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**Approaches used by other RFMOs and CCAMLR to avoid significant adverse
impacts on Vulnerable Marine Ecosystems**

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Approaches used by other RFMOs and CCAMLR to avoid significant adverse impacts on Vulnerable Marine Ecosystems

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1. Purpose of paper

This paper provides context on the management of impacts of bottom fisheries on Vulnerable Marine Ecosystems (VMEs) by summarising the protocols and procedures used by other RFMOs and CCAMLR to avoid significant adverse impacts on VMEs.

2. Introduction

Intent

This document reviews VME encounter protocols and selected additional management measures developed by other RFMOs and by CCAMLR for bottom fisheries. It aims to provide context and examples on how significant adverse impacts (SAI) on VME could be managed in deep-water bottom fisheries for the SPRFMO Scientific Committee. This document draws heavily on a paper by Masashi Kiyota of Japan's National Research Institute of Far Seas Fisheries, Fisheries Research and Education Agency (paper NPFC-2018-WS VME01-WP02), presented to NPFC in 2018. Several changes have occurred since then, and all measures have been checked and the text herein updated or expanded to reflect those changes.

The focus both in Kiyota (2018) and here was on VME encounter protocols, a common management tool across many RFMOs and CCAMLR, and one of several practical options on how to address the need to reduce SAI on VMEs. We extracted key elements specific to VME encounter protocols (VME indicators, encounter thresholds, move-on protocols, post-encounter actions) from the texts of current conservation measures (CM) or conservation and management measures (CMM) of bottom fishing RFMOs and CCAMLR, including those adjacent to SPRFMO. Throughout this document, we consider the following elements used by each management body to avoid significant adverse impacts on vulnerable marine ecosystems (VMEs).

VME Indicator taxa and other VME indicators

The definition of VME indicator taxa and the classification or definition of physical habitat characteristics likely to host VME is used by many RFMOs, as well as CCAMLR, to specify what, within the given geographical region, would be considered an indication that VME are present. How these taxa and attributes are specifically used in the designation of VMEs or areas for protective closure is not always clearly documented for the reviewed R(F)MOs. Where encounter thresholds are used, in some cases there is a clear link between developed VME indicator taxa and the threshold chosen to define a VME community, while in other R(F)MOs not all VME indicator taxa are used in the specified encounter thresholds. It is not always clear how the VME indicator taxa included in protocols were chosen, nor how the thresholds were set.

Move-on protocols

A common encounter protocol is the move-on rule, in place in most RFMOs and CCAMLR. This protocol requires a fishing vessel to move away if more than a pre-specified weight of given taxa are caught. The move-on distance is typically 1 or 2 nautical miles (n.m.), often depending on gear type, and a temporary closure area is then typically specified. The direction

of movement after an encounter is sometimes specified (so as to reduce the risk of further encounters). The exact design of the temporary closures varies among the reviewed organisations.

Procedures following an encounter

Temporary closures generally remain in place until reviewed by a scientific body and/or the management group (typically a Commission or Meeting of the Parties) of the management body. Some R(F)MOs distinguish between existing fishing grounds and new (previously un-fished) areas and apply different protocols and Post-encounter actions between them. Some R(F)MOs also encourage the collection of habitat mapping information to support review of the encounter and improve knowledge on habitats suitable or likely to host VME in the region.

Measures other than encounter protocols

All RFMOs and CCAMLR also have measures other than encounter protocols as part of their respective suites of measures to avoid significant adverse impacts on VMEs. These include spatial closures of designated VMEs, other spatial closures (e.g., for stock management purposes), spatial management, and restrictions on the depth of fishing. The procedures for designing such measures are not commonly specified in CMs / CMMs but we infer that proposals from Members or CCPs are generally reviewed by scientific bodies, then approved by the Commission or Meeting of Parties. Risk assessments and bottom fishery impact assessments are generally required and reviews of such assessments are often specified.

3. Summary of VME encounter protocols and management measures used by other RFMOs and CCAMLR

NPFC, North Pacific Fisheries Commission

Measures are specified in conservation and management measures, separately for the western and eastern parts of the Convention Area: CMM 2018-05 (for the western part of the area); and CMM 2017-06 (for the eastern part of the area), see: <https://www.npfc.int/active-conservation-and-management-measures> for currently active measures.

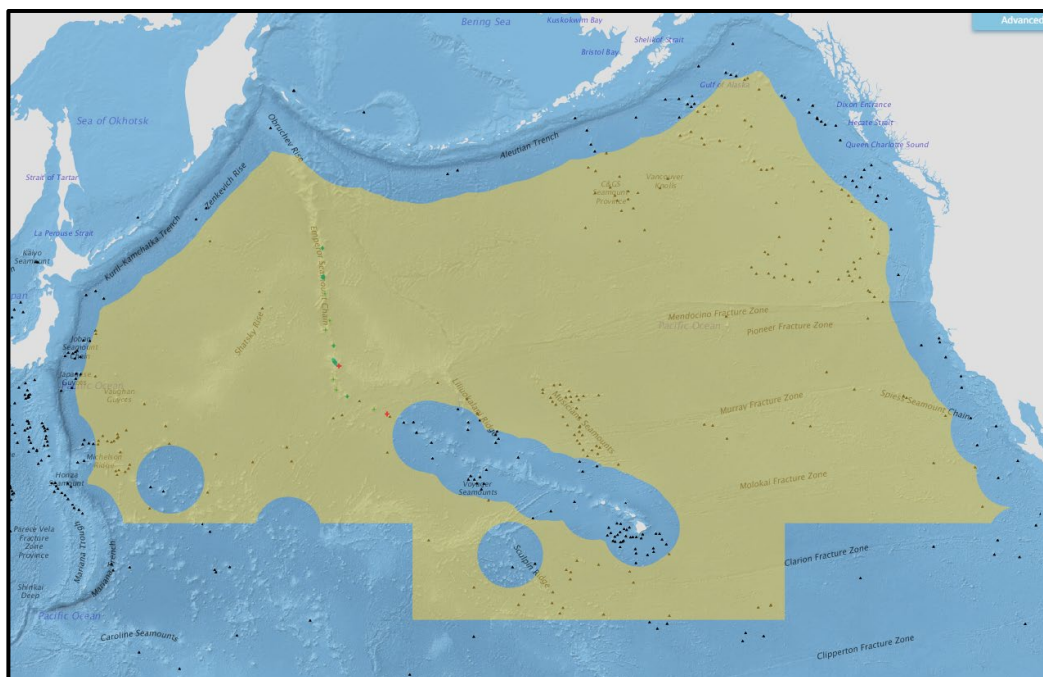


Figure 1: The NPFC Convention Area (from FAO’s VME database) including current fishing areas (green) and VME closures (pink)

VME indicator taxa

Directed fishing is not allowed on cold water corals that include: Alcyonacea, Antipatharia, Gorgonacea, Scleractinia as well as other indicator species for vulnerable marine ecosystems as may be identified from time to time by the Scientific Committee and adopted by the Commission (specified in CMM 2018-05, Paragraphs 4F & G and CMM 2017-06, Paragraphs 3g & j; Convention text, Article 13.5). In addition to the four groups identified above, Annex 2.1 of CMM 2018-05 also identifies some types of sponge dominated communities, xenophyophores, hydroids, bryozoans and invertebrate and microbial species associated with seep and vent communities and found nowhere else as examples VME taxa.

