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Enhancing the Protection of VMEs, including all Seamounts

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Abstract

The DSCC notes the progress made by SIOFA with respect to the management of bottom fishing, and the interim measures adopted to protect vulnerable marine ecosystems (VME) from significant adverse impacts. This paper reviews the status of the benthic fishery impact assessment standard and the benthic fisheries impact assessments prepared to date and proposes that they be updated with more recent information, consideration of cumulative impacts, and inclusion of effects of climate change, including ocean acidification, in the standard. This paper includes several proposals:

Spatial planning and fishing intensity

- The SC recommends to the MoP that spatial closures are the primary mechanism to manage impacts on benthic habitats.

VME and Seamounts

- That a VME registry be established by SIOFA.
- Recognise the importance of seamounts as essential deep-sea ecosystems that provide unique habitats and significantly contribute to marine biodiversity.

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- Acknowledge that VME indicator taxa are characteristic features of seamounts.
- That Seamounts be recognised as VMEs and closed to bottom trawling.
- Apply a precautionary approach in data poor seamount ecosystems.
- Develop robust protection policies to protect seamounts.
- All EBSAs located fully or partly within the SIOFA Area should be recommended for VME/mpa protection.

Saya del Malha

- Saya del Malha be closed to bottom trawling;
- Seagrasses and rhodoliths be considered for inclusion in the added to the list of VME indicator species in Annex 1 of CMM 2020/01;
- Other potential indicator taxa be reviewed to reflect the different depths and taxa that are found at Saya dDe Malha Bank;
- Precautionary thresholds for sea grasses be applied for move-on rules.

BFIA Standard

- DSCC recommends that consideration of climate change factors is included in the BFIA Standard template and that all existing BFIAs incorporate such factors.

- DSCC has further discussion and recommendations in our information paper on Climate Change.

BFIAs

- All BFIAs be updated every five years and include updated information on gear used, what gear is lost annually, how SAIs on VMEs are being assessed and impacts mitigated, and consider catchability of VME taxa;
- All BFIAs to be reviewed and updated in line with the revised SIOFA BFIA standard, they should include effects of climate change and ocean acidification.
- That the SC determines how cumulative benthic impacts of fisheries from different country BFIAs can be assessed.

Encounter measures and catchability

- Undertake a review of the values used in the encounter protocol which recognises the low level of catchability of VME indicator taxa ending up in nets or on hooks, applies the precautionary approach, considers taxa threshold applied by SPRFMO to bottom trawl VME encounters.

Trawling

- Review the encounter thresholds in para 12 of CMM 01 (2023) undertaking a precautionary and ecosystem approach; and
- Taxa should be subdivided into similar taxa groups applied in the SPRFMO CMM03-2023.
- Catchability of taxa should be considered when establishing encounter thresholds.

Longline

- DSCC Recommends that the longline encounter threshold be reviewed so that it includes taxon specific values.

Enhancing the Protection of VMEs, including all Seamounts

1. Introduction

This paper describes the research and action taken by SIOFA thus far to avoid significant adverse impacts on VMEs and identify gaps in management of protection of VMEs. This paper updates the paper submitted to SC9.

This paper briefly reviews the obligations to protect VMEs (the SC9 Info 28 has more detail), Reviews BFIA Standards and tabled BFIAs.

The paper contains several recommendations, including the increased application precautionary approach and the ecosystem approach in the protection of vulnerable marine ecosystems (VMEs). Since the establishment of SIOFA, and in line with the various UN General Assembly resolutions calling for action to prevent significant adverse impacts on vulnerable marine ecosystems (see Annex), the Scientific Committee (SC) has undertaken significant research and made several recommendations to the Meeting of the Parties (MOP).

2. General Obligations

In our observer paper SC 09 INFO we set out the general obligations for the protection of VMEs in the:

a. The SIOFA Agreement
b. The UN Fish Stock Agreement
c. The precautionary approach
d. FAO Code of Conduct
e. FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (the FAO Guidelines)
f. UN General Assembly resolutions
g. Convention on Biological Diversity identified several Ecologically Biologically Significant Areas (EBSAs) for the Indian Ocean:

    There are 11 EBSAs which fall at least partially within Convention Area: Agulhas Front; Walters Shoal; Prince Edwards Islands, Del Caño Rise and Crozet Islands; Saya de Malha Bank; Rusky; East Broken Guyot; Mozambique Channel; Coral seamount and fracture zone feature; Atlantis Seamount; Central Indian Basin; Fools Flat (See https://www.cbd.int/ebsa/).

