SPRFMO
South Pacific Regional Fisheries Management Organisation

9th MEETING OF THE SCIENTIFIC COMMITTEE

Held virtually, 27 September to 2 October 2021

SC9-DW08

Design of a Review Process for VME Encounters in Bottom Fisheries in the SPRFMO Area

New Zealand

South Pacific Regional Fisheries Management Organisation

9th Meeting of the Scientific Committee

Held virtually, 27 September to 2 October 2021

Design of a review process for VME encounters in bottom fisheries in the SPRFMO Area

Marco Milardi[1], Shane Geange[2]

28 August 2021

1 – Fisheries New Zealand - Tini a Tangaroa, Ministry for Primary Industries - Manatū Ahu Matua, Wellington, New Zealand

2 – Department of Conservation – Te Papa Atawhai, Wellington, New Zealand

Contents

1. Purpose

This paper proposes the process for Members to review encounters[1] with potential vulnerable marine ecosystems (VMEs) in bottom fisheries. This paper will also outline a suggested process for the SPRFMO Scientific Committee (SC) to implement when it reviews Member submissions on encounters at its annual meeting.

2. Requirements of the new bottom fishing measure

Objectives

In February 2021, the SPRFMO Commission approved an updated CMM for the management of bottom fisheries, **CMM-03-2021 Conservation and Management Measure for the Management of Bottom Fishing in the SPRFMO Convention Area**.

The objective of the CMM together with CMM 03a-2021 (Deepwater Species) is, through the application of the precautionary approach and an ecosystem approach to fisheries management, to ensure the long-term conservation and sustainable use of deep-sea fishery resources, including target fish stocks as well as non-target or associated and dependent species, and, in doing so, to safeguard the marine ecosystems in which these resources occur, including inter alia the prevention of significant adverse impacts on vulnerable marine ecosystems.

This objective uses much of the text from the Objective statement in the SPRFMO Convention, but is tailored to bottom fisheries and is more specific about the requirement to prevent significant adverse impacts (SAIs) on VMEs. Both objectives are considered further in later sections on developing advice to the Commission.

Relevant paragraphs from CMM-03-2021

CMM-03-2021 provides a detailed description of procedures following encounters that are to be undertaken by Members and CNCPs (Cooperating non-Contracting Parties), the SC, and the Commission.

31. *Members and CNCPs shall submit to the Scientific Committee a detailed description of each encounter by vessels flying their flag that resulted in a temporary suspension pursuant to paragraph 27, a comparison of the encounter with the existing model prediction[2], and suggested management actions to prevent significant adverse impacts on VMEs.*

32. *The Scientific Committee, at its next annual meeting, shall review all encounters reported pursuant to paragraph 27(b), including considering the extent to which encounters are consistent or inconsistent with VME habitat suitability model predictions, and provide advice on management actions proposed by the relevant Member or CNCP under paragraph 31 and any other management actions the Scientific Committee considers appropriate. This review should include consideration of:*

    a) *the detailed analyses provided by a Member or CNCP pursuant to paragraph 31;*

[1] "Encounter" means catch of one or more VME indicator taxa above threshold levels, as set out in paragraph 28 of CMM-03-2021

b) *historical fishing events within 5 nm of the encounter tow, in particular, any previous encounters, and all information on benthic bycatch;*

c) *model predictions for all VME indicator taxa[2];*

d) *details of the relevant fishing activity, including the bioregion; and*

e) *any other information the Scientific Committee considers relevant.*

33. Taking into account the Scientific Committee's review of each encounter and its advice on management actions, at its next annual meeting, the Commission shall determine management actions for each encounter area, which may include: the closing of some areas to some or all bottom fishing gear, temporal restrictions, spatial restriction, reopening areas. Management actions determined by the Commission will apply as appropriate, unless otherwise determined, from the conclusion of the relevant Commission meeting.

3. Steps of an encounter review process

Based on the specifications included in paragraphs 31-33 of CMM03-2021, we identified the following steps to be included in a protocol or terms of reference for Member or CNCP and SC reviews of VME encounters.