Encounter thresholds

An encounter is triggered by more than 50 kg of live cold water corals being “encountered” in one gear retrieval in the western part of the area (specified in CMM 2018-05, Paragraph 4G) or more than 50 kg of live cold water corals or other indicator species as identified by the SC (specified in CMM 2017-06, Paragraph 3j). The type of gear is not further specified.

Move-on protocols

Following an encounter, a vessel is required to relocate no less than 2 n.m. so that additional encounters with VMEs are unlikely (specified in CMM 2018-05, Paragraph 4G and CMM 2017-06, Paragraph 3j).

Procedures following an encounter

All encounters, including the location and the species in question, shall be reported to the Secretariat, who shall notify the other Members of the Commission so that appropriate measures can be adopted in respect of the relevant site (specified in CMM 2018-05, Paragraph 4G and CMM 2017-06, Paragraph 3j).

Additional

Members are required to submit to the SC their assessments of the impacts of fishing activity on marine species or any VMEs, including the proposed management measures to prevent such impact.

Both CMMs pertaining to bottom fisheries include the following relevant annexes:

- Annex 2: Science-based standards and criteria for identification of VMEs and assessment of significant adverse impacts on VMEs and marine species (largely following UNGA resolutions and FAO's deep-sea fishery guidelines);
- Annex 3: Scientific Committee assessment review procedures for bottom fishing activities.

NAFO, Northwest Atlantic Fisheries Organisation

Measures are specified in the NAFO Conservation & Enforcement Measures for 2019 (NAFO CM Doc. 19-01, serial no. N6901, available at: <https://www.nafo.int/Fisheries/Conservation>).

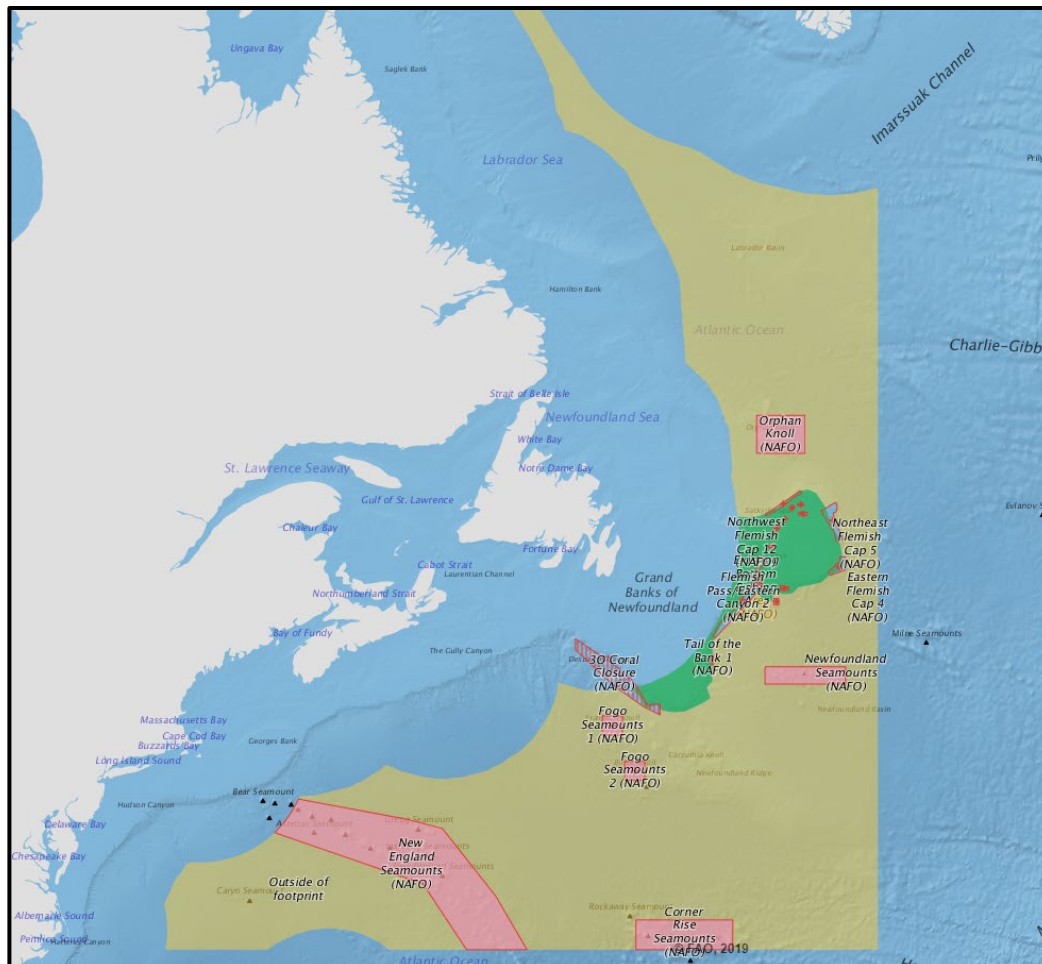


Figure 2: The NAFO Convention Area (from FAO’s VME database) including current fishing areas (green) and VME closures (pink)

VME indicator taxa

The list of NAFO VME indicator species is very long and is grouped into the following categories: large-sized sponges (Porifera), stony corals (Scleractinia, which are thought not to occur in abundance in the NAFO Area), large and small gorgonian corals, sea pens, tube-dwelling anemones, erect bryozoans, sea lilies (crinoids), and sea squirts. The known species are specified in Annex I.E, Part VI, pages 103–104.

VME physical elements

In addition to VME indicator species, a list of physical VME indicator elements is specified that includes seamounts, canyons, knolls, Southeast Shoal at the end of the Grand Banks, and the steep flanks (> 6.4°) of the Flemish Cap (Annex I.E, Part VII, page 105). Some of these features relate to the VME closures in place, but they do not relate directly to the encounter protocol.

Encounter thresholds

An encounter is triggered by the capture of more than 7 kg of sea pens, and/or 60 kg of “other live corals” (the meaning of which is not clear to us), and/or 300 kg of sponges (Article 22.1, page 36). Captures of other VME indicator taxa do not trigger an encounter.

Move-on protocols

Following an encounter, the vessel must move at least 2 nm from the endpoint of the tow/set in the direction least likely to result in further encounters according to the master’s best judgment (specified in Article 22.2, a-2-ii, page 36).

Procedures following an encounter

All encounters, including the location and the species in question, shall be reported to the Member and Executive Secretary, who notifies other Members. The Executive Secretary requests all Members to implement a temporary closure of 2 n.m. radius around the encounter if it is located outside the footprint (specified in Article 22.3, c, page 37). The Executive Secretary requests of Members to maintain the temporary closure until such time that the Commission adopts conservation and management measures if the Scientific Council determines that the area covered by a temporary closure consists of a VME (specified in Article 22.3, d). If the Scientific Council does not conclude that the area covered by a temporary closure consists of a VME, then the Executive Secretary informs Members that they may reopen the area to their vessels (specified in Article 22.3, e)

Additional

Article 17 (page 26–33) specifies additional area restrictions (closures) for bottom fishing activities as part of its ecosystem approach as follows:

- Seamount Closures (unless using gear that is designed to fish for pelagic species, no portion of which is designed to be or is operated in contact with the bottom at any time as specified in Article 13(8), page 21);
- Division 30 Coral Area Closure;
- High Sponge and Coral Concentration Area Closures.

