



Considering Indigenous Peoples and local communities in governance of the global ocean commons

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ABSTRACT

The United Nations are currently negotiating a new international legally-binding instrument to govern the global ocean commons, a vast area beyond national jurisdiction (ABNJ) owned by everyone but not cared for by any single entity. Indigenous Peoples and local communities (IPLCs) have been underrepresented in the debate about governance of ABNJ despite their internationally recognized rights and their role as custodians of many globally-significant migratory species that travel between coasts and high seas. Here we use examples of active transboundary connectivity by migratory species as case studies to highlight the relevance of IPLCs on islands, coasts and beyond to the governance of the global ocean commons, and make a case for their essential and beneficial inclusion in it. Many migratory species are culturally and economically important to IPLCs, who are frequently the first to suffer if these species are overexploited or decline due to inadequate management in ABNJ. Four case studies (Pacific salmon, Marine Turtles, Black-footed and Laysan Albatrosses, Northern fur seal) illustrate knowledge, innovations and practices of IPLCs that have global importance in informing strategies for conservation, sustainable and equitable use of marine species in general. IPLCs can contribute to enriching the diversity of approaches and solutions, and by elaborating on principles directly relevant for governance of ABNJ within the UN process and beyond.

1. Introduction

The United Nations (UN) is currently addressing deficiencies in the governance of the global ocean commons—a vast region owned by everyone but not cared for by any single entity. These areas beyond national jurisdiction (ABNJ) consist of the deep seabed and the water column above it, commonly referred to as ‘the Area’ and the high seas respectively; ABNJ represent 64% of the global ocean and 46% of Earth’s surface. Increasing and widespread impacts in ABNJ [48,83,83, 144] have resulted in calls for improved management of high seas fisheries, shipping, use of marine genetic resources, deep-sea mining,

and other activities [74,218]. All humans will be impacted by the future of the global ocean commons, however, this diversity is seldom reflected in corresponding UN processes and negotiations. Government representatives participate in discussions in accordance with established procedures, with UN agencies, non-governmental organizations and, occasionally, academia, actively providing input [30]. Yet, Indigenous Peoples and local communities (IPLCs) have generally been underrepresented in the debate about governance of ABNJ, as evidenced by lists of participants in the intergovernmental meetings on this topic [215–217], with some regional exceptions within the context of the Convention on Biological Diversity (CBD). In an interconnected ocean

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crisscrossed by migratory and straddling species, island and coastal communities around the world are custodians of globally-significant species and ecosystems [141], and hold knowledge that is important for their management.

While this paper primarily relates to IPLCs on islands and coastal areas, some species, such as salmon, migrate upstream through rivers, and communities thousands of kilometers inland also rely on them and should be recognized in their governance. Paraphrasing the definition of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [106], IPLC include groups connected to a particular place or natural resource over multiple generations, ranging from descendants of original inhabitants to migrant groups. Their long-standing relationship with the area or resource results in a heightened knowledge about its ecology, which may provide a basis for sustainable use of species and habitats. In the context of this paper, we refer specifically to the relationship between IPLCs and species and habitats connected to ABNJ.

Because their lives, food, and livelihoods depend on the health of ocean resources, Indigenous Peoples have, through millennia, developed social-ecological systems of marine resources management that rely on cultural traditions as well as an intimate, dynamic and long-term knowledge of the environment [25,51,111,219]. In this paper we examine evidence for the relevance of IPLCs to governance of the global ocean commons and call for their inclusion in the UN process towards high seas governance.

Gaps in ABNJ governance and the lack of a comprehensive framework for biodiversity conservation and management [17,144] have been debated in the UN for over a decade [52,74,174]), progressing from a working group (2006–2015) to a Preparatory Committee (PrepCom) (2016–2017). In 2017, the UN General Assembly initiated negotiations for a new international legally-binding instrument under the UN Convention on Law of the Sea (UNCLOS) (United Nations General Assembly, 2017a); a landmark treaty for marine areas beyond national jurisdiction could be adopted as early as 2020.

However, despite calls by Pacific Island countries and other supportive delegations for inclusion of traditional knowledge, local community consultation and cultural dimensions into the new treaty [103, 164,214], some countries still struggle to accept the relevance of IPLCs and their knowledge to high seas governance [99–104]. We argue that IPLCs need to be involved in UN discussions relating to governance of ABNJ for three key reasons: (i) communities already are custodians of many commercially and culturally important migratory species and their habitats during at least a portion of their migratory cycles (for example, nesting beaches of sea turtles, [58]; (ii) Indigenous Peoples' right to their traditional resources is recognized in the UN Declaration on the Rights of Indigenous Peoples (UNDRIP); and (iii) knowledge, innovations and practices of IPLCs have global importance in informing strategies for conservation and sustainable use of marine species and habitats, by enriching the diversity of available approaches, worldviews, and solutions, and by elaborating on principles that are of direct relevance for ABNJ governance. This paper addresses these issues through case studies on culturally important migratory species and by examining how traditional knowledge and IPLCs have contributed to international and regional policy processes, and how they might do so in the context of a new international agreement for marine areas beyond the limits of national jurisdictions.

2. Biocultural connections between coasts and the high seas

IPLCs are connected to ABNJ through ecological and oceanographic pathways [54,171] that result in longstanding traditions, knowledge, and resource use including (i) subsistence harvest of migratory species that cross jurisdictional boundaries, and associated traditional knowledge and management activities based on regular observations of the species and their behavior [41,51,111]; (ii) cultural and spiritual practices and beliefs related to such migratory species, which are often

intertwined with the use and care of the species (*cultural keystone species*, [67]; specific examples below); (iii) the passive transport of nutrients, particles, larvae and pollution through currents and other oceanographic features [171]; and (iv) traditional voyaging and navigation through the high seas in the Pacific and elsewhere, which relies on intimate knowledge and observations of the ocean, swells, sky, stars, weather, clouds, as well as fishes, seabirds, marine animals, other ocean life, and phenomena [63,130]. This paper addresses the first two pathways of connection, while keeping in mind that the connections between communities and the high seas are numerous and extend beyond migratory species.

