



Traditional Dimensions of Seabed Resource Management in the Context of Deep Sea Mining in the Pacific: Learning From the Socio-Ecological Interconnectivity Between Island Communities and the Ocean Realm

OPEN ACCESS

Edited by:

Prateep Kumar Nayak,
University of Waterloo, Canada

Reviewed by:

Timo M. Koivurova,
University of Lapland, Finland
Karen Nadine Scott,
University of Canterbury, New Zealand

*Correspondence:

Virginie Tilot
v.tilot@wanadoo.fr;
ettjhn@gmail.com

Specialty section:

This article was submitted to
Marine Affairs and Policy,
a section of the journal
Frontiers in Marine Science

Received: 04 December 2020

Accepted: 01 March 2021

Published: 09 April 2021

Citation:

Tilot V, Willaert K, Guilloux B,
Chen W, Mulalap CY, Gaulme F,
Bambridge T, Peters K and Dahl A
(2021) Traditional Dimensions
of Seabed Resource Management
in the Context of Deep Sea Mining
in the Pacific: Learning From
the Socio-Ecological Interconnectivity
Between Island Communities
and the Ocean Realm.
Front. Mar. Sci. 8:637938.
doi: 10.3389/fmars.2021.637938

Virginie Tilot^{1,2,3*}, Klaas Willaert⁴, Bleuenn Guilloux⁵, Wenting Chen⁶,
Clement Y. Mulalap⁷, François Gaulme^{8,9}, Tamatoa Bambridge¹⁰, Kimberley Peters^{11,12}
and Arthur Dahl¹³

¹ UMS Patrimoine Naturel, Muséum National d'Histoire Naturelle, Paris, France, ² Instituto Español de Oceanografía, Málaga, Spain, ³ Académie Royale des Sciences d'Outre-Mer, Brussels, Belgium, ⁴ Department of European, Public and International Law, Maritime Institute, Faculty of Law and Criminology, Ghent University, Ghent, Belgium, ⁵ Center of Law and Economics of the Sea (AMURE), Interdisciplinary Graduate School for the Blue Planet (Isblue), University of Brest, Brest, France, ⁶ Norwegian Institute for Water Research, Oslo, Norway, ⁷ Federated States of Micronesia to the United Nations, New York, NY, United States, ⁸ Académie des Sciences d'Outremer, Paris, France, ⁹ Institut Français des Relations Internationales, Paris, France, ¹⁰ USR 3278 Centre de Recherche Insulaire et Observatoire de l'Environnement, Moorea, French Polynesia, ¹¹ Helmholtz Institute for Functional Marine Biodiversity, Institute for Chemistry and Biology of the Marine Environment, University of Oldenburg, Oldenburg, Germany, ¹² Alfred-Wegener-Institut, Bremerhaven, Germany, ¹³ International Environment Forum, Châtelaine, Switzerland

In many of the Pacific Islands, local communities have long-held cultural and spiritual attachments to the sea, in particular to species and specific marine areas, processes, habitats, islands, and natural seabed formations. Traditional knowledge, customary marine management approaches and integrated relationships between biodiversity, ecosystems and local communities promote conservation and ensure that marine benefits are reaped in a holistic, sustainable and equitable manner. However, the interaction between local traditional knowledge, contemporary scientific approaches to marine resource management and specific regulatory frameworks has often been challenging. To some extent, the value of community practices and customary law, which have provided an incentive for regional cooperation and coordination around ocean governance, is acknowledged in several legal systems in the Pacific and a number of regional and international instruments, but this important connection can be further enhanced. In this article we present a science-based overview of the marine habitats that would be affected by deep seabed mining (DSM) along with an analysis of some traditional dimensions and cultural/societal aspects of marine resource management.

We then assess whether the applicable legal frameworks at different levels attach sufficient importance to these traditional dimensions and to the human and societal aspects of seabed (mineral) resource management in the region. On the basis of this analysis, we identify best practices and formulate recommendations with regard to the current regulatory frameworks and seabed resource management approaches. Indeed, the policies and practices developed in the Pacific could well serve as a suitable model elsewhere to reconcile commercial, ecological, cultural and social values within the context of deep sea mineral exploitation in addition to sustaining the Human Well-being and Sustainable Livelihoods (HWSL) of the Pacific communities and the health of the Global Ocean.

Keywords: human–nature interconnectivity, Pacific Island communities-ocean connectivity, ocean sustainability, high seas and deep sea ecosystems, Law of the Sea, deep sea mining, global change, science-policy-society

INTRODUCTION AND CONTEXT

The Pacific Ocean is of profound cultural, social, spiritual, and economic significance to Pacific Island communities. These dimensions and centuries of acquaintance with the interconnectivity of its ecosystems underlay traditional and indigenous knowledge, and constitute keystones to holistic forms of marine resource management mainly linked to fisheries including protected areas and species. Discoveries of rich metal deposits (polymetallic nodules, rare earths, metal-rich muds, cobalt rich ferro-manganese crusts, and hydrosulfide deposits) on the deep seabed (Hein and Koschinsky, 2014) have led to commercial interest from all over the world, as seabed mineral extraction is increasingly regarded as a suitable alternative to land-based mining and might be necessary to satisfy the increasing metal demand in the global shift toward sustainable energy (Zalik, 2018; Havice and Zalik, 2019). Conflicting ambitions of conservation and exploitation are especially tangible in the most biodiversity rich Pacific region (Dahl and Carew-Reid, 1985; D’Arcy, 2006; Petterson, 2008; Trichet and Leblic, 2008; Vieux et al., 2008; Kingsford et al., 2009; Cardno Limited, 2016), which covers an area of about 30 million km² within the world’s largest ocean and, on the one hand, is seen as the most promising area for seabed mineral extraction in the near future (Figure 1). On the other hand, deep sea ecosystem services have been considered to have high societal benefits in Europe (O’Connor et al., 2020a) with strong public support to conserve and restore the deep sea ecosystem (O’Connor et al., 2020b). Studies estimating the values of the deep sea ecosystem services in the Pacific area are limited. The study for the Solwara project (Earth Economics, 2015) has many scientific errors which make the estimates unreliable (Rosenbaum and Grey, 2016). The terrestrial forest ecosystem is also used to infer the deep sea ecosystem (Wakefield and Myers, 2018) which potentially biases their estimates of ecosystem services.

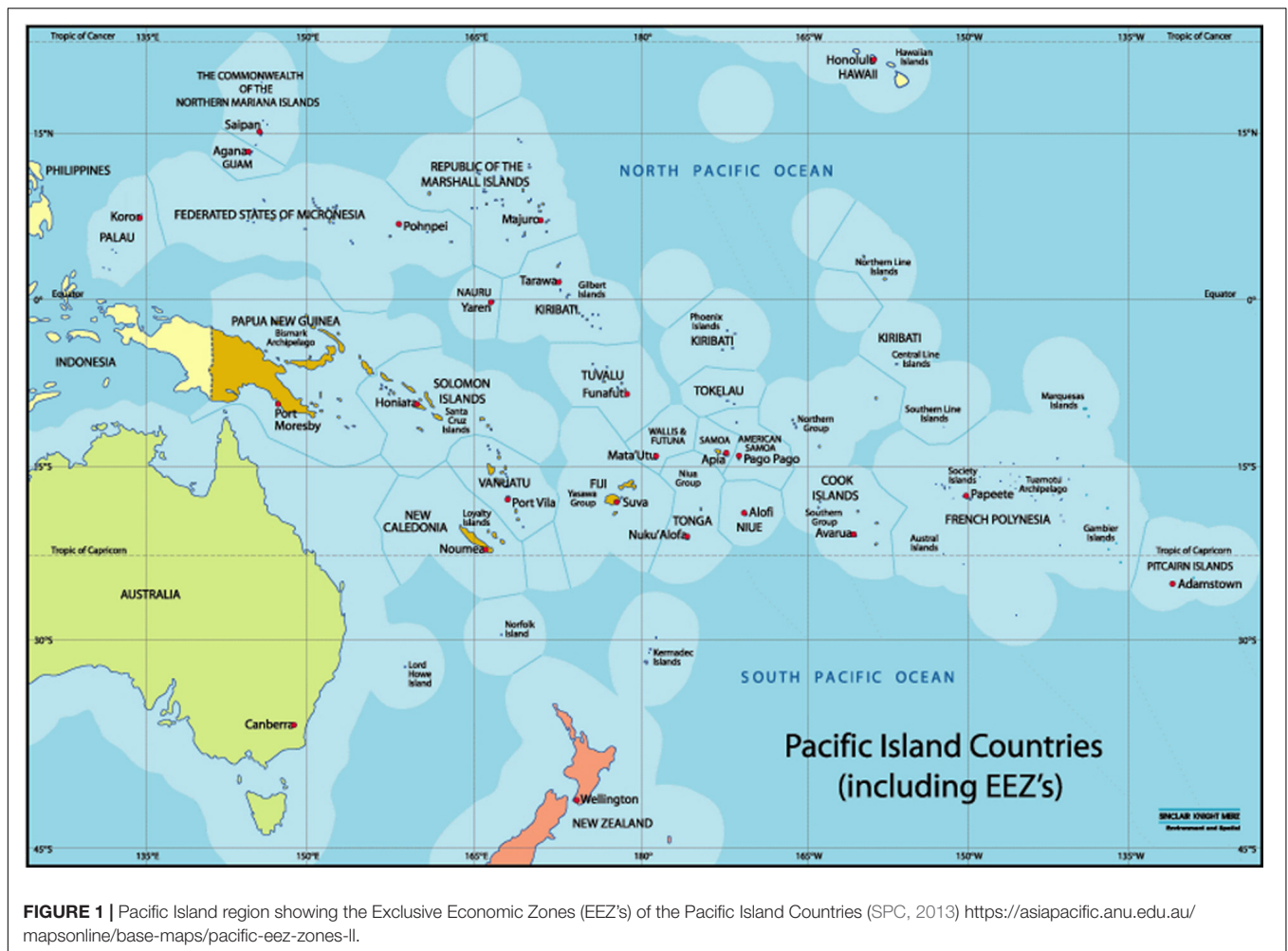
Ultimately, both in the Area, comprising the seabed and subsoil beyond national jurisdiction, as well as on the continental shelves of the Pacific Island states, which fall under national jurisdiction, abundant resources are up for grabs. Yet the impact of deep seabed mining on the local communities with rich maritime cultures (Malinowski, 1935; Kent, 1980; Johannes, 1981;

Hviding and Baines, 1992; Hau’ofa, 2008) might be significant and affect their Human Well-being and Sustainable Livelihoods (HWSL)¹ (D’Arcy, 2013a).

These newly recognized HWSL dimensions require an innovative regulatory framework to manage the potential exploitation of deep sea mineral resources. This would ensure the preservation of the seabed, as well as of the water column above, considering the cumulative impacts of other human activities (Woodall et al., 2014) and of global change, and guarantees the HWSL of the Pacific Island communities. This framework should acknowledge the fact that the Pacific Island states are presently subject to multiple stress factors including population growth, natural disasters including extreme weather events from climate change, unsustainable fisheries practices, alien species invasions and especially sea level rise, acidification and coral bleaching associated with global warming, in particular in the Marshall Islands, Guam, Northern Mariana Islands, the North-West Hawaiian Islands, and Kiribati (Pacific Community, 2012; IPCC SROCC, 2019).

Deep sea mining (DSM) involves a range of practices including the exploration, extraction, transportation, and processing of minerals retrieved from the ocean floor and transiting through the water column to the surface. Thus DSM takes place in a tridimensional perspective as the extraction of ore might take place at the seabed through a process of cutting and disaggregation, but it is then pumped upwards through the water column as a slurry, concentrated with the release of diluted seawater, and then transported across the sea to a terrestrial processing center. DSM occurs also in different geographic areas with varied mineralogy and different associated value chains (Petterson and Tawake, 2018), governed by distinct legal regimes. Indeed, there are two relevant legal frameworks that might apply to DSM activities. When taking place on the continental shelf-comprising the seabed and subsoil beyond the territorial sea up to a distance of 200 nautical miles from the coast (possibly

¹HWSL are commonly used in the Convention for Biological Diversity (CBD) and the international fora on sustainable development. HWSL are the social, spiritual, cultural and traditional characteristics and the capabilities, tangible assets and means of living that set the stage for sustainability, resilience and adaptability of people to change collectively (The World Commission on Environment and Development, 1987; Holden et al., 2014).



extended to the outer edge of the continental margin when this exceeds the stipulated 200 nautical miles) (UNCLOS, Art. 76)-these activities fall under national jurisdiction and are governed by the national legislation of the coastal state (UNCLOS, Art. 77). Beyond the outer limits of the continental shelf, however, the seabed and subsoil of the Areas Beyond National Jurisdiction (ABNJ) are referred to as ‘the Area’ and are governed by a comprehensive international regime (Infra section “International Legal Framework”).

The DSM industry was initially encouraged by the governments of the Pacific Island States, as well as some scientists (Hein et al., 2013; Bourrel, 2015; Navarre and Lammens, 2017). It was regarded as an opportunity to support the long-term economic sustainability of Island States and the social development of the people of the Pacific, notably to limit their dependence on foreign development aid. However, the perspective of Indigenous Peoples and local communities, and even “outsiders” (i.e., non-community members), may be characterized as reluctant or even hostile toward this new activity and its risks (Secretariat of the Pacific Community, 2012). More so, the potential for economic independence for Island States is potentially compromised by DSM projects – led often by

large corporate businesses in the Global North – which rely on economic trade-offs and compromises (re)creating new forms of financial reliance and perpetuating existing power imbalances between the wealthy ‘West’ and the ‘rest’ (Le Meur et al., 2018; Childs, 2019). The nations that have considered DSM in the near future, and have formulated policies and legislation on offshore mineral development, need to ensure the long-term preservation of their marine environment, including the seabed and the associated water column, acknowledging the HWSL, in particular traditional knowledge, of the people and communities who rely on the resources from the open sea (D’Arcy, 2013b). In line with the long-standing call of civil society to prioritize the health and values of Pacific communities [in reference to the Deep Sea Conservation Coalition (DSCC)]², Fiji, recently supported by Vanuatu and PNG, proposed, at the Pacific Islands Forum on August 14, 2019, a 10-year moratorium on DSM from 2020 to 2030 to allow for prudent research in marine areas under the national jurisdiction of Pacific nations (Doherty, 2019).

²The DSCC is an alliance of over 60 international organizations working to promote the conservation of biodiversity on the high seas (www.savethehighseas.org).

This is why debate as to the collaboration with local people and the integration of traditional, indigenous and local knowledge should not be neglected when considering emergent regimes of conservation and management in the region.

OVERVIEW OF THE MAIN NATURAL RESOURCES AND ACTIVITIES THAT WOULD BE AFFECTED BY DEEP SEABED MINING IN THE PACIFIC REGION

The main natural resources and activities that would be affected by DSM are located both within coastal waters (nearshore pelagic and deep-water bottom fish) and beyond the limits of national jurisdiction (open waters and deep sea). In the Pacific Islands region, coastal fishing is mainly artisanal and for subsistence, supplying domestic markets, and deep-water bottom fisheries are the most active and export-oriented. The main tuna fishing activities are within Pacific Island national waters including waters of State Parties to the 1982 Nauru Agreement which provide 60% of the west and central Pacific Ocean tuna catch, 25–30% of world canned tuna with a value of around US\$4.5 billion annually (Brouwer et al., 2018; The Western and Central Pacific Fisheries Commission, 2019). In the open seas, some large species range to a depth of 1,000 m for yellowfin tuna, bigeye tuna and swordfish, to 1,500 m for Bottlenose whales or approximately 3,000 m for sperm whales (Fisheries and Aquaculture Department, 2000; Block et al., 2011; Schor et al., 2014). The deep sea ecosystems in the Pacific region provide important ecosystem services and societal benefits (De Groot et al., 2012), not only for the people in the Pacific Islands but also for people around the world due to the migrating nature of many marine species. Indeed, the region has been part of important migration routes for several species of whales, which not only have strong cultural values for the population in the Pacific region (Flood et al., 1999; Creason, 2004; Firestone and Lilley, 2007) but also globally for activities such as whale watching (Hoyt, 1995).

Many Pacific Island countries have joined international agreements promoting the conservation of whales and created whale sanctuaries, now covering over 11 million km² of the South Pacific Ocean. Indigenous Peoples and Local Communities (IPLCs) have a role as custodians of significant ecosystems and of species generally traveling between coasts and high seas (Ey and Sherval, 2016; Eckstein and Schwarz, 2019). They are central to the debate addressing gaps in governance in ABNJ and the lack of a comprehensive framework for biodiversity conservation and management (Vierros et al., 2020).

In the mesopelagic, bathyal (200–2000 m) and abyssal realms (2000–6000 m) and especially the deeper hadal realm (more than 6000 m), there is an important lack of knowledge on species, on biodiversity and on the functional relationships of deep-sea ecosystems. Deep ocean environments represent the least explored areas on the planet and are assumed to serve as a cradle of non-renewable resources and to be the largest reservoirs of mostly unknown species and ecosystems which

might contribute significantly to planetary biodiversity and global livelihoods. Deep sea ecosystems have adapted to extreme stable environmental conditions, whilst also are interconnected with ecosystems in the water column, in particular for their trophic input which is generally very low. Such ecosystems are also enriched and diversified by deep ocean circulation, topography and hydrothermalism.

Accordingly, concern for potential and real threats to deep-sea biodiversity, alongside recent global conservation and biodiversity issues, has stimulated efforts to explore the structure and function of benthic communities in the abyssal and bathyal zones and the oceanographic processes in the water column. Deep sea faunal communities are characterized by slow biological mechanisms, a taxonomically high diversity and a non-random sparse distribution over large areas. As connections between the different layers of the ocean are studied, it is becoming increasingly apparent that global changes and environmental impacts are affecting all marine organisms from phytoplankton to higher marine vertebrates and all oceanic processes (Sharma, 2019).

The characteristics and the assessed vulnerability of the three main types of deep seabed mineral resources of the Pacific region targeted by DSM- Ferro-manganese polymetallic nodules, Cobalt-rich ferro-manganese crusts or Cobalt Rich Crusts (CRCs) and Hydrosulfide or Seafloor massive sulfide (SMS) deposits (Le Meur et al., 2016) are displayed in **Table 1**.