Articles 18–21 (pages 33–36) deal extensively with the assessment of exploratory bottom fisheries. Article 23 specifies reassessment of all bottom fisheries in 2021 and every 5 years thereafter, or

- when there is new scientific information indicating a VME in a given area;
- other new scientific information becomes available; or
- there is significant change in the fishery.

NEAFC, North-East Atlantic Fisheries Commission

Measures are specified in Recommendation 19:2014 (as amended by Recommendation 09:2015 and Recommendation 10:2018): Recommendation on the protection of vulnerable marine ecosystems in the NEAFC Regulatory Area. Measures can be found at: http://www.neafc.org/managing_fisheries/measures/current

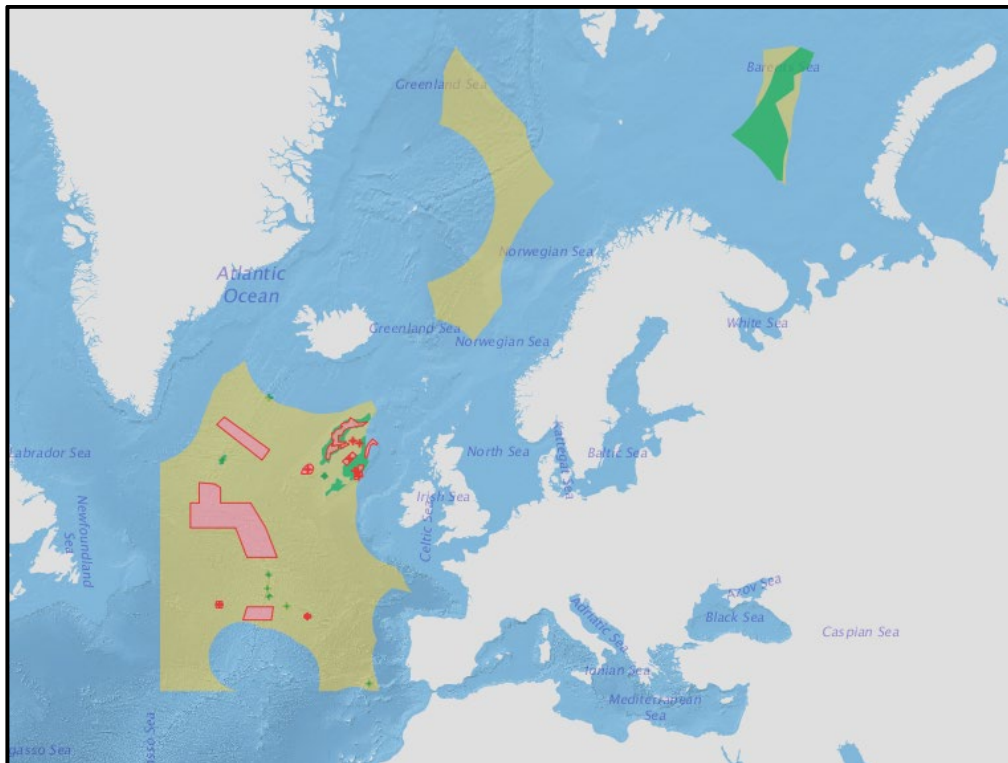


Figure 3: The NEAFC Convention Area (from FAO's VME database) including current fishing areas (green) and VME closures (pink)

VME indicator taxa

A list of seven broad habitat types is specified in Annex 5 (of Rec.19:2014 as amended) and these are considered as VME indicators. The VME habitat types are cold water coral reef, hard- and soft-bottom coral gardens, three types of sponge aggregations, sea pen fields, tube-dwelling anemone patches, various mud- and sand-emergent fauna, and bryozoan patches. Representative taxa are identified for each grouping.

VME elements

In addition to VME indicator habitats and indicator taxa, a list of physical VME indicator elements is specified that are considered VME indicators. These are isolated seamounts, steep-slopes and peaks on mid-ocean ridges, knolls, canyon-like features, and steep flanks (> 6.4°) as specified in From NAFO SCR Doc. 11/73. Some of these features relate to the VME closures in place, but they do not relate directly to the encounter protocol.

Encounter thresholds

An encounter is triggered (as specified in Article 9) by:

- For a trawl tow or other gear (not longline): more than 30 kg of live coral and/or 400 kg of live sponge “of VME indicators” (the meaning of which is unclear to us) (specified in Article 9a of Rec.19.2014 as amended). Captures of other VME indicator taxa (e.g., sea pens, tube-dwelling anemones, bryozoan patches) do not appear to trigger an encounter;
- For a longline set: presence of VME indicators on 10 hooks per 1000-hook segment or per 1200 m section of longline, whichever is shorter (specified in Article 9b of Rec.19.2014 as amended).

Move-on protocols

For a trawl tow, the vessel must move out of an area defined as a 2 n.m. wide band (polygon) on both sides of the “track” of the tow, extended by 2 n.m. at both ends (specified in Article 8.1 a-i). For other fishing gear, the vessel moves away at least 2 n.m. from the position that is closest to the exact encounter location, based on the master’s best judgment and all available information (specified in Article 8.1, a-ii).

Procedures following an encounter

Following an encounter, the encounter must be reported by the vessel to the FS Member, the Executive Secretary, and the International Council for the Exploration of the Sea (ICES) (specified in Article 8.1, b-iii). The Secretary then implements a temporary closure in the encounter area(s) identified. Article 8.3 specifies a preference that sea-bed mapping using echo-sounders or multi-beam sounders of the encounter areas and environs should be conducted and submitted to ICES for its evaluation and advice to the Permanent Committee on Management and Science (PECMAS).

PECMAS evaluates the information, including any sea bed mapping, at its next meeting or by correspondence. If it concludes that the area has or is likely to have a VME, then the temporary closure is maintained until the Commission has acted upon the advice from PECMAS. If it does not conclude that the area has or is likely to have a VME, then Members may re-open the area for fishing (specified in Article 8.4).

Additional

Article 5 (of Rec.19:2014 as amended) specifies that area closures for the protection of VMEs shall be based on advice from ICES. Annex 2 specifies 19 such closures.

Article 10 (of Rec.19:2014 as amended) specifies the following review procedures:

- A review by the Commission every 5 years to examine the effectiveness of measures protecting VMEs from significant adverse impacts. This review will address modifications required as a result of new scientific advice;
- A review by the Commission of closed areas specified in Article 5.2 before it expires in at the end of 2022. This review has the intention of extending Article 5.2 unless it is concluded that the continued application of the measure or parts of the measure is not required.

Any Notice of Intent for an exploratory fishery must be accompanied by a mitigation plan for VME encounters.

GFCM, General Fisheries Commission for the Mediterranean

No encounter protocols are presently specified by GFCM, but through its working group on VMEs the Commission is in the process of defining them for corals and sponges.



Figure 4: The GFCM Convention Area (from FAO's VME database) including current fishing areas (green) and VME closures (pink)

Other GFCM decisions provide protection for sensitive habitats were made in 2005 and 2006. These can be found at: <http://www.fao.org/gfcm/decisions/en/>.

Recommendation GFCM/29/2005/1 prohibited fishing using towed dredges or trawl nets deeper than 1000 m anywhere in the Commission Area.

