North Pacific Fisheries Commission

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Observer paper submitted by the Deep Sea Conservation Coalition and the Pew Charitable Trusts on Behalf of the Deep-Ocean Stewardship Initiative (DOSI)

Ecosystem-Based Management of Seamounts in the NPFC Convention Area: Recommendations from the Seamount Science Summit – Ecological Insights Workshop, October 23–25, 2024, University of Hawai‘i at Mānoa

The Deep-Ocean Stewardship Initiative (DOSI) is a global network of experts which integrates science, technology, policy, law and economics to advise on ecosystem-based management of resource use in the deep ocean, and on strategies to maintain the integrity of deep-ocean ecosystems within and beyond national jurisdiction. In October 2024, DOSI – with support from the United Nation's Ocean Decade program Challenger 150 – convened international experts to participate in the *Seamount Science Summit - Ecological Insights Workshop*, the first major gathering focused on seamount ecology and conservation worldwide in over a decade.

To assist the Scientific Committee (SC) in implementing its program of work regarding bottom fisheries and vulnerable marine ecosystems (VMEs), DOSI has prepared a summary report of the workshop, attached, relevant to the work of the NPFC with suggestions and recommendations.

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Ecosystem-Based Management of Seamounts in the NPFC Convention Area

Recommendations from the Seamount Science Summit – Ecological Insights Workshop 23–25 October 2024, University of Hawai'i at Manoa

Background

The Deep-Ocean Stewardship Initiative (DOSI) is submitting this paper to assist the Scientific Committee in implementing its program of work designed to improve conservation and management measures (CMMs) for bottom fishing and to enhance the protection of vulnerable marine ecosystems (VMEs).

DOSI is a global network of experts which integrates science, technology, policy, law and economics to advise on ecosystem-based management of resource use in the deep ocean, and on strategies to maintain the integrity of deep-ocean ecosystems within and beyond national jurisdiction. Comprising over a thousand specialists from over 115 countries, DOSI operates through 10 specialised working groups, and one cross-cutting task force, each focusing on key aspects of deep-sea stewardship.

The DOSI Fisheries Working Group is dedicated to ecosystem-based deep-sea fisheries management and includes over 200 experts. In October 2024, with support from the DOSI UN Ocean Decade program, Challenger 150, the group hosted the Seamount Science Summit – Ecological Insights Workshop, the first major gathering focused on seamount ecology and conservation in over a decade. This collaborative effort underscores DOSI's role in transforming scientific insights into actionable policies for the sustainable management of deep-sea fisheries, globally.

Over three days, 26 seamount experts from around the world assessed the current understanding of seamount ecosystems, examined current management frameworks and discussed strategies to improve seamount ecosystem resilience, particularly in the face of fishing impacts and climate change. Through plenary sessions and subgroup discussions, scientists consistently emphasised the unique ecological importance of many seamounts as critical deep-sea habitats that can support rich biodiversity and provide essential ecosystem services. The group identified promising research avenues, and developed policy recommendations to preserve seamount biodiversity.

DEEP-OCEAN STEWARDSHIP INITIATIVE

Of particular relevance to the NPFC, the discussion session titled **Case Study of the Northwest Hawaiian Ridge and Emperor Seamount Chain**, concentrated on assessing significant adverse impacts (SAIs) on VMEs in this region. Participants (hereafter referred to as 'the expert group') discussed aspects of the NPFC's progress toward its work plan and formulated recommendations to inform and support conservation goals set forth by international bodies such as the UNGA, FAO, and Convention on Biological Diversity.

Key recommendations for the management of seamount ecosystems in the NPFC region

Recommendation 1 – Management of seamounts as VMEs

The United Nations General Assembly (UNGA) has expressed significant concern regarding the conservation of seamounts, recognising their ecological importance and vulnerability. In response, UNGA Resolution 59/25, adopted in 2004 and all subsequent resolutions have called upon States and regional fisheries management organisations to take immediate action to sustainably manage fish stocks and "*protect vulnerable marine ecosystems, including seamounts*", from destructive fishing practices. To date, only the Northwest Atlantic Fisheries Organization (NAFO) has fully implemented these recommendations, designating all seamounts within its Regulatory Area as VMEs and prohibiting bottom-contact fishing in these areas.

