SIOFA Workshop on the development of VME management WS2022-VME1

Held via Zoom videoconferences on 12 and 14 December 2022, and 9 and 16 January 2023.

SIOFA Scientific Committee Chair

Opening of the SIOFA SC Workshop on the development of VME management (WS2022-VME1)

1. The Workshop was convened by Mr Alistair Dunn, Chair of the Scientific Committee (SC) who welcomed the participants (Annex A). Mr Dunn replaced Mr Patrice Pruvost (FR-OT, and Chair of the PAEWG) as Chair of the Workshop, as Mr Pruvost was unable to attend all the scheduled workshop days.

2. The Workshop noted the attendance of Dr Berta Remiro-Sanchez at the Workshop as an invited expert.

3. In this report, paragraphs with key recommendations and advice to the Scientific Committee have been highlighted in grey.

Administrative arrangements

4. The Workshop participants (Annex A) agreed that the Workshop would be convened by Mr Alistair Dunn (SC Chair) and that a Conveners report would be developed, drawing on the proceedings of the Workshop and highlighting recommendations for consideration by the SIOFA Scientific Committee.

5. The SC Chair outlined the administrative arrangements for the meeting as per SC Circular 2022-20. Notes of the sessions were circulated for comments and the Workshop website https://siofa.org/node/923 contains the workshop related documents (Annex B).

6. The Workshop agreed that the Convener's report should report a summary of key points of discussion and report on broad areas of agreement, including outcomes, actions and recommendations that are proposed.

7. The Convener noted that this report is not a formal adopted report, but rather records the views and recommendations of the Workshop participants as recorded by the Convener,

based on the discussions that occurred, and includes summaries of the comments and contributions from the participants.

8. Rapporteuring and meeting notes for the workshop were taken by Mr Trent Timmis (AUS), Dr Alistair Dunn (SC Chair), and Dr Marco Milardi (SIOFA Science Officer).

9. The Workshop welcomed Dr Ramiro-Sanchez, the invited expert to the meeting, and thanked her for providing a draft paper (WS-VME1 2022/02 Annex 3) with a draft review of management measures to prevent Significant Adverse Impacts (SAIs) and the relationship to the information that is available to SIOFA.

10. The Workshop thanked the SIOFA Science Officer for providing the background paper (WS-VME1 2022/01) to the workshop that provided a broad overview of the current management of VMEs in SIOFA, as well as different annexes detailing VME data availability, methods for VME thresholds setting, VME management in other RFMOs, observer positions on VME management and the current VME taxa guide.

Determination of the workshop objectives and agenda

11. The meeting objectives and agenda (Annex C) were adopted and are detailed in SC Circular 2022-21.

12. The meeting agreed that the focus of the workshop would be

    a. Management options for VME protection

    b. Scientifically informed VME indicator species thresholds

    c. Potential SIOFA VME indicator species thresholds

    d. Development of recommendations of potential SIOFA VME indicator species thresholds and management options for VME protection

General recommendations on development of VME management

13. The Workshop noted that the taxa described in CMM2020/01 Annex 1 contained some potential typographic errors, summarized in Table 1, and recommended that the SC consider advising on a revision to correct these errors.

Table 1: List of current taxa names in the description of taxa in CMM2020/01 Annex 1 and proposed corrected taxa name

Current taxa name	Proposed taxa name
Anthoathecatae	Anthoathecata
Bryozoans	Bryozoa
Xenophyophora	Xenophyophorea

Stalked crinoids	Crinoidea

14. The Workshop agreed that the nomenclature as defined in Table 1 of WS-VME-2022/01 Annex 3 (included in this report as Annex D) would be used in discussions at future meetings of the workshop and recommended that this table of definitions be presented to the Scientific Committee.

Management options for VME protection

15. The Workshop recalled that management of VMEs was regulated under CMM2020/01 (Interim Management of Bottom Fishing) paragraph 12, and the role of the Scientific Committee is detailed in CMM2020/01 paragraphs 5–9.

