood Ltd.	IND	AUSTRALIA
4 Seas Pty Ltd	IND	AUSTRALIA
National Fisheries Developments Ltd	IND	SOLOMON ISLANDS
CTSI Logistics FSM	IND	FEDERATED STATES OF MICRONESIA
Thales Group	IND	FRANCE
Western Pacific Enterprises Ltd.	IND	CANADA
Soltai Fishing and Processing Company	IND	SOLOMON ISLANDS
F.C.F. Fishery Co., Ltd.	IND	TAIWAN
Walloda Pacific Ltd.	IND	COOK ISLANDS
Narooma Seafood Direct	IND	AUSTRALIA
Finite Resources Management	IND	
Shanghai Dier Deep Sea Fisheries Co., Ltd	IND	CHINA
Zunibal	IND	SPAIN
PT Sinar Pure Foods	IND	INDONESIA
Chikami Miltec Inc.	IND	JAPAN
Yamasaki Giken	IND	JAPAN
Toyokunimaru SK	IND	JAPAN
Fukushima Fishery Co. Ltd	IND	JAPAN
Industry Representative	IND	
Winson Oil Bunkering PTE	IND	SINGAPORE
Socksargen Federation of Fishing and Allied Industries, Inc.	IND	PHILIPPINES
SRT Marine	IND	UNITED KINGDOM
Marshall Islands Fishing Company	IND	REPUBLIC OF THE MARSHALL ISLANDS
Southern Seas Logistic Ltd.	IND	SOLOMON ISLANDS
Solomon Islands Industry	IND	SOLOMON ISLANDS
SolTuna Ltd.	IND	SOLOMON ISLANDS
San Sheng Ocean Ltd.	IND	TAIWAN
SCS Global Services	IND	UNITED STATES OF AMERICA
Island Fisheries	IND	UNITED STATES OF AMERICA
Pesquera Jadran	IND	ECUADOR
Adriatic Sea Fisheries Ltd.	IND	COOK ISLANDS

Sea Delight, LLC	IND	UNITED STATES OF AMERICA
Tuna Australia	INGO	AUSTRALIA
China Overseas Fisheries Association	INGO	CHINA
China National Fisheries Corporation	INGO	CHINA
Fundacion International FIPESCA	INGO	PANAMA
Maritime Cook Islands	INGO	COOK ISLANDS
The Organization of Producers of Frozen Tuna (OPAGAC)	INGO	SPAIN
Indonesian Pole & Line and Handline Fisheries Association (AP2HI)	INGO	INDONESIA
Overseas Fishery Cooperation Foundation (OFCF)	INGO	JAPAN
Japan Far Seas Purse Seine Fishing Association	INGO	JAPAN
National Offshore Tuna Fisheries Association	INGO	JAPAN
Federation of North Pacific District Purse Seine Fisheries Co- operative Associations of Japan	INGO	JAPAN
Sanin Makiami (Purse Seine) Fisheries Cooperative	INGO	JAPAN
National Ocean Tuna Fishery Association	INGO	JAPAN
Federation of Japan Tuna Fisheries Co-operative Associations	INGO	JAPAN
Korea Overseas Fisheries Association	INGO	REPUBLIC OF KOREA
South Cotabato Purse Seiners Association	INGO	REPUBLIC OF KOREA
Umbrella Fish Landing Association (UFLA)	INGO	PHILIPPINES
Deep Sea Tuna Purse Seiners Boat-Owners and Exporters Association	INGO	TAIWAN
Taiwan Tuna Association	INGO	TAIWAN
Deep Sea Tuna Long-Line Boatowners And Exporters Association	INGO	TAIWAN
American Fishermens Research Foundation	INGO	UNITED STATES OF AMERICA
Hawaii Longline Association	INGO	UNITED STATES OF AMERICA
Camara de Pesqueria	INGO	ECUADOR
Centro Desarrollo y Pesca Sustentable (CeDePesca)	INGO	ARGENTINA
American Tunaboat Association	INGO	UNITED STATES OF AMERICA
International Pole and Line Foundation (IPNLF)	INGO	UNITED KINGDOM
International Seafood Sustainability Foundation	INGO	UNITED STATES OF AMERICA
Organization for the Promotion of Responsible Tuna Fisheries (OPRT)	INGO	JAPAN
Pacific Island Tuna Industry Association (PITIA)	INGO	FIJI
World Tuna Purse Seine Organisation (WTPO)	INGO	GLOBAL
Tuna Industry Association of Solomon Islands (TIASI)	INGO	SOLOMON ISLANDS
National Commission of Fisheries and Aquaculture (CONAPESCA)	INGO	MEXICO