1. Once the Secretariat has notified all Members and CNCPs that bottom fishing is suspended in the encounter area, all Members and CNCPs should provide information on all benthic bycatch to the Secretariat, including, but not limited to, bycatch from the trawl tow that led to the encounter and all previous encounters and historical trawl tows within at least 5 nm of the encounter event;
2. The Member or CNCP whose vessel triggers an encounter provides a detailed description of the encounter to the SC, including a comparison of the encounter with:
    - all historical trawl tows in the open area, including any previous encounters, and all information on benthic bycatch within at least 5 nm of the encounter tow;
    - the existing model predictions for VME indicator taxa habitat suitability within at least 5 nm of the encounter or preferably the open area in which the encounter occurred, using the HSI values, the HSI values above ROC thresholds, and either the power transform approaches, or thresholds based on that approach, until robust abundance models become available;
    - the estimated uncertainty associated with HSI layers.
3. The Member or CNCP provides to SC, on the basis of the best available information and science, an assessment of whether the encounter constitutes evidence of VME presence;
4. Member or CNCP determines the significance of historical and likely future fishing impacts, with considerations on the spatial scale at which this assessment is made and taking into account the precautionary approach, to evaluate the risk of SAIs on VMEs and proposes potential management actions to prevent SAIs;
5. The SC reviews the available information, including consideration of:
    - *the detailed analyses provided by a Member or CNCP*
    - *Any analyses or additional information provided by other members or CNCPs on VME*

[2] Note that model predictions are currently not available for all VME indicator taxa

indicator species presence in this area including video or acoustic data;

- *historical trawl tows within 5nm of the encounter tow or preferably for the entire open area in which the encounter occurred, in particular, any previous encounters, and all information on benthic bycatch;*
- *all existing model predictions for VME indicator taxa, and associated uncertainty layers;*
- *details of the relevant fishing activity, including the bioregion in which the encounter occurred; and*
- *any other information the Scientific Committee considers relevant.*

6. The SC considers whether the encounter was inconsistent with the relevant VME habitat suitability models and associated uncertainty layers;
7. The SC reviews advice on management actions proposed by the Member and develops recommendations for the Commission on the management actions that it considers appropriate to prevent SAIs on VMEs for each encounter area.

4. Member or CNCP review process

The Member or CNCP must complete the following three-step review process for all bottom fishing encounters that occurred more than 90 days before the start of the SC's annual meeting by vessels flying their flag, and that resulted in a temporary suspension pursuant to paragraph 26 of CMM 03-2021.

A checklist of the steps and elements for the Member or CNCP review process is provided in Annex 1.

Step 1: Member or CNCP provides a detailed description of each encounter

A Member or CNCP should provide the following information for the consideration of the SC:

- The date that the encounter occurred;
- The start and finish locations of the encounter trawl tow;
- The start and finish depths of the encounter trawl tow;
- Details of the relevant fishing activity, including the bioregion in which the encounter occurred;
- The location of all historical bottom trawl tows within at least 5 nm of the encounter tow, or preferably, for the entire open area in which the encounter occurred.
- The catch weight of all benthic invertebrate species, including but not limited to, VME indicator taxa, in the encounter and all other historical trawl tows within at least 5 nm of the encounter or preferably in the entire open area in which the encounter occurred (to the extent that these data are available to the Member);
- The existing model predictions of VME indicator taxa within 5 nm of the encounter or preferably for the open area in which the encounter occurred, using the HSI values, the HSI values above the model ROC thresholds, the power transformed HSI, or thresholds based on that approach, until robust abundance models become available;
- The estimated uncertainty associated with HSI layers.
- The existing model predictions of VME indicator taxa, discounted for historical fishing impacts

These spatial data layers and maps of the predicted habitat suitability for each of the ten VME indicator taxa modelled in the most recent **Bottom Fishing Impact Assessment** [and any species subsequently added to the list of VME indicator taxa] are available at the Secretariat:

- **Species of framework-forming stony corals**
  - *Enallopsammia rostrata* (FAO code GDV)
  - *Goniocorella dumosa* (FAO code FEY)
  - *Madrepora oculata* (FAO code MVI)
  - *Solenosmilia variabilis* (FAO code RZT)
- **Sponges:**
  - Demospongiae (demosponges) (FAO code DMO)
  - Hexactinellida (glass sponges) (FAO code not assigned)
- **Other groups:**
  - Gorgonian Alcyonacea (soft corals) (FAO code not assigned)
  - non-Gorgonian Alcyonacea (soft corals) (FAO code AJZ)
  - Antipatharia (black corals) (FAO code AQZ)
  - Pennatulacea (sea pens) (FAO code NTW)
  - Stylasteridae (hydrocorals) (FAO code AXT)