The expert group concurs that substantial scientific evidence supports designating all high seas seamounts of the Northwestern Hawaiian Ridge (NWHR) and the Emperor Seamount Chain (ESC) as VMEs, based on a quantitative and robust body of scientific research visually confirming the widespread presence of VME indicator communities, habitats, and species. Notable features of these seamounts include deep-sea coral gardens, scleractinian coral reefs, and extensive sponge fields (Baco et al., 2017, 2019, 2020, 2023a; Dautova et al., 2019; Miyamoto & Kiyota, 2017; Miyamoto et al., 2017; Galkin et al., 2020; Watling et al., 2024). Furthermore, the Southern Emperor–Northwestern Hawaiian Ridge (SE-NWHR) contains the largest documented population of pelagic armorhead, *Pseudopentaceros wheeleri*, a species believed to spawn extensively on SE-NHR seamounts (Lavery et al., 2020).

Historically, the pelagic armorhead fishery collapsed within a decade of intensive fishing as a direct result of overexploitation. Despite more than 50 years since this collapse, stocks have shown minimal recovery (Kiyota et al., 2015; Victorero et al., 2018). Current research shows that the stock remains overfished, highlighting the need for sustained

protective measures (NPFC, 2023, 2024). This evidence collectively reinforces the ecological significance and vulnerability of the SE-NHR as a habitat for pelagic armorhead, underscoring its importance as a priority for conservation.

According to the FAO Guidelines, an area needs to meet only a single VME criterion to be designated as a VME, yet the NWHR and ESC meet all five VME criteria (additional supporting information in CBD, 2016a):

- **Criterion 1 – Uniqueness or Rarity:** An area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems. These include: habitats that contain endemic species; habitats of rare, threatened or endangered species that occur only in discrete areas; or nurseries or discrete feeding, breeding, or spawning areas.
- **Criterion 2 – Functional Significance of the Habitat:** Discrete areas or habitats that are necessary for the survival, function, spawning/reproduction, or recovery of fish stocks, particular life-history stages (e.g., nursery grounds or rearing areas), or of rare, threatened, or endangered marine species.
- **Criterion 3 – Fragility:** Ecosystems that are highly susceptible to degradation by anthropogenic activities.
- **Criterion 4 – Life-History Traits of Component Species That Make Recovery Difficult:** Ecosystems characterized by populations or assemblages of species with one or more of the following traits: slow growth rates, late age of maturity, low or unpredictable recruitment, or long-lived.
- **Criterion 5 – Structural Complexity:** Ecosystems are characterised by complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems, which often have high diversity reliant on the structuring organisms.

The expert group concurs that all available current scientific evidence indicates that bottom trawling on seamounts results in SAIs, with no information suggesting these impacts can be avoided during such activities on seamounts. Specifically, the NWHR and ESC have some of the most exhaustive documentation of SAIs of any seamount ecosystems worldwide. According to the FAO Guidelines, SAIs compromise ecosystem integrity, which is reflected in multiple indicators of degradation observed on the NWHR-ESC.

In this region, extensive research has documented the following impacts that align with FAO SAI criteria:

1. **Impairment of Ecosystem Integrity:** Observations show a significant decline in the abundance of corals and benthic megafauna on seamounts that continue to experience trawling (Baco et al., 2019). Additionally, one of the dominant structure-forming corals in the NWHR and central North Pacific, the coralliid octocorals, have substantially decreased abundances (or were absent) on all ten trawled seamounts surveyed, compared to untrawled sites. There is little evidence of recovery even after decades, particularly on the most heavily fished seamounts of Yuryaku and Kammu (Baco et al., 2023b). The pelagic armorhead population has shown minimal signs of recovery from historic overfishing, further indicating long-term damage to the ecosystem's functional integrity.

2. **Lack of Recovery in Impacted Areas:** Studies report that bottom trawled sites show signs of early coral regrowth only after 30–40 years (Baco et al., 2019, 2023b) far exceeding the agreed timescale of 5–20 years for temporary impacts in the FAO Guidelines (FAO, 2009).