Indonesian Tuna Longline Association (ATLI)	INGO	INDONESIA
Indonesia Tuna Association (ASTUIN)	INGO	INDONESIA
Tuna Management Association of New Zealand (TMA)	INGO	NEW ZEALAND
Yayasan Masyarakat dan Perikanan Indonesia (MDPI)	INGO	INDONESIA
Tautai-O-Samoa Longline & Fishing Association	INGO	AMERICAN SAMOA
Samoa Association of Manufacturers and Exporters	INGO	SAMOA
Game Fishing Association of Australia	INGO	AUSTRALIA
FSM Offshore Fisheries Association	INGO	FEDERATED STATES OF MICRONESIA
American Albacore Fishing Association	INGO	UNITED STATES OF AMERICA
Game Fishing Association Australia	INGO	AUSTRALIA
Alliance of Philippine Fishing Federation Incorporated	INGO	PHILIPPINES
Tuna Canners Association	INGO	PHILIPPINES
National Tuna Industry Council	INGO	PHILIPPINES
Guam Fishermen's Cooperative Association	INGO	GUAM
Nacional Ocean Tuna Fishery Coop	INGO	JAPAN
China Fisheries Association	INGO	CHINA
Palau Federation of Fishing Associations	INGO	PALAU
National Federation of Fisheries Cooperative Association	INGO	JAPAN
Western Fishboat Owners' Association	INGO	UNITED STATES OF AMERICA
National Association of Tuna Freezer Vessels Shipowners (ANABAC)	INGO	SPAIN
Spanish Fishing Confederation (Cepesca)	INGO	SPAIN
Société du Port de Pêche de Papeete (S3P)	INGO	FRENCH POLYNESIA
Tonga Fish Exporters Association	INGO	TONGA
Korea Deep-sea Fisheries Association	INGO	REPUBLIC OF KOREA
Suao Fishermen's Association	INGO	TAIWAN
le Groupement des Armateurs et Industriels de la Peche au Senegal (GAIPES)	INGO	SENEGAL
Federation Of Fishing Associations Of The Philippines	INGO	PHILIPPINES
U.S. Tuna Foundation	INGO	UNITED STATES OF AMERICA
Tongan Fish Exports Association	INGO	TONGA
Fiji Fishing Industry Association	INGO	FIJI
Kochi Offshore Tuna Fisheries Association	INGO	JAPAN
San-In Purse Seine Fisheries Cooperative	INGO	JAPAN
Miyazaki Tuna Fisheries Association	INGO	JAPAN
Central Japan Sea Purse Seine Fishery Council	INGO	JAPAN
Purse Seine Fisheries Cooperative Associations of Japan	INGO	JAPAN

Okinawa Tuna Fisheries Association	INGO	JAPAN
Taiwan Tuna Longline Association	INGO	TAIWAN
Taiwan Tuna Purse Seine Association	INGO	TAIWAN
United Fishing Agency	IND	UNITED STATES OF AMERICA
Tuna Conservation Group (TUNACONS)	INGO	ECUADOR
ATUNEC	INGO	COLOMBIA
FishWise	INGO	UNITED STATES OF AMERICA
International Environmental Law Project	OTH	n/a
Locally Managed Marine Area (LMMA) Network	OTH	n/a
Pacific Islands News Association	OTH	n/a
Pacific Dialogue	OTH	n/a
ANZ Papua New Guinea	OTH	n/a
Hawaii Medical Service Association	OTH	n/a
Security Bank	OTH	n/a
Bernice Pauahi Bishop Museum	OTH	n/a
Maritime Training Institute I.F.M.-P.C.	OTH	n/a
Abogados Ecuador	OTH	n/a
Callen Services for Persons with Disabilities	OTH	n/a
Pacific Islands Association of Non-Governmental Organisations (PIANGO)	OTH	n/a
AZTI Tecnalia	RES	n/a
El Instituto Espanol de Oceanografia (IEO)	RES	n/a
Research Institute for Fisheries Enhancement and Conservation Indonesia	RES	n/a
U.S.-Japan Research Institute	RES	n/a
Research Institute for Marine Fisheries	RES	n/a
WCPFC CHAIR	RFMO	n/a
WCPFC SECRETARIAT	RFMO	n/a
WCPFC CHAIR	RFMO	n/a
Unknown	UNK	UNKNOWN

Table S14 Industry representation on WCPFC delegations (2005-2018). Companies only (i.e. IND), no INGOs.