Globally, the potential changes to the seabed and the water-column that will be brought about by mining activity will inevitably impact the faunal communities over large spatial and temporal scales with multiple effects due to the complexity and seasonal variations of the water masses and ocean circulation (Tilot et al., 2018; Tilot, 2019). There is evidence that the seabed is affected by climate change with a reduction of surface primary production and carbon export to the deep sea (Levin et al., 2018). Furthermore one must consider cumulative impacts, within the water column and on the seabed, with both natural impacts (natural climate variation, El Niño events, earthquakes, tsunamis, underwater volcanism, benthic storms. . .) and anthropogenic disturbances (pollution, fishing, seabed mining, oil and gas extraction, disposal of wastes. . .) generally resulting in degradation and homogenization of habitats across broad tridimensional areas (Glover and Smith, 2003; Thiel, 2003; Smith et al., 2008; Tilot, 2010; Woodall et al., 2014; Levin et al., 2016; Miller et al., 2018).

TRADITIONAL INSIGHTS TOWARD SEABED RESOURCE MANAGEMENT IN THE PACIFIC

From oceanian Indigenous Peoples and Local Communities (IPLCs) point of view, DSM is not distanced from the island environment because the ocean is at the heart of one's identity, and part of each individual's future (Hau'ofa, 1994, 2008; Mawyer and Jacka, 2018). It is integral to the core identity of Islanders. In "Our Sea of Islands," Hau'ofa (1994), drawing on other indigenous thinkers (Wendt, 1976; Waddell, 2000), appropriately

TABLE 1 | The characteristics of three main types of seabed mineral resources on the deep seabed of the Pacific region targeted by DSM.

	Ferro-manganese polymetallic nodules	Cobalt Rich Crusts (CRCs)	Seafloor massive sulfide (SMS) deposits
Location, characteristics of the seafloor	On the seafloor and buried in extensive fine sediment-covered abyssal plains and hills between 3500 and 6500 m depth.	On seamounts, volcanoes and carbonate platforms in varying depths from 400 to 7000 m.	SMS require a long-lived hydrothermal system and occur at depths between 1000 and 4000 m. The deposits are located in small, discontinuous areas (several 100 m ²) which are strictly associated with hydrothermal vents emitting at high temperatures (350°C) variable in space and time (Dyment et al., 2014).
Mineral Composition, formation	Rock concretions of 4–14 cm characterized by a very slow growth (1–10 mm in about 1 million years) (Hein et al., 2015).	Formed by layers of iron and manganese oxides enriched with metals including rare earth elements	The main metals are copper, iron and gold with small quantities of silver and zinc (Hannington et al., 2010, 2011).
Location in Pacific region	The most commercially interesting mineral deposit lies on the seabed of the Clarion Clipperton Zone (CCZ), NE Pacific region of the Area at 3500 and 5500 m depth. The CCZ has the highest density of seabed mineral exploration licenses on the planet. Other areas of potential interest: Central Indian Ocean basin, the EEZs of the Cook Islands, Kiribati and French Polynesia.	Most CRC's of economic interest are between 800 and 2500 m depth (Hein et al., 2013; Hein and Koschinsky, 2014). CRC's are particularly abundant close to the Federated States of Micronesia, Marshall Islands, Kiribati, Tuvalu, Cook Islands, and French Polynesia.	Gold-bearing polymetallic sulfides are most abundant within EEZs/on the continental Shelf of Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Tonga, and New Zealand
Faunal characteristics	Faunal communities are significantly more abundant and diverse where there are nodule deposits and in particular when nodule coverage is higher, habitat heterogeneity, slopes and current regimes greater (Tilot, 2006, 2010; Tilot et al., 2018).	Cobalt-rich associated biotopes are hot spots of marine biodiversity due to important hydrodynamism especially on seamounts where there is evidence of important faunal communities, mostly sessile, characterized by long life spans and slow growth rates, high speciation and endemism. These attract a large trophic chain in particular benthic-pelagic communities which interest fisheries. Seamounts play a major role as stepping stones for population dynamics, biological connection and colonization.	Chemo synthetic microorganisms and bacteria (free or symbiotic) are the basis of the food chain. Associated faunal communities have narrow ecological niches within variations of physical parameters at hydrothermal vents (T°C, pH, H ₂ S, CO ₂ , O ₂) which make them highly vulnerable to any environmental change. Globally, hydrothermal ecosystems are unstable (smokers, active sites, diffuse vents), the life span of organisms is relatively short with a very fast growth rate and reproduction (6 months) (Beaulieu, 2010). Their biomass is very important and can reach several kg/m ² (1000–10,000 times the biomass in proximate areas). Species richness is relatively poor, most species being strictly restricted to hydrothermal habitats with 95% endemism.
Assessed impacts	DSM would probably have a considerable negative biological impact on a long term (and at a regional scale in the case of the CCZ with an estimated area of over more than 3 million km ²). Benthic megafaunal communities, mostly suspension feeders and detritus feeders, are sensitive to hyper-sedimentation. Impacts overall the water column including interconnected foodwebs, surface, and above. As technologies of extraction are not totally finalized, impacts cannot be correctly assessed on spatio-temporal scales. Impacts on the ecosystem would have also to take in account the combination of natural and human impacts in the water column up to the surface and the layer of air above the ocean (Tilot, 2019).	The impact of DSM on relatively small areas (seamounts, volcanoes) could lead to the extinction of these biocenoses. The cumulative effects of natural impacts and other anthropic activities on the seabed and in the water column, such as fishing on seamounts, are not well known but would be assessed as high.	Despite the fact that these species are adapted to rapid extinctions and recolonizations, the exploitation of a total hydrothermal area would interrupt the genetic flux and hinder any recolonization. As well as a highly repetitive exploitation of the mineral resources would not leave enough time for the species to complete their life cycle. Options for conservation are quite complex and should be even more adaptive than for the other mineral associated ecosystems.



FIGURE 2 | 'Kaygasiw Usul'. The sculpture references star constellations and their relation to the movements of the shovel-nosed shark. Australian National Maritime Museum (ANMM) Collection Sydney/Alick Tipoti/AAPN. Alick Tipoti is a world renowned professional artist from Badu Island in the Torres Strait. His work depicts many meaningful symbols about the Land, Sea and Sky of his country through traditional Melanesian patterns.

addresses the nexus of islander's identity in terms of belonging and connection: "Oceania refers to a world of people connected to each other." This oceanian "way of being" or "disposition of mind" induces resistance as well as empowerment (Bambridge, personal communication).

For generations, this "oceanian way of being" or local habitus³ as defined further, has helped islanders transmit their identity and unique relationship to each other and to their environment, taking a variety of forms, not always directly tied to nature. Myths, oral traditions and, cosmologies of the Samoan, Cook islander, Niuean, Tokelau, Kiribati, Fijian, Tongan, Maori (from Aotearoa- New Zealand), Native Hawaiian, Kanak, Mā'ohi (in French Polynesia), Ni-Vanuatu, Solomons and, Papuan peoples show that they conceived their world in term of a holistic view, dissolving classic western distinctions between human and non-human, nature and culture, as objects. Settled over a thousand years ago by voyagers in giant outrigger canoes, the mobile "people of the sea" (D'Arcy, 2006) envision their world embedded in the ocean (Figure 2).

Bourdieu's notion of local habitus³ practices "collectively orchestrated without being the product of the orchestrating action of a conductor" (Bourdieu, 1977) allows for shared social structures that are embodied, perpetuated, and embedded in everyday practice.³

In islands, local habitus stems from a standardized improvisation based, not just on skills and activities, but on a spiritual connection to one's environment (Torrente

et al., 2018). For example, mā'ohi habitus illustrates today the intimate relationship with both natural and cultural resources. In historically considered seascapes that are bordered by taro plantations, pandanus (*Pandanus tectorius*) and coconut (*Cocos nucifera*) trees, and contain fish nurseries and historical coral sites, ancestral spirits make themselves felt and heard for instance through strange animal calls, goosebumps, or a tingling of the feet.

Most Islanders who sense these disgruntled spirits respond by demonstrating *fa'atura* ('respect' in Tahitian): either withdrawing from that place or following certain behaviors like asking permission, speaking to the spirits; not going into or playing on historic structures or trees; not disturbing the stones of historic ruins; not spitting on *marae* (ancient 'shrines') stones or objects; and not urinating, defecating, or lighting fires on or around historic ruins or sacred trees (Douglas, 1974).

A common socialization mechanism in Oceania is the islanders' attention to the birds, wind, currents, tides, and the carefully guarded secret knowledge that has served to transmit ancestral wisdom across generations. As one elder explained in French Polynesia, these behavioral rules come from Mā'ohi "origins" from the "ancient *tapu*" that once structured Tahitian society around *mana*. In fact, certain types of transmission have continued, embedded in an oceanian habitus based on the observation, practice, and perpetuation of a uniquely oceanian, post-settler, and embodied cultural capital. This transmission is also rooted in social and moral expectations which perpetuate an active indigenous relationship with history, the land, the ocean and each other. Such transmitted patterns of resource use and of a holistic relationship between society, the sea and the land both respond to and resist ongoing colonially rooted processes including imported land and marine management, the coming of

³Pierre Bourdieu developed a theory of action around the concept of habitus. This theory seeks to show that social agents develop strategies, based on a small number of dispositions acquired by socialization which, although unconscious, are adapted to the necessities of the social world (Bourdieu, 1980).

Christianity, a commodification of nature and, most recently, the advance of conservation as well as DSM initiatives.

Yet this relationship has lately come under pressure from international DSM initiatives. Pacific islanders are now courted by global institutions as international mining companies, scientific research centers, European projects, Governments and International institutions such as the World Bank. Current projects include, the Solwara project in PNG, the SPC-EU Deep Sea Minerals projects in the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor Leste, Tonga, Tuvalu, and Vanuatu. French Polynesia and the French State ordered a study on DSM feasibility in their Extended Economic Zone (EEZ) (Le Meur et al., 2016). Wallis and Futuna customary authorities are continuing to resist a French tentative renewal of the mining code in their country and EEZ (RNZ, 2018).

Monetary and political power, rather than ancestral respect, are increasingly driving the local treatment of resources, even as Oceanians continue to grapple with the notion of respect and the lingering spiritual power, or *mana* and *tapu* of certain places and things. The resulting battle, embodied in local habitus, highlights colonial versus Indigenous, rationalization against enchantment, orthodoxy versus heterodoxy, written against oral, even as it questions and ultimately dissolves each of these binary categories. Generated through a traumatic history of cultural and political colonization, depopulation, commodification of nature, and religious conversion, the ongoing practice of the local habitus reflects the fragmented sacred, or *tapu*, structures of the past as well as the rational, institutionalized traps of the present.

Sovereignty and the urge for development, rather than local belonging and hereditary respect are another transforming force for the use of marine resources and minerals. Many independent and non-independent states from the Pacific, proud of their auto-designation as “large maritime states” since the Law of the Sea Convention, also induce “territorial instinct to where there was none before” (Hau’ofa, 1994). It is interesting here to draw a parallel with conservation initiatives because they share with DSM projects a fundamental dissonance toward local oceanian habitus. As a matter of fact, global conservation projects (from private foundations, research centers, and governments) also drive environmental management (Childs, 2019), and this illustrated today by customary practices supported by external factors including seasonal bans on harvesting, temporary closed (no-take) areas, and restrictions being placed on certain times, places, species or classes of persons. Closed areas incorporate the “tabu” areas of Fiji, Vanuatu and Kiribati, the « ra’ui » in the Cook Islands, the “kapu” in Hawaii, the “tambu” in PNG, the “bul” in Palau, the “mo” in the Marshall Islands, the “tapu” in Tonga and the “rāhui” in Aotearoa-New Zealand and French Polynesia (Bambridge, 2016; Bambridge et al., 2019). Indeed, while it appears as an ideal to reconcile cultural identity with modern ecological science and the conservation of endangered species, such an approach involves an intrinsic contradiction.

For example, *Rāhui* rules expressed by a set of mā’ohi habitus, enter in conflict with the top-down governance culture of Polynesian administrations in charge of Marine Protected Areas (MPA), including the large scale marine managed area in the EEZ. Certain tutelary spirits personifying particular extended families have become iconic endangered species while the mere fact of talking about them is secret (some would say *tapu*) in most oceanian families. Land and seascapes associated with families whose *mana* and ancestors remain, are still known and recalled whereas the Christian religion tends to erase the knowledge and praxis associated with ancient spirits. The official land and maritime law under the Polynesian and French governments, separates the sea from the land, while mā’ohi habitus tends to integrate them into a meaningful, holistic view of the relationship between nature and culture. In some countries of Oceania, modern privatization of land enters in conflict with the concept of traditional extended family lands (including sometimes portions of the lagoon, fishing holes and reefs) which is still appreciated as common heritage.

However, the past is not only embodied in traumatic historic events, as habitus also emerges from “the historically and socially situated conditions of its production” (Bourdieu, 1977). The diversity of Oceanic societies is too great to be reduced to a dichotomy: Melanesian “big men” society (Godelier, 1990), versus Polynesian “hierarchical” societies (Kirch, 2010). Yet if common characteristics can be identified, they would rather be in the way in which Pacific Island societies view their worlds and base their relationships. First, the ‘foundation’ (rather than the ‘origin,’ to stay close to an Oceanic image) of the universe is envisioned as a continual process of growth and expansion where gods, half-gods, ancestors, and humans are themselves the products of this cosmic development. Polynesian and Melanesian cosmogonies are polytheistic and ancestors-oriented (Figure 3). There is no “creator god” at the origin of the universe. On the contrary, a myriad of gods and half-gods are encountered who are not themselves at the origin of the world: “This is particularly true of the Hawaiian Kumulipo [Hawaiian mythical song] where the gods are second: Kanaloa, Kane [Taaroa, Tane in Tahitian] are born in the eighth song, at the same time as men and long after the multiple nocturnal gestations of the *Pō* [‘night’] matrix. This is also true of Maori cosmogony where a genealogical recitation lists all the natural stages by which still empty space generates night (...)” (Rigo, 2004).

Secondly, mythical Oceanian songs establish a principle of continuity between human and non-human entities (Figure 3) between mineral, vegetal, animal, gods, and humans. Humans are not cut off from the invisible world but participate in it and share with it a more or less important part of the sacred. Whether we refer to Firth (1936) on the social structure of “ramage” among the Tikopia or to Oliver (1974) for the bilinear social structure among the Tahitians, or to Melanesian societies with “big men” according to Godelier (1990), the observation is ultimately the same: the ties of kinship between the highest social hierarchies and the lowest ones are seen only as an extension of the ideal world. Myths, like social organization, are conceived as a vast kinship network where the *mana* circulates and must circulate.

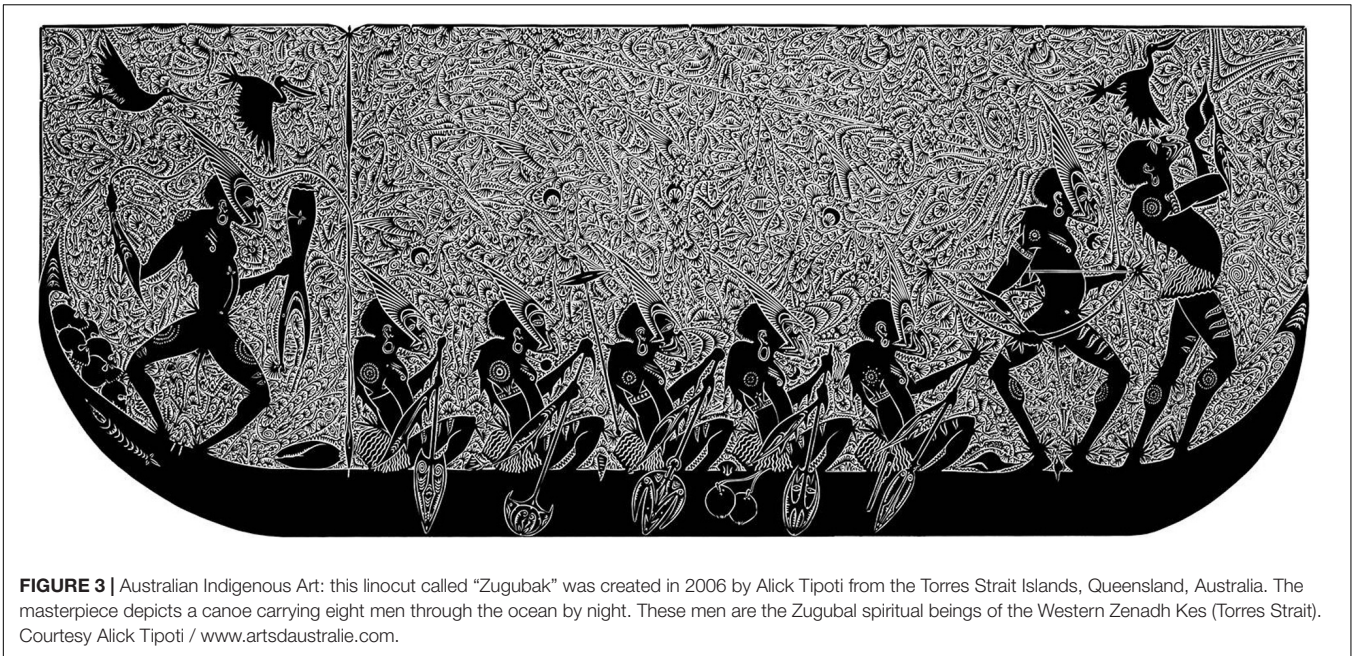


FIGURE 3 | Australian Indigenous Art: this linocut called “Zugubak” was created in 2006 by Alick Tipoti from the Torres Strait Islands, Queensland, Australia. The masterpiece depicts a canoe carrying eight men through the ocean by night. These men are the Zugubal spiritual beings of the Western Zenadh Kes (Torres Strait). Courtesy Alick Tipoti / www.artsaustralia.com.

Finally, the pluralism founded by Oceanic cosmogonies is maintained by incessant interactions between human, deified and non-human entities. Minerals, birds, sharks, plants, west or northeast wind, fine rain, in turn, are messengers, personify invisible ancestors, communicate with the world of the living. However, such a continuum between the visible and invisible world does not imply the idea that these societies live entirely in the sphere of the myth which governs all human activities and are deeply an-historical and adverse to change. On the contrary, this continuity is constantly updated, distorted and reworked by humans: a god or an ancestor (in the case of Melanesian societies) who has become less effective or does not respond to the convocations of priests, is provisionally dismissed.