3. **Visible Physical Damage to Habitat Structure:** The seafloor in trawled areas is characterised by extensive barren hard substrates and scattered coral rubble, showing scars from bottom-contact gear along with remnants of arborescent corals (Baco et al., 2019, 2020; Dautova et al., 2019).

4. **Reductions in Species Diversity and Community Structure:** A recent study documents declines in overall faunal abundance and ecological diversity on Koko seamount strongly correlated with increasing abundance of fishing debris and gear scars (Biede et al., *submitted*). There were also significant shifts in community structure and ecosystem function due to the loss of habitat-forming corals (Biede et al., *submitted*). These changes suggest lasting alterations to the ecological functions and biodiversity that define a healthy seamount ecosystem.

Cumulative evidence meeting multiple criteria for significant adverse impacts in the FAO Guidelines suggests that bottom trawling on the NWHR-ESC has caused a significant loss of species richness, loss of habitat and changes in ecosystem function. These impacts have compromised ecosystem integrity and hinder ecosystem recovery.

Continued trawling in areas with SAIs exacerbates damage to VMEs that have endured historical impacts, and puts any remnant populations at further risk. Remnant populations are critical for maintaining residual ecosystem functions and providing recovery potential for the regeneration of degraded VMEs. Specifically, remnant

populations accelerate the recovery process, serving as essential nearby sources of propagules to reseed affected areas. These remnant populations may represent the sole remaining habitat for species associated with VMEs; the 2022 UNGA Resolution calls for assessing fisheries impacts on all species associated with and dependent on VMEs, not only VME indicator species. Thus, it is crucial to protect these populations while they persist.

Managing the NWHR and ESC as a VME aligns with UNGA resolutions endorsed by NPFC Contracting Parties, and would aid in the recovery of overfished stocks. The expert group recommends that any future bottom trawling proposals include rigorous visual mapping of VMEs and ecosystem-scale studies as part of their Impact Assessment and proposed Management and Monitoring Plan, including connectivity assessments. Proposals should carry the burden of proof to demonstrate that no SAIs will occur, following a precautionary, science-based framework.

While the expert group focused on the NWHR and ESC case study, other seamount complexes worldwide were reviewed and discussed, including those in the eastern NPFC convention area. Research conducted on the Cobb-Eickelberg Seamount Chain (CESC) echoes that of the research on the NWHR and ESC.

- The CESC meets all VME criteria (summarised in CBD, 2016b), and within-seamount VMEs have also been identified, including bioherms of reef-building corals (e.g., Du Preez et al., 2016; DFO, 2024).
- Impacts documented include SAIs from previous bottom-contact fishing, lost or discarded fishing gear (Du Preez et al., 2020), deoxygenation, and ocean acidification (Ross et al., 2020).
- Additionally, all CESC seamounts within Canada (even partially within) are protected as VMEs and EBSAs, yet, despite the high seas CESC representing rare or unique seamounts classes (especially Cobb Seamount), they are still fished with bottom-contact gear (Du Preez & Norgard, 2022).

Based on this body of research, the recommendation by the expert group was the same as for the NWHR and ESC, that all of the high seas seamounts of the CESC are VMEs and should be managed as such.

Recommendation 2 – Implementation of mandatory reporting for any bycatch of VME indicator taxa, regardless of whether the encounter threshold is exceeded

The expert group acknowledges the current challenges in accurately predicting VME indicator taxa occurrence in the NPFC seamounts, due to the highly variable and patchy nature of VME indicator taxa (e.g., cold-water corals and sponges), compounded by limited data availability. Comprehensive reporting of all VME indicator taxa bycatch records across the NPFC would improve understanding of VME indicator taxa distribution, impacts on VMEs, and seamount connectivity.

To accomplish this, observer data and logbooks from bottom fisheries in the Northwest Pacific—collected since the 2008 adoption of interim management measures—should be utilised to record all occurrences and quantities of VME indicator species catch and bycatch, regardless of bycatch weight. This approach aligns with recent recommendations from the International Council for the Exploration of the Sea (ICES) to the North East Atlantic Fisheries Commission (NEAFC) (ICES, 2024). Increased data availability would enhance the predictive accuracy of species distribution and habitat suitability models, which currently show limited reliability at seamount spatial scales in the high seas.