Recommendation GFCM/30/2006/3 established fisheries restricted areas (closures) to protect the following deep-sea sensitive habitats:

- The *Lophelia* reef off Capo Santa Maria di Leuca;
- The Nile delta area cold hydrocarbon seeps; and
- The Eratosthenes Seamount.

SEAFO, South East Atlantic Fisheries Organisation

Measures are specified in Conservation Measure 30/15 on Bottom Fishing Activities and Vulnerable Marine Ecosystems in the SEAFO Convention Area available at: <http://www.seafo.org/Management/Conservation-Measures>

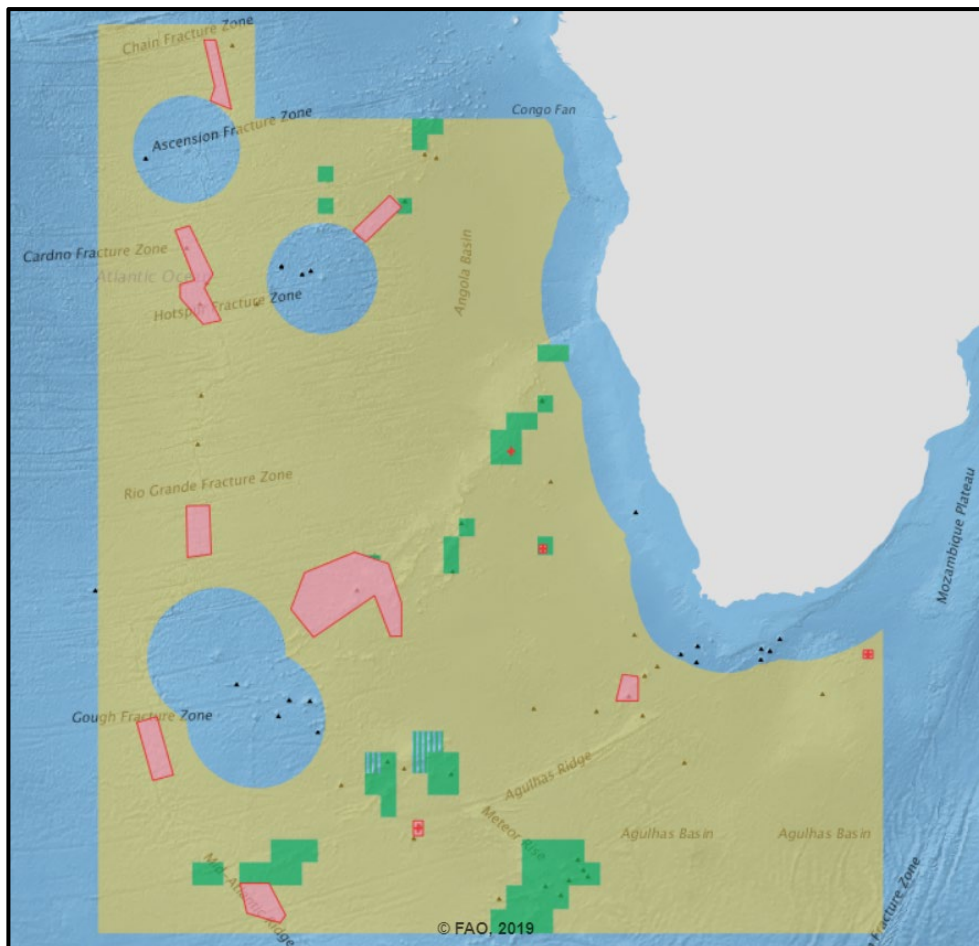


Figure 5: The SEAFO Convention Area (from FAO's VME database) including current fishing areas (green) and VME closures (pink)

VME indicator taxa

In 2010, the Scientific Committee identified a provisional list of benthic invertebrate VME indicator species or groups including sponges, gorgonian corals, hydrocorals, stony corals, black corals, zoanthids, soft corals, sea pens, erect bryozoans, sea lilies, basket stars, serpulid worms, and sea squirts (these are shown at: <http://www.seafo.org/Management/VME-Protection>). The list defines which organisms should be recorded as indicator species by scientific observers, however no taxa-specific thresholds have yet been defined and not all identified taxa fall into the two overarching categories of 'live corals' and 'live sponges' that trigger encounter protocols. It is not clear precisely how these indicator species are used, although there is currently only very limited fishing occurring.

Encounter thresholds

An encounter is triggered (as specified in Article 8 and Annex 6.2 of CM30-15) by:

- For a trawl tow in an existing fishing area: more than 600 kg of live sponges and/or 60 kg of live coral;
- For a trawl tow in a new fishing area: more than 400 kg of live sponges and/or 60 kg of live coral;
- For a longline set in either an existing or new fishing area: more than 10 VME-indicator units (1 unit being 1 kg or 1 litre of live coral and/or live sponge) in one 1200 m section of line or 1000 hooks, whichever is shorter;
- For a pot set in either an existing or new fishing area: more than 10 VME-indicator units in one 1200 m section of line.

Move-on protocols

For a trawl tow, the vessel must move at least 2 n.m. from the end point of the tow in the direction least likely to result in further encounters, and define a buffer of 2 n.m. radius. For other gears, the vessel must move away at least 1 n.m. from the position that is closest to the exact encounter location, defining a buffer of 1 n.m. radius, based on the master's best judgment and all available information (specified in Article 8.1-b).

Procedures following an encounter

Following an encounter, the encounter must be reported to the Member and the Executive Secretary (specified in Article 8.1, b-iii). If the encounter occurred outside existing fishing areas, the Executive Secretary then implements a temporary closure in the encounter area(s) identified. Article 8.3 specifies that sea-bed mapping of the encounter areas and environs should be conducted using echo-sounders or multi-beam sounders and submitted to the Scientific Committee for its evaluation.

The Scientific Committee evaluates each temporary closure at its next meeting or by correspondence. If the SC concludes that there is sufficient evidence of a VME, the temporary closure is maintained until the Commission decides whether to reopen the temporary closure or add it to the SEAFO fishing closures (which are specified in Annex 2). If the SC does not conclude that there is sufficient evidence of a VME, Members may re-open the area to fishing (specified in Article 8.4).

Additional

Annex 2 of CM30-15 specifies 11 closed areas to bottom contact gears to protect sensitive species or vulnerable marine ecosystems.

Articles 6 and 7, together with Annex 3, specifies (somewhat briefly) procedures and what must be considered in an assessment of exploratory bottom fishing activities.

Annex 5 specifies rules and procedures for opening of new areas for fishing based on representative exploratory fishing data from the specified area where the VME thresholds were not exceeded.