Thus, in oceanian societies where the world is conceived as a vast kinship network, with continual interactions between mineral, plants and animals, the relationship is the basis of such societies. In terms of social organization, and as far as DSM is concerned, one therefore ought to learn from the remarkable traditional institutions that manage the ocean and the resources in the Pacific region. Integrating indigenous people into DSM management is not just a mere issue of a ‘participatory approach’ as acknowledged by several Western/international projects or as established in some regulations of Pacific States; it is indeed the very foundation of holistic custom-based relationships. Therefore, any DSM regulation system that had only a minor representation of indigenous communities would be philosophically problematic for oceanian societies. The same could be said also of a poor consultation process with traditional leaders and/or political representatives proposed in conservation as well as in DSM projects, which might be illustrated through typical cases in Kiribati (Mallin et al., 2019) or Rapa nui (Aburto et al., 2020).

LEGAL REFLECTIONS OF TRADITIONAL DIMENSIONS AND HUMAN ELEMENTS IN THE PACIFIC

Yet how do these traditional dimensions play out in the legal context? Within the framework of the United Nations Convention on the Law of the Sea, the ‘Area’ is defined as “the seabed and ocean floor and the subsoil thereof, beyond the limits of national jurisdiction” (United Nations Convention on the Law of the Sea, 1982).⁴ It is governed by a complex international regime, which determines by whom and under what conditions these natural resources can be mined.⁵ The fundamental principles of the deep seabed regime are set out in the 1982 United Nations Convention on the Law of the Sea and the 1994 Implementation Agreement, and are further developed in detailed regulations issued by the International Seabed Authority (ISA), which is tasked with managing the deep seabed and its natural resources.⁶ The ISA has already produced rules regarding prospecting and exploration in the Area (International Seabed Authority, 2010, 2012b, 2013a) but has yet to adopt exploitation regulations International Seabed Authority, 2019a). However, international law is also relevant in this context. Companies wishing to pursue activities in the Area must be sponsored by the state of which they are nationals and, therefore, should adhere to national legislation defining the conditions to obtain a certificate of sponsorship⁷. Moreover, seabed mineral activities within national jurisdiction are exclusively governed by the national laws of the coastal states.⁸ Furthermore, Pacific

⁴UNCLOS, Preamble and Art. 134.

⁵*Ibid.*, Art. 137.

⁶*Ibid.*, Art. 157(1).

⁷*Ibid.*, Art. 153(2)(b), Annex III Art. 4(1) and (3).

⁸*Ibid.*, Art. 77.

Island states have also developed regional policies and regulatory frameworks regarding exploration and exploitation of seabed resources, and it is important to properly integrate these traditional dimensions and human aspects associated with seabed resource management into all three of these regulatory levels through thoughtful rules and principles.

International Legal Framework

The island states of the Pacific are not only relevant because of the mining prospects on their own continental shelf and their proximity to some of the international DSM sites, but also because they hold important interests in the Area. Indeed, the Cook Islands (Cook Islands Investment Corporation) (International Seabed Authority, 2014b), Tonga (Tonga Offshore Mining Limited) (International Seabed Authority, 2011a), Kiribati (Marawa Research and Exploration Ltd.) (International Seabed Authority, 2012a) and Nauru (Nauru Ocean Resources Inc.) (International Seabed Authority, 2011b) are all sponsor companies which obtained exploration contracts for polymetallic nodules in the Clarion Clipperton Fracture Zone in the last decade. Therefore, the international legal framework is highly relevant, and it is important that this regime incorporates traditional dimensions and human elements of seabed resource management to the fullest possible extent.

The status of the deep seabed and its natural resources as the Common Heritage of Mankind (CHM) – which has an interesting history (Oude Elferink, 2007; Noyes, 2012) – is one of the most important international legal concepts reflecting traditional visions of collective ownership and embodying human aspects of seabed resource management in the Area. The predominant motivation behind this concept was to prevent the scenario that only a handful of industrialized countries, possessing the capacities and means to invest in DSM, would be entitled to the mineral resources of the deep seabed, excluding developing states from these economic opportunities (Frakes, 2003; Guntrip, 2003; Shackelford, 2008; Noyes, 2012; Jaeckel et al., 2016). Furthermore, it was a sophisticated solution to avoid the dreaded phenomenon of the “tragedy of the commons,” through the absence of an accountable authority and an established management regime that would pose a significant risk of unbridled exploitation and drastic ecological decline (Hardin, 1968; Shackelford, 2008; Franckx, 2010). By designating the Area and its mineral resources as the CHM, the international community is tasked to manage it for the benefit of all countries and to preserve it for future generations. At the time, CHM, embedded in article 136 of UNCLOS, was a revolutionary concept and it is still seen as a remarkable achievement in legal and diplomatic terms, taking into account the huge difficulties to reach a consensus on the conflicting ambitions of exploitation and conservation (Jaeckel et al., 2016). Despite the lack of a clear definition (Frakes, 2003; Shackelford, 2008; Franckx, 2010; Noyes, 2012; Jaeckel et al., 2016; Bourrel et al., 2018a), the CHM constitutes the guiding principle of the deep seabed regime and is expressed in different ways (Oude Elferink, 2007; Jaeckel et al., 2016): a ban on appropriation⁹, exclusive use for

peaceful purposes¹⁰, international cooperation and knowledge dissemination¹¹, protection of the marine environment¹², and equitable sharing of financial and economic benefits derived from activities in the Area¹³.

Without seemingly affecting the principles (arising from the CHM), the 1994 Implementation Agreement significantly reformed several underlying rules and mechanisms, further complicating the operationalization of the ideals embedded in Part XI of UNCLOS (Beurier, 2021). A lot of work remains to effectively implement the CHM concept in the run-up to the DSM exploitation phase (Willaert, 2020a) and there is still ample room for improvement with regard to transparency and public participation (Willaert, 2020b). Moreover, direct references to traditional knowledge and visions have not yet been integrated in the provisions of the “Mining Code,” this being the comprehensive set of rules and procedures issued by the ISA to regulate activities in the Area. However, some states and stakeholders have suggested including such aspects. These ambitions have been demonstrated by a recent proposal regarding a template with required minimum content for Regional Environmental Management Plans (REMPs) (International Seabed Authority, 2020a). To date, one REMP has been adopted for the Clarion Clipperton Fracture Zone, among others indicating Areas of Particular Environmental Interest (APEIs) where no mining operations can be conducted. In this proposal, which pleads for a standardized approach, Germany and the Netherlands list traditional knowledge of indigenous peoples and local communities as one of the guiding principles for the development of REMPs.¹⁴ Furthermore, attention is paid to the connectivity of migratory species, which are of cultural significance to indigenous peoples, traditional marine management areas and measures, as well as routes and marine features used by local communities for traditional instrument-free navigation.¹⁵ The ISA Council decided that the Legal and Technical Commission should take this proposal into account when further developing the guidance on the development of REMPs and a relevant template (International Seabed Authority, 2020b). Whilst there is no guarantee concerning the adoption of these guiding principles and considerations, the current developments certainly demonstrate that there is a growing call for inclusion of traditional visions and interests of local communities. Proposals were also submitted to promote participation of so-called ‘vulnerable communities’ within the context of the Environmental Compensation Fund. These suggested amendments to the Draft Exploitation Regulations were welcomed during the first part of the 26th session of the ISA Council meetings (International Seabed Authority, 2020d), and one of the delegates suggested to refer specifically to indigenous people and local communities who reside in adjacent coastal

⁹*Ibid.*, Art. 137.

¹⁰*Ibid.*, Art. 141.

¹¹*Ibid.*, Arts. 143 and 144.

¹²*Ibid.*, Art. 145.

¹³*Ibid.*, Art. 140.

¹⁴International Seabed Authority, 2020a, at p. 5.

¹⁵*Ibid.*, at pp. 6–7.

states, who are likely to be impacted (International Seabed Authority, 2019b).

Given the fact that DSM activities not only have an impact on the immediate seabed and the subsoil, but in the whole water column to the surface and the air above, it is necessary to also pay attention to the international legal regime governing ABNJ, which have tight “socio-ecological connectivity” to small Pacific Island States and populations (Popova et al., 2019). The revised draft text for an agreement under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of ABNJ (A/CONF.232/2020/3¹⁶) contains numerous references to the incorporation of relevant traditional knowledge of indigenous peoples and local communities in measures and activities connected to ABNJ, including the establishment of area-based management tools and the conducting of environmental impact assessments in the Area and the water column above it. It shows the influence of the group of Pacific Island Developing States (P-SIDS) in particular, in reconciling so-called “modern” and “traditional” knowledge of marine biodiversity. If such references remain in the final version of the text of the BBNJ instrument, they will send a strong signal that the ISA framework must take into consideration relevant traditional knowledge, in the interest of ensuring coherence and complementarity in the Ocean governance systems established under two implementing agreements of UNCLOS (i.e., the BBNJ instrument and the 1994 Implementing Agreement). It also bears mentioning that article 138 of UNCLOS mandates that the “general conduct of States in relation to the Area” must be in accordance with, among other things, “other rules of international law in the interests of [...] promoting international cooperation and mutual understanding.” Arguably, such “other rules” must include not just those that will eventually form the BBNJ instrument but also those currently in force in relevant multilateral environmental agreements and processes.

For example, the work under the Convention on Biological Diversity (CBD) (Convention on Biological Diversity, 1992) with respect to the identification of Ecological or Biologically Significant marine Areas (EBSAs) involves the convening of regional workshops where holders of relevant traditional knowledge participate in the identification of such areas. Their participation means providing practical insights (for e.g., best practices) about the role of immemorial knowledge in understanding and managing marine socio-ecosystems as traditional commons.

Using a holistic and integrative representation that goes further than the spatial approach *stricto sensu*, the ecosystem approach, entrenched in EBSAs, is mirroring the commonalities between the scientific and traditional understanding of biodiversity. The ecosystem approach is the primary framework for action under the CBD (Convention on Biological Diversity (CBD), (Conference of the Parties) COP, 2000)¹⁷. It accommodates the human appetite for earth

ecosystems, including coastal and marine ecosystems, with a science-based and “beyond fragmentation” governance that seeks integration for sustainable development. The ecosystem approach, which has given rise to several tools for integrated management of the marine environment (MPAs, Marine Spatial Planning (MSP), etc.), relies primarily on the scientific community as the main provider of knowledge. Pursuant to the objectives of the CBD (Art. 1 CBD), traditional knowledge, i.e., “knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles” (Art. 8 j) must be encouraged and protected [see also, Art. 10 (c), 15.5, 17.2, and 18.4. CBD], as a source of knowledge ‘in its own right.’ Neither of these two complementary and inextricable scientific and traditional perspectives of biodiversity dissociate the biotope from the biocenosis, the living from the non-living, the life from the cosmos, except for the purpose of making the complexity of the relationships between humans, societies and nature intelligible. Nevertheless, the economic and strategic utility and scarcity, whether virtual or real, of certain resources, areas and uses, more or less closely associated with the biodiversity and its knowledge, justify, legally speaking, particular management conditions and modalities within and beyond the ‘realm’ of national jurisdiction.

Regional Legal Framework

The “Pacific Way” [advocated by the Fijian Prime Minister Ratu Mara (1920–2004)] is a cultural norm elevated to the political level during UNCLOS III negotiations (1973–1982), shortly after the independence of most of Pacific Island States. It promotes shared local values, including the respect for the *Vanua* encompassing the sea, and relies on a “unanimous” mode of decision-making, that stems from facilitative dialogue among the members of the community (Haas, 1992; Mara, 1997; see also the Talanoa dialogue within the framework of the 1992 United Nations Framework Convention on Climate Change).

Most Pacific Island countries have ratified or acceded to global, regional or sectoral instruments relevant to ensuring the protection of the marine environment and biodiversity from DSM activities, such as the 1992 CBD (in force on December 29, 1993), the 1999 Madang Guidelines on Principles for the Development of National Offshore Mineral Policies and the 1986 Noumea Convention for the Protection of Natural Resources and the Environment of the South Pacific Region (in force on November 24, 1990), containing an indirect reference to the cultural value of areas and the exercise of traditional customary rights in its Protocol concerning Cooperation in Combating Pollution Emergencies in the South Pacific Region.

An example of regional cooperation with strong conservation benefits in the Pacific is the subregional Pacific Nauru Agreement (PNA) concerning Cooperation in the Management of Fisheries of Common Interest signed in 1982 between the Federated States of Micronesia, Kiribati, the Marshall Islands,

are to ensure that activities based on natural resources: (1) are ecologically and economically sustainable; (2) meet societal needs; and (3) singularly or in combination do not threaten ecosystem integrity and health or compromise marine or biological diversity or intergenerational equity (Convention on Biological Diversity, 2007).

¹⁶<https://undocs.org/en/a/conf.232/2020/3>

¹⁷According to the CBD, the overall goals in applying an ecosystem approach in the management of natural resources, land and oceans surrounding islands

Nauru, Palau, Papua New Guinea, Solomon Islands, and Tuvalu. This agreement has been updated and the measures were subsequently endorsed by the Western and Central Pacific Fisheries Commission (WCPFC). This regional Fishery Management Organization (RFMO) includes all Distant-water fishing nation fleets (DWFN) and coastal States that participate in the western and central Pacific tuna fisheries, the major commercial fisheries resource harvested in the Pacific (Thakur, 1991; South et al., 2004).

A further step toward collaborative ocean governance in the Pacific has been taken with the endorsement of the Pacific Oceanscape initiative in August 2010 by the Pacific Islands Forum (PIF) leaders which include Australia, the Cook Islands, the Federated States of Micronesia, the Republic of Kiribati, Nauru, New Zealand, Niue, Palau, Papua New Guinea, the Republic of the Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu. This is the largest ocean governance initiative on Earth encompassing an area of 38.5 million square kilometers. Its framework emphasizes integrated ocean management across all sectors among which protection of the biodiversity is a key objective as well as building in-country capacity and expertise to ensure good governance (United Nations Environment Programme, 2010; Bourrel et al., 2018b).

Realizing their dependence on the Pacific Ocean and the shared responsibility to protect and preserve its vital resources, the Pacific Island states, supported by EU funding, also joined forces and cooperated with experts and stakeholders to develop a contemporary regional legislative framework for deep sea minerals exploration and exploitation (Secretariat of the Pacific Community, 2012). The document serves as a roadmap to guide policy-makers and government agencies of Pacific Island states toward effective legislation and adequate decision-making for the long-term benefit of island communities and future generations. Next to this legislative framework, the SPC-EU Deep Sea Minerals Project also produced a cost-benefit analysis of DSM in the region, regional scientific research guidelines, a regional financial framework and a REMP framework¹⁸. However, the Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation evidently is the most important document within the context of this article.

In the Pacific-ACP States Regional Legislative and Regulatory Framework (RLRF) for Deep Sea Minerals Exploration and Exploitation, several provisions take into account the interests and visions of the island communities. Potential benefits to citizens are mentioned, such as job creation, training and capacity building opportunities, attraction of foreign investment, and improvement of public services and infrastructure through additional funding, but the likely risks are not neglected. Therefore, environmental protection, responsible management of resources and due regard for social impacts are clearly emphasized¹⁹. A balance between all competing interests must be struck, and the environmental and social costs should

not outweigh the potential benefits. Significant importance is also attached to public participation, in order to ensure that all relevant information and visions are taken into account, to enhance public knowledge, and to improve the effectiveness of the policy and decisions²⁰, which might be particularly relevant within the context of environmental impact assessment (Bradley and Swaddling, 2018). By implementing public consultation procedures regarding DSM in relevant processes (e.g., environmental impact assessments) within the national legal order, the human rights of local communities potentially affected by these activities²¹, including their right to Free, Prior and Informed Consent (FPIC), and traditional rights over resources, marine species (e.g., migratory species) and spaces (e.g., “tabu” areas) – are respected. Here there must be an appreciation of the contested and complex assessment of compensation because value is held differently by different ocean stakeholders (see Cowell, 2003; Mason, 2003; on the politics of compensation). Fishing of, and activities relating to, highly migratory species such as sharks, turtles, and tuna, and other customary rights linked to the ocean, including cultural, social, political and spiritual rights, should be respected or compensated if they are negatively impacted. Although the areas which will be directly affected by seabed mining activities will be largely outside customary fishing zones, it is deemed important for all Pacific Island states to identify all customary marine tenure in their EEZ and avoid any conflicts, for example by concluding agreements with traditional leaders or local councils.

Public consultation processes should be implemented both in the development of laws as well as in subsequent decision-making. The importance of transparency is stressed and the introduction of appeal options against seabed mining decisions is encouraged to guarantee due consideration of the input and comments from members of the public.²² Thus, the RLRF for Deep Sea Minerals Exploration and Exploitation clearly acknowledges the fact that Pacific Island communities rely for their livelihoods upon sustainable use of the ocean and its resources.²³ New activities should not unduly interfere with the various existing uses, including uses relating to highly migratory marine species and marine ecosystems adjacent to ABNJ. Therefore, integrated legislative or management regimes, which take into account all sea uses and their mutual impact, are highly recommended. The discussed framework document contains a concise model template for national DSM legislation, leaving sufficient room to elaborate a suitable regime according to the unique characteristics of each Pacific Island state, and provides a significant contribution to adequate regulation and legislative harmonization of seabed mining activities in the region²⁴.

In addition, the Pacific region, through its regional organizations, has developed a regional framework for the protection of traditional knowledge and expressions of

²⁰ *Ibid.*, at pp. 32–33.

²¹ *Ibid.*, at p. 33.

²² *Ibid.*, at pp. 33–34.

²³ *Ibid.*, at pp. 42–44.

²⁴ *Ibid.*, Annex II.

¹⁸ <https://dsm.gsd.spc.int/index.php/publications-and-reports>

¹⁹ Secretariat of the Pacific Community, 2012, at pp. 7–8.

culture, in collaboration with WIPO, UNESCO, and other partners. The regional framework includes a model law on traditional knowledge and expressions of culture, on traditional biological knowledge, innovation, and practices as well as guidelines for the implementation of the model laws in national legislation. The framework is designed to enable Pacific Island countries to develop national legislation to protect, preserve and promote their traditional knowledge in close consultation with indigenous peoples and local communities. It contains definitions of traditional knowledge as well as traditional biological knowledge, innovation, and practices. Of relevance to seabed resource management, the model law on traditional biological knowledge, innovations, and practices defines “traditional biological knowledge” as “knowledge whether embodied in tangible form or not, belonging to a social group and gained from having lived in close contact with nature, regarding: (a) living things, their spiritual significance, their constituent parts, their life cycles, behavior and functions, and their effects on and interactions with other living things, including humans, and with their physical environment; (b) the physical environment; (c) the obtaining and utilizing of living or non-living things for the purpose of maintaining, facilitating or improving human life.” To the extent that DSM impacts such living things, their physical environments, and/or the ways in which holders of traditional knowledge utilize them for maintaining, facilitating, or improving human life (e.g., traditional knowledge and practices pertaining to highly migratory marine species of cultural significance, as well as to open Ocean traditional navigation routes), the regional framework should play a key role in addressing such impacts.