Delegation	Company on delegation (by country)	Attendees (n)
AMERICAN SAMOA	**American Samoa**	**1**
	Samoa Tuna Processors	1
	Fiji	**2**
	Pacific Energy SWP Ltd	2
	Republic of Korea	**2**
	Starkist	2
	United States of America	**4**
	Island Fisheries	1
	SCS Global Services	1
	Tri Marine Group	2
AUSTRALIA	**Australia**	**7**
	4 Seas Pty Ltd	1
	De Brett Seafood Ltd.	1
	Narooma Seafood Direct	1
	Ocean Oils Pty Ltd	1
	Walker Seafoods Australia Pty Ltd	3
	Finite Resources Management	1
CHINA	**Bermuda**	**3**
	Golden Ocean Group	3
	Canada	**1**
	Ocean Pride Fisheries Ltd.	1
	China	**114**
	China Southern Fishery (Shenzhen) Co., Ltd.	5
	China Transport Telecommunications & Information Center	2
	Dalian Jinguang Fishing Co., Ltd	2
	Dayang Ocean Fishery Co., Ltd	2
	Guangdong Guangyuan Fishery Group Co. Ltd	1
	Liancheng Overseas Fishery (Shenzhen) Co., Ltd.	24
	Liaoning Kimliner Ocean Fishing Co., Ltd.	1
	Liaoning Pelagic Fisheries Co. Ltd	6
	Ping Tai Rong Ocean Fishery Group Co., Ltd.	16
	Rongcheng Yong Jin Aquatic Products Co., Ltd.	1
	Shandong Zhonglu Oceanic Fisheries Co Ltd	3
	Shanghai Deep Sea Fisheries Co., Ltd.	2
	Shanghai Dier Deep Sea Fisheries Co., Ltd	2
	Shanghai Fisheries General Corporation Group	1
	Shanghai Jinyou Deep Sea Fisheries Co., Ltd.	4
	Shanghai Kaichuang Deepsea Fisheries Co Ltd	22
	Shenzhen Shengang Ocean Industry Co	1
	Weihai Changhe Fishery Co., Ltd.	1
	Zhejiang Ocean Family Co., Ltd.	11
	Zhongyu Global Seafood Co., Ltd.	7
	Fiji	**3**
	CKP Fishing Co., Ltd.	1
	Green Tuna Fisheries Co., Ltd.	1
	Sea Quest (Fiji) Limited	1

	Taiwan	**1**
	Yuh Yow Fishery Co., Ltd	1
	United States of America	**2**
	Tri Marine Group	2
TAIWAN	**China**	**1**
	Ming Feng Zhoushan Marine Aquatic Food Co., Ltd.	1
	Taiwan	**59**
	F.C.F. Fishery Co., Ltd.	3
	Fair Well Fishery Co., Ltd.	1
	Fong Haur Fishery Co., Ltd.	4
	Fong Kuo Fishery Co., Ltd	18
	Fong Seong Fishing Group	1
	Jih Yu Fishery Co Ltd	1
	King Chou Marine Technology Co., Ltd.	3
	San Sheng Ocean Ltd.	5
	Tong Seong Fishery	1
	Win Far Fishery Co., Ltd.	7
	Yuh Yow Fishery Co., Ltd	15
	United States of America	**1**
	Tri Marine Group	1
COOK ISLANDS	**China**	**5**
	Luen Thai Fishing Venture Ltd.	5
	Singapore	**2**
	Hai Soon Diesel & Trading Pte Ltd	2
ECUADOR	**Cook Islands**	**2**
	Adriatic Sea Fisheries Ltd.	2
	Ecuador	**7**
	Delipesca S.A.	1
	Negocios Industriales Real Nirsa, S.A	3
	Pesquera Jadran	1
	Pesquera Ugavi S.A.	2
EL SALVADOR	**El Salvador**	**2**
	Calvopesca El Salvador S.A.	2
EUROPEAN UNION	**European Union**	**15**
	Satlink S.L.	7
	Albacora S.A	5
	Atunera Dularra Sl	1
	Zunibal	2
FEDERATED STATES OF MICRONESIA	**China**	**18**
	Liancheng Overseas Fishery (Shenzhen) Co., Ltd.	3
	Luen Thai Fishing Venture Ltd.	15
	Federated States of Micronesia	**82**
	Caroline Fisheries Corp.	14
	Centerpac	1
	CTSI Logistics FSM	1
	Diving Seagull, Inc.	48
	FSM-National Fisheries Corporation	13
	Kasar Fishing Corporation	2
	Pohnpei Public Broadcasting Corp.	1
	Taiyo Micronesia Corporation	2
FIJI	**Fiji**	**14**