16. The Workshop also recalled that paragraph 6 of CMM2020/01 includes requiring the Scientific Committee to provide advice on (i) criteria for what constitutes evidence of an encounter with a VME, in particular, the threshold levels and indicator species for all gears (CMM2020/01 paragraph c); and the most appropriate response to a VME encounter, including inter alia closing particular areas to a particular gear type or types (CMM 2020/01 paragraph d).

17. The Workshop recalled that the current status of VME measures in force in the SIOFA area included spatial closures (in the form of the interim BPAs), effort limitations (e.g., CMM 2020/01 paragraph 10, and the interim fishing footprint that spatially limits fishing effort), and VME encounter thresholds and move-on rules.

18. The Workshop noted that a review of the VME measures should be considered, and that the review should identify whether the current measures are as appropriately precautionary.

19. The Workshop recommended that the Scientific Committee note that different VME management options were available, and were summarized by McConnaughey et al. (2020). The options are given in Table 2.

20. The Workshop noted that the Scientific Committee had provided some advice on these options at its previous meetings, and also considered plausible timelines that the Scientific Committee may need to provide further advice on these options (Table 2).

21. The Workshop recommended that the Scientific Committee note the options in Table 2 and also note the potential timelines for providing additional advice for these.

22. The Workshop noted that CMM 2020/01 currently describes the implementation of move-on rules, including the application of encounter-based closures and threshold limits for defining an encounter, and discussed the pros and cons of different management approaches for managing VMEs (see Table 3).

Table 2: Expected performance of different management measures and voluntary industry actions intended to minimize trawling effects. Evaluation of each measure/action is based on four evaluation metrics and predicted impacts from a yield-impact model (derived from McConnaughey et al. 2020). The table was edited by the Workshop by assigning a colour coding to each measure/action according to whether advice had previously been elaborated by Scientific Committee and by providing an estimate of the timeline that the Scientific Committee would need to provide (further) advice on each measure/action.

Measure/action	Objective	Benthic biota	Sustainable fish populations and food production	Ecosystems and ecosystem services	Fleet performance	Impact	Timeline that the SC would need to provide (further) advice
Technical measure							
1. Gear design and operations	• Reduce impacts and maintain or increase catchability of target species.	• Less depletion per unit effort and/or catch. • Reduced gear penetration could open access to new grounds thereby increasing overall footprint. • Smaller footprint if operational changes improve efficiency and/or reduce total effort.	• Higher catch per unit effort and/or catch per unit of benthic impact—may be lower if gear durability limits bottom contact.	• Increased stability and function with increased RBS. • Limited knowledge of newly developed designs.	• Reduced operating costs for more-selective/energy efficient/'smart' gears. • Increased F for same yield if d and q decrease equally. • Must recover capital costs for conversion. • Extended gear life. • Experimental access to closed areas.	RBS ↑ d↓ q↑↓	3-4 years
Spatial controls							
2. Prohibitions by gear type	• Eliminate high-impact gears in a defined region.	• Comprehensive protection and decreased d. • More follow-up studies needed	• Reduced harvest of some target species if high impact gears were more efficient. • Bycatch or product-quality complications possible for different	• Increased stability and function with increased RBS.	• New economic opportunities for artisanal fisheries. • In the short term, reduced catches of target species unless other gears compensate. • In the long term, increased	RBS ↑ d↓	3-4 years