These maps should be used to assess the extent that each encounter event was consistent with the predictions of relevant VME indicator taxa habitat suitability models. This assessment could be done, at the simplest level, by visually comparing the bycatch data from encounter trawl tows and historical tows with the model predictions for habitat suitability.
The SC should note that there might be many nuances in the concept of consistency between the predicted levels of habitat suitability and known distributions. For example, depending on the HSI gradient (and its components), whether historical fishing footprint has been taken into account, or the spatial scale considered.

For each encounter tow event, maps should be provided having the following characteristics:

- Oceanographic features (e.g., bathymetry) as available;
- A colour scale indicating the predicted HSI for each VME indicator taxon within the area that has an HSI model available, at a scale (granularity) of 1 km, and within at least 5 nm of the encounter;
- Predictions, using the HSI values, the HSI values above the model ROC thresholds, and either the power transformed HSI, or thresholds based on that approach, until robust abundance models become available;
- The estimated uncertainty associated with HSI layers;
- Predictions that correct for estimated “naturalness”, i.e., areas already impacted by fishing;
- Overlay of the encounter trawl tow track, corrected, to the extent practicable, for differences between the location of the vessel and the gear;
- Overlay of historical trawl tows within at least 5 nm of the encounter, corrected, to the extent practicable, for differences between the location of the vessel and the gear.

Once the encounter is notified, paragraph 28 of the CMM prescribes that “Members and CNCPs shall cooperate with the Secretariat and other Members or CNCPs engaged in bottom fishing to exchange

such data and information as may be relevant to the Scientific Committee's consideration of the encounter area". This data and information should also be included in the Members or CNCP detailed description, when available.

Based on this information the member provides their description of the encounter, including whether encounters were consistent or inconsistent with VME habitat suitability model predictions.

Discussion points for SC:

- Should data be centralised to provide for easier access? Has the Secretariat got the resources to provide such a service?
- If an encounter trawl tow passes through multiple grid cells with different habitat suitability predictions, should each trawl tow be represented by more than a single point, or should habitat suitability predictions be averaged?

Step 2: Member or CNCP provides an assessment of whether the encounter constitutes evidence of a VME

For the purposes of CMM03-2021, the term VME means a marine ecosystem that has the characteristics referred to in paragraph 42 of, and elaborated in the Annex to, the International Guidelines for the Management of Deep-sea Fisheries in the High Seas (referred to henceforth as the Deep-sea Fisheries Guidelines) (FAO, 2009). A marine ecosystem is classified in the Deep-sea Fisheries Guidelines as vulnerable based on the characteristics it possesses. The list of VME indicator taxa included in Annex 5 and 6 of CMM03-2021 has previously been assessed against the FAO's VME criteria, so the triggering of the encounter protocol indicates the potential presence of a VME. However, merely detecting the presence of a VME indicator taxon itself is not sufficient to identify a VME. That identification should be made on a case-by-case basis through application of relevant provisions in the Deep-Sea Fisheries Guidelines, particularly Sections 3.2 and 5.2. Two complementary approaches are available for determining whether an encounter constitutes evidence of a VME. The first is a direct assessment, where possible. The second is an indirect assessment, which should be undertaken when there are insufficient resources to complete a direct assessment, or where there is a need to conduct an indirect assessment to support a direct assessment.

Direct assessment of potential VME presence

Direct assessments involve surveying and mapping the encounter area to directly determine the presence and extent of a potential VME. Within SPRFMO, fishing includes the actual or attempted searching for, catching or harvesting of fishery resources; consequently, surveys of seabed communities could be interpreted as fishing. However, survey gear does not need to come into direct contact with the bottom, so although seabed surveys may constitute fishing, they would not necessarily violate the closure in force for bottom fisheries. Regardless, a process might have to be developed for SC or Commission to release appropriate permits or approval to conduct the survey.