Highly migratory (transboundary) species of cultural, social and economic significance to IPLC include sea turtles [35,115,154,169,193, 195], whales and other cetaceans [51,88,149,151], sharks [140,206], fish, including salmon and tunas [67,78,125,145,156], seals and other pinnipeds [121,198,221,229], and seabirds [44,118]. Nearly 900 migratory species from the taxonomic groups mentioned above use ABNJ [53,124] and this number is likely not exhaustive. Knowledge of migratory routes remains limited for understudied species and while IPLC often hold traditional knowledge associated with these species, little of it has been published or is widely accessible.

Migratory species pose particular challenges for effective conservation and governance [191,192]. Accordingly, there is concern that migratory species may be particularly at risk [225] due to the human stressors they may encounter across their complex life-cycles [191]. Furthermore, migratory species cross many boundaries and are governed by a multitude of regulations, policies and processes. Accordingly, distant stakeholders or rights-holders may not be involved in, or are marginalized from, key decision-making processes [150].

3. Case studies of culturally important migratory species

Here we present four case studies illustrating the biocultural importance of seven migratory species to IPLCs in the Pacific Ocean (Fig. 1). We focus on leatherback turtles (*Dermochelys coriacea*), albatross (Laysan albatross [*Phoebastria immutabilis*] and black-footed albatross [*P. nigripes*]), northern fur seal (*Callorhinus ursinus*), and three species of Pacific salmon (*Oncorhynchus* spp.). Each species spends part of their lives in coastal or riverine habitats and part in the high seas, in the process crossing the jurisdictional boundaries of multiple countries [84]. We selected these species based on the availability of scientifically robust spatial data describing their migratory routes and published traditional knowledge about their cultural, social and livelihoods significance. Collectively, the movements of these species illustrate the ecological connectivity between IPLCs with each other and with the high seas (Figs. 2 and 3).

3.1. Case study 1: leatherback turtle and other sea turtles

Sea turtles, including the leatherback turtle, have been a key source of meat for coastal Indigenous peoples for thousands of years [59], and are culturally significant to communities around the world [79,179]. Turtles also play a role in strengthening community relationships and identities through the exchange of turtle meat [15,111,112,138,139, 186]. In Pacific Islands, consumption is sometimes restricted to special ceremonies and consumed only by specific classes such as chiefs and priests. For Fijians, turtles are both a subsistence and a prestige food associated with hierarchical obligations among chiefs and clans [152], and the use of turtles as restricted food sources may have been part of ancestral Polynesian society [186].

Honu or Hawaiian sea turtles (*Chelonia mydas*), play many roles in traditional Hawaiian culture, similar to those seen in other indigenous communities, particularly in the Pacific, including as a source of food and medicine [173]. The Hawaiian hawksbill turtle, locally known as the honu 'ea (*Eretmochelys imbricate*), along with the honu, continue to have significance in the Hawaiian culture, as references appear in hula,



Fig. 1. A 4-panel photo panel illustrating relationships described in case studies. **Fig. 1a:** Ancient turtle cave painting in Baja California Sur, Mexico. Photo credit: Amanda Mirran (<http://myd.as/p3805>). **Fig. 1b:** photo of Wet'suwet'en Nation salmon fishermen at Moricetown Falls, British Columbia, Canada. Photo credit: Dave Herasimtschuk. **Fig. 1c:** Mōli in Hawaii. Photo credit: Office of Hawaiian Affairs. **Fig. 1d:** Seal grounds at English Bay, St. Paul's Island. Photo credit: Henry Wood Elliott [Public domain], via Wikimedia Commons.

traditional dance, and recreation activities. For example, a hula honu is a specific traditional hula that imitates the movements of the honu [173]. Such dances are still created and performed today. The shell of the honu 'ea was used as traditional medicine to treat 'ea, the Hawaiian general term for infections and infectious diseases [173].

Sea turtles play an important role within the folklore of Indigenous peoples of Jeju Island, Korea, who rely upon marine resources for their livelihoods. Islanders consider sea turtles sacred animals and will not harm them. Sea turtles are considered the third daughter of the Ocean God, who the islanders worship and pray to for safety and fishing success. Among other sea-turtle related beliefs and rituals, the Jeju Island shellfish divers ("Haenyeo") believe that sea turtles should not be harmed [117,146].

The cultural significance of leatherback turtles extends to many regions. In the Maluku Province (Kai Islands) of Indonesia, leatherback turtles (locally known as "Tabob") serve both ritual and subsistence needs of local Indigenous communities [152]; WPFMC, 2014). For the Seri (Comcaac) people in the Mexican state of Sonora, the leatherback turtle is considered to be one of their five main creators, and they continue to devote ceremonies and celebrations to the turtle where one is caught and then released. With a severe decline in leatherback populations (see section below), these ceremonies now occur less frequently contributing to a reduced transfer of knowledge from elders to youth, and a gradual loss of Seri knowledge about leatherbacks [33,62,154, 155].

For many leatherback turtle populations in the Pacific Ocean, nesting beaches fall under the custodianship of IPLCs [58]; Fig. 2). From their nesting beaches, leatherback turtles undertake long-distance migrations over thousands of kilometers [24,195] and in the process cross through both national exclusive economic zones (EEZs) and ABNJ [84] (Fig. 2). Adult leatherback turtles tracked with satellite tags from populations in the eastern [193] and western [24] Pacific Ocean visited 49 EEZs sovereign to 32 countries during their migrations [84]. Turtles tagged on nesting beaches within Costa Rica ranged as far south as Rapa Nui (Easter Island), Chile, while turtles tagged at western Pacific nesting beaches in Papua New Guinea, routinely conducted *trans*-Pacific

migrations to foraging habitats within the cold upwelled waters of the California Current [24,193,194].