Measure/action	Objective	Benthic biota	Sustainable fish populations and food production	Ecosystems and ecosystem services	Fleet performance	Impact	Timeline that the SC would need to provide (further) advice
Technical measure							
			gears or fishing grounds.		costs if less efficient gears adopted. • Reduced costs if less efficient gears are replaced. • New transition/allocation costs and socioeconomic impacts		
3. Freeze trawling footprint	• Confine impacts to previously disturbed areas.	• Minimizes benthic impact on previously unfished areas.	• Reduced catch if distribution of target species change. • Constrains full exploitation of an expanding fishery. • May prevent fishery development and overexploitation (creates de facto MPA).	• Preserves ecosystem integrity and function in untrawled areas, with potential spillover benefits for trawled areas.	• Opportunity costs if unable to prospect for new stocks/areas. • Limits adaptive capacity. • May deter development of new fleets and technologies.	RBS ↑	1-2 years
4. Nearshore restrictions and zoning	• Reduce trawling in shallow sensitive habitats and minimize gear conflicts.	• Protects shallow or nearshore (nursery) habitats. • Displaced effort could increase footprint.	• Initial decline offset by future benefits if sensitive nursery areas for target species are protected, unless markets exist for juvenile stages.	• Beneficial if sensitive habitats or nursery areas are included.	• May be allocative, protecting nearshore/recreational fisheries and eco-tourism. • Possible expenditures to increase fleet capacity for new grounds.	RBS ↑ (inshore) RBS =↓ (offshore)	
5. Prohibitions by habitat type	• Protect small-scale sensitive habitats.	• Beneficial when sensitive habitats identified and permanently protected — particularly useful offshore.	• Probably very small because these are small areas—difficult to estimate.	• Provides protected representative habitats (ecological reference points). • Preserves unique ecological functions.	• Lost yield if target species are strongly associated with sensitive habitats. • Economic benefits for small-scale fisheries and eco-tourism.	RBS ↑ (designated area) RBS =↓ (other areas)	3-4 years

Measure/action	Objective	Benthic biota	Sustainable fish populations and food production	Ecosystems and ecosystem services	Fleet performance	Impact	Timeline that the SC would need to provide (further) advice
Technical measure							
					• Real-time closures impose movement costs.		
6. Multipurpose habitat management	• Broadly protect essential, representative and vulnerable habitats.	• Protects sensitive habitats when trawling is restricted. • Spillover effects benefit depleted areas. • Displaced effort could increase footprint.	• Benefits of larval export and spillover of juveniles/adults into adjacent fisheries but may be limited by poaching and trawling along the boundary.	• Spatial extent/connectivity, population/habitat characteristics and level of protection determine benefits. • Serve as ecological references for trawled areas.	• No-take rules modify fishing patterns. • Networks may increase recruitment/prey availability, but large networks may reduce yields.	RBS ↑ (designated area) RBS =↓ (other areas)	5+ years
Impact quotas							
7. Invertebrate bycatch quotas	• Reduce bycatch of benthic invertebrates	• Provides incentives for fleet to avoid sensitive species at much smaller spatial scale than could be regulated top-down.	• Effects could be very small— needs to be evaluated.	• Should reduce impacts on sensitive habitats and associated functions — needs to be evaluated.	• Extra costs for observer or observer systems. More flexible than other gear/area restrictions.	RBS =↑	5+ years
8. Habitat impact quotas	• Habitat conservation to protect benthic biota	• Limits impacts by reducing effort on sensitive biota, if habitat maps exist.	• Provides limited access to stocks in sensitive habitats. • Effects could be very small - needs to be evaluated	• Should reduce impacts on sensitive habitats and associated functions — needs to be evaluated.	• Requirement for high frequency VMS and habitat maps may impose costs.	RBS =↑ rb↑ in the fished areas	5+ years
Effort control							
9. Removal of effort	• Reduce impacts by reducing fishing activity.	• Generally reduces benthic impacts (especially high	• Yield benefits for overfished stocks only.	• Generally beneficial as degraded habitats recover.	• Reduced competition for those that remain, but total catch may decline.	RBS ↑ F ↓ Bf ↑	3-4 years

Measure/action	Objective	Benthic biota	Sustainable fish populations and food production	Ecosystems and ecosystem services	Fleet performance	Impact	Timeline that the SC would need to provide (further) advice
Technical measure							
		impact gears in sensitive areas). • Smaller footprint will relocate / concentrate impacts	• Limiting days at sea may concentrate effort nearshore.		• Gains offset by increasing capacity and technology 'creep'. • Problematic for employment goals.		

Colour key:	No advice currently available from SC	Some advice provided by SC	Not applicable

Table 3: Pros and cons of the different categories of VME management measures available to SIOFA.