3. SIOFA VME research

a. Review of work done

In DW09 INFO-28 we set out the work that the SIOFA had undertaken relevant to the identification, distribution and protection of VMEs. The outcomes of these various projects were presented to SC-09 in WP SC-09-27.

i) Bioregionalisation of the SIOFA Area based on VME indicator taxa: This showed that the SIOFA area contains significant diversity of bioregions, all of which should be considered in conservation efforts, as per criterion 'bioregional representation' listed in the Protocol.

ii) Systematic Conservation Planning in SIOFA: This project used a range from three conservation features: Ecologically or Biologically Significant Areas (EBSAs), bioregions based on VME indicator taxa, and geomorphic seafloor features. This adds to the protection to all EBSAs

located fully or partly within the SIOFA Area.

iii) Biodiversity models based on VME indicator taxa: While this project was data limited this method could contribute to identifying and evaluating important biodiversity hotspots.

iv) Holistic framework for assessing and preventing significant adverse impacts on VMEs: This project concludes that 'spatial closures are widely accepted by stakeholders as the primary mechanism to manage impacts on benthic habitats' and that encounter protocols and 'move-on' rules 'should be established as a secondary measure in support of spatial closures.'

v) Assessment of significant adverse impacts from fishing activities in SIOFA: This project reviewed existing potential fishing impacts within the fishing footprint against the distribution of three large scale bioregions predicted from VME indicator taxa. Bioregion 1 was the most impacted by trawling, gillnets, and line fishing and subregion 1.2 seems to be the most impacted from trawling, gillnets, and line fishing and subregion 2.4 by traps fishing.

DSCC Recommendations

- **The SC recommends to the MoP that spatial closures are the primary mechanism to manage impacts on benthic habitats.;**
- **The SC notes the potential risk of Bioregion 1 from fishing impacts, and particularly the risks in subregion 1.2.**

b. Recognition of Seamounts as VMEs

Other RFMOs and CCAMLR have developed processes and measures to protect identified VMEs. For example, SPRFMO CMM03-2023 (para 48) includes an Annex to be established as a register of VMEs. The CCAMLR VME Registry' records the locations and taxa of Vulnerable Marine Ecosystems (VMEs) and associated areas in the CCAMLR Convention Area which have been notified under Conservation Measure 22-06 and Conservation Measure 22-07. The CCAMLR registry currently includes 61 VMEs.

Protecting biodiversity in the marine environment is recognised in the SIOFA Convention which specifically requires the safeguarding of the marine ecosystems in which fishery resources occur through the application of the precautionary approach and an ecosystem approach to fisheries management.

In the SIOFA area significant knowledge gaps remain regarding both VME indicator taxa and the non-VME indicator species that are associated with and dependent on VMEs. These gaps include seamount vulnerability and identification of the full range of species associated with VMEs (including cryptic and undescribed species) and biological information about these species and ecosystems, such as population structure, connectivity, endemism – all of which is essential to assessing the impacts of bottom trawling.

c. Closing Seamounts to Bottom Trawling

Seamounts are recognised in UNGA Resolutions as explicit examples of VMEs and in the FAO Guidelines (FAO 2008) as being "topographical, hydrophysical or geological features" that support a range of sensitive and potentially vulnerable species to deep sea fishing. Seamounts are VMEs based on the language of UNGA resolutions (Watling & Auster, 2017). While the protection of these features is included in the UNGA resolutions, they are absent from the SIOFA CMM and SIOFA protected areas. However, seamounts are ecosystems equally vulnerable to SAIs as other taxa recognized as VMEs by SIOFA. Research by Baco et al., 2020 on the Emperor Seamount Chain, North-western Hawaiian Ridge, identified SAIs caused by deep-sea fishing on all surveyed seamounts. Seamounts are considered to be VMEs by Northwest Atlantic Fisheries Organization