In the Pacific Ocean, leatherback turtles are critically endangered [108], having experienced severe population declines in both the Eastern and Western Pacific (Spotila et al., 2000, [24,205]. Impacts occur throughout the leatherback life cycle. Incidental mortality in fisheries [128,181], loss of nesting habitat and unsustainable egg harvest [39,211] are thought to be the main causes of decline. Similar trends have been reported by communities, for example in Vanuatu [169] and by the Seri [62].

The continued decline in leatherback turtle populations will have substantial consequences for many IPLCs, affecting cultural heritage, identity and livelihoods. Due to the many types and locations of impacts, the transboundary nature of sea turtle life history, and the significance of turtles to IPLCs described in this case study, recovery of leatherback populations, will require a holistic approach [58] that involves international cooperation, collaboration at many levels, and integration of management efforts at nesting beaches and at-sea to reduce mortality from fisheries interactions, ship strikes, pollution, and climate change. Despite focused conservation efforts at many nesting beaches, leatherback populations in the Pacific continue to decline. Beach-based conservation efforts also require local communities in developing countries where many nesting beaches are located to shoulder a disproportionate share of conservation-related costs [57]. In the Pacific Ocean, nesting site conservation alone will not prevent the continued decline of leatherback turtle populations [57]. Significant effort is also needed to reduce bycatch from small-scale fisheries (e.g. coastal gillnets and longlines) operating within high-use near-shore leatherback foraging habitats [3, 50,165] and to protect turtles on the high seas where they interact with commercial longline fleets [94,181]. A holistic conservation strategy is needed that balances cost impacts [58] through creative conservation incentives for fisheries [201] and for local communities [57] to reduce mortality throughout the turtle life cycle, including in ABNJ. A strategy that involves IPLCs directly in international governance decisions affecting sea turtles could therefore provide opportunity for a more equitable distribution of conservation benefits and impacts.

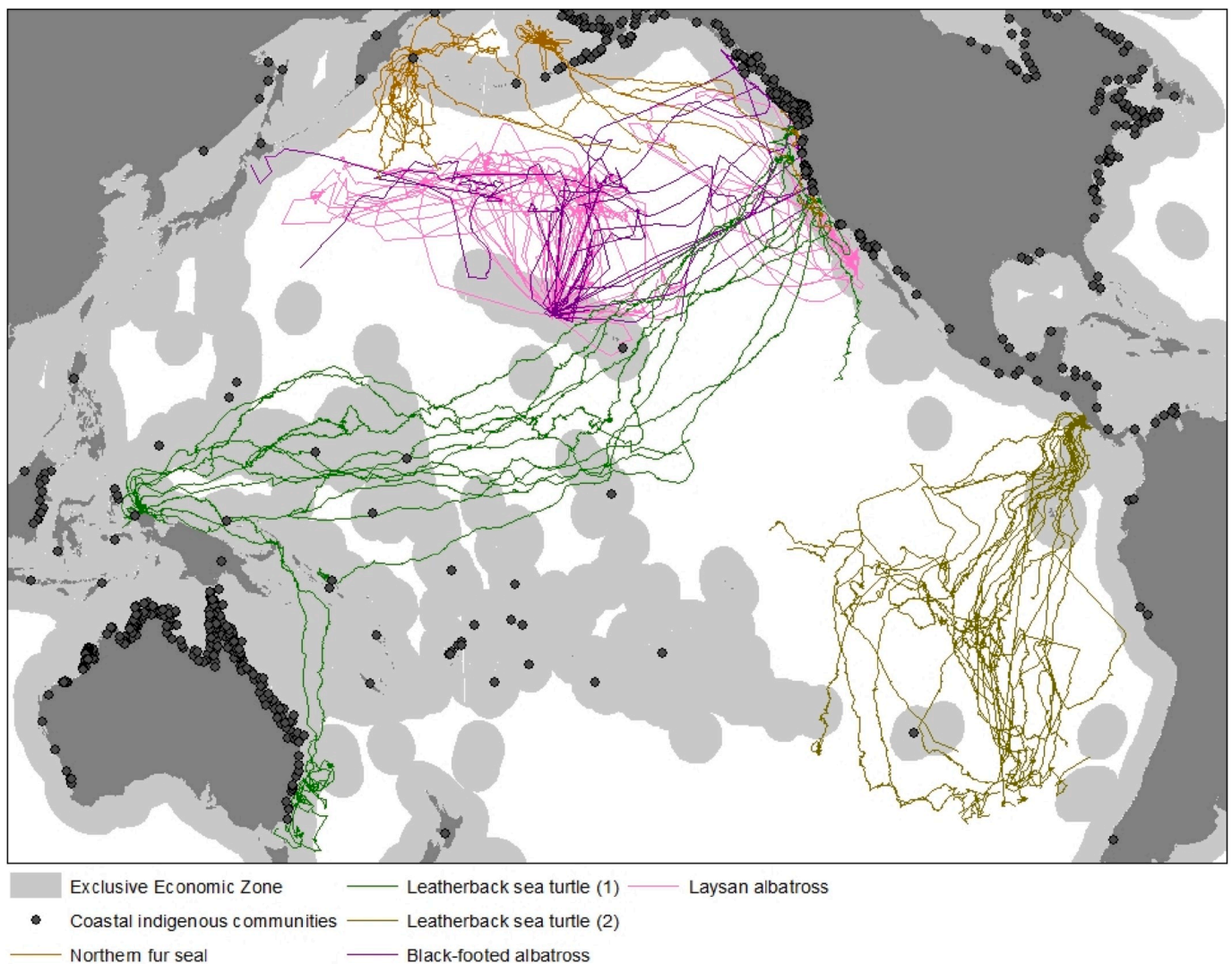


Fig. 2. Selected migration paths of culturally important migratory species crossing jurisdictional boundaries in the Pacific Ocean overlaid on a map of Indigenous coastal communities (black points; data from Refs. [41]). Note that there are likely many other communities that are not represented in these data, and which in the Pacific Island Countries and Territories alone number around 10,000 [76]. In addition, the points depicted on the map are only small post-colonial representations of Indigenous Peoples seascapes; original, much larger, extent of Indigenous territories can be viewed at, for example, <https://native-land.ca>. Animal tracking data were obtained from the U.S. Animal Telemetry Network Data Assembly Center and were originally collected between 2002 and 2009 by the Tagging of Pacific Predators project of the Census of Marine Life [31]; leatherbacks: [24,193]; albatrosses: [232,233], northern fur seals: [203].