Categories	Pros	Cons	Implications	Additional notes
Technical measures (e.g., gear restrictions, gear performance criteria, etc)	Most vessels only fish with one or two gear types, so monitoring is simpler Allows fishing to continue in some forms in most areas	Need to develop gear/method definitions for management	What gear coverage would be managed and how. All bottom contact gears? Or 'high impact' gear only?	
Spatial controls (area closures)	Only tool that can provide absolute protection of VMEs in closed areas Compliance tools should already exist for most Members	Restricts fishing from 'closed' locations Potential to concentrate fishing into smaller areas on VMEs as well as target and bycatch species		
Spatial controls (move on rules)	Adaptive to new information	High resolution location data for fishing activity Displace effort into new areas where VMEs may be present	May affect confidentiality of fishing locations and commercial enterprise Requires a review process to assess move-on locations and then follow-up actions	
Impact quotas	Adaptive to new information	Difficult to implement a management regime, especially given the lack of data in the SIOFA Area Requires a higher threshold of data to develop a management regime	Unsure if this is useful in the SIOFA Area? Are there any case studies elsewhere that can be drawn upon?	e.g., a cumulative amount of taxa recorded over a period of time for a spatial area may trigger a management response
Effort controls	SIOFA has some management controls for total effort in place already (CMM 2020/01) Relatively simple to implement	..but they may not be that good for managing VMEs! Requires a harmonised approach over a large area	Broad and potentially a coarse management approach that may not provide protection at smaller spatial scales. Unlikely to be useful unless fishing is essentially random over space	e.g., limit total effort in an area (i.e., number of tows or lines set in an area)

23. The Workshop noted that a Scientific Research and Exploratory Fisheries CMM may be in development for the consideration of MoP at a future meeting, and that ideally, this would consider VME data collection and research. However, in the interim, the Workshop recommended that any proposals for research in the SIOFA area should collect VME data as a part of the proposal.

24. The Workshop recommended that proposals for exploratory fishing both inside and outside of the current fishing footprint should provide information on VMEs and environmental data (e.g., bottom current, temperature, substrate type), and include consideration of the use of benthic cameras, and collection and retention of samples, etc. as a part of the research activity.

25. The Workshop also recalled that paragraph 12 of CMM 2020/01 notes that CCPs shall apply to vessels flying their flag the following threshold levels for encounters with VMEs:

    (a) the threshold that triggers the encounter protocol for longline gears shall be the catch/recovery of 10 or more VME-indicator units of species listed in Annex 1 in a single line segment

    (b) the threshold that triggers the encounter protocol for the trawls shall be more than 60 kg of live corals and/or 300 Kg of sponges in any tow.

    The threshold that triggers the encounter protocol for the trawl as defined is paragraph 12b shall be reviewed by the Scientific Committee in 2020.

26. The Workshop noted that in 2020 the Scientific Committee agreed that the existing threshold value should be maintained, and this was agreed by MoP6 (MoP6 Report 2006, para 11bis) until the SC provides advice for the setting of a new optimum value (SC report 2020, paragraph 74).

27. The Science Officer introduced the background document submitted to the Workshop (WS-VME1 2022-01). Dr Ramiro-Sanchez, the Workshop invited expert, introduced Annex 3 of the document, including Table 3 of paper WS-VME1 2022-01 Annex 3, that compiled the types of management and listing current management regimes for VMEs in different RFMOs.

28. The Workshop noted the different VME management options that were available, but that the appropriate management would also need to consider the level of data needed for the different options. The Workshop agreed that precautionary spatial closures could be enough to do away with move-on rules altogether if these were extensive, but a mix of spatial closures and/or move-on rules would potentially be a more effective initial approach given that most of the SIOFA Area was data poor with high uncertainty as to the extent of VMEs.

29. The Workshop discussed how a certain level of protection/management measure would be suitably precautionary and noted that this was a complex question with consequential implications for managers.

30. The workshop noted the key importance of spatial scale in assessments of Significant Adverse Impacts (SAIs) and noted that the FAO Deep Sea Fisheries Guidelines were not specific as to the spatial scale that SAIs would need to be assessed. The Workshop noted that the choice of spatial scale would likely be different for individual encounters versus spatial protection of vulnerable ecosystems. The choice of an appropriate scale would also be linked to the ensemble of management measures that may be adopted for VMEs.