National Legislation

The Cook Islands

The Cook Islands, a self-governing country which comprises 15 islands in the southern part of the Pacific Ocean (**Figure 4**), are no strangers to DSM. They have not only obtained a contract from the International Seabed Authority to explore polymetallic nodules in the Area (International Seabed Authority, 2014a), but they also started exploration activities on their own continental shelf (DSM Observer, 2017). To achieve their DSM ambitions, the Cook Islands maintain close ties with the Belgian DSM company Global Sea Mineral Resources (GSR), a subsidiary of the DEME Group which obtained an exploration contract for polymetallic nodules in the Clarion Clipperton Fracture Zone in 2013 (International Seabed Authority, 2012c). The reserved area which GSR initially contributed is being explored by a joint venture between the Cook Islands Investment Corporation and GSR (International Seabed Authority, 2013b), sponsored by the Cook Islands which are also cooperating with GSR on the exploration and future exploitation of the mineral resources on their continental shelf (Hein et al., 2015; DSM Observer, 2017; Global Sea Mineral Resources, 2019).

Traditional dimensions of seabed resource management are clearly integrated in the national laws of the Cook Islands (**Table 2**). In 2017, the island state set up a vast marine park, covering their entire territorial sea and EEZ which encompasses almost 2 million km² and is said to hold a huge share of the world’s currently known cobalt reserves (Cook Islands Marae Moana Act, 2017; DSM Observer, 2017). The area and the relevant legal Act are named “Marae Moana” (“ocean sanctuary”), signifying the importance of the ocean space to Cook Islanders (Flood et al., 1999;

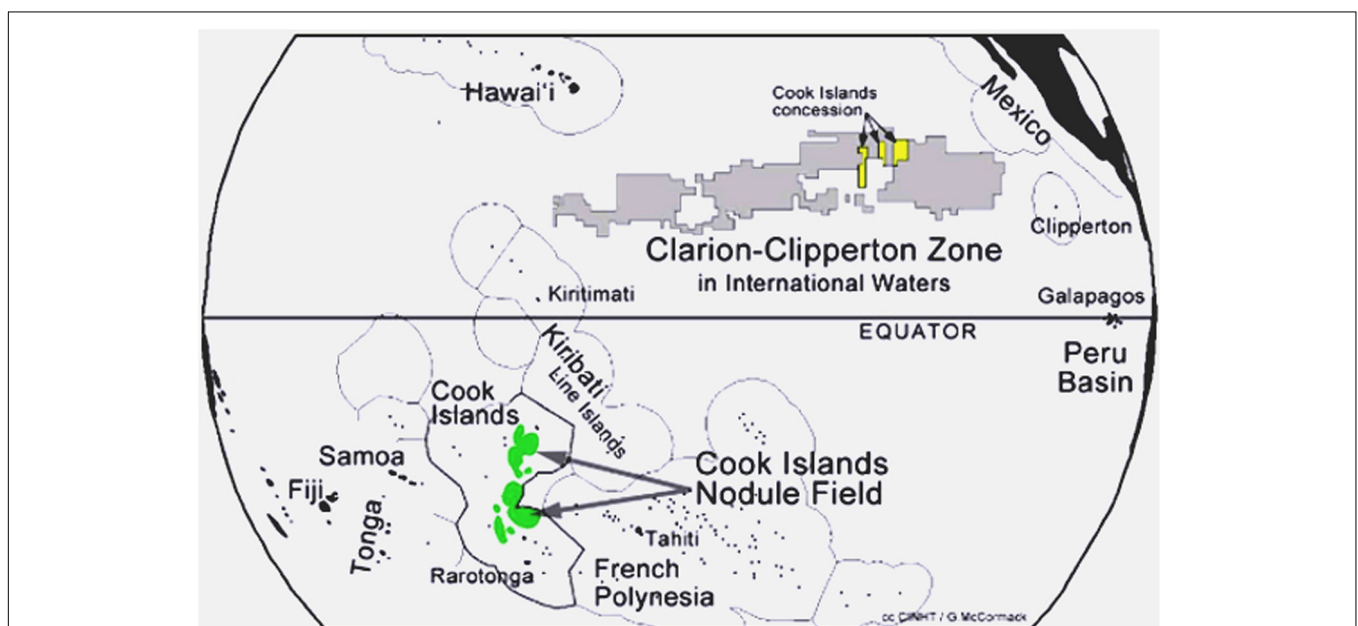


FIGURE 4 | Context map showing the Cook Islands manganese nodule fields in relation to neighbouring countries and the Clarion Clipperton Zone [Figure constructed by McCormack (2016) and Petterson and Tawake (2016)].

International Union for Conservation of Nature, 2018).

Interestingly, the Cook islanders did not use the term “tapu moana” (“sacred ocean”), which would imply a strict and formal interdiction, but “marae” (“open air sanctuary”), referring to the ancient stone platform where political and religious decisions were made (Bambridge, personal communication). Cook Islanders feel that the sea ties them to their ancestors, who believed that it is vital to be good to the ocean: in order to harvest, you first have to protect. Therefore, the Marae Moana Act has the primary purpose of protecting and conserving the ecology, biodiversity and heritage values of the Cook Islands marine environment²⁵. The holistic framework of this Act, which also recognizes the connectivity between terrestrial and marine environments, aims to promote shared use²⁶ and sustainable development. It balances economic interests like tourism, fishing and deep-sea mining with conserving marine biodiversity and ecology, in order to maximize the benefits for the current and future generations of Cook Islanders²⁷.

The multiple use Marae Moana park, which is managed by a Marae Moana Council²⁸ supported by a Technical Advisory Group²⁹ and a Coordination Office³⁰, is thoughtfully divided into specific zones, linked to well defined purposes³¹. National ownership and widespread support are ensured by promoting transparency and by involving the island communities in the decision-making processes: the Marae Moana is believed to belong to all Cook Islanders, so everyone should have a say on how it is managed³². However, in reality, the Coordination Office is placed under the direct authority of the Prime minister’s cabinet, limiting the participation of the *Matahiapo* (chief of villages). One of the most prominent measures is the creation of MPAs (extending up to 50 nautical miles around each of the fifteen islands), which are reserved for the local communities and impose a ban on commercial fishing or seabed mineral activities³³. Some of these zones are designated as *ra’ui* areas, referring to the ancient Polynesian form of resource management. The power of *ra’ui* as unwritten rules to manage certain areas or specific resources always remained strong in the outer Cook Islands, where local tradition often overrules national laws, but it fell into disuse on the main island Rarotonga half a century ago. Following a few unsuccessful attempts, the Marae Moana Act wants to reinvigorate and support this practice, as the reimplementation of *ra’ui* should also serve to restock the lagoon fish and protect the coral reef communities (Initiative Française pour les Récifs Coralliens, 2008).

To keep large scale DSM activities under control, the Marae Moana Act designates specific zones for nodule collection³⁴.

Moreover, the specific DSM legislation of the Cook Islands – which covers both marine mineral activities within the Cook Islands national jurisdiction, as well as seabed mining in the Area – also contains several provisions that take the visions, interests and well-being of local communities into account (Cook Islands Seabed Minerals Act, 2019). Next to the usual application criteria regarding financial and technical capability³⁵, as well as compatibility with the applicable international rules³⁶, the Seabed Minerals Act for example requires that the proposed seabed mineral activities in the Area are likely to lead to capacity-building, long-term employment or structural economic benefits, and will not result in irreparable harm to any community, environment or cultural practice in the Cook Islands³⁷, which is quite unique in the global landscape of DSM laws (Willaert, 2020c,d).

With regard to DSM activities within national jurisdiction, the Seabed Minerals Act stipulates no license may be granted which is not demonstrably in the national interest, but capacity building, long-term employment and the preservation of cultural practices are not explicitly mentioned as relevant factors in such assessment³⁸.

Although the Seabed Minerals Act does not prescribe an obligatory consultation process for DSM applications in the Area, the Cook Islands Seabed Minerals Authority may at any time and in any way it sees fit consult with experts, interest groups or the general public before making a decision³⁹. With regard to DSM activities within national jurisdiction, a mandatory public consultation process is instituted, specifying that any application shall be notified to the public of the Cook Islands and all remarks and information received must be considered⁴⁰.

To safeguard the interests of the general public, specific provisions to prevent collusion or conflicts of interest are moreover included⁴¹. Due to the recent enactment of the discussed national laws of the Cook Islands, it is very hard to evaluate their merits and effects, but it can arguably be stated that the references to traditional dimensions of seabed resource management and the provisions safeguarding the interests and values of island communities included in the 2017 Marae Moana Act and the 2019 Seabed Minerals Act appear very promising, even if traditional participation is not yet taken into account in the Marae Moana Coordination Office. Moreover, the discussed legislation of the Cook Islands has since been subject to review and public consultation processes and has subsequently been amended, demonstrating willingness to consider the opinion of all stakeholders and act accordingly (Cook Islands Seabed Minerals Amendment Act, 2020).

Papua New Guinea

Papuan colonial and post-colonial history features numerous cases of socio-ecological accidents or conflicts between

²⁵Cook Islands Marae Moana Act, 2017, s. 3(1) and 5(a).

²⁶*Ibid.*, s. 5(a)(ii).

²⁷*Ibid.*, s. 3(2)(b) and 5(b).

²⁸*Ibid.*, s. 9–13.

²⁹*Ibid.*, s. 14–17.

³⁰*Ibid.*, s. 18.

³¹*Ibid.*, s. 3(3)(d), 20 and 23.

³²*Ibid.*, s. 3(2)(c) and 5(d)–(e).

³³*Ibid.*, s. 24 and Schedule 1.

³⁴*Ibid.*, s. 23(1)(c).

³⁵Cook Islands Seabed Minerals Act, 2019, s. 134(2)(a)(ii).

³⁶*Ibid.*, s. 134(2)(b).

³⁷*Ibid.*, s. 134(1)(c).

³⁸*Ibid.*, s. 69(1)(c) and (2).

³⁹*Ibid.*, s. 124.

⁴⁰*Ibid.*, s. 66.

⁴¹*Ibid.*, s. 26(e) and 163.

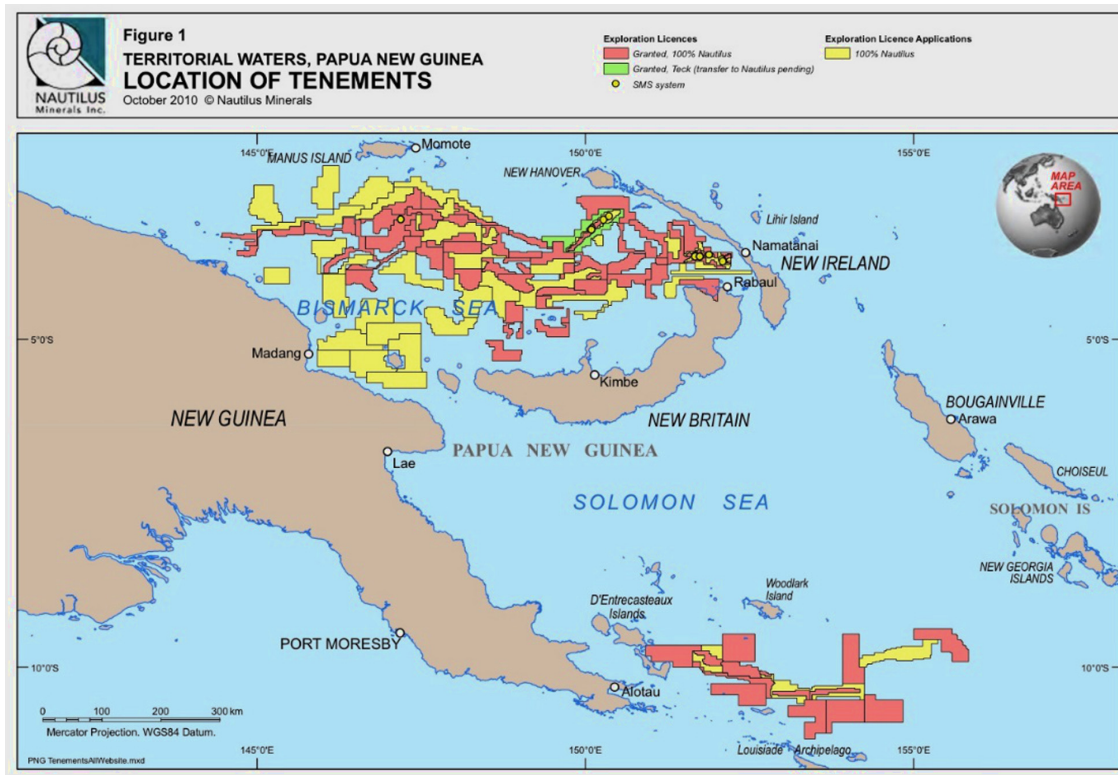


FIGURE 5 | Solwara 1 project is the first proposed DSM area for PNG. Nautilus Tenements in PNG (<https://www.solwaramining.org/>).

indigenous peoples, the State and extractive industries (Navarre and Lammens, 2017; Childs, 2019). Despite that history, PNG has been the first country in the world engaged in DSM within its EEZ and, to invest in a commercial seafloor massive sulfide mining venture (**Figure 5** and **Table 2**). Since 1997, Nautilus Minerals Inc., a Canadian owned company founded in 1987, has been exploring PNG for polymetallic sulfides deposits. It was also the first private company, through its subsidiary Tonga Offshore Mining Ltd. (TOML), with an exploration license in the Area. In 2009, PNG gave the company an environmental permit for the Solwara 1 deposit, followed by a 20-year mining lease to explore mineral-rich hydrothermal vents at the Solwara 1 site obtained in 2011.

The Solwara 1 Project was approved under the Papua New Guinea (PNG) Mining Act (1992) (**Table 2**). Just as there is no special legislation on offshore mining beyond the territorial seas, there is no specific provision on DSM in the Environment Act 2000, such as Strategic Environmental Assessment or Seabed Protection Areas. Enacting a comprehensive legal framework to ensure that DSM activities are sustainably managed is most urgent. The Environment Act 2000 should be interpreted together with the Mining Act 1992 to provide the necessary legal framework to conduct secure DSM activities, for instance to oblige applicants to conduct Environmental Impact Assessment (EIA) in compliance with environmental law standards (Kakee, 2020). The Papua New Guinea (PNG) Environment Act (2000)

categorizes activities that require environmental permits as level 3, because the latter may result in serious environmental harm⁴². Level 3 activities comprise generic mining activities that require the issue of a Special Mining Lease under the Mining Act 1992 (Div. 2). The extensive EIA provisions (Div. 3) apply to such activities and make major amendments to environmental permits.

Shortly after the mining lease was issued, PNG entered into a State Equity Option Agreement with Nautilus Minerals Inc. To exercise its 30% interest option, PNG had to take on a controversial 15% equity stake financed by a loan from the Bank of the South Pacific.

Due to repeatedly delayed payments, the government lost approximately 120 million USD. After having supported the Solwara 1 project for a long time, the government described it as “a total failure” and called, along with other South Pacific governments, for a moratorium on DSM in 2019 (RSC Mining and Mineral Exploitation, 2019). The same year, Nautilus Minerals Inc., in dire financial straits, was restructured and acquired by DSM Finance. It now has full ownership of interests and rights to Solwara 1 and is positioned to lead the project into commercial production.

The Papuan Solwara 1 project demonstrated shortcomings in the traditional dimensions of seabed resource management in the absence of an adequate and up-to-date regulatory framework. It

⁴²PNG Environment Act, s. 42(2)(b).

resulted in public opposition of various forms, including petitions to the government (Rosenbaum, 2011). Criticism has crystallized around the lack of Free, Prior, and Informed Consent (FPIC) of Indigenous Peoples and local communities, as well as the undervalued social and cultural impacts of the project (Table 2).

Pursuant to the Papua New Guinea (PNG) Mining Act (1992)⁴³ and the PNG Environment Act 2000⁴⁴, Nautilus Minerals Inc. has arguably conducted consultations among the coastal communities likely to be impacted by the Solwara 1 project (Earth Economics, 2015). These consultations have been criticized for being biased, too technical and not sufficiently publicized (Blue Ocean Law and Pacific Network on Globalisation, 2016; Navarre and Lammens, 2017). Members of communities nearby the Solwara 1 site often claimed a lack, an ignorance or even a breach of their rights, in particular for not having been consulted about their perspective on DSM and its implications on indigenous culture (*Sensu*, PNG Karkum National Seabed Mining Forum Statement, 2008, §8). Furthermore, according to the local communities, social and cultural impacts of DSM have been disregarded by Nautilus Minerals Inc. The company declared that its mining operations would “have no human impact,” by virtue of being distant at sea (Childs, 2019). According to PNG positive law, it remains unclear whether the EIA, which is not legally defined, includes the social and cultural impacts (Papua New Guinea (PNG), 2004). The PNG Environment Act, 2000 defined the environment and environmental harms holistically as encompassing “people and communities”⁴⁵. Without being landowners *per se* (Filer and Gabriel, 2018), small island communities nearby the Solwara 1, have argued that their relational ontology positions “beings,” “spirits,” and “nature” as co-shapers of *graun* (the world or the cosmos) and not as separate realms (Guilloux, 2018; Childs, 2019)⁴⁶.

Independent studies also highlighted that Nautilus Minerals Inc. failed to properly identify the risks associated with the project and underestimated its impact on local communities (Intercontinental Cry, 2008; Luick, 2012; *contra*, Batker and Rowan, 2015; RSC Mining and Mineral Exploitation, 2019). Paradoxically, Nautilus Minerals Inc. tried to enact different forms of community engagement, based on the need for “a social license to operate” (Baker and Beaudouin, 2013; Childs, 2019).

Other Pacific Island States

Several other Pacific Island States have taken concrete steps toward developing (if not enacting) national legislation governing DSM in their maritime zones as well as in the Area by actors subject to the jurisdiction or control of those Pacific Island States. In Table 2, we assess the degree to which the Pacific Island States—namely the Federated States of Micronesia, Fiji,

Kiribati, the Marshall Islands, Nauru, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu, as well as Cook Islands, PNG presented earlier, incorporate traditional dimensions and considerations into their statutory governance of deep seabed resources. This includes engaging in suitable consultations with Indigenous Peoples and Local Communities (“IPLCs”) whose maritime interests could be impacted by DSM and taking their traditional management of maritime spaces into consideration, as well as securing the Free, Prior, and Informed Consent (“FPIC”) of Indigenous Peoples for extractive DSM activities in relevant domestic maritime zones as well as in the Area (Table 2).