3.2. Case study 2: pacific salmon

For millennia, IPLCs of the North Pacific Rim have harvested salmon during their predictable annual migration from ocean feeding grounds to spawning sites in inland freshwater bodies. Archaeological evidence of Indigenous harvest of salmon dates back over ten thousand years, coinciding with the earliest human settlements in North America [40]. Salmon may have facilitated the initial peopling of the Americas following the last glacial maximum [82,204], providing food security that enabled relatively permanent settlements and the development of complex cultures from northeastern Asia [37] to western North America [4,126].

IPLCs developed complex management and cultural systems to enable sustainable harvest of salmon through diverse methods (e.g., Refs. [12,213,222]). These salmon management systems were generally place-based, linking the harvest of local populations of salmon with their management and habitat stewardship [213]. Such a place-based management system contrasts with the current diffuse and disconnected governance of salmon in the ABNJ. Salmon scientists have called for re-invigorating place-based salmon management [12,68].

Salmon remain integral to the sustenance, culture and economics of IPLCs today. For example, salmon are the most prevalent traditional food of British Columbia (BC) First Nations. In a recent survey of Indigenous Peoples living on reserves in BC, participants consumed wild salmon an average of 47 days per year [38], and large rivers provide a conduit of salmon to IPLCs located hundreds of kilometers inland [156]. First Nations over 400 km upstream on the Skeena River, BC, eat an average of 11 kg of salmon per person per year and consume salmon 63 days a year on average, an amount similar to First Nations on the coast [38]; this demonstrates the importance of preserving ecological connectivity across systems and jurisdictions.

Salmon fisheries are a clear example of the need for integration of IPLCs in ABNJ governance. European colonization disrupted cultural and traditional salmon management [213] and is generally associated with wide-spread declines and local extirpation of salmon populations [81]. Many salmon stocks are endangered due to impacts to freshwater and marine phases of their life histories [81]. IPLCs are actively engaged in freshwater habitat restoration, but they have little control over governance of high seas where salmon undertake long-distance migrations and spend much of their lives (Fig. 3). Nevertheless, governance of

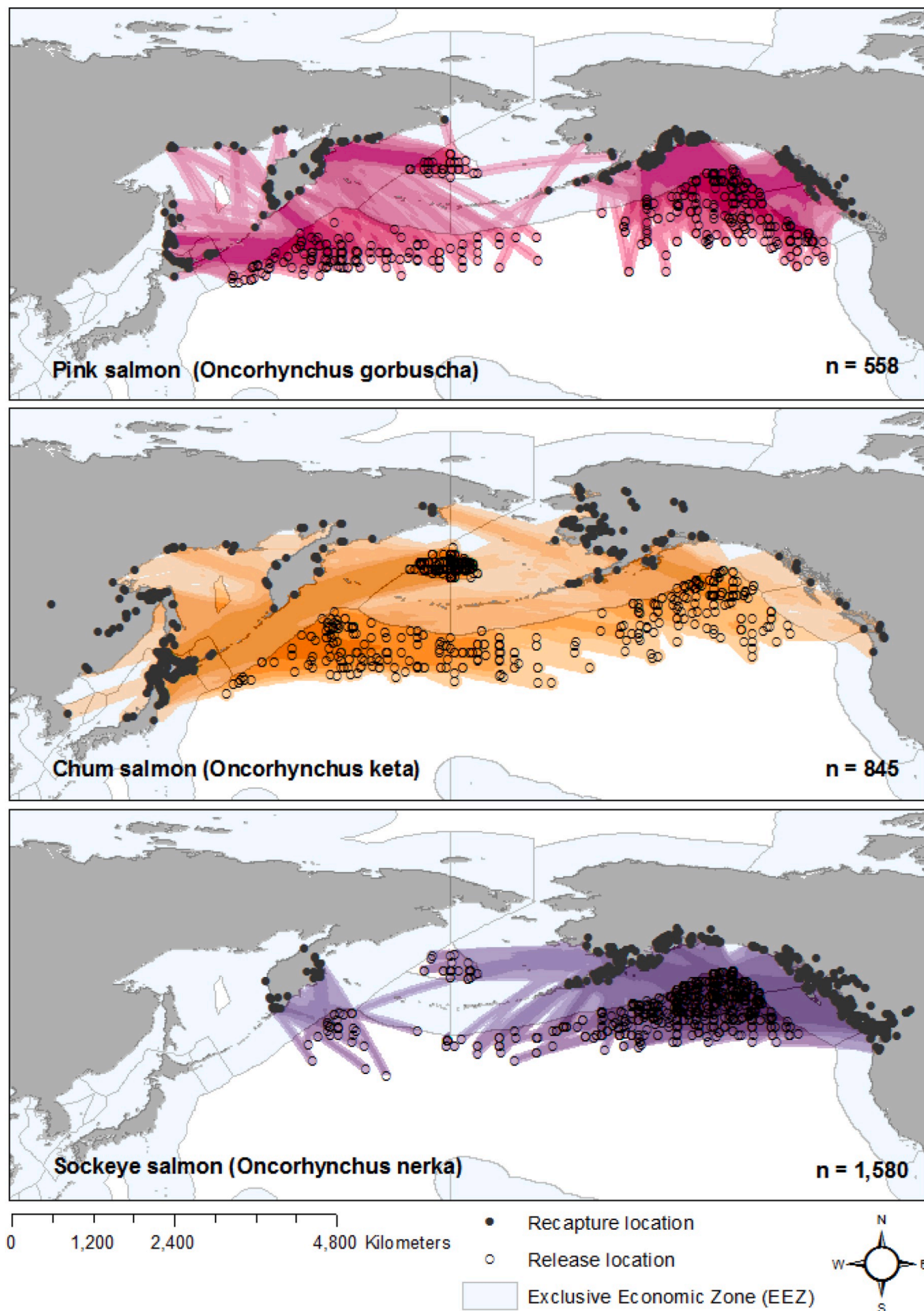


Fig. 3. Ocean and freshwater capture locations for Pacific salmon marked on the high seas. Semi-transparent colored lines link ocean mark (open circles) and freshwater recapture (close circles) locations for individual pink (A), chum (B), and sockeye (C) salmon. Salmon data are from Ref. [162]. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