31. The Workshop agreed that scientific evaluation of SAIs should be considered at multiple spatial scales, including at a scale of individual encounters as well as at a relatively larger scale (e.g., fisheries management areas or another ecologically significant area) when evaluating spatial protection measures.

32. The Workshop noted that individual encounters resulting in a move-on, and subsequent area closure under CMM 2020/01, should be reviewed by the Scientific Committee. The Scientific Committee could then advise the MoP on whether to reopen the closed area to benthic

fishing. The Workshop also noted that this could also consider advice on reopening for specific gears or other such effort controls as a result of the review.

33. The Workshop recommended that a process for reviewing individual encounters resulting in a move-on be developed by the Scientific Committee

34. The Workshop noted that the management options available for VME protection could be categorized as (i) technical measures, (ii) spatial controls, (iii) impact quotas, and (iv) effort controls, as described in Table 2 of WS-VME-2022/01 Annex 3.

35. The Workshop noted that the low level of data available to SIOFA limits the available options for development of scientific advice and noted that the uncertainty resulting from the low level of data would likely result in advice for more precautionary management. Further, the Workshop noted that, given the lack of data, few suitable approaches were available so that the Scientific Committee may be able to provide advice on for managing VMEs in the SIOFA area.

36. The Workshop recommended that the Scientific Committee develop research and data collection plans on how to fill the data gaps and hence reduce the uncertainty in its advice. The Workshop recommended that the potential timelines given in Table 2, and the pros and cons of the different management approaches for VMES in the SIOFA Area given in Table 3 be considered and further developed by the Scientific Committee.

37. The Workshop noted that the following topics would need to be considered in future discussions on VMEs:

    a. Spatial scales

    b. Data limitations, including approaches to overcome them and precautionary approach

    c. Table 1 from the Annex 3 of the background document

    d. Definitions for the 4 categories of VME management options

    e. Consider the definitions in Table 2 of the convener's report

    f. Considerations on whether the current measures are sufficiently precautionary

Development of scientifically informed VME indicator taxa thresholds

38. The SIOFA Science Officer introduced Annexes 1 and 2 of the information in the background document submitted to the Workshop (WS-VME1 2022/01) on an overview of available data in SIOFA and methods to scientifically inform VME indicator taxa thresholds.

39. The Workshop noted that the current VME indicator taxa thresholds were introduced following the advice of PAEWG2 (see paragraph 72 of the 2020 SC report).

40. The Workshop discussed if the current reporting requirements were suitable to collect the data needed to update and assess the current VME taxa thresholds and noted that there was no requirement for reporting of VMEs in the vessel logbook under CMM 2021/02.

41. The Workshop noted that there may not be enough data from demersal longline effort to undertake a robust analysis, and there was a lack of quantitative underwater (e.g., ROV and image surveys) and fisheries surveys data on VME indicator taxa.

42. The Workshop noted that all of the available data on the occurrence and presence of VME indicator taxa may not be held by SIOFA and recommended that the Scientific Committee identify any data that may be available from research cruises that have been conducted in the SIOFA Area, and make a call for any data that may not have been submitted.

43. The Workshop noted that there may be oceanographic research programs with funds available to support such data collection efforts, and recommended that the Scientific Committee investigate the possibility to apply to such funds to support its VME research, including consideration of e.g. https://en.unesco.org/ocean-decade funding.

44. The Workshop noted that some Members have submitted photographic images to the Secretariat on a voluntary basis, but these photos are collected in a folder and not included as a part of the SIOFA Secretariat observer database. The photos include coordinates of the location where they were taken.

45. The Workshop recommended that the Scientific Committee consider recommending that photograph images on VME indicator taxa be included in the SIOFA observer database and linked to a specific fishing activity along with spatial coordinates.

46. The Workshop recommended that the Scientific Committee consider recommending to the MoP that presence/absence data for all VME taxa be recorded in the vessel logbooks as a first step to collect information on VME taxa encountered by fishing vessels.