The NPFC should make these data publicly available to support the work of the NPFC Scientific Committee, NPFC and PICES researchers, and other interested parties. The NPFC Secretariat could produce a public summary analysis of collected data on indicator species to deepen insights into VMEs in the Convention Area. Additionally, storing this information in a database accessible to researchers globally can help address key knowledge gaps and support more informed management decisions for seamounts globally.

Recommendation 3 – Integration of cumulative impacts, including historical fishing and present and projected climate change and ocean acidification into the management of impacts from bottom fisheries on seamounts

The Second UN World Ocean Assessment identifies bottom trawling as the most significant current threat to seamount ecosystems (Clark et al., 2021). However, growing evidence highlights the increasing impacts of longer-term climate change on seamounts, particularly those at fishable depths, which may be more vulnerable to these effects (FAO, 2018; Jones et al., 2014; Ross et al., 2020). For example, basin-scale deoxygenation and shoaling of the calcium and aragonite carbonate saturation horizons (ocean acidification) have and continue to impact seamount communities in the NPFC, especially VME indicator taxa like reef-forming corals (Ross et al., 2020). In the Northeast Pacific, offshore waters from 0 to 3,000 m have lost 15% of their oxygen over the past 60 years, the mid-water hypoxic zone is expanding at 3 metres per year, and the saturation horizons are shoaling at 1 metre per year (Ross et al., 2020). It has been estimated that the aragonite saturation horizon in the Pacific has already been shoaling at a rate of 1-2m per year (Feely et al., 2012, Carter et al., 2017), and this is expected to impact the survival and distribution of all deep-sea corals that utilise the aragonite form of calcium carbonate for skeleton productions, especially the reef-forming scleractinians (e.g. Guinotte et al., 2006).

Seamounts may be important sites of refugia for fauna at certain depths as water chemistry changes (Tittensor et al., 2010). Additionally, recruitment dynamics of targeted fish stocks, such as pelagic armorhead are likely to be affected by climate change, as recruitment is closely tied to interannual ocean-atmospheric climate oscillations (Lavery et al., 2023). Since 2016, UNGA resolutions [Resolution 71/123] have recognised the need to address climate change impacts and protect marine biodiversity, a priority also emphasised in the BBNJ Agreement (UN, 2023). Addressing combinations of cumulative impacts is essential for assessing SAIs (FAO, 2009) and ensuring the resilience and protection of seamount ecosystems.

The expert group recommends that impact assessments incorporate historic, current, and projected cumulative impacts to improve evaluations of vulnerability to inform adaptive management strategies for seamount ecosystems, fish stocks, and the broader deep-sea environment (aligning with FAO, 2009). Fisheries impact assessments should include any historical fishing impacts, the presence of abandoned or lost fishing gear and associated ongoing habitat destruction and ghost fishing, climate change effects, and other human activities, including potential deep-sea mining. As with any ecosystem

impacts, these interact with each other, generating effects that may be additive, antagonistic, or synergistic (Ban et al., 2010). For example, when an SAI already exists from previous fishing, additional negative effects from current or future bottom-contact fishing are additive impacts - potentially synergistic – that increase the scale and/or significance of the SAI and can delay or even prevent the recovery of natural ecosystem function and productivity (i.e., further depletion and/or sustained loss, outlined by Pitcher & Pauly, 1998). Seamounts already qualify as vulnerable, and degraded ecosystems and fish stocks are even more vulnerable and less resilient to impacts, making comprehensive seamount management essential to avoid further harm and support long-term recovery.

Furthermore, the expert group recommends evaluating cumulative impacts across multiple spatial scales, from individual seamounts to interconnected seamount networks. This approach aligns with the interconnected nature of seamounts and will support a more comprehensive understanding of impacts across communities and ecosystem/s, alterations in connectivity pathways, and the identification of seamount areas that exhibit resilience to climate change. Recognising and prioritising these latter areas is essential for developing management measures that enhance seamount ecosystem resilience and long-term conservation of deep-sea biodiversity.

Workshop Participants

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