ABNJ could improve food security for IPLCs. Conditions in ABNJ are affected by increased and uncoordinated production from salmon hatcheries that intensify ocean competition for common prey resources [93,168]. For example, large-scale hatchery chum salmon production in Asia was associated with a 72% decrease in wild chum salmon returning to Norton Sound, AK (USA) [188], reducing Indigenous harvest and producing significant hardship for IPLCs in the region [226]. Increased ocean abundance of pink salmon, many of which are produced in hatcheries, is associated with lower abundances and smaller body size in North America sockeye salmon [187], including Fraser River, BC stocks that support First Nations fisheries [42,156]. Approximately 4.5 billion hatchery chum and pink salmon are now released into the North Pacific annually [189,190]. Thus, the scale of hatchery salmon propagation has increased to a level producing international impacts on the size and abundance of wild salmon returning to coastal and in-river fisheries. Currently, there is no international regulation of hatchery releases into the high seas [93,168]. Thus, the lack of cross-boundary cooperative governance of biodiversity in ABNJ poses risks to IPLCs that rely on salmon.

3.3. Case study 3: black-footed and Laysan albatross

For millennia, humans have had a close relationship with marine birds and continue to use them for food, oil and guano, tool-making, clothing, ornamentation and rituals. For example, Ma'ori harvest, knowledge and stewardship of *tī tī* (sooty shearwaters, *Puffinus griseus*) highlights the role of both traditional knowledge and management practices in designing long-term conservation strategies for a declining species [69]. Similarly, albatrosses, which migrate long distances in both northern and southern hemispheres, are culturally significant for communities throughout their range. The Laysan, black-footed, and short-tailed albatross (*P. albatrus*), are the only albatross species to breed in the northern hemisphere [64]. These species have significance to coastal communities from northern California to Canada, the Aleutian Islands and Japan. Based on archaeological data, albatrosses were a major contributor to the avian portion of the prehistoric Aleut diet [44]. Many names for albatrosses exist. The black-footed albatross, despite its offshore habitat, has a special name ("sk'aay") in the Haida First Nation (Canada) language [46,47]. The black-footed albatross is known as the "ka'upu" in Hawaiian, whereas the Laysan albatross is known as the "mōli" (although some sources also refer to the Laysan albatross as the ka'upu).

Both the black-footed albatross and Laysan albatross have cultural significance for Native Hawaiians. The mōli and ka'upu return to Hawai'i to nest during a four-month season of peace known as Makahiki, which is considered a time that honors the Hawaiian god Lono, who is closely associated with agriculture and fertility. Thus, mōli are considered an embodiment of Lono during this time, or his kinolau, his body form. Skins from the ka'upu, among other sacrificial offerings, are hung from "akua loa" (lit. "The long god") a cross-like staff that is utilized during Makahiki ceremonies [1,21,118]. The cultural significance of the albatross is still prevalent today [182]; mōli and ka'upu are still gathered to make kahili (traditional feather staffs) and for ceremony [134]. Seabirds, including albatrosses, are also used by Native Hawaiians to assist with navigation by alerting navigators to changing weather patterns, and to their distance from land. Albatrosses are typically indicative of being far from land, or within a certain distance of breeding colonies. Fishermen use their presence to find schools of fish [148,209]. The Rime of the Ancient Mariner [43] elevated the albatross into mythic status among Europeans and whaling captains for its symbolism of the connection between the natural and spiritual worlds [73].

While their pelagic habitat includes most of the North Pacific Ocean (Fig. 1) and they spend an estimated 67–75% of their annual cycles in ABNJ [84], a majority of Laysan and black-footed albatrosses nest in the Northwestern Hawaiian Islands. The Northwestern Hawaiian Islands and the surrounding waters out to 200 nautical miles are encompassed

in the Papahānaumokuākea Marine National Monument. The protection of this area was advocated for by Native Hawaiians, and the current co-management arrangement includes the Office of Hawaiian Affairs representing the interests of the Native Hawaiian community [161]. Papahānaumokuākea is considered a sacred area, an origin of genealogies, and the place to which spirits return to after death [116].

Both species of albatross live forty to over sixty years, typically form long-term breeding pairs, and return to the same nesting area [13,14]. Laysan and black-footed albatrosses have very low reproductive rates, laying one egg per breeding attempt every one or two years [13,14]; their populations are thus slow to recover from human impacts [11]. Both species are classified as near threatened by the IUCN [27,28]. Incidental catch (bycatch) of albatross in commercial fisheries is considered the main threat [27,28], with others including ingestion of plastics, pollution, invasive species on breeding sites, and sea-level rise [27,28]. Effective long-term conservation will require mitigation of the multiple threats in the albatrosses' pelagic habitat in ABNJ, and at their nesting sites in Papahānaumokuākea. The relationship between Native Hawaiian practitioners and governing agencies has allowed for some restoration and perpetuation of the practice of Kiamanu, bird feather gatherers [167]. Thus, effective long-term governance of species such as albatrosses will require linking international efforts on ABNJ governance, reduction of carbon emissions and marine litter with the efforts of the Native Hawaiian community and others at Papahānaumokuākea to protect nesting sites. Such connections cannot be made without the meaningful participation of IPLC in global ocean governance.