In the Southeast Atlantic Fisheries Organisation (SEAFO), there are requirements to map encounter areas using echo-sounders or multi-beam sounders, with the results of mapping exercises submitted to their SC for its evaluation. Similarly, in the North-East Atlantic Fisheries Commission (NEAFC) there

is a specific preference that sea-bed mapping using echo-sounders or multi-beam sounders should be conducted within encounter areas and submitted to ICES (International Council for the Exploration of the Sea) for its evaluation and advice to the Permanent Committee on Management and Science.

Similar direct assessments could also be undertaken in SPRFMO, using on-site camera observations from remote vehicles and seabed mapping through echosounders (see UNGA 74/18 para 201 and UNGA72/72 para 185). However, challenges related to the spatial scale of surveys and the resourcing required to undertake surveys could limit the ability of Members or CNCPs to undertake direct assessments of potential VMEs. Nonetheless, this form of assessment could be used when the area of the encounter is sufficiently limited, and logistically and financially viable, to allow for a meaningful survey.

Indirect assessment of potential VME presence

Indirect assessments rely on the available information without additional data collection. Historical bycatch data should be used to assess whether the encounter is likely to indicate the presence of a VME. Such assessments should evaluate the taxa, weight and catch density and frequency of all species within at least 5 nm of the encounter to identify consistent spatial and taxonomic patterns that would suggest VME presence. Examples of possible approaches include using relatively high weights or data density in the bycatch record to infer the presence of a VME. As an example, more sophisticated (and data-demanding) approaches are used in Morato et al. (2018), while Jones & Lockhart (2011) used both direct and indirect approaches to detect VMEs.

We note that taxonomic resolution may be variable throughout historic datasets (and generally poorer in older data), which could pose a challenge when analysing patterns through time. Adjusting taxonomic resolution should be done on an as need-basis, with the aim of ensuring that an appropriate level of resolution to inform management decisions is maintained while ensuring data that could be used in the review is not discarded.

Step 3: Member or CNCP determines the scale and significance of historical and likely future fishing impacts

If the encounter is deemed to constitute evidence of the presence of a VME, Members or CNCPs are required to evaluate whether reopening the area will expose any VMEs to SAIs.

The Deep-sea Fisheries Guidelines (partly accounted for in CMM-03-2021 and within the definitions of VME indicator taxa) should be used when determining the scale and significance of an impact and if SAIs have occurred.

Article 17 of the Deep-sea Fisheries Guidelines defines SAIs as those that compromise ecosystem integrity (i.e., ecosystem structure or function) in a manner that:

(i) impairs the ability of affected populations to replace themselves;
(ii) degrades the long-term natural productivity of habitats; or
(iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types.

Impacts should be evaluated individually, in combination and cumulatively.

Article 18 of the guidelines identifies six factors that should be considered when determining the scale and significance of an impact:

i. the intensity or severity of the impact at the specific site being affected;
ii. the spatial extent of the impact relative to the availability of the habitat type affected;
iii. the sensitivity/vulnerability of the ecosystem to the impact;
iv. the ability of an ecosystem to recover from harm, and the rate of such recovery;
v. the extent to which ecosystem functions may be altered by the impact; and
vi. the timing and duration of the impact relative to the period in which a species needs the habitat during one or more of its life-history stages.

Temporary impacts are those that are limited in duration and that allow the particular ecosystem to recover over an acceptable time frame. Such time frames should be decided on a case-by-case basis and should be in the order of 5-20 years, taking into account the specific features of the populations and ecosystems.

In determining whether an impact is temporary, both the duration and the frequency at which an impact is repeated should be considered. If the interval between the expected disturbance of a habitat is shorter than the recovery time, the impact should be considered more than temporary. In circumstances of limited information, the precautionary approach should be applied in the determination regarding the nature and duration of impacts.