	Golden Ocean Fish Ltd	4
	Ocean Bountiful Limited	4
	Pacific Fishing Co., Ltd.	5
	Winfull Fishing Co Ltd.	1
	Taiwan	**3**
	Yuh Yow Fishery Co., Ltd	3
FRANCE	**France**	**4**
	Collect Localisation Satellites	3
	Thales Group	1
	Spain	**1**
	Samper SA	1
FRENCH POLYNESIA	**France**	**13**
	Ac2p –Rava'Ai Rau	1
	Fetu Armement (Sarl)	1
	Mekathon –Daniella 4 (Sc)	1
	Moorea Peche (Sca) Bp 712	1
	Tahiti Island Seafood	3
	Tahiti Rava'Ai	1
	Titaua Tautai (SC)	2
	Vaeanapa (SCA)	1
	Vaianahoa (SC)	1
	Vini Vini Long Line Products (Eurl)	1
INDONESIA	**Indonesia**	**5**
	Jalaveva Company	1
	Pt Sinar Pure Foods	1
	Pt. Jalesveva Nusantara	1
	Pt. Pathemaang Raya	2
JAPAN	**Japan**	**132**
	All Nippon Airways	2
	Asahi Gyogyo	5
	Chikami Miltec Inc.	2
	Cubic-I Ltd.	7
	Daishimaru Fishery Co., Ltd	3
	Eisei Maru Co., Ltd	2
	Fukuichi Fishery Co., Ltd.	11
	Fukushima Fishery Co. Ltd	1
	Furuno	1
	Hakko Gyogyo Co., Ltd.	8
	Itochu Corporation	13
	Japan Nus Co., Ltd.	6
	Kaneshimeichi KK	3
	Kazuoh Co Ltd	2
	Kyokuyo Co., Ltd.	18
	Miyamaru Gyogyo Kk	2
	Murata Gyogyo Co Ltd	7
	New Eikyu	1
	Nikko Suisan Co., Ltd.	5
	Nipponmaru Corporation	1
	Otoshiro Fishery Co., Ltd.	3
	Suya Fishery Co., Ltd	4
	Taiyo A & F Co. Ltd	23

	Toyokunimaru SK	1
	Yamasaki Giken	1
KIRIBATI	**Bermuda**	**2**
	Golden Ocean Group	2
	Kiribati	**8**
	Kiribati Fish Ltd	6
	Marin Marawa Fisheries Ltd.	2
	Republic of Korea	**2**
	Kirikore Fisheries Co., Ltd	2
LIBERIA	**United States of America**	**4**
	Liberian International Ship & Corporate Registry	4
MEXICO	**Mexico**	**1**
	Maricultura Del Norte	1
NAURU	**United States of America**	**1**
	Sea Strong, LLC.	1
NEW ZEALAND	**New Zealand**	**9**
	Sanford Ltd	8
	Industry Representative	1
	Papua New Guinea	**7**
	Talleys Group Limited	7
PALAU	**China**	**3**
	Luen Thai Fishing Venture Ltd.	3
PAPUA NEW GUINEA	**Canada**	**1**
	Western Pacific Enterprises Ltd.	1
	Papua New Guinea	**80**
	Devads Limited	6
	Frabelle Png Limited	8
	High Energy Co., Ltd	11
	Majestic Seafood Corporation Limited	1
	Nambawan Seafoods Limited	3
	PNG Fishing Industry Association Inc.	9
	Rd Tuna Canners Ltd.	11
	South Seas Tuna Corporation	29
	Toboi Shipbuilding Co. Ltd.	2
	Parties to the Nauru Agreement (PNA)	**1**
	Pacifical c.v.	1
	Philippines	**19**
	BSJ Fishing and Trading Inc.	1
	Frabelle Fishing Corporation	3
	Rd Fishing Industry	11
	Trans-Pacific Journey Fishing Corp.	4
	Republic of Korea	**3**
	Dong Won Fisheries	1
	Haya No.17, Ltd	2
	Singapore	**1**
	Winson Oil Bunkering Pte	1
	Taiwan	**20**
	Fair Well Fishery Co., Ltd.	20
PHILIPPINES	**France**	**2**
	Cls Collect Localisation Satellites	2
	Indonesia	**1**

	Pt. Rd Pacific International	1
	Japan	**6**
	Itochu Corporation	6
	Philippines	**194**
	A.V.M Bernardo Engineering	1
	Alliance Select Foods International, Inc.	4
	BSJ Fishing and Trading Inc.	2
	Celebes Canning Corporation	1
	CHL Fishing Industry, Inc	7
	Citra Mina Group of Companies	4
	Damalerio Fishing Ind. Inc.	1
	Euthynnus Venture Corporation	1
	Frabelle Fishing Corporation	23
	Gensan Fishing Incorporated	1
	Internet France Philippines Corporation	2
	Manila Cordage Company	3
	Marchael Sea Ventures	14
	Mommy Gina Tuna Resources (MGTR)	1
	Nh Agro Industrial Inc	5
	Propmech Corporation	1
	Rbl Fishing Corporation	10
	Rd Fishing Industry	28
	Reefership Phils Inc	1
	Rell And Renn Fishing Corporation	4
	RLG Fishing Company	1
	Roel Fishing Industry Inc	4
	Royal Pacific Rim Fishing Corporation	2
	Rugela Fishing Industries, Inc.	3
	San Andres Fishing Industries, Inc.	10
	San Lorenzo Ruiz Fishing Industry Inc.	4
	Seatrade Canning Corporations	1
	SOCSKSARGEN Federation of Fishing & Allied Industries, Inc	19
	Starcki Venture Corporation	1
	Sto. Nino Aqua Fishing Venture Corp.	1
	Sun Tai Fishing	2
	Sun Warm Tuna Corporation	2
	Thunnidae Venture Corporation	5
	Trade One Incorporated	1
	Trans-Pacific Journey Fishing Corp.	14
	Trinity Home Industrial Development Corporation	3
	Tsp Marine Industries	6
	Willshine Enterprise Company	2
	United Kingdom	**1**
	Srt Marine	1
	Republic of Korea	**156**
REPUBLIC OF KOREA	Agnes Fisheries Co Ltd	3
	Dong Won Fisheries	51
	Hansung Enterprise Co., Ltd	7
	Korea Trading and Industries Co., Ltd.	1
	Nambuk Fisheries Co., Ltd.	3