3.4. Case study 4: northern Fur seal

Evidence of ancestral linkages between humans and pinnipeds of the eastern North Pacific continues to grow [60,61,157]. Seal meat is an important food source for many communities, including the Aleuts, Inuit, Ainu and Makah, and the pelts, oil and blubber are also often utilized [121,198,221,229]. In addition, the Inuit use seal meat for medicinal purposes [32]. The Northern fur seal (*Callorhinus ursinus*) has a special place in history and culture. It was historically hunted by peoples throughout the Pacific coast of North America, from the Aleutian Islands to Oregon, and hunting may have influenced the current spatial distribution of fur seal breeding colonies [60]. Today, however, only a subsistence hunt by the Aleuts on the Pribilof Islands remains, with the pelts additionally used for traditional handicrafts [45].

Northern fur seals inhabit waters of the North Pacific from Japan to Russia, across the Bering Sea to the Aleutians, and along the North American coast down to Baja California in Mexico. Fur seals currently breed only on high latitude offshore islands, with 65% of the population breeding on the Pribilof Islands in the Bering Sea [70,157]. Communities of the Pribilof Islands thus provide custodianship of the majority of the breeding Northern fur seal population. Fur seals breed on rocky beaches, but spend most of their annual cycles foraging at sea [71,114]. Adult males usually remain in the Bering Sea and the North Pacific Ocean near the Aleutian Islands, often within jurisdictional waters, while females and pups range more widely to the central North Pacific Ocean (in ABNJ), as far south as California [26,114,129,175,203], and including the high seas pocket in the Bering Sea (Fig. 2).

Commercial harvesting for fur seal pelts started in the mid-1700s, initially on a seasonal basis and by the 1820s in permanent settlements [229]. Northern fur seal pelts became the commercial backbone of the Pribilof communities, while the meat was a subsistence staple for the Aleuts, thus intertwining the lives of the Pribilof Aleuts, who call themselves Unangaḡ with those of the fur seals [159]. The Russian commercial fur trade rapidly decimated fur seal populations [60,160], and sharp declines in the Pribilof Islands were further observed in the 1890s due to pelagic sealing [229]. The North Pacific Fur Seal Convention of 1911 halted pelagic sealing and is recognized as the first international wildlife preservation treaty, setting a precedent for future treaties. Pribilof Island communities provide custodianship of the

Table 1

Methodology used by the CBD, the United Nations Framework Convention on Climate Change (UNFCCC), and the Arctic Council to incorporate Indigenous Peoples and traditional knowledge into their work, and in their assessment processes.

Convention/process	Mode of Indigenous participation	Modalities for incorporating traditional knowledge	Selected impacts and results
Convention on Biological Diversity (CBD)	Indigenous Peoples participate in CBD meetings as observers	<ul style="list-style-type: none"> - IPBES has a Task Force on Indigenous and Local Knowledge Systems. IPBES' work on this topic is coordinated by the Technical Support Unit (TSU) on Indigenous and Local Knowledge, hosted by UNESCO (UNESCO, 2020 [107]; - The CBD Conference of the Parties (COP) has called for inclusion of traditional knowledge in the identification of EBSAs (See COP decisions IX/20, X/29 and XI/17) 	Involvement of Indigenous authors, a culturally inclusive conceptual framework, and participatory networks of knowledge holders resulted in extensive inclusion of traditional and local knowledge in the IPBES <i>Global Assessment of Biodiversity and Ecosystem Services</i> [105]
United Nations Framework Convention on Climate Change (UNFCCC)	Indigenous Peoples participate in UNFCCC meetings as observers	<ul style="list-style-type: none"> - Local Communities and Indigenous Peoples Platform (LCIPP) established, <i>inter alia</i>, to enhance the engagement of local communities and Indigenous peoples in the UNFCCC process. It also facilitates integration of diverse knowledge systems (UNFCCC, 2020) 	LCIPP is still a new process. However, IPCC Assessment Report 5 has increased coverage of issues and traditional knowledge in comparison to previous reports [65]
Arctic Council	Indigenous Peoples' organizations have Permanent Participants status, and have full consultation rights in connection to the Council's negotiations and decisions [6]	<ul style="list-style-type: none"> - Indigenous Peoples Secretariat (IPS) facilitates participation [7] - Ottawa Traditional Knowledge Principles strengthen the work of the Arctic Council [8] 	<ul style="list-style-type: none"> - Traditional knowledge is included in Arctic Council assessment reports - Reports such as <i>Arctic Traditional Knowledge and Wisdom: Changes in the North American Arctic</i> were written in large part by Arctic Indigenous Peoples [5]

majority of the Northern fur seal population during the breeding season. The tribal governments on St. Paul and St. George have internationally recognized rights and responsibilities as co-managers of Northern fur seals, together with the U.S. government. Commercial fur seal harvest ended on the Island of St. George in 1972 and the Island of St. Paul in 1983, causing considerable hardship for communities at that time [229]. Today, only a subsistence hunt remains, and the US government and the tribal governments on St. Paul and St. George have a co-management agreement [161]. Unanga thus have internationally recognized rights and responsibilities pertaining to this migratory species. Although the Pribilof Island communities have transitioned to a fisheries-based economy [131], the cultural importance of the fur seal remains paramount to these communities. Referring to the seals in the award-winning video, "People of the Seal" [230], Aquilina Lestenkof, a fifth-generation resident of the Pribilof Islands says, 'if they're not here, then we won't be either.'

Despite the cessation of the commercial harvest, the northern fur seal population has declined by approximately 66% over the last three generations (1972–2014) [70]. Patterns of steep decline have also been observed for harbor seals and Steller sea lions in Alaskan breeding populations [200], and the reasons for these declines are not well understood [70]. Possible causes include mortality at sea due to negative interactions with commercial fisheries [70,119,212], entanglement in discarded fishing gear and other marine debris impacts [34,70], ecosystem changes in the North Atlantic [70], predation by orcas [200], and chemical contamination [178]. The Unanga made observations of stressed and declining populations of seabirds and northern fur seals, and recognized changes to the North Pacific ecosystem decades before these changes received attention from Western scientists [65]. The northern fur seal is currently classified as threatened by the IUCN [70] and "depleted" under the US Marine Mammal Protection Act [160]. While the causes of the decline remain unresolved, it is clear that conservation of the northern fur seal is dependent not only on actions in coastal areas but also offshore in international waters.