Article 47 of the Deep-sea Fisheries Guidelines identifies seven factors that should be addressed when establishing if fishing activities are likely to produce SAIs in a given area:

i. type(s) of fishing conducted or contemplated, including vessels and gear types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing (harvesting plan);
ii. best available scientific and technical information on the current state of fishery resources and baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes are to be compared;
iii. identification, description and mapping of VMEs known or likely to occur in the fishing area;
iv. data and methods used to identify, describe and assess the impacts of the activity, the identification of gaps in knowledge, and an evaluation of uncertainties in the information presented in the assessment;
v. identification, description and evaluation of the occurrence, scale and duration of likely impacts, including cumulative impacts of activities covered by the assessment on VMEs and low productivity fishery resources in the fishing area;
vi. risk assessment of likely impacts by the fishing operations to determine which impacts are likely to be SAIs, particularly impacts on VMEs and low-productivity fishery resources; and
vii. the proposed mitigation and management measures to be used to prevent significant adverse impacts on VMEs and ensure long term conservation and sustainable utilization of

low-productivity fishery resources, and the measures to be used to monitor effects of the fishing operations.

If available, members could incorporate taxon-specific catchability in their evaluation of impacts. For example, estimates of catchability may be useful in converting reported bycatch of VME indicator taxa into estimates of the extent of impact on VMEs on the seafloor. Catchability relates the amount of bycatch landed on deck to the amount of taxa impacted on the seafloor, with catchability likely to differ between taxa depending on their morphology and susceptibility to the impacts of bottom fishing gear.

Ideally, estimates of catch efficiency should be specific to area, fishery and VME indicator taxon. Previous analyses described in SC07-DW21-rev1 (Pitcher et al. 2019) and in SC07-DW14 (Geange et al. 2019), showed that fish-trawls typically catch (into the net) only very small proportions of VME taxa abundance on the seabed, and demonstrated that the VME indicator taxa thresholds outlined in CMM 03-2019 were very likely to correspond to very high covers and biomasses of VME taxa on the seabed. The Bottom Fishery Impact Assessment 2020 (SC8-DW07_rev1), presents updated catch rates obtained from paired video/trawl gear, which corroborate previous estimates of low catchability in trawling gear. Any uncertainty in catchability estimates should be appropriately evaluated and communicated when considering its effect on VME presence, estimated impacts or SAIs risk.

Members or CNCPs should consider Articles 17, 18 and 47 of the Deep-sea Fisheries Guidelines when assessing whether further fishing in the area is likely to cause SAIs. It is envisioned that this assessment would be a complex and partially subjective task, which aims to compare and evaluate different "lines of evidence" and the "weight" of these lines of evidence. This assessment could be aided through the use of Multi Criteria Analysis Methods (MCAM) or Multi Criteria Decision Making (MCDM). MCDM and MCAM are analysis techniques that explicitly evaluate multiple criteria in decision making (see e.g., Franco and Montibeller 2010). Notably, these have not been widely applied to fisheries management (but see Morato et al. 2018 for detecting VMEs) and have yet to be applied to the SPRFMO context. Different lines of evidence should be weighted, wherever possible, based on their robustness as assessed through either quantitative or qualitative methods.

Based on their assessment of the scale and significance of historical and likely future fishing impacts, Members or CNCPs should provide a description of the changes, if any, in the measures specified in CMM-03-2021 that they consider to be necessary to prevent SAIs on VMEs. These measures might include, for example, the continuation of a temporary closure, changes to existing boundaries, or the reopening of an encounter area.

If no changes to the measures specified in CMM-03-2019 are deemed necessary to address the impacts a rationale must be provided.

Discussion points for SC:

- Are there other matters that Members should be required to address and provide for the SC's consideration?

5. SC review process

A checklist of the steps and elements for the SC review process is provided in Annex 2.

Step 1: SC reviews encounters

The SC will compile and consider the following information to formulate a recommendation to the Commission:

- the detailed analyses provided by the Member or CNCP;
- historical trawl tows within at least 5 nm of the encounter tow but preferably for the open area in which the encounter occurred, in particular, any previous encounters, and all information on benthic bycatch;
- all existing model predictions for VME indicator taxa and associated uncertainty layers, including predictions discounted for historical fishing impacts;
- details of the relevant fishing activity, including the bioregion in which the encounter occurred (noting that different regions have different compositions of benthic bycatch, for example stony coral are more commonly caught on the Louisville than elsewhere); and
- any other information it considers relevant. This could include spatial scales of endemicity for the taxa impacted, spatial scales of connectivity and meta-population dynamics, catchability of VME indicator taxa, and taxonomic resolution of the bycatch records in relation to species complexes.