	National Fishery Products Quality Management Service	4
	New Development Fisheries Co. Ltd.	1
	Sajo Industries	38
	Sein Shipping Co., Ltd.	1
	Shipping-Land Co., Ltd.	1
	Silla Co., Ltd	40
	Tunaquest	4
	Unotech Co., Ltd.	2
REPUBLIC OF THE MARSHALL ISLANDS	**China**	**13**
	Luen Thai Fishing Venture Ltd.	13
	Republic of Korea	**15**
	Koo's Fishing Company	15
	Republic of the Marshall Islands	**41**
	Marshall Islands Fishing Venture, Inc	17
	Marshall Islands Service Corporation	8
	Pacific International Inc.	2
	Pan Pacific Foods (RMI) Inc	12
	RMI Trust Company	2
	United States of America	**4**
	Norpac Fisheries Export	3
	Tri Marine Group	1
SAMOA	**France**	**1**
	Collect Localisation Satellites	1
	Samoa	**3**
	Apia Export Fish Packers Ltd	1
	Tradewinds Fishing Co. Ltd	2
SOLOMON ISLANDS	**New Zealand**	**3**
	Southern Seas Investment, Ltd.	3
	Republic of Korea	**1**
	Hansung Enterprise Co., Ltd	1
	Singapore	**3**
	Global Fisheries Limited	3
	Solomon Islands	**28**
	National Fisheries Development Ltd.	20
	Solfish Company Limited	3
	Solomon Islands Industry	1
	Soltai Fishing and Processing Company	2
	Soltuna Ltd.	1
	Southern Seas Logistic Ltd.	1
	Taiwan	**1**
	Yuh Yow Fishery Co., Ltd	1
	United States of America	**18**
	Tri Marine Group	18
THAILAND	**Thailand**	**6**
	Thai Union Group	6
TONGA	**France**	**2**
	Collect Localisation Satellites	2
TUVALU	**Taiwan**	**1**
	Fong Haur Fishery Co., Ltd.	1
	Tuvalu	**10**
	Tuvalu Tuna Fong Haur Co. Ltd.	10

UNITED STATES OF AMERICA	**American Samoa**	**1**
	FV Jeanette	1
	Japan	**1**
	C & F Design Products	1
	Republic of Korea	**9**
	Majestic Blue Fisheries LLC	2
	Starkist	7
	Thailand	**7**
	Chicken of the Sea International	6
	Thai Union Group	1
	United States of America	**70**
	Anova Food, LLC	1
	Bumble Bee Foods	17
	C & F Fishing Ltd	1
	Clipper Oil	2
	De Silva Sea Encounter Corp.	2
	Gs Fisheries Inc.	5
	Ihu Nui Kona Sportfishing	1
	Pacific Ocean Producers, LLC	1
	Pacific Princess Partnership Ltd	4
	Sardinha & Cileu Management Co	3
	South Pacific Tuna Corporation	6
	Tradition Mariner LLC	4
	Tri Marine Group	16
	United Fishing Agency	1
	Western Pacific Fisheries, Inc.	6
VANUATU	**France**	**2**
	Collect Localisation Satellites	2
	Vanuatu	**26**
	Ming Dar Fishery (Vanuatu) Co., Ltd.	10
	Tuna Fishing (Vanuatu) Company Ltd	14
	Tunago Fishery Co., Ltd.	2