4. Facilitating indigenous and local community representation and the inclusion of traditional knowledge

The case studies above demonstrate that, as users and custodians of biodiversity in the ocean, Indigenous Peoples and some local communities are connected to ABNJ and impacted by management decisions

taken there. They possess knowledge, innovations and practices that could benefit international policy and science, including in ABNJ. The consideration of traditional knowledge in policy is not new. Indigenous Peoples, local communities and their knowledge have been included in international conventions and processes, for example, in the work of the CBD, the United Nations Framework Convention on Climate Change (UNFCCC), and the Arctic Council (Table 1). Scientific assessments, including the CBD's effort to describe Ecologically or Biologically Significant Areas (EBSAs) in the oceans [56], the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and its Global Assessment on Biodiversity and Ecosystem Services [105], as well as the Arctic Council's assessments of climate change and biodiversity [2,20], have incorporated traditional ecological knowledge (TEK) to varying degrees. Peer reviewed studies have similarly integrated TEK with science to better understand species and their patterns of distribution [87,95,110,199,202].

The use of TEK in international environmental policy, including in the context of ABNJ, requires the meaningful inclusion and involvement of Indigenous communities in a dialogue-based and collaborative process that treats each knowledge system as equally valid, and addresses power imbalances [197,207]. It requires the engagement of actors and institutions in equitable and empowering knowledge-sharing processes [208]. The methodologies used by the CBD, UNFCCC, and Arctic Council, while not perfect, offer lessons for the inclusion of IPLCs and their traditional knowledge in the UN process to negotiate a new international legally-binding treaty for ABNJ (Table 1). The three examples represent a range of approaches and degrees of inclusion. The Arctic Council presents the most inclusive model for participation whereby Indigenous Peoples organizations were granted Permanent Participants status in the Arctic Council and work with scientists to assess and monitor biodiversity and climate change. This degree of participation in decision-making processes and knowledge production was made possible by Arctic Indigenous activism, as well as the non-legally binding nature of the Arctic Council, but is not yet seen as being fully representative of all Indigenous Peoples of the Arctic [137,196].

In each process described in Table 1, a framework or body was created to support the participation of IPLCs. This lesson, along with the need to include a full diversity of IPLC voices, may be key for supporting their participation in a new international agreement on marine biodiversity beyond national jurisdiction. As a first step, an inclusive working group with appropriate IPLC representation could be formed to develop

proposals for participation and incorporation of traditional knowledge in a future treaty, following and learning from the process that was undertaken to create the UNFCCC Local Communities and Indigenous Peoples Platform (LCIPP) [153].

Additional challenges to IPLC participation in the UNFCCC, CBD and other UN processes still remain, including material constraints, such as funding and accreditation; procedural constraints that include closed meetings and uneven access; and constraints that relate to recognition and include lack of political will and understanding of the relevance of traditional knowledge, as well as disrespect and tokenism [22,176]. These barriers will need to be addressed, concurrent with creating a framework, body and/or process to support participation. Further discussion on issues related to Indigenous participation and incorporation of traditional knowledge in a future treaty can be found [153].

5. Lessons from indigenous cultures for the governance of ABNJ

IPLCs can provide valuable lessons on how to improve governance and management of the global ocean commons [18]. Concepts that underlie traditional management systems including stewardship and intergenerational responsibility that link use, conservation and equity; an understanding of connections between species, ecosystems and humans (ecosystem approach); adaptive management and long-term stewardship; and the rapid application of multiple tools and approaches to achieve management outcomes are principles that apply to formulating a new international instrument for marine areas beyond national jurisdiction. With TEK inseparable from its cultural context [227], Tongan and Fijian anthropologist Epeli Hau'ofa explained that Oceania collectively and effectively managed its common ocean spaces for centuries before nineteenth-century imperialism created political boundaries that obstructed these efficient management systems [86].

Traditional management systems evolve through generations in response to dynamic changes in the ocean environment and its resources, and in response to human pressures [25,49]. The idea that resources are finite has long been an important component of traditional marine tenure and management systems in places such as the Pacific Islands [111]. The possibility of overharvesting common resources to the detriment of all led to the notion of stewardship and intergenerational responsibility, where the use of resources comes with a responsibility to care for them, and with an imperative to share benefits.

The idea of stewardship is, implicitly, enshrined in the 1982 UNCLOS. Part XII of UNCLOS sets out the general obligation for States to protect and preserve the marine environment (article 192), and includes a number of provisions, which elaborate on this obligation. Many recent publications on governance of marine areas beyond national jurisdiction have also advocated for improved stewardship of ecosystems [9], of fisheries [9,180], of deep-sea mining [218,224] and as part of the new international treaty for marine biodiversity beyond national jurisdiction [52]. A study of long-standing traditional management systems may provide us with a deeper understanding of how stewardship might be practiced in the global ocean commons in order to foster long-term sustainability.

UNCLOS is currently implemented through a sectoral regime, where fishing, shipping, mining and other ocean uses are governed by different bodies and organizations, or in the case of some new uses (e.g. climate change mitigation techniques and floating energy or aquaculture installations), no organization at all [17,85,174]. This has created fragmentation and an inability to respond to cumulative impacts of multiple threats using an integrated ecosystem approach [17,174]. While ecosystem approaches are meant to be central to the activities of many international and regional ocean conventions, policies and bodies, they have often proven to be difficult to undertake due to many political and ecological complexities [66,83,113,127,183].