Step 2: SC develops advice on management actions it considers appropriate, and provides advice to the Commission

Using the management actions proposed by the Member as a starting point, SC will develop a proposed package of management actions it considers appropriate for the Commission to consider. These could include some or all of:

- **Maintaining closure** of the encounter area/s when the SC's assessment is that:
  - insufficient evidence to review the temporary closure has been provided, OR
  - the benthic bycatch recorded during individual trawl tows (or a series of trawl tows) was inconsistent with model predictions, OR
  - reopening the area could reasonably result in SAIs on VMEs;
- **Re-opening** the area/s to fishing, when no SAIs on VMEs are likely if fishing is resumed;
- **Changing the boundaries** of the open area/s where closures occur close to the boundary, and modified boundaries can be kept simple to avoid unreasonable complexity, where modifying boundaries is reasonably required to prevent SAIs on VMEs if fishing is resumed;
- **Any other changes** the SC considers appropriate, including e.g. recommending further research on the closed area (e.g. video or acoustics), reopening only part of the closed area, temporal restrictions, other spatial restrictions.

The recommendation to the Commission should clearly indicate what management actions would be most appropriate to prevent SAIs on potential VME.

The SC's report will include specific recommendations to the Commission on a management response for each encounter area and, as appropriate, all encounter areas combined. Because the onus is on

the Member or CNCP whose vessel triggered an encounter to provide sufficient information for SC to review that encounter and temporary closures remain in place until adequately reviewed, there should be no need for any additional work or development of papers between the SC meeting and the following Commission meeting. However, the Member or CNCP might seek intersessional work arising from cases outlined in Section 6, where timing is particularly challenging.

The boundaries between the different roles of SC and Commission in this process must be clear from the outset, as SC is not responsible for making management decisions in SPRFMO. The role of the SC is to make recommendations to the Commission, on a scientific basis, but the choice of the management response lies solely with the Commission. In that light, the SC must ensure that its recommendation is evidence-based, clear on its uncertainties and trade-offs, and properly framed in the context of advice to the Commission.

Discussion points for SC:

- Is it agreed that broad-scale testing of habitat suitability models, including for false positives / false negatives/ under and over-prediction, should not be part of SC's VME encounter review process?
- Should a "terms of reference" for an SC review include, for example:
    - Specific matters to assess (consistency compared with model predictions)?
    - Specific data and quality requirements of Members' submissions?
    - A formal checklist like that used for exploratory fishery proposals?
- Is it agreed that the onus should reside primarily on the Member whose vessel triggered an encounter to provide sufficient information for SC to review that encounter?
- Is it agreed that the default is that temporary closures remain in effect until appropriately reviewed (we think this is required by the CMM).

6. Potential challenges and issues with the process

The predictions of habitat suitability models could be misleading in terms of both false positive (predicting VME indicator taxa where they do not occur) and false negatives (failing to predict VME indicator taxa where they do occur). A review of the consistency of encounters with HSI models, as described in this paper, is designed to detect false negatives by identifying potential areas of high abundance of VME indicator taxa that the models (combined with discounting for naturalness) did not predict.

Detecting false positives using fishing information is more challenging and would require, at a minimum, an assessment of the bycatch records of all past trawling and a comparison with model predictions. False positives would have important implications for assessing the performance of spatial management measures but are not entirely in the scope of the review required for encounters under CMM-03-2021.

To mitigate any confidentiality issues with the provision and/or central storage of trawl events, the target species and their catch weight data are not required as part of the assessment, as they are not directly relevant to the assessment of the encounter and the potential for SAIs to occur if fishing was

to resume. Should there be an agreement that target species and catch data are necessary, a clear recommendation should be put forward to the Commission to amend Annex 7 of CMM-03-2021 accordingly.

The Secretariat may request all Members and CNCPs to provide relevant data (either directly to the Member or through the Secretariat) once an encounter occurs. If data cannot be provided by other bottom fishing Members or CNCPs in a timely manner, for example because of confidentiality concerns and time or legal challenges, the Member or CNCP should have the discretion to conduct a review with the information available.

Where an encounter event occurred less than 90 days before the start of SC's annual meeting, a Member of CNCP may, at their discretion, provide the above data for consideration by the SC in the same year or in the following year.