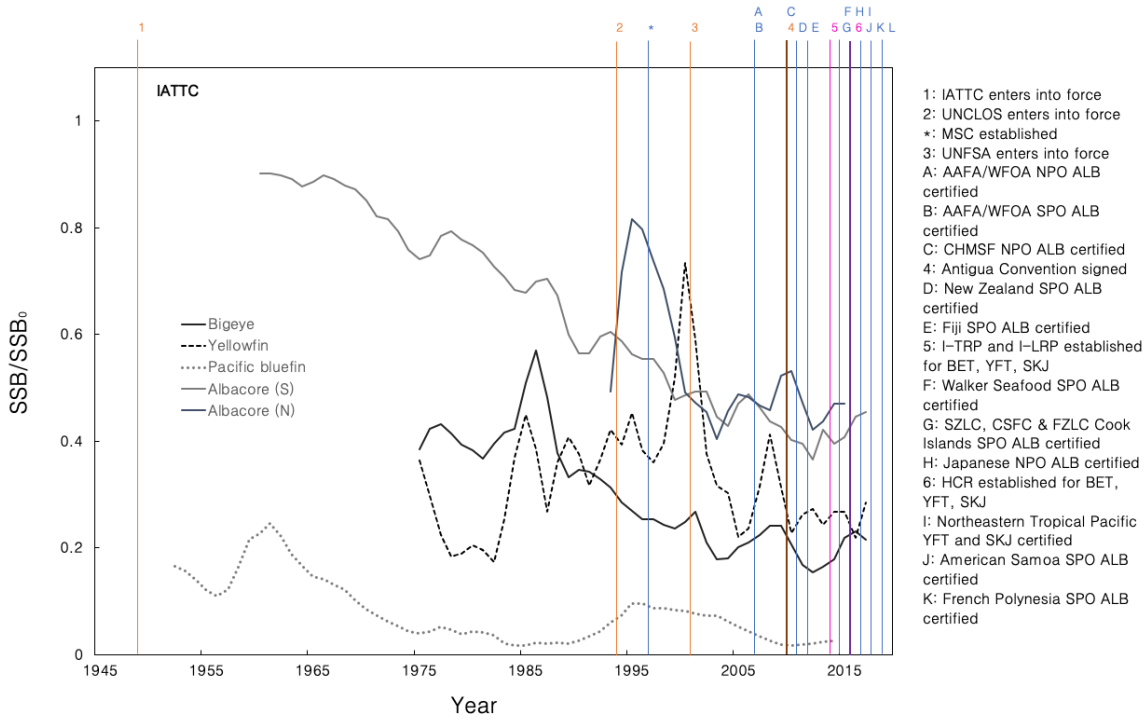

Figure S1 Trends in tuna abundance (grey) relative to key governance measures under jurisdiction of IATTC. Vertical bars depict intergovernmental treaties (including RFMO establishment; orange), MSC-certifications (excluding those currently in assessment; blue), and RFMO CMMs pertaining to HCRs and L/TRPs (pink). See Tables S3, S5 and S7 for source data.