(NAFO), VME elements by the North East Atlantic Fisheries Commission (NEAFC), and VME indicator features by the General Fisheries Commission for the Mediterranean (GFCM).

d. Examples of Sensitive and Vulnerable Species in the Guidelines

Examples of species groups, communities, and habitat-forming species that are documented or considered sensitive and potentially vulnerable to DSFs in the high seas, and which may contribute to forming VMEs:

- **Certain cold-water corals and hydroids**, including:
    - Reef builders and coral forests such as:
        - Stony corals (*Scleractinia*)
        - Alcyonaceans and gorgonians (*Octocorallia*)
        - Black corals (*Antipatharia*)
        - Hydrocorals (*Stylasteridae*)
- **Some types of sponge-dominated communities**
- **Communities composed of dense emergent fauna**, where large sessile protozoans and invertebrates form an important structural component of habitat, including:
    - Xenophyophores
    - Hydroids and bryozoans
- **Seep and vent communities**, comprised of invertebrate and microbial species found nowhere else (i.e., endemic)

Watling and Auster (2021) Recommendations included:

- **Using indicator species** to identify individual seamount VME communities, recognizing that protecting only part of a seamount—identified solely by the presence and distribution of an indicator species—is not sufficient.
- **Using a seamount classification system to:**
    - Delimit groups of similar seamounts to focus conservation management efforts.
    - Distinguish between rare and abundant seamount types.

As Rogers (2018) noted in a recent review:

> *"Our understanding of aspects of seamount ecology has advanced, but it is clear that there are many areas that remain poorly understood, meaning that management of human activities that exploit seamount ecosystems or impinge upon them has a high risk of impacting biodiversity and ecosystem function."*

Given these knowledge gaps, the true scale of impacts on VMEs is likely underestimated. Therefore, since the UNGA Resolutions and FAO Guidelines recognize seamounts as VMEs and emphasize the need for a precautionary approach, the DSCC recommends managing them as VMEs. To effectively mitigate potential harm, the closure of all seamounts to bottom trawling is necessary.

The DSCC recommends:

That a VME registry be established by SIOFA.

That Seamounts be recognised as VMEs and closed to bottom trawling.

All EBSAs located fully or partly within the SIOFA Area should be recommended for VME/mpa protection.

e. Saya de Malha bank

A recent review of seagrass ecosystems stated, “seagrass ecosystems among the most threatened ecosystems in the world” (Krause-Jensen et al 2020). Further, “clear water areas offer seagrass refugia from warming in deeper, cooler waters; but trawling can prevent seagrass from reaching these refugia.”They also report that “Trawling may exert both direct physical losses due to uprooting of shoots Lewis, and indirect negative effects caused by resuspension and settling of sediment particles on eelgrass leaves, which reduce light availability and nocturnal oxygen uptake”.

A review published in 2009 (Waycott et al 2009) found “Seagrass loss rates are comparable to those reported for mangroves, coral reefs, and tropical rainforests and place seagrass meadows among the most threatened ecosystems on earth.” Rogers (2021) recommended that the SIOFA list of indicator species be reviewed and modified to reflect VMEs that occur in the Indian Ocean region that may be distinct or even unique to this region and that seagrasses should be added, and other taxa considered as further research is reported on.

Seagrasses support fisheries and biodiversity, clean the surrounding water and help take carbon dioxide out of the atmosphere. Seagrasses likely have low catchability. As Rogers (2021) notes “it is unknown whether seagrass would be retained by fishing gear or rather just torn up and left on the seafloor”. Seagrasses are a key part of the marine ecosystem and seagrass are vulnerable to a range of impacts including trawling (Griffiths et al 2020).

The Saya de Malha Bank has been recognised as an Ecologically and Biologically Significant Area (EBSA) by the Convention on Biodiversity and includes seagrasses.. These include *Thalassodendron ciliatum, Halophilia decipens*, and *Enhalus accaroides* (Rogers 2021, pages 7 & 8).