The survey in Table 2 shows that most of the listed Pacific Island States have DSM legislation or policies, many of which stem largely from the SPC-EU DSM Project (Secretariat of the Pacific Community, 2015), either already enacted/adopted or currently in draft form and subject to ongoing national consultations. Approximately half of the legislation surveyed in this sub-section does not contain provisions pertaining to Indigenous rights or other relevant human rights, including FPIC. The other half contains some provisions on FPIC, consultations, and the precautionary approach/principle, although enforceability of such provisions remains questionable. Some of the legislation also references applicable international law standards in connection with the protection of the marine environment (if not DSM specifically), which might sweep in considerations of FPIC, consultations with IPLC, and other Indigenous and human rights, even if they are not explicitly addressed in such legislation (Aguon and Hunter, 2018).

Additionally, although there are references to FPIC and other rights and considerations pertaining to IPLC in the national legislation of several Pacific Island States, there are almost no explicit references to IPLC themselves in such legislation. This is not necessarily a repudiation of IPLC as legitimate populations. The predominant populations in the Pacific Island States whose legislation is reviewed in this section are essentially IPLC already, given their status as descended from the first peoples of those islands. By some accounts, the native inhabitants of Pacific Island States own or have some other customary tenure relationship to at least 80 percent of the land in those States, along with associated marine tenureship (Australian Agency for International Development, 2008). However, as there is no established definition for IPLC in international law, and as rights and considerations such as FPIC are typically tied explicitly to references to IPLC in international law and discourse, the absence of explicit mentions of IPLC in most of the national legislation surveyed in this sub-section is striking and might lead to a less-than-robust appreciation of IPLC in the legislation.

To summarize, to the extent that they address DSM in national legislation or policies, Pacific Island States generally recognize the precautionary principle/approach as well as the applicability of prevailing standards of international law, particularly with regard to averting, minimizing, or remedying harm to the marine environment. Several Pacific Island States explicitly recognize FPIC, including in connection with consultations with potentially affected “marine or coastal users.” However, few of those Pacific Island States also explicitly reference Indigenous Peoples and attendant Indigenous Rights (with the exception of FPIC), which introduces a vagueness in the legislation of those States that could

⁴³Papua New Guinea (PNG) Mining Act, 1992, s. 3.

⁴⁴Papua New Guinea (PNG) Environment Act, 2000, s. 4(i).

⁴⁵*Ibid.*, s. 2.

⁴⁶For example, the inhabitants of *Lavongai* (New Hanover Island) are concerned that they will not be able to join their ancestors after death, as the place where spirits are supposed to pass over is located within the area Nautilus Minerals Inc. had been awarded an exploration lease by the government (Navarre and Lammens, 2017). DSM could also alter the development of shark populations and thereby affect a traditional fishing practice known as “shark calling,” an indigenous rite of passage from PNG in which young men lure sharks from the deep using magic, catch and kill them bare-handed (Messner, 1990).

be exploited to minimize or dismiss the full application of FPIC and similar rights and considerations to IPLC. Accordingly, there will be a need to reshape legal regimes, likely through some legal creativity, to include traditional dimensions of seabed resource management in all of these Pacific Island States solely based on their relevant national DSM legislation and policies. However, the “hooks” are there, if only interested stakeholders utilize them.

DISCUSSION

Traditional Practices in Managing Sustainably the Marine Environment and Natural Resources

Presently, there is a recognition that many science-based sectoral and top-down approaches for managing marine resources have not always adequately protected species, habitats and ecosystems. The customary marine management practices of the Pacific Islands States preceded the development of science-based conservation and resource management and were generally effective since they were evolved by and protected the long-term interests of the resource users. These practices continue to play an important role in the co-management of local marine resources (Johannes, 1978, 2002). Many traditional marine management practices offer selective and flexible restrictions of access and use that can be applied either on their own or together with other science-based tools and approaches such as Ecosystem Based Management (EBM), Environmental Impact Assessments (EIA), Guidelines, Monitoring strategies, permits, the control of techniques or gear. . . These practices can be flexibly applied according to space/location, time/weather conditions and seasons, and can be subject to monitoring and review, making adaptive management possible. They are governed by customary institutions and laws that incorporate local socio-economic considerations (Johannes, 1998; Johannes and Hickey, 2004) and thus continue to play an important role in the co-management of local marine resources (Johannes, 1978, 2002; Doulman, 1993).

Traditionally, Pacific Islanders generally own their coastal resources and can demonstrate their commitment to undertaking resource management activities which are in some cases integrated in national legislation. Therefore, traditional knowledge and community-based marine managed areas have a central role to play in reaching national, regional and international MPA targets, and this role is explicitly recognized in the CBD work program on island biodiversity (CBD, decision VIII/1). The Pacific Island states have collectively established some of the world’s most sophisticated and highly collaborative conservation and management tools in their EEZs. Through the establishment of cooperative capacity building institutions, these island states characterized by minimal institutional capacity and large maritime domains provide an important example of the benefits of regional and sub-regional cooperative approaches.

As many Pacific Island countries are in the beginning stages of the formal implementation of the ecosystem and integrated approaches [Integrated Coastal Zone Management

(ICZM), MSP] as defined by international conventions and processes, there is an opportunity and as this paper shows, a need to take into account the important role of traditional knowledge in such approaches and decision-making processes. Stakeholder participation is a central concept of the ecosystem and integrated approaches which in the case of DSM implies the recognition in domestic law of Indigenous Peoples and local communities as stakeholders or, *a minima*, as holders of a right to participate in decision-making processes. Under customary law, Indigenous Peoples and coastal local communities of the Pacific consider themselves principal rights *holders* as resource owners (or resource custodians) rather than stakeholders. Regardless, Indigenous Peoples and coastal local communities are often underrepresented in national management committees or have their own customary decision-making processes (palavers, pourparlers) concerning the management of customary coastal and marine tenures. For example, the traditional term “ra’ui” and the modern term “Protected Areas” can essentially be considered synonymous in the case of Cook Islands due to the role of its Council of its Traditional Leaders (Koutu Nui). In recent years, traditional owners, island councils, landowners, communities and government have all played roles in establishing and managing Protected Areas. Science based tools such as monitoring, control and surveillance capacity as well as continued education and awareness are important for maintaining support to “ra’ui.” The coral reefs of Polynesia Mana Node (Cook Islands, French Polynesia, Kiribati, Niue, Tokelau, Tonga, and Wallis and Futuna) have a network of MPAs where local populations participate, reviving their culture and traditions as a basis for sustainable reef management. The French Polynesia and Cook Islands Rāhui or Ra’ui is imposed by chiefs on some marine areas, to turn them into temporary no-take zones to protect fish spawning, or to ensure that there is suitable food for upcoming celebrations (Vieux et al., 2004).

The success of traditional marine management by communities combined with science-based tools and approaches in Pacific Islands may help the world find appropriate solutions to conserve cultural and biological diversity and reach the international targets related to conservation and the sustainable use of the biodiversity. Traditional practices are generally accompanied by strategies and resources to support sustainable use, viable livelihoods and equitable sharing of benefits. In several cases, customary laws can provide more diverse and culturally appropriate approaches to enforcement, compliance, monitoring and restitution. The effectiveness of traditional practices is often a reflection of the strength and the viability of the customary law regime. There may also be issues regarding enforcement, the viability of a closed area in the long term, and the roles taken by governments, communities and traditional leaders (Tuquiri, 2001).

Traditional Knowledge and Practices Leading to Sustainable Ocean Management

As traditional knowledge and practices increasingly play central roles in existing intergovernmental ocean management processes,

TABLE 2 | Analysis of the actions taken by Pacific Island States towards developing national legislation and policies governing DSM in their EEZs and in the Area and of the degree to which these States incorporate traditional dimensions.

	DSM legislation	DSM policies/e.g., incorporated in Marine Protected Areas	Degree to which traditional dimensions are incorporated
Cook Islands	The Cook Islands Seabed Minerals Act of 2019 governs both marine mineral activities on the continental shelf of the Cook Islands, as well as seabed mining in the Area.	The Cook Islands Seabed Minerals Act of 2019 complements the Marae Moana Act of 2017, which sets up a multiple-use marine park, including Marine Protected Areas and specific zones for seabed mineral activities.	The 2019 Seabed Minerals Act and the 2017 Marae Moana Act both reflect traditional dimensions and safeguard the interests of local communities by, among others: <ul style="list-style-type: none"> – recognizing the heritage value of the ocean and the connectivity between terrestrial and marine environments; – introducing specific conditions for the award of a sponsorship certificate or license; – promoting transparency and public participation; – designating specific zones as ra'ui areas.
PNG	<p>– Papua New Guinea (PNG) Mining Act, 1992; Under its Article 2 (1)(d), the State owns all mineral resources in any land, in or on the seabed under the archipelagic waters and territorial sea only, which leaves a <i>ratione loci</i> gap even if the State of PNG has sovereign rights for the purpose of exploring and exploiting its natural resources in its EEZ and on its continental shelf pursuant to the UNCLOS (UNCLOS, Art. 56 and 77) to which PNG has been a State party since January 14, 1997.</p> <p>– Papua New Guinea (PNG) Mining (Amendment) Act, 2015; But there is no special legislation on offshore mining beyond the territorial seas.</p> <p>– Papua New Guinea (PNG) Mining (Safety) Act, 1977, the Papua New Guinea (PNG) Mineral resources Authority Act, 2005, the Papua New Guinea (PNG) Environment (Amendment) Act, 2014, the Guidelines for Conduct of Environmental Impact Assessment and Preparation of Environmental Impact Statement 2004 and their respective regulations also primarily apply, but inadequately, to DSM activities.</p> <p>There is no specific provision on DSM such as Strategic Environmental Assessment or Seabed Protection Areas in the Environment Act 2000.</p>		Papua New Guinea (PNG) Mining (Amendment) Act, 2015 has for purpose to promote and support the development of offshore mining in an orderly, sustainable and environmentally and socially responsible manner and to provide for national mapping and identification of customary traditional sea users (SOPAC, 1999).
FSM	FSM Seabed Resources Act (2014) recognizes the duty to “employ best environmental practices in accordance with prevailing international standards in order to avoid, remedy, or mitigate the adverse effects of DSM on the Environment ¹ ” as well as to secure FPIC (including through compensation) “if marine or coastal users likely to be directly adversely affected by DSM Activities ² ” are identified by the relevant governing institution/entity at any time, including through the environmental impact assessment process.		These provisions do not specify Indigenous Peoples or similarly situated local communities, although an argument could be made that such Peoples and communities are included as “marine or coastal users,” especially if the reference to “prevailing international standards” in connection to best environmental practices is interpreted to include FPIC and similar rights afforded to Indigenous Peoples by international law. Such users arguably include native inhabitants of the FSM who engage in instrument-free traditional navigation on the open Ocean, perpetuating a centuries-old practice in the FSM and elsewhere in the Pacific that relies on a keen understanding of marine life and processes (Gladwin, 1970; Feinberg, 1995; Finney, 1998; Lewis, 2017).
Kiribati	The Kiribati Seabed Mineral Act, 2017 echoes the FSM legislation with respect to best environmental practices, prevailing international standards, and FPIC ³		However, the Kiribati legislation defines the “deep seabed” as areas that, among other things, are “beyond reefs and traditional fishing grounds ⁴ ,” which might militate against a full consideration of Indigenous and local maritime interests.

(Continued)

TABLE 2 | Continued

	DSM legislation	DSM policies/e.g., incorporated in Marine Protected Areas	Degree to which traditional dimensions are incorporated
Marshall Islands	The Marshall Islands has not yet enacted DSM legislation, although draft legislation was submitted at cabinet level in June 2015 (Secretariat of the Pacific Community, 2015), with provisions quite similar to those in the legislation for the FSM and Kiribati. The EEZ of the Marshall Islands is proximate to part of the Area situated in the Northwest Pacific where there is currently significant interest in cobalt-rich ferromanganese crusts (International Seabed Authority, 2020c).		Similar to those of the FSM, the native inhabitants of the Marshall Islands have a rich tradition of instrument-free Ocean navigation relying on Indigenous and local knowledge and deep connections to the marine environment (Flood et al., 1999; Gooley, 2016; New York Times Magazine and Tingley, 2016). It is critical for the national legislation to consider fully the interests and views of native inhabitants as the exploration and exploitation of the crusts in the Northwest Pacific could impact the EEZ of the Marshall Islands and the biological diversity and processes on which they rely on for traditional uses. As a first step, the College of the Marshall Islands, non-governmental organizations and local communities have worked together with local governments to strengthen traditional practice, undertake surveys and establish a representative network of marine protected areas.
Nauru	Nauru's International Seabed Minerals Act (2015) references "best environmental practice in accordance with prevailing international standards," including the application of the precautionary principle ⁵ .		The Act does not reference FPIC or IPLC. However, the Act stresses that Nauru cannot impose an "unnecessary, disproportionate or duplicate regulatory burden" on sponsored entities unless those are consistent with UNCLOS, the Rules of the ISA, and "other applicable standards of international law ⁶ ." Such international law standards may arguably include those pertaining to FPIC and other rights of Indigenous Peoples, if not human rights in general.
Palau	Palau does not have dedicated DSM legislation or policies in place	Palau's National Marine Sanctuary Act has relevant language on DSM. It explicitly prohibits the "extraction, disturbance, destruction, removal or alternation of any Sanctuary resource" from 80% of Palau's EEZ ⁷ , with "Sanctuary resource" defined in the Act as "any living or non-living resource ⁸ ."	Palau's national legislation recognizes traditional resource management to protect biodiversity, habitats and natural resources in their network system of protected areas. The Palau National Marine Sanctuary has been described as the modern-day statutory embodiment of the Palauan concept of a <i>bul</i> , which is essentially a traditional closure of marine space in Palauan waters for various reasons, including the revitalization of key marine species in those waters (e.g., Marine Spatial Planning Programme- UNESCO – Palau, 2017). The Act's prohibition on the extraction of non-living resources from approximately 500,000 km ² of Ocean space would seem to comport with traditional management of marine resources in Palauan waters, including concerns about the impacts of DSM on marine life in the water column above Palau's seabed.
Solomon Islands	Solomon Islands promulgated a National Minerals Policy in early 2020 covering the period of 2017 to 2021 (Solomon Islands (S.I.) National Minerals Policy, 2020). The Policy applies to all mineral extraction activities under the jurisdiction or control of Solomon Islands, including DSM.		The Policy is "developed in support of, and in alignment with The United Nations Declaration on the Rights of Indigenous Peoples." The Policy also requires "consultations with communities and stakeholders on the appropriateness of deep-sea mining for Solomon Islands" and establishes an advisory committee made up of "key stakeholders" to assess the impacts of DSM. Significantly, the Policy requires the relevant Ministry to be guided by numerous international obligations and duties, including applying the precautionary approach and the employment of the best environmental practice. "If marine and coastal users likely to be adversely affected by the proposed [DSM] projects are identified at any time, [a DSM] Company will be required to obtain informed consent from those persons, including by way of compensation, prior to those activities." To the extent that "marine or coastal users" include IPLCs, and in light of the applicable international obligations and duties, there appears to be at least an implied regime of FPIC applicable under the Policy. In further support of this, there is evidence that in the Solomon Islands, traditional and modern law combine to protect secret sites for the preservation of sacred species according to the special management based on deity/cultural heroes type rules (Eliade, 1957).
Tonga	Tonga Seabed Minerals Act (2014) requires the application of the precautionary approach ⁹ and the employment of best environmental practice in accordance with "prevailing international standards."		The Act required the securing of FPIC from "marine or coastal users likely to be adversely affected" by DSM activities ¹⁰ . However, it does not explicitly recognize Indigenous Peoples, choosing instead to give the primary DSM authority in Tonga the power to identify the "marine or coastal users" that could be adversely affected by DSM activities, as opposed to allowing those users (which could conceivably include IPLC) to self-identify.

(Continued)

TABLE 2 | Continued

	DSM legislation	DSM policies/e.g., incorporated in Marine Protected Areas	Degree to which traditional dimensions are incorporated
Tuvalu	Tuvalu Seabed Minerals Act (2014) mandates the application of the precautionary approach, the employment of best environmental practice in accordance with prevailing international standards for the avoidance/remediation/mitigation of adverse effects of DSM on the marine environment, and the obtaining of FPIC from “marine or coastal users likely to be adversely affected” by DSM activities ¹¹ .		The Act also establishes an Advisory Council to assist the primary DSM authority in Tuvalu. It mandates that at least one person on the Council must represent “coastal communities of Tuvalu” and one person must represent “women’s interests ¹² .” These direct references to specific community interest groups in Tuvalu, FPIC, and relevant international law augur well for the incorporation of traditional approaches to marine resource management in Tuvalu, even with the lack of an explicit reference to Indigenous Peoples.
Vanuatu	No DSM legislation	A draft DSM Policy, stemming from the SPC-EU DSM Project, has been under consideration since 2014. The draft contains language on consultations with local communities as well as references to rights of Indigenous Peoples, but the draft also characterizes DSM activities as occurring “far offshore” with “minimal” or “negligible” on-land impacts (Vanuatu Deep Seabed Minerals Policy, Vanuatu Deep Seabed Minerals Policy).	Vanuatu has a strong heritage of traditional marine resource management including legally recognized customary marine tenure systems that allow reef custodians to control activities on their fishing grounds. There are traditional seasonal and species closures, tabu areas, behavioral prohibitions, food avoidance, and refugia created as part of the cultural diversity found throughout Vanuatu (Hickey, 2006, 2007; Ruddle and Hickey, 2008).
Fiji	Fiji gazetted its International Seabed Mineral Management Decree in 2013 to regulate and administer Fiji’s engagement in mineral activities in the Area. The action appeared to be in connection to an application by Lockheed Martin for exploration in the Clarion Clipperton Zone, with Fiji poised to be the company’s Sponsoring State, but the application was not approved ¹³ . It remains unclear whether the Decree ever attained the force of law after gazetting, and if so, whether in whole or just in part. Prior to the gazetting of the Decree, Fiji relied on existing land-resource management legislation to govern seabed extractive activities, with slight changes to the legislation to broaden its scope to seabed minerals extraction.	No DSM policies/e.g. incorporated in Marine Protected Areas	The 2013 Decree does not reference IPLCs or Indigenous/traditional knowledge. However, it does require, in Article 27(1)(b)(i), a determination of, among other things, whether proposed seabed mineral activities “will not result in irreparable harm to any community, cultural practice or industry in Fiji.” It also requires, in Article 32(e), all actors engaging in seabed mineral activities to apply the precautionary approach and “employ best environmental practice in accordance with prevailing international standards in order to avoid, mitigate, or remedy adverse effects of Seabed Mineral Activities on the environment.”
Samoa	No DSM legislation	no DSM policies/e.g. incorporated in Marine Protected Areas	same as Fiji

¹FSM Seabed Resources Act, 2014, § 403(a).²Ibid., § 403(d).³Kiribati Seabed Mineral Act, 2017, § 45.⁴Ibid., § 3(1).⁵Nauru’s International Seabed Minerals Act, 2015, § 28(d).⁶Ibid., § 30(d).⁷Palau National Marine Sanctuary Act, 2015, § 149.⁸Ibid., § 102(y).⁹Tonga Seabed Minerals Act, 2014, § 2(e).¹⁰Ibid., § 39(c).¹¹Tuvalu Seabed Minerals Act, 2014, § 45(a) and (d).¹²Ibid., § 30(c).¹³Amie Saiki, SOPAC Expedites New Seabed Mining Legislation for Lockheed Martin, FOREIGN POLICY IN FOCUS, Mar. 20, 2013, http://fpif.org/sopac_expedites_new_seabed_mining_legislation_for_lockheed_martin/.

the international community will appreciate more fully the interactions between traditional knowledge and practices on the one hand, and classic notions of science on the other hand, particularly in connection with the Ocean. In 2017, in the wake of the first World Ocean Assessment of the United Nations in 2016 and its findings on the limited time remaining to manage the ocean sustainably, the United Nations General Assembly, in resolution 72/73, decided to proclaim the decade of 2021–2030 as the United Nations Decade of Ocean Science for Sustainable Development, with a view to ensuring that ocean science is at the heart of sustainable ocean management. To prepare for the Decade, per resolution 72/73, the United Nations General Assembly tasked the Intergovernmental Oceanographic Commission (IOC) of UNESCO to develop—in “consultation with Member States, specialized agencies, funds, programs, and bodies of the United Nations, as well as other intergovernmental organizations, non-governmental organizations and relevant stakeholders”—an Implementation Plan for the Decade for review and endorsement by the United Nations General Assembly (UNGA).