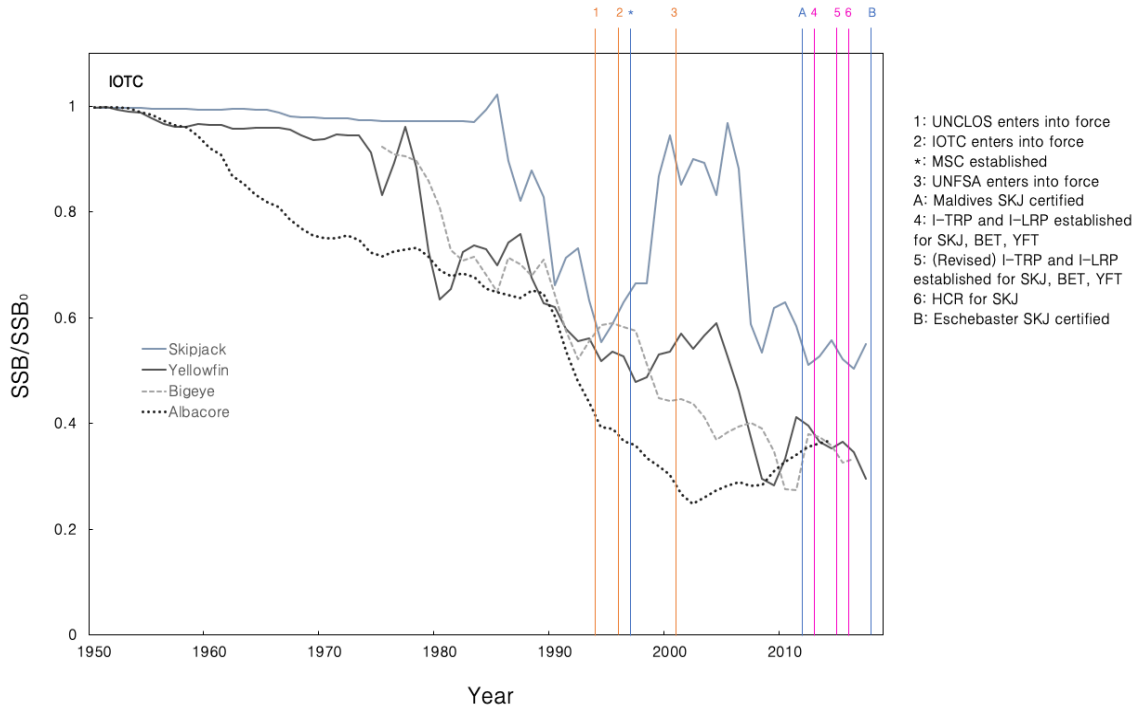

Figure S2 Trends in tuna abundance (grey) relative to key governance measures under jurisdiction of IOTC. Vertical bars depict intergovernmental treaties (including RFMO establishment; orange), MSC-certifications (excluding those currently in assessment; blue), and RFMO CMMs pertaining to HCRs and L/TRPs (pink). See Tables S3, S5 and S7 for source data.

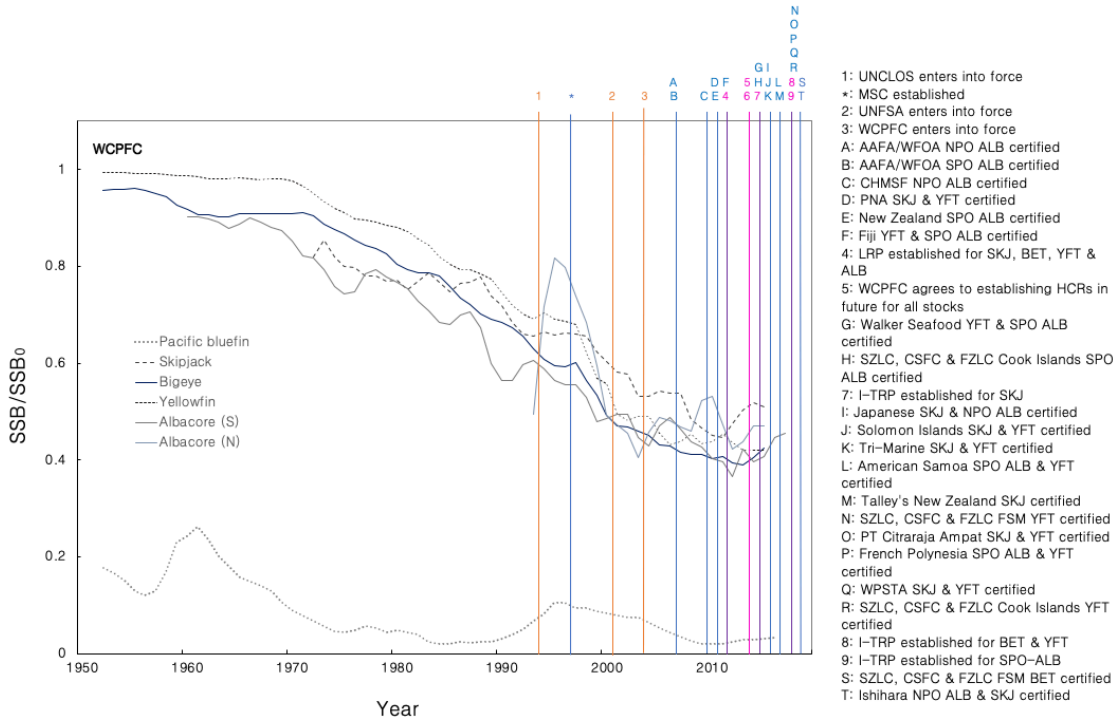

Figure S3 Trends in tuna abundance (grey) relative to key governance measures under jurisdiction of WCPFC. Vertical bars depict intergovernmental treaties (including RFMO establishment; orange), MSC-certifications (excluding those currently in assessment; blue), and RFMO CMMs pertaining to HCRs and L/TRPs (pink). See Tables S3, S5 and S7 for source data.