As acknowledged last year by the SC neither rhodolith beds nor sea grasses are included in the definition of VME indicator taxa. The “SC agreed to discuss potential revision to the list of VME taxa, including the potential inclusion of seagrass and rhodoliths, as part of a focused session on VME at SC10” (para 307). The review of VME indicator taxa list is included in the SC work programme for 2025-2029.

DSCC recommends (subject to the views of the coastal States and Joint Management Area Joint Commission) that:

- **Saya de Malha be closed to bottom trawling;**
- **Seagrasses and rhodoliths be considered for inclusion in the added to the list of VME indicator species in Annex 1 of CMM 2020/01;**
- **Other potential indicator taxa be reviewed to reflect the different depths and taxa that are found at Saya de Malha Bank;**
- **Precautionary thresholds for sea grasses be applied for move-on rules.**

4. Actions thus far and ongoing

a. Conservation Measures

Paragraphs 5, 6 and 7 of CMM 01(2023) Conservation and Management Measure for the Interim Management of Bottom Fishing in the Agreement Area (Interim Management of Bottom Fishing) (Appendix 1) set out the requests for advice from the Scientific Committee to update the measure. The original request was for the SC to report in 2020 but this deadline was delayed due to the pandemic.

The provisions of the CMM request information from the SC including:

- Bottom Fishing Impact Assessment Standard (BFIAS) which takes account of the

latest scientific information available;
- maps of where VMEs are known to occur, or likely to occur, in the Agreement Area;
- a standard protocol for future protected areas designation;
- SIOFA bottom fishing footprint based on the data provided by a CCP;
- criteria for what constitutes evidence of an encounter with a VME, in particular threshold levels and indicator species for all gears;
- the most appropriate response to a VME encounter, including inter alia closing particular areas to a particular gear type or types.

b. Seamounts as VME

In a separate paper DSCC reviews seamounts against the VME criteria in the FAO guidelines (2008) (SIOFA SC10 INFO XX).\. The review finds strong scientific support for classifying seamounts as VMEs, since surveyed seamounts meet at least four of the five VME criteria without exception. Visual studies have also repeatedly confirmed their capacity to sustain extensive VME communities. Consequently, the best available science supports a precautionary, ecosystem-based approach to protect seamounts.

DSCC recommends that the SIOFA Scientific Committee recommends that the MoP:

- **Recognise the importance of seamounts as essential deep-sea ecosystems that provide unique habitats and significantly contribute to marine biodiversity.**
- **Recognise seamounts should be identified as VMEs and managed accordingly.**
- **Acknowledge that VME indicator taxa are characteristic features of seamounts.**
- **Apply a precautionary approach in data poor seamount ecosystems.**
- **Develop robust protection policies to protect seamounts.**

c. DOSI Recommendations on VMEs

Recommendations from a recent meeting of the Deep-Ocean Stewardship Initiative (DOSI) (Attached Appendix 1) may also be of use to the Scientific Committee considerations. This workshop took place in October 2024 at the University of Hawai'i, United States with support from the UN Ocean Decade program, Challenger 150 and represents the first major gathering focused on seamount ecology and conservation in over a decade bringing together 26 seamount experts globally. The workshop developed several recommendations for managing seamounts that are applicable to RFMOs.

The attached report is focused on the North Pacific Fisheries Commission (NPFC) area but is relevant to the deliberations of SIOFA. The report is included in Appendix 1.

The **Key recommendations for the management of seamount ecosystems:**

Recommendation 1 – Management of seamounts as VMEs

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

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 last recommendation will be taken up in discussion on the BFIAs.

d. Benthic Fisheries Impact Assessment Standard

A Benthic Fisheries Impact Assessment Standard (BFIAS), including a definition, was adopted by the MOP4 in 2017 (para 12).

The BFIAS has not been reviewed or updated since 2017. Other RFMOs have applied regular review provisions (see SPRFMO CMM03-2023 para 25) The FAO Guidelines calls on states and RFMOs to "ensure regular and independent reviews of the data and impact assessments." (para 83).

DSCC notes that climate change is not considered in the BFIAS. In 2023 the UNGA Resolution 78/68 (2023) at para 227 calls on RFMO "to take into account the potential impacts of climate change and ocean acidification".