SIOFA, Southern Indian Ocean Fisheries Agreement

Measures are specified in the CMM 2019/01: Interim Management of Bottom Fishing in the Agreement Area. Measures can be found at: <http://www.siofa.org/cmm>

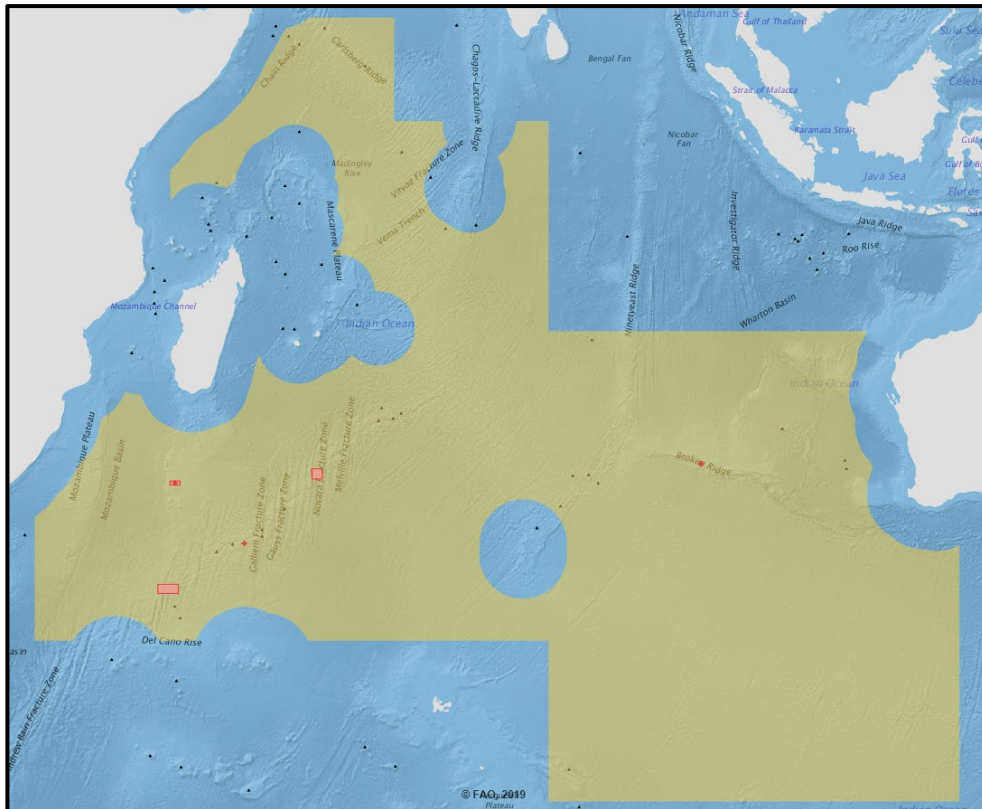


Figure 6: The SIOFA Agreement Area (from FAO's VME database) showing areas closed to fishing using trawl gears (pink)

VME indicator taxa

SIOFA has very recently adopted a list of VME indicator taxa at its annual Meeting of Parties in 2019 based on the list developed by CCAMLR. At the time of writing, the list was not yet available online.

VME Encounter thresholds

An encounter is triggered (as specified in Article 12 of CMM 2019-01) by:

- For a trawl tow: more than 60 kg of live coral and 300 kg of live sponges in any one tow;
- For longlines: 10 or more VME Indicator Units per line segment of 1000 hooks or 1200 m length of taxa given in the VME indicator taxa list (1 IU = 1 kg or 1 litre of VME indicator organisms).

Move-on protocols

For a trawl tow, the vessel must move at least 2 n.m. and outside of an area 2 n.m. either side of a trawl track extended by 2 n. m. at each end (Article 13a). For longline and trap gears, the vessel must move away at least a 1 n.m. radius from the mid-point of the line-segment that triggered the encounter protocol (Article 13b). For other gears, the vessel must move away at least 1 n.m. from the mid-point position of the operation (Article 13c).

Procedures following an encounter

Any encounter is reported by the CCP to the Secretariat, and also in their National Report to the Scientific Committee (specified in Article 13). The Secretariat notifies all CCPs within 3 working days that bottom fishing is suspended in the encounter area (specified in Article 14). Fishing remains suspended in the designated encounter area unless and until the Meeting of Parties, on the basis of advice from the Scientific Committee, decides whether the encounter area should remain closed to all or some gears, or whether fishing activities may resume. The Scientific Committee reviews all encounters at each ordinary meeting together with any other benthic bycatch data it considers relevant to provide advice to the Meeting of Parties thereon (specified in Articles 15-17).

Additional

Annex 2 of CMM 2019-01 outlines areas provisionally designated as protected areas, where bottom fishing activities, excluding longline and pot activities, are prohibited. Furthermore, benthic fisheries need to provide a Bottom Fishing Impact Assessment which includes an assessment of likely VME encounters.

CCAMLR, Commission for the Conservation of Antarctic Marine Living Resources

CCAMLR is not a RFMO but an International Commission whose Convention forms part of the Antarctic Treaty System, with the objective to conserve Antarctic marine life, including through managed and sustainable exploitation of marine living resources. CCAMLR implemented its first CM on VME protection in 2006, restricting bottom trawling and deep-sea gillnetting and specifying conditions for new and exploratory fisheries, such as an assessment of likely impact on benthic ecosystems. In 2008, the first CM detailing consistent approaches to VME encounters came into force (CM 22-07). Indicator species were identified in 2009, and the thresholds for VMEs defined based on encountered VME indicator species units. Management and mitigation measures were introduced to reduce further impact on the identified VME regions. CCAMLR acknowledges that, due to the nature of longline fishing methods, which are not designed to collect or retain benthic sessile organisms such as VME indicator species, an absence of VME indicator species does not necessarily mean an absence of VMEs. The developed approach, therefore, is a precautionary approach to balance both the useful information on species distribution gained through incidental by-catch on longlines, and the need to implement measures that avoid significant adverse impacts on VMEs. Additional CMs introduced limits on depth, protecting shallower regions (CM 22-08), and permanently closed regions based on registered and verified VME locations (CM 22-09). The Conservation Measures can be found here: <https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures>.