47. Further, the Workshop recommended that the Scientific Committee consider recommending to the MoP that a trial collection of photographs for all invertebrate occurrences (one picture per occurrence in each haul) should be added to the data required to be collected by the Scientific Observers and that this be required for a 3-year trial period, after which the Scientific Committee would evaluate the data collected and recommend whether the trial needs to be continued. The Workshop noted that consideration would be required to assess if Scientific Observers had access to the appropriate equipment to undertake this task.

48. The Workshop noted that this requirement could be considered for inclusion in the harmonization of the observer framework.

49. The Workshop noted that the scientific advice on VME indicator taxa thresholds should be considered holistically, in the context of the full range of management measures, the SIOFA fishing footprint, and spatial habitat modelling.

50. The Workshop noted that the VME indicator taxa ID guide in SIOFA would require revision and that training for observers and revision of the ID guides would likely be required. The Workshop noted that revision could utilize the images collected during the trial proposed for photographic image collection by the Scientific Observers.

51. The Workshop noted that no update or revised assessment of VME indicator taxa thresholds has been attempted since 2020, and also noted that preliminary data presented to the workshop by the SIOFA Secretariat indicated a significant increase in available data.

52. The preliminary analysis suggested that the VME data available in the SIOFA observer database up to 2019 was 811 records, and increased by 781 records up to 2021, an increase of 96% in available observer data. For corals, the preliminary analysis suggested that there

were 20 records of catches over the trawl threshold, all prior to 2019 from 1592 observed fishing events that captured VME taxa (i.e., 0.012 encounters per observed haul); and for sponges the preliminary analysis suggests 0 encounters over the trawl threshold from 1592 observed fishing events that captured VME taxa (i.e., 0.0 encounters per observed haul). The Workshop noted that these encounter rates are likely overestimated, as trawls that did not catch VME taxa are not included in the observer database, and that more accurate analyses would be appropriate.

53. The Workshop recommended that a data analysis be presented to the Scientific Committee, including how many times the thresholds would have been triggered in the past, how much data have become available since 2020, and present the data as tentative cumulative curves etc. Further, the Workshop recommended that the analysis include, where possible, the number of encounters that had occurred each year; how many will occur in the future assuming different threshold levels (e.g., half or double the current thresholds); how these compared with equivalent SPRFMO encounter rates; what is the pattern of VME indicator taxa in fishing events around the encounter area; and develop spatial maps of encounters.

54. The Workshop recommended that, given the low levels of data available, that the level of taxonomic aggregation be used in further analyses of the historical catch data be for corals and sponges. However, the Workshop also recommended that the current level of aggregation be as that defined in CMM 2020/01 when considering thresholds, and that data continue to be collected and reported at the highest taxonomic level possible.

Potential SIOFA VME indicator species thresholds

55. The SIOFA Science Officer introduced Annexes 1 and 2 of the information in the background document submitted to the Workshop (WS-VME1 2022/01) on potential VME indicator taxa thresholds.

56. The Workshop considered a preliminary analysis on available VME indicator taxa accidental captures undertaken by the SIOFA Science Officer using the Observer and the CatchEffort databases and its usability for setting VME encounter thresholds.

57. The Workshop noted that encounters from demersal longline are required to be reported at the line segment level (i.e., per 1000 hooks or 1200 m, see CMM 2020/01), but that the data record VMEs for each haul/set. The Workshop recommended that the Scientific Committee consider revisions to either CMM 2020/01 (Interim Management of Bottom Fishing) or CMM 2021/02 (Data standards) that would ensure that vessel reported VME indicator taxa captures and Observer data reports were consistent.

58. The Workshop noted that VME indicator taxa captures are reported by vessels for live corals, but the Observer data does not record if coral captures were alive or dead. The Workshop recommended that the Scientific Committee consider revisions to either CMM 2020/01 (Interim Management of Bottom Fishing) or CMM 2021/02 (Data standards) that would ensure that reporting of corals alive and/or dead.

59. The Workshop noted that a full spatial and temporal descriptive analysis by species/family/class would be helpful to explore the pattern of VMEs in future analyses, and recommended the Scientific Committee consider how this work may be undertaken in future.