DSCC recommends that consideration of climate change factors is included in the BFIA Standard template and that all existing BFIAs incorporate such factors.

DSCC has further commentary in our information paper on Climate Change.

e. Benthic Fisheries Impact Assessments

Fishing members have provided information on the Benthic Fisheries Impact Assessments. The BFIA should consider impact, risk and existing monitoring, management and mitigation measures in assessing the potential for SAI on VMEs and should follow the adopted standard (BFIAS).

So far there has been no approach to develop cumulative BFIAs in areas jointly fished by SIOFA members. Most members did not consider the cumulative impact of different fishing methods. Japan has produced updated BFIAs for each of the fishing method used (bottom trawl, mid-water trawl, and bottom longline) but there was no consideration of the cumulative impact of these methods.

DSCC has updated its review of BFIAs against the elements in the standards that benthic bycatch was reported, and whether VMEs where defined and reported on, and whether any significant adverse impacts (SAIs) were assessed.

Table 1 looks at the bycatch reporting and the VME and SAI reporting in published BFIAs. In the review of BFIAs recently conducted by the Secretariat of BFIAs, (SIOFA Secretariat 2024) the bycatch information reported is patchy and the BFIAs only focus on sponges and coral taxa listed in the CMM01.

Japan produced three BFIAs, one for each of the methods of fishing used, ie, bottom trawl, mid-water trawl and bottom longline. An updated bottom fishing assessment has been tabled at this meeting and is included in this analysis (SC10-80). Mauritius has prepared an assessment for a potential bottom trawl vessel (SC10-61) and the Union of Comoros has tabled a dropline fishery BFIA for Hapuku.

The catchability of VME taxa should be discussed in BFOAs, a discussion on catchability can be found in section **e** (below).

Our analysis shows that the BFIAs, apart from the revised Japan Bottom Trawl assessment (SC10-80) and Mauritius Bottom trawl assessment (SC10-61) and Comoros Dropline fishery proposal, are more than five years old. There is little detail in the BFIAs on benthic bycatch and no analysis of the bycatch of VME taxa other than a generic assessment of corals and sponges. The oldest assessment by Australia (2011) is actually the most detailed on bycatch information but was produced prior to the BFIA standard being agreed. Australia has not updated their BFIA.

Table 1: Published BFIAs on the SIOFA Website

Country	Date	Methods	Protected areas/ Known VMEs reported	VME bycatch reported	Corals and Sponges taxa assessed	Other benthic bycatch taxa assessed	VME definition	Includes estimates of catchability
Australia	Oct 2011	Bttm Trawl Mid-Trawl Bttm-LL	10 areas	Yes	Yes	No	Yes	No
Cook Islands	2018	Bttm Trawl	7 areas	No	No	No	Y	No
EU	Update 2021	Bttm LL	No	Sites but not Taxa	Partial	No	No	No
French Territories	Feb 2018	Bttm LL	No	No	No	No	No	No
Japan	2017 2025 2017	BttmLL BttmTrawl Mid-Trawl	No No No	No Yes No	No Yes No	No No No	No No No	No No No
Thailand	2017	Bttm Trawl Trap/pots	11 areas	No	No	No	Partial - applies only to trigger levels of sponges and corals	No
Comoros	2019 2025	Handline Dropline	No No	No No	No ?	No ?	No ?	No ?
Mauritius	2025	Bttm Trawl	No	?	?	?	?	?

Notes to table: The EU Assessment (EU BFIA 2021) states: "This assessment will be revised taking into account the results of all catches, the distribution and abundance of bycatch species and when a new assessment on the composition, distribution and abundance of VME indicator species becomes available."

Table 2 looks at other aspects of the BFIA including whether there is information on footprint, whether information on gear used and lost gear is reported, whether a risk assessment is used, any consideration of SAIs on VMEs, and where any VME criteria was applied to the footprint reported.

The annual reports by members have more detail on benthic bycatch than in individual BFIAs. For example, Thailand does not include information on any reported VME bycatch in its BFIA but the last two Annual Country Reports to the SC does contain this information. DSCC welcomes this level of reporting, and it should be used as the basis of reporting in updated BFIAs.