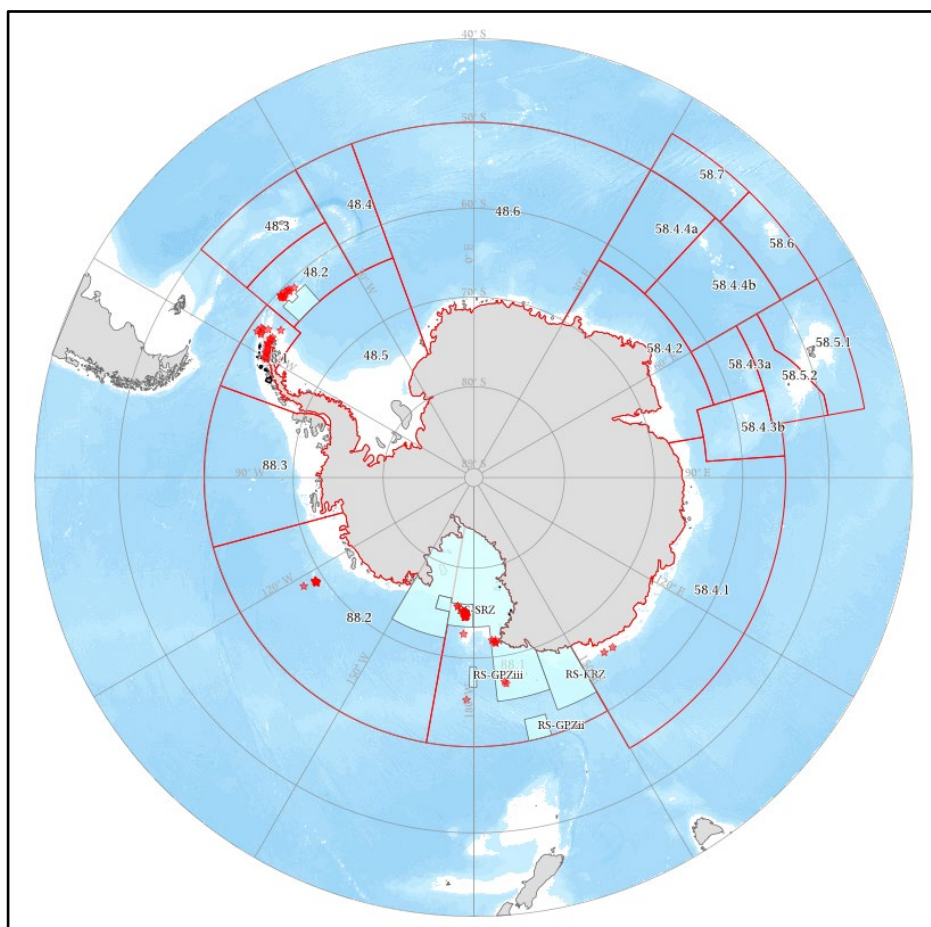


Figure 7: The CCAMLR Convention Area (from CCAMLR GIS database) including Marine Protected Areas (light blue) and locations of registered VMEs (red)

VME indicator taxa

The list of VME indicator taxa was adopted in 2009, and includes Gorgonians, Alcyonacea, Scleractinia, Anthipatharia, Hydrocorals, Zoanthids, Anemones, Sea pens, Hexasponges, Demosponges, Sea squirts, Erect bryozoans, Brachiopods, Acorn worms, Tube-dwelling annelids, Xenophyophores, Goose and acorn barnacles, Antarctic scallop, Sea lilies, and Chemosynthetic communities (CCAMLR VME Taxa Classification Guide, <https://www.ccamlr.org/en/document/publications/vme-taxa-classification-guide>)

VME measures

Bottom trawling in high seas areas within the Convention Area is prohibited (CM 22-05). For the protection of benthic shelf-based systems, bottom fishing with longlines or pots may be carried out only at depths deeper than 550 m (CM 22-08). Areas with registered and verified VMEs are permanently closed (CM 22-09).

Encounter thresholds

- For longline and pot (bottom trawl is prohibited): 10 or more VME Indicator Units per line segment of 1000 hooks of taxa given in the VME indicator taxa list (1 IU = 1 kg or 1 litre of VME indicator organisms) triggers a Risk Area Closure (CM 22-07 Article 4); 5 units triggers a VME fine-scale rectangle (CM 22-07 Article 5).

Move-on protocols

For longline and pot gear, the vessel must move away at least beyond the Risk Area that is defined as having a 1 n.m. radius from the mid-point of the line-segment that triggered the encounter protocol (CM 22-07 Article 2-v).

Procedures following an encounter

Any encounter of 10 or more VME units is immediately reported to the Secretariat and the Flag State including location of the midpoint of the line segment which triggered the encounter, and the number of VME indicator units. No further lines intersecting with the Risk Area may be set (CM 22-07 Article 4).

Any encounter of 5 or more VME units is immediately reported to the Secretariat and the Flag state including location of the midpoint of the line segment which triggered the encounter, and the number of VME indicator units (CM 22-07 Article 5).

When receiving a notification for a Risk Area, the Secretariat notifies all relevant fishing vessels and their Flag States within one working day of the closure of the Risk Area. All vessels must immediately cease setting any further lines intersecting with the Risk Area (CM 22-07 Article 6-ii). When the Secretariat receives five notifications of 5 VME units within the same fine-scale rectangle, it notifies all relevant vessels and flag states that a VME may be encountered in this area, although fishing activities may continue (CM 22-07 Article 7). Risk Areas remain closed until reviewed by the Scientific Committee and a management action determined by the Commission.

Additional

Two Marine Protected Areas are established within the Convention Area, the South Orkneys Marine Protected Area (CM 91-03) and the Ross Sea Region Marine Protected Area (CM 91-05). Both MPAs include protection to known VME distributions and representative benthic ecoregions. Additionally, the General Framework for the establishment of CCAMLR Marine Protected Areas (CM 91-04) includes objectives that protect habitats and regions that are vulnerable to human activities, including unique, rare, or highly diverse habitats or features.

New and exploratory fisheries further need to provide an assessment of bottom fishing activities evaluating if the fishing activities would contribute to having SAI on VMEs, as specified in CM 22-06 Article 7.

CCAMLR publishes all its VME locations and taxa in the CCAMLR VME registry (<https://www.ccamlr.org/en/document/data/ccamlr-vme-registry>) and on its GIS portal (<https://gis.ccamlr.org>).

4. Conclusions and next steps

There were several key commonalities and differences between how the examined bodies address the call in UNGA 61/105 (and subsequent resolutions) to close areas to bottom fisheries until appropriate measures have been put in place to prevent significant adverse impacts on VMEs. What constitutes evidence of a VME is defined differently by different bodies. Most bodies have identified suites of VME indicator taxa, but there is some variation in terms of how the presence of indicator taxa is considered evidence of VME communities rather than isolated organisms. There are also different approaches to the question of spatial scale, e.g. local such as VME Risk Areas (CCAMLR) to regional such as seamount features (NAFO), or whether there is a scale limit at which SAI should be prevented. In a different approach to area-wide indicator taxa, NEAFC identified characteristic VMEs (e.g., cold-water coral reef, coral garden, deep-sea sponge aggregation, sea pen field) and designated indicator taxa specific to each of the identified VME.

Most bodies define VME encounter protocols which generally include “move-on rules” that apply when a fishing vessel encounters a potential VME. Encounters are defined in terms of catch weights of VME indicator taxa, but not all VME indicator taxa identified by each body are included in their respective encounter protocols (see Tables 1 to 3). Following an encounter, a vessel is required to cease fishing and move a specified distance from the encounter. Most management bodies specify the reference point or reference line of the move and some specify that movement must be in a direction that will reduce the risk of additional impacts on VMEs (based on the master’s judgment and available information). Some management bodies have also defined existing fishing grounds and distinguish those from unfished areas, applying different protocols and Post-encounter actions to fished and unfished areas. Some management bodies close the area around the VME encounter point in new fishing areas (e.g., NAFO, SEAFO).

Amongst the reviewed bodies, the approaches can also be grouped into management measures that include not just encounter thresholds and move-on rules, but also include broader definitions of VME such as the inclusion of features, groups, habitats associated with VME indicator species and, as such, likely to host VMEs. Closures or specific spatial management measures around such features can then also contribute to the mitigation of significant adverse impacts on VMEs.

A conceptually different approach is taken by CCAMLR, where the fishery is only one part of the whole ecosystem-based management to conserving Antarctic marine ecosystems. As with all bycatch, the approach by CCAMLR is to if possible avoid, then mitigate, and finally limit the impact on VME indicator species. The prohibitions on benthic trawling and the depth limitations remove much of the potential for encounters of VME indicator species by fisheries, placing emphasis on avoidance as a mitigation measure. The nature of longlines, whereby target species actively take a bait rather than be swept into a net, means that bycatch of VME indicator species is incidental and several orders of magnitudes lower than bycatch in benthic trawls. The closures of Risk Areas and Registered VME sites limit further impact on these identified ecosystems.