After extensive consultations, including at the Pacific regional level, the IOC released a draft implementation plan in July 2020 for consideration of United Nations Member States (United Nations Educational, Scientific and Cultural Organization/Intergovernmental Oceanographic Commission, 2020). The draft implementation plan, among other things, states that “Ocean science is broad: it encompasses natural and social disciplines [and] local and indigenous knowledge.” Moreover the plan envisions “holders of indigenous and local knowledge... as essential partners of the Decade [who] will contribute to highlighting the multiple cultural values of the ocean,” including through the “co-development, co-design and co-delivery” of key actions for the Decade. It also “embraces local and indigenous knowledge as a key knowledge source” for ocean science; and calls on local, regional, and global initiatives enacted for the Decade to “accommodate forms of knowledge [e.g., indigenous and local knowledge] that may not align with scientific numeration or may require new ways of digital representation of evidence.” UNGA has accepted the Implementation Plan on 31 December 2020 as part of Resolution A/RES/75/239.

While the draft implementation plan for the Decade appears to treat traditional knowledge (or, in the parlance of the plan, “indigenous and local knowledge”) as well as its holders as intrinsic partners alongside classic understandings of ocean science, the draft does define ocean science in a broad manner to include—or at least accommodate—such knowledge, even if such knowledge might not follow classic methods for producing science (e.g., “may not align with scientific numeration”). There is tension in this approach, in which the draft, on the one hand, acknowledges the distinct nature of traditional knowledge that can complement classic ocean science, but on the other hand, tries to sweep traditional knowledge under a larger umbrella of ocean science with other sources of knowledge that might have different approaches to knowledge production and testing. Nevertheless, the draft represents one of the most robust acknowledgments by the

international community of the key role played by traditional knowledge in ocean management at all levels, including regional and global levels.

A possible test of the Decade’s approach to ocean science and traditional knowledge in the context of DSM will likely play out in the interactions between the BBNJ instrument and the work of the ISA. The ISA is mandated by UNCLOS to regulate all activities in the Area but does not have a direct mandate to regulate activities in the water column above the Area; whereas the BBNJ instrument will likely have a mandate to regulate the conservation and sustainable use of marine biological diversity of all ABNJ, including the Area and the water column above the Area (Warner, 2014). However, according to United Nations General Assembly Resolution 72/249—i.e., the enabling resolution for the current intergovernmental conference to adopt the BBNJ instrument—the BBNJ instrument “should not undermine existing relevant legal instruments and frameworks and relevant global, regional and sectoral bodies,” which presumably include the work of the ISA. Also, the ISA is increasingly considering the impacts of activities in the Area on the water column above, including on the biological diversity therein. To what extent can both processes work together without undermining each other?

Traditional knowledge will likely play a role in answering that question. The current revised draft text of the BBNJ instrument (United Nations, 2019)⁴⁷ has numerous references to the applicability and incorporation of the relevant traditional knowledge of IPLC in multiple facets of the instrument. These include in reference to area-based management tools (ABMTs) that will likely be placed in the Area or in the water column above the Area [e.g., in article 16(1) as a basis for the identification of areas needing management, in article 17 on the development of proposals for ABMTs, and in article 18 on consultations for and assessments of ABMT proposals]. Traditional knowledge may also be incorporated in EIAs for planned activities that can potentially impact marine biological diversity of ABNJ (e.g., in article 32 requiring that relevant traditional knowledge of Indigenous Peoples and local communities be used as a basis for the identification and evaluation of impacts in EIAs, in article 34 requiring that holders of relevant traditional knowledge be consulted as stakeholders in the EIA process, and in article 35 requiring that the content of an EIA include a description of potential impacts of an assessed activity). Finally traditional knowledge will be crucial for institutional arrangements under the BBNJ instrument [e.g., in article 49(2) specifying the involvement of experts in relevant traditional knowledge of Indigenous Peoples and local communities in the Scientific and Technical Body established for the BBNJ instrument]. These mentions of such relevant traditional knowledge in the draft BBNJ instrument are typically paired with mentions of the best available scientific information, thus underscoring the complementary role played by such traditional knowledge relative to classic understandings of science.

By contrast, the current draft of the exploitation regulations for the Mining Code of the ISA does not mention traditional

⁴⁷<https://undocs.org/en/a/conf.232/2020/3>

knowledge or its holders at all. It has a few references to sociocultural issues and environments as part of the Annex on Environmental Impact Statements, but they are vague and do not explicitly reference traditional knowledge or its holders. Instead, the draft places major emphasis on classic science, thus setting up a potential conflict with the BBNJ instrument's likely incorporation of traditional knowledge in its regulation of marine spaces and activities that will overlap in some manner with the work of the ISA.

RECOMMENDATIONS

This article has touched upon several elements, which are important to establish and maintain adequate systems and policies with regard to sustainable seabed resource management. Ideally, science-based approaches and traditional perspectives are harmoniously integrated in one coherent and effective approach, embedded in a clear legal framework. However, our analysis has demonstrated the tensions that exist between these aspects, complicating efficient policy-making that is, notably, respectful of indigenous and traditional knowledge. In case of conflicts, it is unclear which of these considerations should be prioritized and translating these methods and ideas into adequate laws and regulations is a difficult task. Moreover, customary rules must be taken into account and national, regional and international legal instruments should be properly aligned, generating additional challenges, as identified through our analysis of cross-scalar legal landscapes. Finally, although embedding the discussed concepts in legal frameworks constitutes a crucial first step, it must be stressed that the law in theory differs from the law in practice. Indeed, without appropriate implementation and enforcement, laws and regulations are just empty words and will not contribute to the integration of traditional dimensions in seabed resource management in the Pacific.

On the international level, the status of the Area and its mineral resources as CHM can be considered a clear reflection of the general idea of collective ownership – including, of course, indigenous ownership – and of mutual conservation objectives. The concept is supported by various rules and principles, including the strict duty to effectively protect the marine environment and the prominent goal of equitable sharing of financial and economic benefits. However, several mechanisms have not yet been operationalized and a lot of work remains to be done. In specific policy areas, a trend toward inclusion of traditional perspectives and due regard for the impact on local communities seems to be developing, but this has not yet been translated into enforceable legal rights and obligations. Furthermore, more transparency and public participation of local communities should be injected in the functioning of the ISA and in the legal regime governing exploration and exploitation activities in the Area.

Despite positive legal developments supporting both the ecosystem and customary-based approaches under the CBD, Indigenous Peoples and local communities, when recognized as such under national laws, remain challenged by the complex operationalization in space and time of DSM activities. Because

custom and traditional commons have always been highly flexible and adaptable, DSM activities fall inside the 'realm' of customary discussion and exchange. With the promotion of scientific knowledge production, the integration of traditional knowledge generated by local communities into multi-actor and multi-scale decision-making processes and governance systems is key for the implementation of the ecosystem approach to DSM. This integration still depends on variable and complex socio-ecological systems. Those systems and circumstances influence and shape the development and implementation of norms, knowledge, innovations, practices, and capacities highly relevant for managing interconnectivity and extensive human activities and ecosystems, such as deep seabed mining and ecosystems, and must therefore be addressed in that regard too.

On the regional level, The Pacific Island states could benefit from combining their resources and expertise on traditional knowledge on ocean matters to include in a regional integrated strategy, such as in the Pacific Islands Regional Ocean Policy and Framework for Integrated Strategic Action (Tuquiri, 2001; Secretariat of the Pacific Community, 2005), for addressing the challenges of DSM, as fostered by Lily (2016), which would include innovations, cooperative planning and the involvement of all stakeholders which would encourage partnerships and collaboration locally and internationally. DSM mitigation responses and adaptations in the Pacific Islands have to be appropriate for each of these nations. Simulations and various scenarios can be applied to explore anticipated impacts.

On the national level, the case studies in this paper have demonstrated that some relevant laws of the Pacific Island states, which are clearly inspired by the regional legislative efforts, try to embed the traditional perspectives and interests of local communities to a certain extent. Cook Islands clearly play a pioneering role in this regard and their recent laws on MSP and seabed resource management can serve as examples for other Pacific Island states. The Cook Islands Marae Moana Act, which lists the conservation of heritage values of the marine environment as one of its primary objectives, starts from the idea of an 'ocean sanctuary' and reinforces this concept through several deliberate measures, including involvement of the general public and thoughtful spatial planning, enabling the reinvigoration of traditional resource management systems, such as the designation of ra'ui areas. The specific DSM legislation of the Cook Islands equally contains additional criteria to evaluate a sponsorship application, which promotes capacity-building and long-term employment and prevents irreparable harm to local communities or cultural practices.

Several other Pacific Island States have taken concrete steps toward developing national legislation governing DSM in their maritime zones such as Fiji, Tonga, Tuvalu and Kiribati. Some others, such as Papua New Guinea, demonstrate the dire necessity to reform the national legal and institutional framework for deep-sea mining in accordance with international conventions to which they are Parties. This also implies accommodating such a framework with the traditional values, needs and practices of Island communities and ultimately, securing scientific and DSM activities, as well as related foreign investments, based on trust and transparency.

The actionable recommendations are the following:

- As most oceanian cultures do not assert human dominion over the ocean but rather, formulate it in terms of responsibilities, it is important to recognize the cultural and social values attached to traditional knowledge and practices related to marine ecosystems and seabed resource management through national legislation and ISA regulations. Therefore, risk assessment measures prior to DSM exploration should include this particular relation of Pacific islanders' traditions to their environment through a precautionary approach.
- Scientific knowledge should be gathered, and when agreed upon by local and traditional communities, traditional knowledge related to marine ecosystems and seabed resource should be integrated into management bodies in the region.
- The Ecosystem approach perspective should be analyzed through the lens of natural resources functioning and management and traditional practices should be promoted in its implementation.
- Because custom and traditions about resource management in the Pacific fundamentally rely on reciprocal relationships, it is crucial to foster an adaptive context-based socio-ecological governance that relies on the active participation of local and traditional communities in decision-making, as well as in implementation of DSM projects.
- The holistic approach should be envisioned as continually changing with the variability of socio-ecological factors, one reason for which implementation of seabed resource management should be adaptive and progressive.
- As most customs in the Pacific are centered around the concept of responsibility established with respect to the ocean and its many inclusive entities, it is important, to foster positive learning and sharing of marine ecosystems, in particular those related to the deep sea resource management and traditional dimensions at a regional level.
- This holistic approach should be replicated, integrating deep sea ecosystem functioning and seabed resource

management and traditional practices, in applying traditional knowledge to MSP and management in DSM projects in other oceanic regions in the world.

AUTHOR CONTRIBUTIONS

VT worked on the deep sea mineral resources and associated ecosystems, impact assessments on the seabed and water column, socio-ecological perspectives integrated in ocean governance. KW worked on the legal aspects at all levels. BG worked on the legal aspects at all levels, and the socio-ecological dimension of ocean governance. FG and TB contributed on the traditional perspectives in area based management in the Pacific Islands. WC worked on socio-economic aspects of DSM. CM worked on the legal aspects at all levels, international and national as well as the traditional perspectives of Pacific Island countries. KP contributed with human geography. AD worked overall on the text in particular in the context, the ecosystems and traditional sections, and the discussions and conclusions. All the authors contributed to the article and approved the submitted version.

FUNDING

The full cost of submission has been supported by personal funding from the authors.

ACKNOWLEDGMENTS

This publication is based upon work from COST ACTION CA15217-Ocean Governance for Sustainability-challenges, options and the role of science, supported by COST (European Cooperation in Science and Technology, www.cost.eu). BG's contribution is supported by ISblue Project, Interdisciplinary Graduate School for the Blue Planet (ANR-17-EURE-0015) and co-funded by a grant from the French Government under the program "Investissements d'Avenir."

REFERENCES

- Aburto, J. A., Gaymer, C. F., and Govan, H. (2020). A large-scale marine protected area for the sea of Rapa Nui: from ocean grabbing to legitimacy. *Ocean Coastal Manag.* 198:105327. doi: 10.1016/j.ocecoaman.2020.105327
- Aguon, J., and Hunter, J. (2018). Second wave due diligence: the case for incorporating free, prior, and informed consent into the deep sea mining regulatory regime. *Stanford Environ. Law J.* 38, 3–55.
- Australian Agency for International Development (2008). *Making Land Work: Reconciling Customary Land and Development in the Pacific, 2008*, Vol. 1. Canberra: Australian Agency for International Development.
- Baker, E., and Beaudouin, Y. (2013). "Deep Sea Minerals: Sea-Floor Massive Sulphides, a physical, biological, environmental and technical review," in *Ed. Secretariat of the Pacific Community*, Vol. 1A, eds E. Baker and Y. Beaudouin (Noumea: Secretariat of the Pacific Community).
- Bambridge, T. (2016). *Rāhui: Legal Pluralism in Polynesian Traditional Management of Resources and Territories*. Canberra: Pacific Series. Australian National University Press, 269.
- Bambridge, T., Gaulme, F., Montet, C., and Paulais, T. (2019). *Communs et océans. Le Rāhui en Polynésie*. Papeete: Au vent des îles, 175.
- Batker, D., and Rowan, S. (2015). *Environmental and Social Benchmarking Analysis of Nautilus Inc. Solwara 1 Project. Report. May. Nautilus Document Reference SL01-NMN-XEE-RPT-0180-A*. Tacoma, WA: Earth Economics.
- Beaulieu, S. E. (2010). *InterRidge Global Database of Active Submarine Hydrothermal Vent Fields: Prepared for InterRidge, Version 2.0*. World Wide Web Electronic Publication.
- Beurier, J.-P. (2021). *Droits maritimes*. Paris: Dalloz, 1824.
- Block, B. A., Jonsen, I. D., Jonsen, S. J., Winship, A. J., Schaefer, S. A., and Bograd, S. J. (2011). Tracking apex marine predator movements in a dynamic ocean. *Nature* 475, 86–90. doi: 10.1038/nature10082
- Blue Ocean Law and Pacific Network on Globalisation (2016). *Blue Ocean Law and Pacific Network on Globalisation Release Legal Analysis*