Table 2: Application of BFIAs to the published BFIA

Country	Date	Methods	Footprint or potential footprint included	Detail on Gear Used	Loss of fishing gear	Risk assess-ment included	SAI on VMEs considered	VME criteria applied to footprint
Australia	Oct 2011	Bttm Trawl Mid-Trawl Bttm-LL	Yes	Yes for LL but not for other gear	No	Yes	Yes	No
Cook Islands	2018	Bttm Trawl	Yes	Yes	Yes	Definitions only	Partial	No
EU	Update 2021	Bttm LL	Yes	Yes	N	Partial - no detail	No	No
French Territories	Feb 2018	Bttm LL	Yes	Yes	N	No	No	No
Japan	2017 2025 2017	BttmLL Bttm Trawl Mid-Trawl	Yes Yes Yes	No Partia Partial	No No No	No Partial Partial	No Partial No	No No No

Thailand	2017	Bttm Trawl Trap/ pots	Yes	Yes	No	No	No	No
Comoros	2019 2025	Handline Dropline	No No	No No	No ?	No ?	NA ?	No ?
Mauritius	2025	Bottom trawl	No	No	?	?	?	?

Note: Partial - only some information included or not considered in detail.

There was very little reporting on lost gear in the BFIAs. The Secretariat report SC-10-INFO-05 (SIOFA Secretariat 2025) on lost gear should assist members in developing this section in their revised and updated BFIAs.

DSCC recommends that:

- **All BFIAs be updated every five years and include updated information on gear used, what gear is lost annually, how SAIs on VMEs are being assessed and impacts mitigated, and consider catchability of VME taxa;**

- **All BFIAs to be reviewed and updated in line with the revised SIOFA BFIA standard, they should include effects of climate change and ocean acidification.**
- **The SC determines how cumulative benthic impacts of fisheries from different country BFIAs can be assessed.**

f. Catchability of VME taxa

The catchability of VME indicator taxa is considered to be extremely low, and best available science (e.g. Pitcher et al (2019); Stephenson et al (2022)) indicates that the amount of VME taxa that ends up in the net on the vessel deck is only a small fraction of the VME impacted on the seabed. Seagrasses likely show similar characteristics.

These differences in selectivity and catchability of different taxa varies between taxa due to differences in morphology, ecology, and life history (Parker and Bowden, 2010).

The primary source of VME records is the bycatch data gathered during fisheries surveys and commercial fishing operations (Morato et al., 2018). However, bycatch data is not representative of the impacted bottom communities as not all of the impacted taxa are captured in fisheries gear (Wassenberg et al. 2002, Auster et al. 2011, Jones and Lockhart 2011, Pitcher et al. 2019).

In the South Pacific Regional Fisheries Management Organisation (SPRFMO), trawl catches of 30 kg of coral have been estimated to equate to seabed coverage of 65-80% of *Solenosmilia variabilis*, suggesting that the gear will contact more than 3.9–12.5 tonnes of coral biomass and cause seabed impacts of more than 3.2–10.2 tonnes (Pitcher et al. 2019). In other words, some 100 to 400 times more coral are estimated to be damaged or destroyed on the seabed even with only 30 kg ‘caught’ in a single trawl tow. In the Louisville Seamount Chain (SPRFMO), evidence of VMEs were only recorded in 4 out of 255 trawl tows but camera tows did record VME indicator species repeatedly (Clark et al. 2015, Watling and Auster 2017). These discrepancies highlight that no true absence data can be obtained using bycatch data only (Gros et al., 2022; Knudby et al., 2013;

Preez et al., 2016; Watling & Auster, 2017). Visual surveys or high-resolution mapping are required to understand the distribution of VMEs and to prevent deep-sea fisheries from causing adverse as per the UNGA resolutions (61/105, paragraphs 80–91).

Watling and Auster (2021) estimate that catch efficiency for taxa retained in the net is as low as 10% or even 1%. Williams et al (2010) estimated the catch efficiency for deep-sea trawl net to be 0 to <0.01 for *Gorgoneia* (now Gorgonian Alcyonacea). Further, several groups of corals did not show up in the net.