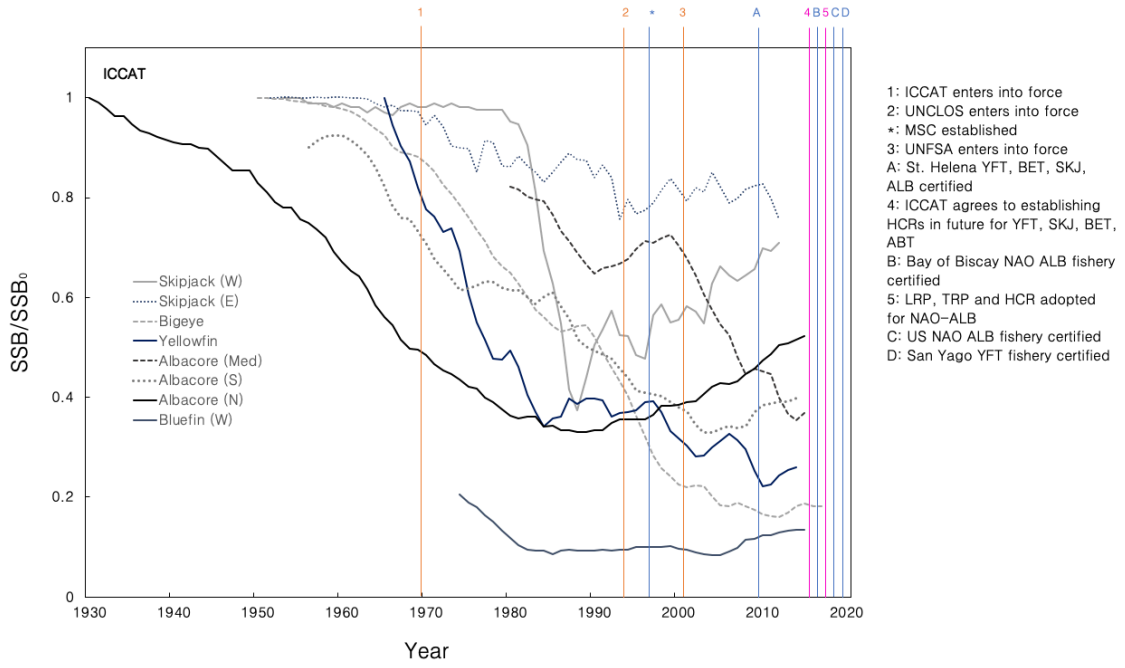

Figure S4 Trends in tuna abundance (grey) relative to key governance measures under jurisdiction of ICCAT. Vertical bars depict intergovernmental treaties (including RFMO establishment; orange), MSC-certifications (excluding those currently in assessment; blue), and RFMO CMMs pertaining to HCRs and L/TRPs (pink). See Tables S3, S5 and S7 for source data.

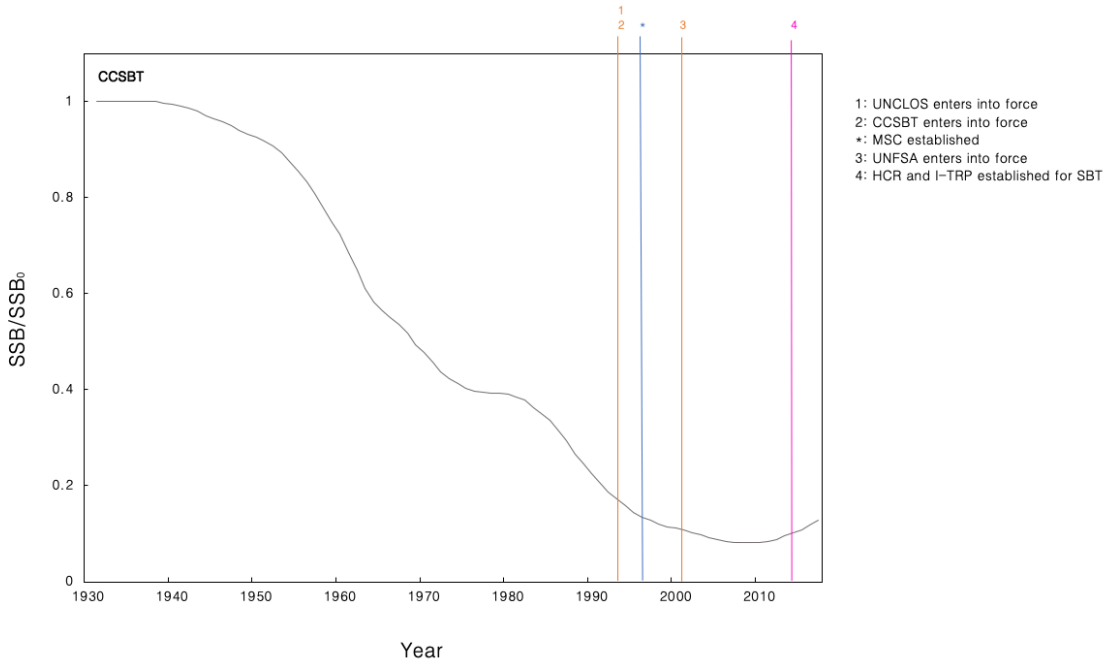

Figure S5 Trends in southern bluefin tuna abundance (grey) relative to key governance measures under jurisdiction of CCSBT. Vertical bars depict intergovernmental treaties (including RFMO establishment; orange), MSC-certifications (excluding those currently in assessment; blue), and RFMO CMMs pertaining to HCRs and L/TRPs (pink). See Tables S3 and S7 for source data.