Should an encounter have legal implications, e.g., subject of an ongoing investigation that may lead to prosecution, or time prove insufficient to develop a detailed analysis, the Member whose vessel triggered the encounter might seek approval from the SC to either defer its consideration to the following year, delay consideration to an intersessional activity post SC, or ensure that information provided to SC does not conflict with ongoing investigations (withholding sensitive information that is not crucial to the review).

However, in any of the above cases, the temporary closure should remain in effect until the information has been reviewed by SC and a decision has been made by the Commission.

Another potential issue lies in Annex 5 and 6b of CMM03-2021, which list 13 VME indicator taxa for which thresholds are set, but spatial models are not available for all 13 taxa. Therefore, an encounter could be triggered by a combination of taxa under Annex 6b that includes one or more of the taxa for which habitat suitability models are not available (e.g., Order Actiniaria, Class Crinoidea, Order Brisingida). In this case, the consistency analysis would not be possible, and the challenge would be how to undertake an indirect assessment of the encounter in the absence of HSI models. When habitat suitability information is not available for a taxon, the description could be considered complete with existing information, and all available information should be used to determine the level of impact and the possible risk of SAIs.

If relevant information becomes available after a SC assessment, the SC should have the ability to re-assess the case in light of the new information. This situation could pose a challenge as to the exact procedure and timing of such a revision, which might have to be developed on a case-by-case basis.

Discussion points for SC:

- It takes significant time to check the observer database information and to conduct the types of analyses described above. If papers are due with SC 30 days before the meeting, a 90-day limit would still give only 60 days to complete and document all this work.
    - Is 90 days a reasonable time to collect these data and conduct the analyses or should encounters for the previous calendar year be the minimum standard?

        - Note: CMM-02 (data standards[3]) does not require benthic bycatch data to be submitted until 30 September of the following year, too late to be part of a substantive analysis for SC that year;
    - If 90 days is acceptable, should there be a "late submission" clause somewhere to enable a Member to bring analyses to the table for review by SC?
        - Para 31 seems to preclude any intersessional review by SC ("*at its next annual meeting*…")
- Is it reasonable to withhold sensitive information in particular cases, while ensuring that all relevant information for the review is provided to SC?
- If target species and catch data are not necessary, could SC put forward a clear recommendation to the Commission to amend Annex 7 of CMM-03-2021?
- What kind of procedure should be followed in cases where habitat suitability models are not available for a given taxa that was part of an encounter?

7. Recommendations

It is recommended that the Scientific Committee:

- **Notes** that a geodatabase with Habitat Suitability layers for 10 VME indicator taxa is held by the Secretariat and can be provided to Members and CNCPs to aid in the evaluation of encounters each year;
- **Adopts** the components of a review process identified in this paper for application in future years and **develops** a protocol or terms of reference for the review process, including a checklist of elements to be provided, using an intersessional working group if necessary;
- **Agrees** to recommend to the Commission that, with respect to individual temporary suspensions / closed areas following encounters, that the Commission:
    - **Notes** that SC-09 has adopted a protocol for reviewing encounters;

References

FAO (2009). International guidelines for the management of deep-sea fisheries in the high seas. Rome, 73p.

Franco, L.A.; Montibeller, G. (2010). Problem structuring for multicriteria decision analysis interventions. *Wiley Encyclopedia of Operations Research and Management Science*. doi:10.1002/9780470400531.eorms0683

Jones, C. D., & Lockhart, S. J. (2011). Detecting vulnerable marine ecosystems in the Southern Ocean using research trawls and underwater imagery. *Marine Policy*, *35*(5), 732-736.

[3] (CMM-02 para 2c) (Observer data including catch weights of all VME species and other benthic fauna):
Members and CNCPs will provide by 30 September, their previous (January to December) year's data.
Annex 7B (trawl) specifies (para 2p – 2r): p) Was there any benthic material in the trawl? (Yes/No/Unknown) q) If yes, record sensitive benthic species in the trawl catch, particularly vulnerable or habitat-forming species such as sponges, sea-fans or corals r) Estimate of the amount (weight or volume) of remaining marine resources not recorded under items 2(m) to 2(o) discarded, split to the lowest known taxon

Morato, T., Pham, C. K., Pinto, C., Golding, N., Ardron, J. A., Duran Munoz, P., & Neat, F. (2018). A multi criteria assessment method for identifying Vulnerable Marine Ecosystems in the North-East Atlantic. *Frontiers in Marine Science*, *5*, 460.