Given the uncertainty over catchability the precautionary approach should be used to use lowest realistic values when setting limits under any encounter protocol.

There is no consideration of catchability in the published BFIAs.

DSCC recommends that SC undertake a review of the values used in the encounter protocol which recognises the low level of catchability of VME indicator taxa ending up in nets or on hooks, applies the precautionary approach, considers taxa threshold applied by SPRFMO to bottom trawl VME encounters.

g. Encounter and Move-On Rules

It is important to separate the process of identifying the actual presence of a VME with the management actions. The former is a scientific assessment; the second is a management response to the assessment. Obviously, the triggering of an encounter protocol, although designed to identify VME indicator species, is strong evidence of a VME, especially with a very high threshold and wide range of such indicator species. Other steps may be taken to confirm this, such as the use of cameras. But the process of recognising (rather than designating) a VME is to be followed by the management response, which has been repeatedly stated by the UNGA resolutions to be to close the area to bottom fishing, unless the measure can otherwise prevent SAIs on that VME. Catchability of species by bottom trawl gear is also an important consideration when reviewing encounter thresholds and significant adverse impacts.

The current VME encounter thresholds for trawling in CMM 01(20023) apply to two taxa groups only and for longline all taxa are combined. This approach ignores the different biological characteristics of the taxa impacted by bottom fishing. This includes elements of the species caught are highlighted in the FAO Deepwater Guidelines (Para 14 and 18 of FAO Guidelines 2008) including:

- Uniqueness or rarity of the species
- Presence of endemic species;
- Presence of rare, threatened, or endangered species;

Different taxa have different vulnerability, fragility, and resilience and recovery time. If taxa are amalgamated, then the most at risk VME and VME indicator species are likely to be missed. The approach taken by SPRFMO in dividing taxa into lower taxonomic units and considering a biodiversity component is a more ecologically appropriate way of considering impacts of bottom fishing.

h. Fishing Method

Last year DSCC reviewed encounter thresholds for bottom trawling and bottom longline (SC09-INFO28).

Bottom trawling

Amongst the problems DSCC identified in the bottom trawling VME taxa encounter measures were:

- the current provisions only apply to corals and sponges and not other VME taxa. The FAO Guidelines (2009) includes a number of different taxa as potentially vulnerable species groups, communities and habitats;
- the failure to consider the impact on individual species as opposed to a higher taxonomic unit.
- the measures are not as comprehensive as those applied in SPRFMO.
- that a larger number of taxa are impacted than considered in the measure. In 2023 a review of the observer database by the SIOFA Secretariat 2023 included 42 taxa groups plus two general reporting categories (SC-08-26-Rev1).

The amalgamation of taxa creates a range of potential problems:

- The very coarse taxonomic resolution of the modelled VME indicator taxa may mask ecological patterns and vulnerabilities, and abundance, at scales of communities, populations and species level

- Risks of damaging or destroying other taxa, including populations of rare, cryptic and undescribed species.

- Assessment at a coarse taxonomic level assumes that different species within a axonomic group have similar characteristics and environmental preferences affecting their vulnerability and distribution. This is clearly not always true.

- Diverse life-history traits, distribution patterns, and/or meta-population dynamics within coarser taxonomic resolutions will likely lead to the ecological patterns and vulnerabilities at the population/species level being obscured.

The review in 2023 of the benthic bycatch available from observer records shows that there is sufficient information to review the thresholds and taxa groups in CMM2020/01. Improved reporting by observers and vessels will assist in the implementation of any change. The SC can make precautionary recommendations to the MOP on changes to the thresholds in para 2020/01.

DSCC recommends that:

- **The SC should review the encounter thresholds in para 12 of CMM 01 (2023) undertaking a precautionary and ecosystem approach; and**
- **Taxa should be subdivided into similar taxa groups applied in the SPRFMO CMM03-2023.**
- **Catchability of taxa should be considered when establishing encounter thresholds.**

Bottom longline encounter thresholds

Amongst the issues DSCC raised in last years review of longline encounter measures were:

- that the measures were based on CCAMLR thresholds which are not taxa specific and "results in an incomplete assessment of vulnerability" (Lockhart and Hocevar, 2021).
- The application of the thresholds to other methods including fish traps.