All bodies have area closures that protect VMEs, recognising that encounter protocols are only one part of a suite of measures to avoid significant adverse impacts. In general, the likeliest source of significant adverse impacts is generally accepted as being mobile, bottom-contacting gears, such as bottom trawls and midwater trawls used to target benthopelagic species. Limiting the areas in which these activities may occur can substantially reduce the risk of adverse impacts. Thus, gear-specific closures exist in certain organisations, such as SPRFMO’s different trawl and bottom line management areas, the longline-only areas in SEAFO and SIOFA, or the moratorium on trawling in waters deeper than 1000 m in GFCM. In their comprehensive review, Bell et al. (2018) concluded that the use of closed areas was the most effective management tool for avoiding significant adverse impacts on VMEs (see Figure 8).

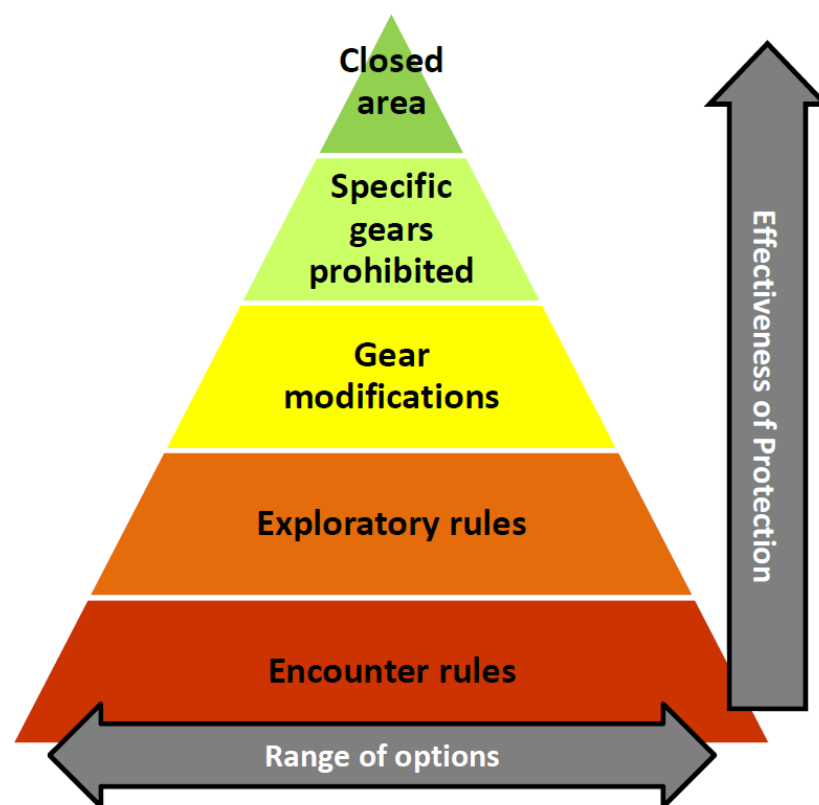


Figure 8 (Figure 2.9.4 from Bell et al. 2018, reproduced with permission): Conceptual hierarchy of fisheries management measures available to organisations to mitigate or avoid adverse impacts upon VMEs in a given area. Effectiveness of encounter rules varies according to observer coverage levels and expected duties. N.B. Hierarchy is not mutually exclusive (e.g. an organisation might opt to have exploratory rules that prohibit certain gear types or configurations).

This review has highlighted a notable emphasis by many RFMOs on encounter protocols as a tool to manage significantly adverse impacts, although almost all also have closed areas and additional measures that protect VMEs. SPRFMO’s current bottom fishing measure [CMM-03-2019](#) restricts bottom-impacting fishing to tightly-defined areas within the historical footprint that were designed to minimise the impacts on VME key indicator taxa while providing access

for fisheries. Like most other RFMOs, SPRFMO has a VME encounter protocol based on threshold weights, but this was envisaged as a “backstop” to complement the spatial management approach rather than a primary tool. Other key differences of SPRFMO’s approach are that there are no designated VMEs and associated closures (all areas outside the defined fishing areas are essentially closed to protect VMEs), and that avoiding significant adverse impacts on VMEs is considered mostly at a broad, regional scale, rather than a local scale.

5. Recommendations

It is recommended that the Scientific Committee:

- **Notes** the variety of approaches used by other RFMOs and CCAMLR to avoid significant adverse impacts on VMEs;
- **Evaluates** the relevance and utility of approaches used by other RFMOs and CCAMLR when reviewing the SPRFMO Bottom Fishery Impact Assessment Standard and the bottom fishing measure, CMM-03-2019, to prevent significant adverse impacts on VMEs.

References

- Bell, J.; Guijarro-García, E.; Kenny, A. (2018). Scientific approaches for the assessment and management of deep sea fisheries and ecosystems in RFMOs and RFBs. Final Report for European Commission Framework Contract EASME/EMFF/2016/008. 171 p. Available at: <https://publications.europa.eu/en/publication-detail/-/publication/0f2b559b-4610-11e9-a8ed-01aa75ed71a1/language-en>.
- Kiyota, M. (2018). Updated summary comparison of VME encounter protocols in bottom fish RFMO/As. Paper NPFC-2018-WS VME01-WP02 to the NPFC/FAO Workshop on Protection of Vulnerable Marine Ecosystems in the North Pacific Fisheries Commission Area: applying global experiences to regional assessments, 12-15 March 2018, Yokohama, Japan.

Table 1: Summary of the elements of encounter protocols for trawl fisheries used by different RFMOs as of 2019. CCAMLR is omitted from this table as bottom trawl fisheries are not permitted within the high seas of its Convention Area.

RFMO	VME indicator taxa	VME thresholds	Move-on distance	Reporting and Short-term management action	Encounter review	Long-term management action
NPFC	Alcyonacea, Antipatharia, Gorgonacea, Scleractinia	50 kg of live cold-water corals in the western part or or more than 50 kg of live cold water corals or other indicator species	2 nm	Reported to Secretariat who notifies members	Members submit assessment of impacts to SC	Commission decides appropriate measures to be adopted
NAFO	Porifera, Gorgonacea Scleractinia, Pennatulacea, Ceriantharia, Bryozoa, Crinoidea, Ascidiacea	7 kg of sea pens, and/or 60 kg of “other live corals”, and/or 300 kg of sponges	2 nm from endpoint of tow in direct least likely to result in further encounters	Reported to the Member and Executive Secretary, who notifies other Members. Temporary closure 2 nm radius around the encounter if it is located outside the footprint	Scientific Council reviews area covered by temporary closure to determine presence of VME	Executive Secretary determines if closure remains in effect or can reopen
NEAFC	Porifera, Gorgonacea Scleractinia, Antipatharia, Alcyonacea, Pennatulacea, Ceriantharia, Bryozoa, Crinoidea, Foraminifera, Xenophyophorea	30 kg of live coral and/or 400 kg of live sponge	2 nm wide band on both sides of the bottom trawl tracks, extended by 2 nm at both ends, or 2 nm from the position that is closest to the exact encounter location for other fishing methods	Reported to the Member, the Executive Secretary, and ICES. The Secretary then implements a temporary closure in the encounter area(s) identified.	Seabed mapping using echo-sounders or multi-beam sounders of the encounter areas and environs should be conducted and submitted to ICES for its evaluation and advice to PECMAS	PECMAS evaluates information and advises the Commission if temporary closure should remain in force or be lifted
SEAFO	Porifera, Gorgonacea Anthoathecatae, Scleractinia, Antipatharia, Zoantharia, Alcyonacea, Pennatulacea, Bryozoa, Crinoidea, Euryalida, Serpulidae, Ascidiacea	600 kg of live sponges and/or 60 kg of live coral in existing fishing areas; 400 kg of live sponges and/or 60 kg of live coral in new fishing areas.	2 nm from the end point of a trawl tow in the direction least likely to result in further encounters and define a buffer of 2 nm radius.	Reported to the Member and the Executive Secretary. If encounter occurred outside existing area, Executive Secretary implements a temporary closure.	Seabed mapping of the encounter areas and environs should be conducted using echo-sounders or multi-beam sounders and submitted to the Scientific Committee for its evaluation	Commission decides whether to reopen the temporary closure or add it to the SEAFO fishing closures based on SC advice
SIOFA	Porifera, Gorgonacea, Anthoathecatae, Stylasteridae, Scleractinia, Antipatharia, Zoantharia, Actiniaria, Alcyonacea, Pennatulacea, Ascidiacea, Bryozoans, Brachiopoda, Graptolithoidea, Serpulidae, Xenophyophora, Bathylasmatidae, Crinoids, Euryalida, Cidaroida	60 kg of live coral, 300 kg of live sponges in any one tow	2 nm either side of a trawl track extended by 2 nautical miles at each end.	Report any encounters in their National Reports to the Scientific Committee. Secretariat notifies members of temporary closure to encounter area.	Scientific Committee reviews all encounters at each ordinary meeting together with any other benthic bycatch data it considers relevant	Meeting of Parties decides, upon advice from SC, whether the encounter area should remain in force for some or all gears, or be lifted