- of SPC-EU Regional Legislative and Regulatory Framework-Call for Greater Indigenous and Environmental Safeguards. Available online at: <https://pasifikaaffairs.wordpress.com/blue-ocean-law/> (accessed March 10, 2021).
- Bourdieu, P. (1977). *Outline of a Theory of Practice*. Cambridge: Cambridge University Press, 236. doi: 10.1017/CBO9780511812507
- Bourdieu, P. (1980). *Le Sens Pratique*. Paris: Les Editions de Minuit, 480.
- Bourrel, M. (2015). "Protection and preservation of the marine environment from seabed mining activities on the continental shelf: perspectives from the pacific islands region," in *Research Handbook on International Marine Environmental Law Research Handbooks in Environmental Law series*, ed. R. Rayfuse (Cheltenham: Elgar Publishing), 206–226. doi: 10.4337/9781781004777.00019
- Bourrel, M., Thiele, T., and Currie, D. (2018a). The common of heritage of mankind as a means to assess and advance equity in deep sea mining. *Mar. Policy* 95, 311–316. doi: 10.1016/j.marpol.2016.07.017
- Bourrel, M., Swaddling, A., Atalifo, V., and Tawake, A. (2018b). Building in-country capacity and expertise to ensure good governance of the deep sea minerals industry within the Pacific region. *Mar. Policy* 95, 372–379. doi: 10.1016/j.marpol.2017.03.022
- Bradley, M., and Swaddling, A. (2018). Addressing environmental impact assessment challenges in Pacific island countries for effective management of deep-sea minerals activities. *Mar. Policy* 95, 356–362. doi: 10.1016/j.marpol.2016.06.017
- Brouwer, S., Piling, G., Hampton, J., Williams, P., Vincent, M., and Peatman, T. (2018). *Oceanic Fisheries Programme. Tuna Fisheries Assessment Report no 19*. Noumea, NC: Pacific Community.
- Cardno Limited (2016). *An Assessment of the Costs and Benefits of Mining Deep-sea Minerals in the Pacific Island Region. Deep-sea Mining Cost-Benefit Analysis*. Noumea, NC: Pacific Community.
- Childs, J. (2019). Greening the blue? Corporate strategies for legitimising deep sea mining. *Polit. Geogr.* 74:102060. doi: 10.1016/j.polgeo.2019.102060
- Convention on Biological Diversity (1992). Available online at: https://treaties.un.org/doc/Treaties/1992/06/19920605%2008-44%20PM/Ch_XXVII_08p.pdf (accessed March 10, 2021).
- Convention on Biological Diversity (CBD), (Conference of the Parties) COP (2000). Fifth Meeting, Decision V/6 The Ecosystem Approach, Secretariat of the Convention on Biological Diversity, Montreal. Available online at: www.cbd.int/decision/cop/?id=7148 (accessed March 10, 2021).
- Convention on Biological Diversity (2007). Guidelines and Lessons Learned for the Application of the Ecosystem Approach to Protected Areas in Small Islands. In UNEP/CBD/WS-EA-PA Islands/1/2 - Report of the Workshop on the Ecosystem Approach and Customary Practice in Protected Areas in Small Islands. Bangkok, 12-16 December 2006. Available online at: <https://www.cbd.int/doc/meetings/island/wseapasi-01/official/wseapasi-01-02-en.pdf> (accessed March 10, 2021).
- Cook Islands Marae Moana Act (2017). Available online at: www.seabedmineralsauthority.gov.ck/s/Marae-Moana-Act-2017.pdf (accessed 13 July 2017).
- Cook Islands Seabed Minerals Act (2019). Available online at: www.sbma.gov.ck/ci-sbma (accessed 17 June 2019).
- Cook Islands Seabed Minerals Amendment Act (2020). Available online at: <https://www.sbma.gov.ck/s/OFFICIAL-Seabed-Minerals-Amendment-Act-2020.pdf> (accessed 30 June 2020).
- Cowell, R. (2003). Substitution and scalar politics: negotiating environmental compensation in Cardiff Bay. *Geoforum* 34, 343–358. doi: 10.1016/s0016-7185(02)00081-7
- Creason, A. M. (2004). Culture clash: the influence of indigenous cultures on the international whaling regime. *Calif. West. Int. Law* 35, 83–126.
- Dahl, A. L., and Carew-Reid, J. (1985). "Environment and resources in the pacific: a regional approach," in *UNEP Regional Seas Reports and Studies*, Vol. 69, eds A. L. Dahl and J. Carew-Reid (Geneva: United Nations Environment Programme), 17.
- D'Arcy, P. (2006). *The People of the Sea: Environment, Identity and History in Oceania*. Honolulu: University of Hawai'i Press, 312.
- D'Arcy, P. (2013a). The nourishing sea: partnered guardianship of fishery and seabed mineral resources for the economic viability of small pacific island nations. *Sustainability* 5, 3346–3367. doi: 10.3390/su5083346
- D'Arcy, P. (2013b). "Seabed mining and oceania: imminent resource bonanza or resource curse writ large?," in *L'eau dans le Pacifique Sud: Entre mythe et Réalités*, eds C. Berger and J.-L. Roques (Paris: L'Harmattan), 205–219.
- De Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., et al. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosyst. Serv.* 1, 50–61. doi: 10.1016/j.ecoser.2012.07.005
- Doherty, B. (2019). *Collapse of PNG Deep-Sea Mining Venture Sparks Calls for Moratorium*. Kings Place: The Guardian. Available online at: <https://www.theguardian.com/world/2019/sep/16/collapse-of-png-deep-sea-mining-venture-sparks-calls-for-moratorium>
- Douglas, O. (1974). *Ancient Tahitian Society*, Vol. 3. Honolulu, HI: Hawaii University Press, 1419. doi: 10.2307/j.ctvp2n5ds
- Doulman, D. J. (1993). Community-based fishery management: towards the restoration of traditional practices in the South Pacific. *Mar. Policy* 17, 108–117. doi: 10.1016/0308-597X(93)90025-X
- DSM Observer (2017). *DeepSea Mining from a Pacific Island State Perspective*. Available online at: <http://dsmobserver.com/2017/11/deep-sea-mining-paullynch/> (accessed March 10, 2021).
- Dymest, J., Lallier, F., Le Bris, N., Rouxel, O., Sarradin, P.-M., Lamare, S., et al. (2014). *Les impacts environnementaux de l'exploitation des ressources minérales marines profondes. Expertise scientifique collective*. Brest: CNRS-IFREMER, 930.
- Earth Economics (2015). Environmental and social benchmarking analysis of Nautilus Minerals Inc. Solwara 1 Project. Prepared for Nautilus Minerals. Earth-Economics-Environmental-Social-Benchmarking-Solwara-1-2015.pdf. Available online at: <https://mining.com/wp-content/uploads/2015/06/Earth-Economics-Environmental-Social-Benchmarking-Solwara-1-2015.pdf> (accessed March 11, 2021).
- Eckstein, L., and Schwarz, A. (2019). The making of Tupaia's map: a story of the extent and mastery of polynesian navigation, competing systems of wayfinding on James Cook's endeavour, and the invention of an ingenious cartographic system. *J. Pacific History* 54, 1–95. doi: 10.1080/00223344.2018.1512369
- Eliade, M. (1957). *The Sacred and the Profane: the Nature of Religion*. New York, NY: Harcourt Brace.
- Ey, M., and Sherval, M. (2016). Exploring the minescape: engaging with the complexity of the extractive sector: exploring the minescape. *Area* 48, 176–182. doi: 10.1111/area.12245
- FSM Seabed Resources Act (2014). Available online at: https://www.ffa.int/system/files/Marine_Resources_Act_2002_%5BTtitle_24%5D_0.pdf (accessed March 11, 2021).
- Feinberg, R. (1995). *Seafaring in contemporary Pacific Islands: Studies in Continuity and Change*. DeKalb, IL: Northern Illinois University Press, 237.
- Filer, C., and Gabriel, J. (2018). How could Nautilus Minerals get a social licence to operate the world's first deep sea mine? *Mar. Policy* 95, 394–400. doi: 10.1016/j.marpol.2016.12.001
- Finney, B. (1998). Voyage to Polynesia's land's end. *Antiquity* 75, 172–181. doi: 10.1017/S0003598X0005287X
- Firestone, J., and Lilley, J. (2007). Aboriginal Subsistence Whaling and the Right to Practice and Revitalize cultural traditions and customs. *J. Int. Wildlife Law Policy*. 8, 177–219. doi: 10.1080/13880290590965339
- Firth, R. (1936). *We, the Tikopia: A Sociological Study of Kinship in Primitive Polynesia*. Milton Park: Taylor & Francis, 605.
- Fisheries and Aquaculture Department (2000). *Biological Characteristics of Tuna*. Text by Michel Goujon and JacekMajkowski. Available online at: <http://www.fao.org/fishery/topic/16082/en> (accessed November 30, 2010).
- Flood, N. B., Strong, B. E., and Flood, W. (1999). *Pacific Island Legends: Tales from Micronesia, Melanesia, Polynesia and Australia*. Honolulu, HI: Bess Press, 266.
- Frakes, J. (2003). The common heritage of mankind principle and the deep seabed, outer space, and Antarctica: will developed and developing nations reach a compromise? *Wisconsin Int. Law J.* 21, 409–434.
- Franckx, E. (2010). The international seabed authority and the CHM: the need for states to establish the outer limits of their continental shelf. *Int. J. Mar. Coastal Law* 25, 543–567. doi: 10.1163/157180810X525377
- Gladwin, T. (1970). *East is a Big Bird: Navigation and Logic on Puluwat atoll*. Cambridge, MA: Harvard University Press, 241.
- Global Sea Mineral Resources (2019). *GSR and the Cook Islands Investment Corporation Finish Their First Exploration Campaign*. Available online

- at: <https://www.deme-gsr.com/news/article/gsr-and-the-cook-islands-investment-corporation-finishes-their-first-exploration-campaign/> (accessed March 11, 2021).
- Glover, A., and Smith, C. (2003). The deep-sea floor ecosystem: current status and prospects of anthropogenic change by the year 2025. *Environ. Conserv.* 30, 219–241. doi: 10.1017/S0376892903000225
- Godelier, M. (1990). *The Making of Great Men: Male Domination and Power Among the New Guinea Baruya*. Cambridge: Cambridge University Press, 255.
- Gooley, T. (2016). *How to Read Water. Clues and Patterns from Puddles to the Sea*. London: Hodder & Stoughton, 376.
- Guilloux, B. (2018). *Marine Genetic Resources, R&D and the Law 1: Complex objects of Use*. London: Wiley, doi: 10.1002/9781119451396
- Guntrip, E. (2003). The CHM: an adequate regime for managing the deep seabed. *Melb. J. Int. Law* 2003, 376–405.
- Haas, P. M. (1992). Introduction: epistemic communities and international policy coordination international organization. *Knowl. Power Int. Policy Coord.* 46, 1–35. doi: 10.1017/s0020818300001442
- Hannington, M. D., Jamieson, J., Monecke, Y., and Peterson, S. (2010). Modern sea floor massive sulphides and base metal resources: toward an estimate of global sea-floor massive sulphide potential. *Soc. Econ. Geol. Special Publication* 15, 317–338.
- Hannington, M. D., Jamieson, J., Monecke, Y., Peterson, S., and Beaulieu, S. (2011). The abundance of seafloor massive sulphide deposits. *Geology* 39, 115–1158. doi: 10.1130/G32468.1
- Hardin, G. (1968). The tragedy of commons. *Science* 162, 1243–1248. doi: 10.1126/science.162.3859.1243
- Hau'ofa, E. (1994). Our sea of islands. *Contemp. Pacific J. Island Aff.* 6, 148–161.
- Hau'ofa, E. (2008). *We Are the Ocean: Selected Works*. Honolulu: University of Hawaii Press, 188.
- Havice, E., and Zalik, A. (2019). Ocean frontiers: epistemologies, jurisdictions, commodifications. *Int. Soc. Sci. J.* 68, 219–235. doi: 10.1111/issj.12198
- Hein, J. R., and Koschinsky, A. (2014). “Deep-ocean ferromanganese crusts and nodules,” in *Treatise on Geochemistry*, Chapter 11, ed. S. Scott (Amsterdam: Elsevier), 273–291. doi: 10.1016/b978-0-08-095975-7.01111-6
- Hein, J. R., Mizell, K., Koschinsky, A., and Conrad, T. (2013). Deep-ocean mineral deposits as a source of critical metals for high-and green-technology applications : comparison with land-based resources. *Ore Geol. Rev.* 51, 1–14. doi: 10.1016/j.oregeorev.2012.12.001
- Hein, J. R., Spinardi, F. S., Okamoto, N., Mizell, K., Thorburn, D., and Tawake, A. (2015). Critical metals in manganese nodules from the Cook Islands EEZ, abundances and distributions. *Ore Geol. Rev.* 68, 97–116. doi: 10.1016/j.oregeorev.2014.12.011
- Hickey, F. R. (2006). Traditional marine resource management in Vanuatu: acknowledging, supporting and strengthening indigenous management systems. *SPC Tradit. Mar. Resour. Manag. Knowledge Inf. Bull.* 20, 11–23.
- Hickey, F. R. (2007). “Traditional marine resource management in Vanuatu: World views in transformation,” in *Coastal Management*. Source 4, eds N. Haggan, B. Nels, and I. G. Baird (Paris: UNESCO), 147–168.
- Holden, E., Linnerud, K., and Banister, D. (2014). Sustainable development: our common future revisited. *Global Environ. Change* 26, 130–139. doi: 10.1016/j.gloenvcha.2014.04.006
- Hoyt, E. (1995). *The Worldwide Value and Extent of Whale Watching*. Bath: Whale and Dolphin Conservation Society, 1–36.
- Hviding, E., and Baines, G. B. K. (1992). *Fisheries Management in the Pacific: Tradition and the Challenges of Development in Marovo, Solomon Islands*. UNRISD Discussion Paper (32). Geneva: United Nations Research Institute for Social Development.
- Initiative Française pour les Récifs Coralliens (2008). *Rapport D'activité 2008 de l'IFRECOR. Initiative Française Pour Les Récifs Coralliens*. Réunion: Initiative Française pour les Récifs Coralliens, 46.
- Intercontinental Cry (2008). *Indigenous Communities Oppose Deep Sea Mining*. Winnipeg, MB: Intercontinental Cry.
- IPCC SROCC (2019). Available online at: https://www.ipcc.ch/site/assets/uploads/sites/3/2019/12/SROCC_FullReport_FINAL.pdf (accessed March 11, 2021).
- International Seabed Authority (2010). *Regulations on Prospecting and Exploration for Polymetallic Sulphides in the Area*. Kingston: International Seabed Authority.
- International Seabed Authority (2011a). *Decision of the Council Relating to a Request for Approval of a Plan of Work for Exploration for Polymetallic Nodules Submitted by Tonga Offshore Mining Limited*. Kingston: International Seabed Authority.
- International Seabed Authority (2011b). *Decision of the Council Relating to a Request for Approval of a Plan of Work for Exploration for Polymetallic Nodules Submitted by Nauru Ocean Resources Inc*. Kingston: International Seabed Authority.
- International Seabed Authority (2012a). *Decision of the Council Relating to a Request for Approval of a Plan of Work for Exploration for Polymetallic Nodules Submitted by Marawa Research and Exploration Ltd*. Kingston: International Seabed Authority.
- International Seabed Authority (2012b). *Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts in the Area*. Kingston: International Seabed Authority.
- International Seabed Authority (2012c). *Decision of the Council of the International Seabed Authority Relating to a Request for Approval of a Plan of Work for Exploration for Polymetallic Nodules Submitted by G-TEC Sea Mineral Resources NV*. Kingston: International Seabed Authority.
- International Seabed Authority (2013a). *Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area*. Kingston: International Seabed Authority.
- International Seabed Authority (2013b). *Application for Approval of a Plan of Work for exploration for Polymetallic Nodules by the Cook Islands Investment Corporation*. Kingston: International Seabed Authority.
- International Seabed Authority (2014a). *ISA Web GIS Application*. Kingston: International Seabed Authority.
- International Seabed Authority (2014b). *Decision of the Council Relating to an Application for the Approval of a Plan of Work for Exploration for Polymetallic Nodules Submitted by the Cook Islands Investment Corporation*. Kingston: International Seabed Authority.
- International Seabed Authority (2019a). *Draft Regulations on Exploitation of Mineral Resources in the Area*. Kingston: International Seabed Authority.
- International Seabed Authority (2019b). *Draft regulations on Exploitation of Mineral Resources in the AREA - Collation of Specific Drafting Suggestions by Members of the Council*. Kingston: International Seabed Authority.
- International Seabed Authority (2020a). *Proposal for a Template with Minimum Requirements for Regional Environmental Management Plans: A Proposal for a Standardized Approach*. Kingston: International Seabed Authority.
- International Seabed Authority (2020b). *Decision of the Council Concerning a Standardized Approach for the Development, Approval and Review of Regional Environmental Management Plans in the Area*. Kingston: International Seabed Authority.
- International Seabed Authority (2020c). Available online at: <https://www.isa.org.jm/event/workshop-regional-environmental-management-plan-area-northwest-pacific> (accessed March 11, 2021).
- International Seabed Authority (2020d). Summary of the 26th annual session of the international seabed authority (First Part). *Earth Negot. Bull.* 25, 17–21.
- International Union for Conservation of Nature (2018). *The Journey of Cook Islands: Marae Moana*. Available online at: <https://www.iucn.org/news/oceania/201806/journey-cook-islands-marae-moana> (accessed March 11, 2021).
- Jaekel, A., Ardron, J. A., and Gjerde, K. M. (2016). Sharing benefits of the common heritage of mankind – Is the deep seabed mining regime ready? *Mar. Policy* 70, 198–204. doi: 10.1016/j.marpol.2016.03.009
- Johannes, R. E. (1978). Traditional marine conservation methods in Oceania and their demise. *Ann. Rev. Ecol. Syst.* 9, 349–364. doi: 10.1146/annurev.es.09.110178.002025
- Johannes, R. E. (1981). *Words of the Lagoon: Fishing and Marine Law in the Palau District of Micronesia*. Berkeley: University of California Press, 245.
- Johannes, R. E. (1998). The case for data-less marine resources management: examples from tropical nearshore fisheries. *Trends Ecol. Evol.* 13, 243–246. doi: 10.1016/S0169-5347(98)01384-6
- Johannes, R. E. (2002). The renaissance of community-based marine resource management in Oceania. *Annu. Rev. Ecol. Syst.* 33, 317–340. doi: 10.1146/annurev.ecolsys.33.010802.150524
- Johannes, R. E., and Hickey, F. R. (2004). *Evolution of Village-based Marine Resource Management in Vanuatu between 1993 and 2001*. *Coastal Region and Small Island Papers*, 15. Paris: UNESCO.