DSCC considers SIOFA should review the longline encounter thresholds. This could include discussion with CCAMLR SC on the values used.

DSCC Recommends that the longline encounter threshold be reviewed so that it includes taxon specific values.

i. Scientific Committee Work Plan

The Scientific Committee Work plan and the MOP responses and requests are relevant to the discussion on the protection of VMEs from SAIs.

DSCC notes that the annual Scientific Committee work plan and budget (SC10-35) includes:

- Review of VME indicator taxa list;
- Annual report of VME encounters;
- Annual review of VME encounters.

The SC should consider how the cumulative impacts of different fisheries and different countries can be assessed through a cumulative BFIA.

5. Recommendations:

Spatial planning and fishing intensity

- The SC recommends to the MoP that spatial closures are the primary mechanism to manage impacts on benthic habitats.

VME and Seamounts

- That a VME registry be established by SIOFA.
- Recognise the importance of seamounts as essential deep-sea ecosystems that provide unique habitats and significantly contribute to marine biodiversity.
- Acknowledge that VME indicator taxa are characteristic features of seamounts.
- That Seamounts be recognised as VMEs and closed to bottom trawling.
- Apply a precautionary approach in data poor seamount ecosystems.
- Develop robust protection policies to protect seamounts.
- All EBSAs located fully or partly within the SIOFA Area should be recommended for VME/mpa protection.

Saya del Malha

- Saya del Malha be closed to bottom trawling;
- Seagrasses and rhodoliths be considered for inclusion in the added to the list of VME indicator species in Annex 1 of CMM 2020/01;
- Other potential indicator taxa be reviewed to reflect the different depths and taxa that are found at Saya dDe Malha Bank;
- Precautionary thresholds for sea grasses be applied for move-on rules.

BFIA Standard

- DSCC recommends that consideration of climate change factors is included in the BFIA Standard template and that all existing BFIAs incorporate such factors.
- DSCC has further discussion and recommendations in our information paper on Climate Change.

BFIAs

- All BFIAs be updated every five years and include updated information on gear used, what gear is lost annually, how SAIs on VMEs are being assessed and impacts mitigated, and consider catchability of VME taxa;
- All BFIAs to be reviewed and updated in line with the revised SIOFA BFIA standard, they should include effects of climate change and ocean acidification.
- That the SC determines how cumulative benthic impacts of fisheries from different country BFIAs can be assessed.

Encounter measures and catchability

- Undertake a review of the values used in the encounter protocol which recognises the low level of catchability of VME indicator taxa ending up in nets or on hooks, applies the precautionary approach, considers taxa threshold applied by SPRFMO to bottom trawl VME encounters.

Trawling

- Review the encounter thresholds in para 12 of CMM 01 (2023) undertaking a precautionary and ecosystem approach; and
- Taxa should be subdivided into similar taxa groups applied in the SPRFMO CMM03-2023.
- Catchability of taxa should be considered when establishing encounter thresholds.

Longline

- DSCC Recommends that the longline encounter threshold be reviewed so that it includes taxon specific values.

6. Conclusions

DSCC acknowledges the interim progress that has occurred in the protection of VMEs from SAIs in the SIOFA area. This paper highlights the areas where the SC should provide further assistance to the MOP. This includes: the protection of EBSAs and seamounts, and all VMEs; the use of bioregions; evaluation of biodiversity hot spots and the fishing intensity impact index, noting the risk in bioregion 1 and particularly 1.2; closing seamounts and Saya de Malha Bank to bottom trawling; adding sea grass to the list of VME taxa; regularly revising the BFIA standard and BFIAs for all bottom fishing countries; Including climate change and ocean acidification in the standard and assessments; reviewing encounter thresholds and the taxa divisions used for triggering encounters for both trawling and longlining.

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Appendix 1 **Deep-Ocean Stewardship Initiative (DOSI)**

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 Mānoa

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.

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 1-2 m 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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