Annex 1 – Proposed Member review process

Step 1: Member or CNCP provides a detailed description of each encounter

Has the Member or CNCP provided the following information for the consideration of the SC?

The date that the encounter occurred	
The start and finish locations of the encounter tow	
The start and finish depths of the encounter tow	
Details of the relevant fishing activity, including the bioregion	
The location of all historical trawl tows within at least 5 nm of the encounter tow, or preferably, for the entire open area in which the encounter occurred	
The catch weight of all benthic invertebrate species, including but not limited to, VME indicator taxa, in the encounter tow and all other trawl tows within at least 5 nm of the encounter tow or preferably in the entire open area in which the encounter occurred (to the extent that these data are available to the Member)	
The available model predictions of VME indicator taxa within 5 nm of the encounter tow or preferably for the open area in which the encounter occurred, using the HSI values, the HSI values above the model ROC thresholds, and either the power transformed HSI, or thresholds based on that approach	
The estimated uncertainty associated with HSI layers	
The existing model predictions of VME indicator taxa, discounted for historical fishing impacts	

For each encounter event, have maps been provided having the following characteristics?

Oceanographic features (e.g. bathymetry) as available	
A colour scale indicating the predicted HSI for each VME indicator taxon within the area that has an HSI model available, at a scale (granularity) of 1 km, and within at least 5 nm of the encounter	
Predictions, using the HSI values, the HSI values above the model ROC thresholds, and either the power transformed HSI, or thresholds based on that approach, until robust abundance models become available	
The estimated uncertainty associated with HSI layers	
Predictions that correct for estimated “naturalness”, i.e., areas already impacted by fishing	
Overlay of the encounter tow, corrected, to the extent practicable, for differences between the location of the vessel and the gear	
Overlay of historical trawl tows within at least 5 nm of the encounter, corrected, to the extent practicable, for differences between the location of the vessel and the gear	

Step 2: Member or CNCP provides an assessment of whether the encounter constitutes evidence of a VME

Has the Member or CNCP provided a direct and/or indirect assessment of potential VME presence?

A direct assessment involving surveying and mapping the encounter area to directly determine the presence and extent of a potential VME has been undertaken	
An indirect assessment evaluating the taxa, weight and catch frequency of all species within at least 5 nm of the encounter to identify consistent spatial and taxonomic patterns that would suggest VME presence has been undertaken	

Step 3: Member or CNCP determines the scale and significance of historical and likely future fishing impacts

Has the Member or CNCP evaluated whether reopening the area will expose any VMEs to SAIs?

An assessment of the scale and significance of historical and likely future fishing impacts has been provided	
Management actions to prevent significant adverse impacts on VMEs have been identified, and include:	
Maintaining closure of the encounter area/s	
Re-opening the area/s to fishing	
Changing the boundaries of the open area/s	
Other changes (specify below)	

Annex 2 – Proposed SC review process

Step 1: SC reviews encounters

Has the SC considered the following information to formulate a recommendation to the Commission?

The detailed analyses provided by the Member or CNCP	
Historical trawl tows within at least 5 nm of the encounter tow but preferably for the open area in which the encounter occurred, in particular, any previous encounters, and all information on benthic bycatch	
Model predictions for all VME indicator taxa and associated uncertainty layers, including predictions discounted for historical fishing impacts	
Details of the relevant fishing activity, including the bioregion (noting that different regions have different compositions of benthic bycatch, for example stony coral are more commonly caught on the Louisville than elsewhere)	
Any other information the SC considers relevant (specify below)	

Step 2: SC develops advice on management actions it considers appropriate, and provides advice to the Commission

Has the SC clearly indicated what management actions would be most appropriate to prevent SAIs on potential VME?

Using the management actions proposed by the Member as a starting point, which of the following management actions has the SC identified for the Commission to consider:	
Maintaining closure of the encounter area/s	
Re-opening the area/s to fishing	
Changing the boundaries of the open area/s	
Other changes (specify below)	