A type of ecosystem approach already exists in traditional management systems, implemented through a diverse array of area-based management tools that can be quickly deployed in response to

changing environmental conditions [89,112,177,184,219], and are based on an understanding of humans as part of ecosystems rather than separate from them [19,184,219,228]. Indigenous caring for their environment is not equivalent to the western concept of an ecosystem approach, but is based on specific worldviews, values, practices and information [133,231], which can provide new insights for governance [208]. Indigenous worldviews generally place humans in the context of an interconnected web of life, rather than in a position of dominance over other life, and this understanding may be one of the key components of a holistic, ecosystem-based approach [19,184,199,219]. Similarly, new research on the need to integrate equity and social justice into an ecosystem approach [170], and experiences in developing stronger co-management approaches drawing from multiple knowledge systems and worldviews can offer globally-transferable insights for collaborative and integrated marine management [123,133,135,210]. For ABNJ, new experimental science-based management approaches such as dynamic ocean management [55,91,136] share common characteristics with the quickly adaptive nature of traditional management systems [184,219]. Traditional management systems may thus provide lessons on how ecosystem approaches, adaptive management and area-based tools can be applied to govern a common resource [112,132,184,208].

An example of an application of cultural principles and norms can be found in the governance of the Pacific Ocean, where contemporary policies have been built on traditional knowledge and a strong cultural connection of Pacific peoples to the ocean. The fourteen independent Pacific Island countries and eight dependent island territories, which are predominantly populated by Indigenous Peoples, adopted the Pacific Islands Regional Ocean Policy (2002), and subsequently reinforced the policy through the Framework for a Pacific Oceanscape (2010). These policies made clear the region's interest in managing areas beyond national jurisdiction, both the seabed and the water column. The Framework for Pacific Oceanscape draws heavily on Indigenous concepts of relationships with the ocean, described by Epeli Hau'ofa as "No people on earth are more suited to be guardians of the world's largest ocean than those for whom it has been home for generations" [86]. The central and forward-thinking role of Indigenous Peoples and local communities is highlighted in regional coastal fisheries policies (e.g. the Noumea Strategy and Future of Fisheries Roadmap). In view of the above it is hardly surprising that Pacific Islands leaders are strongly in favour of a new International Agreement under UNCLOS on the conservation and sustainable use of marine biological diversity of ABNJ [166] and have strongly advocated for inclusion. There are also already explicit closures of purse seine fishing in place in the so-called "high seas pockets" in the Pacific Ocean (areas of ABNJ surrounded by Pacific Island countries EEZs) agreed to by Parties to the Nauru Agreement [77,172,180]. These and other Pacific-led processes demonstrate Indigenous cooperation for the management of large ocean areas, including ABNJ, and offer examples for broader Indigenous approaches for ocean governance both within and beyond ABNJ.

6. Conclusions

Indigenous Peoples and local communities on the coasts, islands, and beyond, are culturally and ecologically interconnected with each other and the high seas through ocean ecosystems, including species migrations through the oceans, rivers, and air. This is clearly demonstrated by the migratory pathways of many culturally and ecologically important migratory species (Figs. 2 and 3; see also <http://mico.eco>). Thus, the ocean is not only biologically and ecologically connected [171], but it is also a space of cultural and historical connection, as was demonstrated by Polynesian voyaging canoes [63] and the traditional canoe cultures prevalent in the Pacific and in the Northwest coast of North America. The ocean and coast could be considered as a holistic biocultural seascape, which extends beyond the immediate fishing grounds of individual communities to distant ocean spaces beyond. When viewed in this manner, it becomes evident that governance of shared resources

through their entire life histories and migration cycles will require the participation of all users and custodians, be they villagers, governments or other ocean users.

Indigenous Peoples and local communities are custodians of many globally-significant migratory species spanning coasts and high seas, and the overlap between species and communities is demonstrated in Figs. 2 and 3. They also often suffer disproportionately if these species face declines due to inadequate management in areas beyond national jurisdiction. These losses may negatively impact food security, as is the case with fisheries, but also livelihoods, for example where ecotourism is part of community-managed sea turtle nesting beaches, potentially undermining local resilience and international goals on sustainable development. Thus, local livelihoods and cultures and the success and legitimacy of international governance of marine areas beyond national jurisdiction are as closely interlinked as the ocean itself.

A key task for those contemplating governance of the global ocean commons is to develop a framework that is inclusive of all those who use and depend on the ocean; provides for and builds on a diversity of approaches that have proven successful on local and regional scales; and accounts for the interconnections between coasts, high seas, and coastal and island peoples everywhere. Building such a framework will require structures and bodies that enable the participation of Indigenous Peoples and local communities.

Here, we have provided case studies of the connections between Indigenous Peoples and the global ocean commons, and described how management, or lack thereof, long distances away can impact cultures, lives and livelihoods of communities on islands and along the coast. We have also highlighted the relevance of traditional knowledge to existing governance systems and for the ongoing negotiations at the United Nations over a new treaty. In addition, we provide examples of how an inclusive approach could be implemented through the creation of a framework, body and process to support the meaningful participation of IPLCs and an equitable knowledge-sharing process, learning from the experiences of the Arctic Council, the UNFCCC and other international processes. As the negotiations progress, we urge the delegations to recognize the extensive potential contributions of IPLCs, and to make the necessary accommodations to allow for their full and meaningful participation in a future treaty on marine biodiversity beyond national jurisdiction.

Authors contributions

MKV, YO, A-LH and DCD conceived the study, which was further elaborated on at two workshops organized by DCD and YO respectively, as well as at a side event at the United Nations organized by YO, AMC-M and DCD. MKV and A-LH led the writing of the manuscript. Migratory species maps in Fig. 2 were created by GOC and AMC-M, while the salmon capture locations in Fig. 3 were mapped by MRS, GOC and JWM. Case study 1 on leatherback turtles was written by MKV, A-LH, GS, TKW and GOC. Case study 2 on Pacific salmon was written by MRS and JWM. Case study 3 on black-footed and Laysan albatross was written by A-LH, MKV, TKW and GOC. Case study 4 on Northern fur seal was written by MKV, A-LH and GOC. Insights into Pacific policy and traditional ecological knowledge were provided by HG and TKW, while TKW also provided perspectives from Hawaii, AMC-M from Mexico and GS from Central America and Jeju Island in Korea. All authors contributed to writing and editing of the manuscript.

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