- Kakee, T. (2020). Deep-sea mining legislation in Pacific Island countries: from the perspective of public participation in approval procedures. *Mar. Policy* 117:103881. doi: 10.1016/j.marpol.2020.103881
- Kent, G. (1980). *The Politics of Pacific Islands Fisheries*. Boulder, CO: Westview Press.
- Kingsford, R. T., Watson, J. E. M., Lundquist, C. J., Venter, O., Hughes, L., Johnston, E. L., et al. (2009). Major conservation policy issues for biodiversity in Oceania. *Conserv. Biol.* 23, 834–840. doi: 10.1111/j.1523-1739.2009.01287.x
- Kirch, P. (2010). *How Chiefs Became Kings: Divine Kingship and the Rise of Archaic States in Ancient Hawai'i*. Los Angeles: University of California Press, 275.
- Kiribati Seabed Mineral Act (2017). Available online at: kiribati.tradeportal.org/Regulations/Details?lawId=70&l=en (accessed March 11, 2021).
- Le Meur, P.-Y., Bambridge, T., Degrémont, M., and Rodary, E. (2018). Les espaces marins du Pacifique entre logiques de communs et d'accaparement. *Revue Internationale des Études du Développement* 234, 9–30. doi: 10.3917/RIED.234.0009
- Le Meur, P.-Y., Cochonat, P., David, C., Geronimi, V., and Samadi, S. (2016). *Les Ressources Minérales Profondes en Polynésie Française*. Marseille: IRD Éditions, 288. doi: 10.4000/books.irdeditions.9540
- Levin, L., Mengerink, K., Gjerde, K., Rowden, A., Van Dover, C. L., Clark, M. R., et al. (2016). Defining « serious harm » to the marine environment in the context of deep-seabed mining. *Mar. Policy* 74, 245–259. doi: 10.1016/j.marpol.2016.09.032
- Levin, L., Baker, M., and Thompson, A. (2018). *Deep-Ocean Climate Change Impacts on Habitat, Fish and Fisheries*. Rome: FAO, 166.
- Lewis, D. (2017). *We the Navigators: The Ancient Art of Landfinding in the Pacific*. Wellington, NZ: A.H. and A.W. Reed LTD, 360.
- Lily, H. (2016). A regional deep-sea minerals treaty for the Pacific Islands? *Mar. Policy* 70, 220–226. doi: 10.1016/j.marpol.2016.04.005
- Luick, J. (2012). *Physical Oceanographic Assessment of the Nautilus EIS for the Solwara 1 Project. Report prepared for the DSM Campaign in Papua New Guinea*. Collingwood, VIC: Affiliated with friends of the Earth Australia.
- McCormack, G. (2016). *Cook Islands Seabed Minerals. A Precautionary Approach to Mining*. Rarotonga: Cook Islands Natural Heritage Trust, 33.
- Malinowski, B. (1935). *Coral Gardens and their Magic*. London: George Allen and Unwin.
- Mallin, M., Stolz, D., Thompson, B., and Barbesgaard, M. (2019). In oceans we trust: conservation, philanthropy, and the political economy of the Phoenix Islands Protected Area. *Mar. Policy* 107, 103421. doi: 10.1016/j.marpol.2019.01.010
- Mara, R. K. (1997). *The Pacific Way: A Memoir*. Honolulu, HI: University of Hawaii Press, 298.
- Mason, M. (2003). Civil liability for oil pollution damage: examining the evolving scope for environmental compensation in the international regime. *Mar. Policy* 27, 1–12. doi: 10.1016/s0308-597x(02)00051-9
- Mawyer, A., and Jacka, J. K. (2018). Sovereignty, conservation and island ecological futures. *Environ. Conserv.* 45, 238–251. doi: 10.1017/S037689291800019X
- Messner, G. F. (1990). The shark-calling ceremony in Paruai, New Ireland, Papua New Guinea. *World Music* 32, 49–83. doi: 10.2307/43561243
- Miller, K., Thompson, K., Johnston, P., and Santillo, D. (2018). An overview of seabed mining including the current state of development, environmental impacts, and knowledge gaps. *Front. Mar. Sci.* 4:418. doi: 10.3389/fmars.2017.00418
- Nauru's International Seabed Minerals Act (2015). Available online at: https://isa.org/jm/files/documents/EN/NatLeg/Nauru_ISM.pdf
- Navarre, M., and Lammens, H. (2017). *Opportunities of Deep-Sea Mining and ESG risks. Amundi Discussion Papers Series*. DP-24-2017. Available online at: <https://research-center.amundi.com/page/Publications/Discussion-Paper/2017/Opportunities-of-deep-sea-mining-and-ESG-risks?search=true> (accessed March 10, 2021).
- New York Times Magazine, and Tingley, K. (2016). *The Secrets of the Wave Pilots*. Available online at <https://www.nytimes.com/2016/03/20/magazine/theseecrets-of-the-wave-pilots.html> (accessed March 10, 2021).
- Noyes, J. E. (2012). The common heritage of mankind: past, present, and future. *Denver J. Int. Law Policy* 40, 447–471.
- O'Connor, E., Hynes, S., and Chen, W. (2020a). Estimating the non-market benefit value of deep-sea ecosystem restoration: evidence from a contingent valuation study of the Dohrn Canyon in the Bay of Naples. *J. Environ. Manag.* 275, 1–11. doi: 10.1016/j.jenvman.2020.111180
- O'Connor, E., Hynes, S., Chen, W., Papadopoulou, N., and Smith, C. (2020b). Investigating societal attitudes towards marine ecosystem restoration. *Restor. Ecol.* doi: 10.1111/rec.13239
- Oliver, G. L. (1974). *Ancient Tahitian Society*, Vol. 2. Honolulu, HI: University of Hawai'i Press, 579–1169.
- Oude Elferink, A. G. (2007). The regime of the area: delineating the scope of application of the common heritage principle and freedom of the high seas. *Int. J. Mar. Coastal Law* 22, 143–176. doi: 10.1163/157180807781475272
- Pacific Community (2012). *Coastal Fisheries and Climate Change: Policy Brief 16*. Noumea, NC: Pacific Community.
- Palau National Marine Sanctuary Act (2015). Available online at: www.informea.org/fr/node/192099 (accessed March 11, 2021).
- Papua New Guinea (PNG) Environment Act (2000). Available online at: http://www.paclii.org/pg/legis/consol_act/ea2000159/ (accessed March 10, 2021).
- Papua New Guinea (PNG) Environment (Amendment) Act (2014). Available online at: <http://extwprlegs1.fao.org/docs/pdf/png147641.pdf> (accessed March 10, 2021).
- Papua New Guinea (PNG) (2004). *Guidelines for Conduct of Environmental Impact Assessment and Preparation of Environmental Impact Statement*. Available online at: <http://www.pngcepa.com/wp-content/uploads/2018/07/Information-Guideline-EIA-EIS.pdf> (accessed March 10, 2021).
- PNG Karkum National Seabed Mining Forum Statement (2008). *Indigenous Communities Oppose Deep Sea Mining. Statement Expressed on June 25-27th 2008*. Available online at: <https://intercontinentalcry.org/indigenous-communities-oppose-deep-sea-mining> (accessed March 10, 2021).
- Papua New Guinea (PNG) Mining Act (1992). Available online at: http://www.paclii.org/pg/legis/consol_act/ma199281/ (accessed March 10, 2021).
- Papua New Guinea (PNG) Mining (Amendment) Act (2015). Available online at: <http://www.parliament.gov.pg/index.php/bills-and-legislation/view/mining-amendment-act-2015> (accessed March 10, 2021).
- Papua New Guinea (PNG) Mining (Safety) Act (1977). Available online at: http://www.paclii.org/pg/legis/consol_act/ma1977151/ (accessed March 10, 2021).
- Papua New Guinea (PNG) Mineral resources Authority Act (2005). Available online at: http://www.paclii.org/pg/legis/num_act/mraa2005328.pdf (accessed March 10, 2021).
- Pettersson, M. G. (2008). Minerals sustainability, emerging economies, the developing world, and the truth behind the rhetoric. *Est. J. Earth Sci.* 57, 57–74. doi: 10.3176/earth.2008.2.01
- Pettersson, M. G., and Tawake, A. (2016). “Toward inclusive development of the Pacific region using geoscience,” in *Geoscience for the Public Good and Global Development: Toward a Sustainable Future*, Vol. 520, eds G. R. Wessel and J. K. Greenberg (Boulder, CL: Geological Society of America), 459–478.
- Pettersson, M. G., and Tawake, A. (2018). The Cook Islands (South Pacific) experience in governance of seabed manganese nodule mining. *Ocean Coastal Manag.* 167, 271–287. doi: 10.1016/j.ocecoaman.2018.09.010
- Popova, E., Vousden, D., Sauer, W. H. H., Mohammed, E. Y., Allain, V., Downey-Breedt, N., et al. (2019). Ecological connectivity between the areas beyond national jurisdiction and coastal waters: safeguarding interests of coastal communities in developing countries. *Mar. Policy* 104, 90–102. doi: 10.1016/j.marpol.2019.02.050
- Rigo, B. (2004). Altérité polynésienne, ou les métamorphoses de l'espace-temps. *Paris CNRS Éditions* 2004:350. doi: 10.4000/assr.2460
- RNZ (2018). *Wallis and Futuna Rejection of Seabed Mining Work welcomed by Pacific NGOs*. Available online at: <https://www.rnz.co.nz/international/pacific-news/367152/wallis-and-futuna-rejection-of-seabed-mining-work-welcomed-by-pacific-ngos> (accessed 24 September 2018)
- Rosenbaum, H. (2011). *Out of Our Depth. Mining the Ocean Floor in Papua New Guinea. Mining Watch Canada. Mines Alert*. CELCoR. Los Altos: David and Lucile Packard Foundation.
- Rosenbaum, H., and Grey, F. (2016). Accountability zero; A critique of the Nautilus Mineral Environmental and Social Benchmarking Analysis of the Solwara 1 project. Available online at: http://www.deepseaminingoutofdepth.org/wp-content/uploads/accountabilityZERO_web.pdf (accessed March 11, 2021).

- RSC Mining and Mineral Exploitation (2019). *Collapse of PNG deep-sea mining venture sparks calls for moratorium*. Available online at: <https://www.rscmme.com/seabed-mining-news/collapse-of-png-deep-sea-mining-venture-sparks-calls-for-moratorium> (accessed March 11, 2021).
- Ruddle, K., and Hickey, F. R. (2008). Accounting for the mismanagement of tropical nearshore fisheries. *Environ. Dev. Sustain.* 10, 565–589. doi: 10.1007/s10668-008-9152-5
- Schor, G. S., Falcone, E. A., Moretti, D. J., and Andrews, R. D. (2014). First long-term behavioral Records from Cuvier's beaked whales *Ziphius cavirostris* reveal record-breaking dives. *PLoS One* 9:e92633. doi: 10.1371/journal.pone.0092633
- Shackelford, S. J. (2008). The tragedy of the common heritage of mankind. *Stanford Environ. Law J.* 28, 116–117.
- Sharma, R. (2019). *Environmental Issues of Deep Sea Mining. Impacts, Consequences and Perspectives*. Cham: Springer Nature, 577.
- Smith, C. R., Levin, L. A., Koslow, A., and Tyler, P. A. (2008). "The near future of the deep seafloor ecosystems," in *In Aquatic Ecosystems: Trends and Global Prospects*, ed. N. Polunin (Cambridge: Cambridge University Press), 334–349. doi: 10.1017/cbo9780511751790.030
- Solomon Islands (S.I.) National Minerals Policy (2020). Available online at: solomons.gov.sb/wp-content/uploads/2020/02/National-Minerals-Policy.pdf (accessed March 11, 2021).
- South, G. R., Skelton, P. A., Veitayaki, J., Resture, A., and Carpenter, C. (2004). The Global International Waters Assessment for the Pacific Islands: aspects of transboundary water and coastal fisheries issues. *Ambio* 33, 98–106. doi: 10.1579/0044-7447-33.1.98
- Secretariat of the Pacific Community (2005). *Pacific Islands Regional Ocean Policy and Framework for Integrated Strategic Action, Prepared for the Council of Regional Organisations of the Pacific-Marine Sector Working Group*. Available online at: macbio-pacific.info/wp-content/uploads/2017/08/Pacific-Ocean-Policy.pdf (accessed March 11, 2021).
- Secretariat of the Pacific Community (2012). *Pacific-ACP States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation*. SPC SOPAC Division published report 111 on the Deep Sea Minerals Project. Suva: Secretariat of the Pacific Community.
- Secretariat of the Pacific Community (2015). *Results Report*. Fiji: Pacific Community (SPC), 102.
- SOPAC (1999). "The madang guidelines: principles for the development of national offshore mineral policies," in *Offshore Minerals Policy Workshop* (Madang: SOPAC), 36.
- SPC (2013). "Deep sea minerals: manganese nodules," in *A Physical, Biological, Environmental and Technical Review*, Vol. 1B, eds E. Baker and Y. Beaudouin, 978-982-00-0557-0pp.70.
- Thakur, R. (1991). *The South Pacific: Problems, Issues and Prospects*. New York, NY: St. Martin's Press, 248.
- Thiel, H. (2003). "Anthropogenic impacts on the deep sea," in *Ecosystems of the World, Ecosystems of the Deep Ocean*, Vol. 28, ed. P. A. Tyler (Amsterdam: Elsevier), 427–472.
- Tilot, V. (2006). *Biodiversity and Distribution of the Megafauna. Vol. 1: The Polymetallic Nodule Ecosystem of the Eastern Equatorial Pacific Ocean*. Paris: Intergovernmental Oceanographic Commission. Available online at: <http://unesdoc.unesco.org/images/0014/001495/149556f.pdf>
- Tilot, V. (2010). *Biodiversity and Distribution of the Megafauna. Vol 3: Options for the management and conservation of the nodule ecosystem in the Clarion Clipperton Fracture Zone*, Paris: Intergovernmental Oceanographic Commission. Available online at: <http://unesdoc.unesco.org/images/0014/001495/149556f.pdf>
- Tilot, V. (2019). "Assessment of deep-sea faunal communities-indicators of environmental impact," in *Environmental Issues of Deep-Sea Mining. Impacts, Consequences and Policy perspectives*, Chap. 4, ed. R. Sharma (Salmon Tower Building, NY: Springer International Publishing), 147–189. doi: 10.1007/978-3-030-12696-4_6
- Tilot, V., Ormond, R., Moreno-Navas, J., and Catala, T. (2018). The benthic megafaunal assemblages of the CCZ (Eastern Pacific) and an approach to their management in the face of threatened anthropogenic impacts. *Front. Mar. Sci.* 5:7. doi: 10.3389/fmars.2018.00007
- Tonga Seabed Minerals Act (2014). Available online at: <https://www.isa.org/jm/files/documents/EN/NatLeg/Tonga-2014.pdf> (accessed March 11, 2021).
- Torrente, F., Bambridge, T., Planes, S., Guiart, J., and Clua, E. (2018). Sea swallows and land devourers: can shark lore facilitate conservation? *Hum. Ecol.* 46:10. doi: 10.1007/s10745-018-0018-7
- Trichet, J., and Leblie, I. (2008). *Journal de la Société des Océanistes, Special issue Environnement dans le Pacifique Sud*. Paris: Société des Océanistes, 126–127.
- Tuqiri, S. (2001). *Overview of an Ocean Policy for the Pacific Islands, Prepared by the Council of Regional Organisations of the Pacific-Marine Sector Working Group*. Suva: SPC/PIROP, 77.
- Tuvalu Seabed Minerals Act (2014). Available online at: <https://www.isa.org/jm/files/documents/EN/NatLeg/Tuvalu/Tuvalu-2014.pdf>, (accessed March 11, 2021), 78.
- United Nations Convention on the Law of the Sea (1982). Available online at: www.un.org/Depts/los/convention_agreements/texts/unclos/part1.htm (accessed March 11, 2021).
- United Nations (2019). *Revised Draft Text of for an Agreement Under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable use of Marine Biological Diversity of Areas Beyond National Jurisdiction, A/CONF.232/2020/3* (2019). New York, NY: United Nations.
- United Nations Environment Programme (2010). "Modalities for advancing cross-sectoral cooperation in managing Marine Areas beyond national jurisdiction," in *Proceedings of the Draft for discussion 12th Global Meeting of the Regional Seas Conventions and Action Plans* (Bergen).
- United Nations Educational, Scientific and Cultural Organization/Intergovernmental Oceanographic Commission (2020). *Draft Implementation Plan in July 2020 for Consideration of United Nations Member States*. Available online at: <https://www.oceandecade.org/news/72/Version-20-of-the-Ocean-Decade-Implementation-Plan-submitted-for-presentation-to-the-United-Nations-General-Assembly> (accessed March 11, 2021).
- UNESCO – Palau (2017). *The IOC Marine Spatial Planning Programme*. Available online at: <http://msp.ioc-unesco.org/> (accessed March 11, 2021).
- Vanuatu Deep Seabed Minerals Policy. Available online at: <http://pubdocs.worldbank.org/en/125321460949939983/Pacific-Possible-Deep-Sea-Mining.pdf>
- Vierros, M., Harrison, A. L., Sloat, M., Ortuno Crespo, G., Moore, J., Dunn, D., et al. (2020). Considering indigenous peoples and local communities in governance of the global ocean commons. *Mar. Policy* 119:104039. doi: 10.1016/j.marpol.2020.104039
- Vieux, C., Salvat, B., Chancerelle, Y., Kirata, T., Rongo, T., and Cameron, E. (2004). *Status of Coral Reefs in Polynesia Mana Node Countries: Cook Islands, French Polynesia, Niue, Kiribati, Tonga, Tokelau and Wallis, and Futuna, IFRECOR. Status of Coral Reefs of the World* (Samoa: Secretariat of the Pacific Regional Environment Programme (SPREP), 189–198.
- Vieux, C., Chancerelle, Y., Aubanel, A., and Salvat, B. (2008). Les modifications de la ligne de rivage dans les îles de la Société (*Polynésie française*): un indicateur des pressions anthropiques en zone côtière. *J. Soc. Océan.* 59–66. doi: 10.4000/jso.3162
- Waddell, E. (2000). The emerging intellectual architecture of the Pacific. *N. Pacific Review. Pacific Ident.* 1, 86–103.
- Wakefield, J. R., and Myers, K. (2018). Social cost benefit analysis for deep sea minerals mining. *Mar. Policy* 95, 346–355. doi: 10.1016/j.marpol.2016.06.018
- Warner, R. M. (2014). Conserving marine biodiversity in areas beyond national jurisdiction: co-evolution and interaction with the law of the sea. *Front. Mar. Sci.* 1:6. doi: 10.3389/fmars.2014.00006
- The World Commission on Environment and Development (1987). *Our Common Future. Report of the World Commission on Environment and Development: Our Experts group on Environmental Law. Annexe 2. World Commission on Environment and Development*. Oxford: Oxford University Press.
- The Western and Central Pacific Fisheries Commission (2019). *The Western and Central Pacific Tuna Fishery: 2018. Overview and status of Stocks*. Available online at: www.wcpfc.int/statistical-bulletins (accessed March 11, 2021).
- Wendt, A. (1976). Towards a new oceania. *Mana Rev.* 1, 49–60.
- Willaert, K. (2020a). Effective protection of the marine environment and equitable benefit-sharing in the Area: empty promises or feasible goals? *Ocean Dev. Int. Law* 51, 175–192. doi: 10.1080/00908320.2020.1737444

- Willaert, K. (2020b). Public participation in the context of deep sea mining: luxury or legal obligation? *Ocean Coastal Manag.* 198:105368. doi: 10.1016/j.ocecoaman.2020.105368
- Willaert, K. (2020c). Crafting the perfect deep sea mining legislation: a patchwork of national laws. *Mar. Policy* 119:104055. doi: 10.1016/j.marpol.2020.104055
- Willaert, K. (2020d). On the legitimacy of national interests of sponsoring states: a deep sea mining conundrum. *Int. J. Mar. Coastal Law* 36, 136–153. doi: 10.1163/15718085-BJA10011
- Woodall, L., Sanchez-Vidal, A., Canals, M., Paterson, G. L. J., Coppock, R., Sleight, R., et al. (2014). The deep sea is a major sink for microplastic debris. *R. Soc. Open Sci.* 1:140317. doi: 10.1098/rsos.140317
- Zalik, A. (2018). Mining the seabed, enclosing the Area: ocean grabbing, proprietary knowledge and the geopolitics of the extractive frontier beyond national jurisdiction. *Int. Soc. Sci. J.* 68, 229–230. doi: 10.1111/issj.12159
- Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2021 Tilot, Willaert, Guilloux, Chen, Mulalap, Gaulme, Bambridge, Peters and Dahl. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.