Table 2: Summary of the elements of encounter protocols for longline fisheries used by different R(F)MOs as of 2019.

R(F)MO	VME indicator taxa	VME thresholds	Move-on distance	Reporting and Short-term management action	Encounter review	Long-term management action
NEAFC	Porifera, Gorgonacea Scleractinia, Antipatharia, Alcyonacea, Pennatulacea, Ceriantharia, Bryozoa, Crinoidea, Foraminifera, Xenophyophorea	VME indicators caught on 10 hooks per 1000-hook segment or per 1200 m section of longline, whichever is shorter	At least 2 nm from the position that is closest to the exact encounter location	As for trawl	As for trawl	As for trawl
SEAFO	Porifera, Gorgonacea Anthoathecatae, Scleractinia, Antipatharia, Zoantharia, Alcyonacea, Pennatulacea, Bryozoa, Crinoidea, Euryalida, Serpulidae, Ascidiacea	> 10 VME-indicator units (1 U = 1 kg or 1 l of live coral and/or live sponge) in one 1200 m section of line or 1000 hooks, whichever is shorter	At least 1 nm from the position that is closest to the exact encounter location, defining a buffer of 1 n.m. radius	As for trawl	As for trawl	As for trawl
SIOFA	Porifera, Gorgonacea, Anthoathecatae , Stylasteridae, Scleractinia, Antipatharia, Zoantharia, Actiniaria, Alcyonacea, Pennatulacea, Ascidiacea, Bryozoans, Brachiopoda, Graptolithoidea, Serpulidae, Xenophyophora, Bathylasmatidae, Crinoids, Euryalida, Cidaroida	10 or more VME Indicator Units per line segment of 1000 hooks or 1200 m length (1 U = 1 kg or 1 litre of VME IS)	At least a 1 nm radius from the mid-point of the line-segment that triggered the encounter protocol	As for trawl	As for trawl	As for trawl
CCAMLR	Gorgonians, Alcyonacea, Scleractinia, Anthipatharia, Hydrocorals, Zoanths, Anemones, Sea pens, Hexasponges, Demosponges, Sea squirts, Erect bryozoans, Brachiopods, Acorn worms, Tube-dwelling annelids, Xenophyophores, Goose and acorn barnacles, Antarctic scallop, Sea lilies, Chemosynthetic communities	10 or more VME Indicator Units per line segment of 1000 hooks (1 IU = 1 kg or 1 litre of VME IS) triggers a Risk Area Closure; 5 units triggers a VME fine-scale rectangle	At least a 1 nm radius from the mid-point of the line-segment that triggered the encounter protocol	Report any encounter of 10+ VME units to the Secretariat; no further lines intersecting with the Risk Area may be set. Secretariat notifies members of temporary closure of Risk Area. Report any encounter of 5+ VME units to the Secretariat. Secretariat notifies members that VMEs may be encountered in rectangle once 5 notifications of 5+ VME units received. Fishing may continue.	Risk Areas to be reviewed by the Scientific Committee; no regular review schedule	Risk Areas remain closed until reviewed by the Scientific Committee and a management action determined by the Commission

Table 3: VME indicator taxa adopted by Regional Fisheries Management Organizations and CCAMLR in different oceans as of 2019. Taxa are aggregated into higher-order taxonomic groups (typically Class and Order) to allow direct comparisons between RFMOs. NOTE: Although taxonomists consider Alcyonacea to include gorgonians, they are separated here because of the contrast in structure-forming characteristics.

Phylum	Lower taxonomic group	NW Atlantic ¹	NE Atlantic ²	SE Atlantic ³	Southern Indian ⁴	North Pacific ⁵	South Pacific ⁶	Southern Ocean ⁷
Porifera		X	X	X	X		X	X
Cnidaria	Gorgonian Alcyonacea - Tree-like forms, sea fans, sea whips, bottlebrush	X	X	X	X	X	X	X
	Anthoathecatae (Hydrocorals) - Order			X	X		X	
	Scleractinia (Stony corals) - Order	X	X	X	X	X	X	X
	Antipatharia (Black corals) - Order		X	X	X	X	X	X
	Actiniaria (Anemones) - Order				X		X	X
	Alcyonacea (Soft corals) - Order		X	X	X	X	X	X
	Pennatulacea (Sea pens) - Order	X	X	X	X		X	X
	Zoantharia (Zoanthids) - Order			X	X			X
	Ceriantharia (Tube-dwelling anemones) - Subclass	X	X					
	Hydrozoa (Hydroids) - Class							X
Echinodermata	Brisingida ('Armless' stars) - Order						X	
	Euryalida (Basket and snake stars) - Order			X	X			X
	Crinoidea (Sea lillies) - Class	X	X	X	X		X	X
	Cidaroida (Pencil spine urchins) - Order				X			X
Bryozoa	X	X	X	X			X	
Brachiopoda				X			X	
Foraminifera		X						
Retaria	Xenophyophorea (Xenophyophores) - Class		X		X			X
Chordata	Ascidiacea (Sea squirts) - Class	X		X	X			X
Annelida	Serpulidae (Serpulid tube worms) - Family			X	X			X
Arthropoda	Bathylasmatidae (Goose and acorn barnacles) - Family				X			X
Hemichordata	Graptolithoidea (Acorn worms) - Class				X			X
Mollusca	Pectinidae - (Scallops) - Family							X

¹NAFO CEM 2019; ²NEAFC Rec. 19:2014 (amended 09:2015 and 10:2018); ³SEAFO CM 30/15; ⁴SIOFA SC-4 Report (2019); ⁵NPFC CMM 2018-05; NPFC CMM 2017-06; ⁶SPRFMO CMM 3-2019; ⁷CCAMLR CM 22-07(2013)