60. The Workshop noted that there may be recording or transcription errors in SIOFA data, and that some species data may not be well recorded or identified and recommended the Scientific Committee considers additional procedures that may be required to ensure that high quality data is collected from Observers and vessels when reporting VMEs.

61. The Workshop noted that preliminary cumulative catch curves for VME taxa can be generated using the Observer data, but that the data were sparse (especially for sponges) and that cumulative curves should be interpreted with caution.

62. The Workshop recommended that cumulative catch curves for VME taxa be generated by gear type separately (i.e., demersal trawl or demersal longline), and that more detailed analyses would need to be undertaken in future.

63. The Workshop noted that the current VME encounter thresholds may need to be further considered, but that the analyses required has not yet been undertaken.

64. The Workshop noted that thresholds are part of the requirements for move-on rules, and that move-on rules are one of a range of potential management approaches that could be used for providing protection for VMEs. The Workshop requested that the Scientific Committee consider requesting that the MoP provide it with direction on likely management options for protecting SAIs, so that the Scientific Committee can focus its endeavours on management options that are most likely to be considered by the MoP.

References

McConnaughey, R.A.; Hiddink, J.G.; Jennings, S.; Pitcher, C.R.; Kaiser, M.J.; Suuronen, P.; Sciberras, M.; Rijnsdorp, A.D.; Collie, J.S.; Mazor, T.; Amoroso, R.O.; Parma, A.M.; Hilborn, R. (2020). Choosing best practices for managing impacts of trawl fishing on seabed habitats and biota. Fish Fish 21, 319–337. https://doi.org/10.1111/faf.12431

Annex A. List of registered participants for WS-VME1 2022

Delegation	Title	Name	Function	Contact
MEETING CHAIR				
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Annex B. List of papers submitted to WS-VME1 2022

1. SIOFA Secretariat (2022). Overview of the current status of VME knowledge in SIOFA. Background document prepared by the SIOFA Secretariat for the Workshop on the development of VME management (WS2022-VME1). WS-VME1 2022-01.

Annex C. Meeting agenda

Workshop objectives

To develop scientific strategies that will provide an answer to the following three questions:

- What are the management options for VME protection in the SIOFA Agreement area?
- How can SIOFA develop scientifically informed VME indicator species thresholds?
- What would potential SIOFA VME indicator species thresholds look like?

These objectives will be considered in a series of four separate workshops.

Workshop agenda

1. Opening of the workshop (WS2022-VME1)
2. Administrative arrangements
    a. Adoption of the meeting objectives and agenda
    b. Appointment of rapporteurs
3. Determination of the workshop objectives and agenda
4. Management options for VME protection
    a. Considerations of the workshop
    b. Recommendations on further development
5. Scientifically informed VME indicator species thresholds
    a. Considerations of the workshop
    b. Recommendations on further development
6. Potential SIOFA VME indicator species thresholds
    a. Considerations of the workshop
    b. Recommendations on further development
7. Items for consideration at the following meeting of the series

Annex D. Summary of the definitions and examples of ecological terminology (from Table 1 of WS-VME2022/01 Annex 3).

Concept	Definition	How is it measured	Examples
Realm	Geographic area distinguished by a high proportion of endemic species arising from evolutionary history.	Geographic distribution of species.	Marine realms (Costello et al., 2017)
Biome	A large region characterised by similar habitat-forming plant growth forms enduring over years.		Kelp forest, mangrove forest, seagrass meadow, salt-marsh, shallow coral reefs.
Ecosystem	A large area of similar environmental conditions where it is considered that biological interactions and energy fluxes are greater within the ecosystem than across its boundaries to adjacent ecosystems.	Cluster analysis of environmental variables that would de ne a water mass and be related to ecological conditions, such as nutrients, salinity, light, and temperature.	The 3D "Ecological Marine Units" of (Sayre et al., 2017).
Seascape	A topographic or physiographic area de ned by the shape of the coastline, bathymetry, and/or hydrography.	May be defined visually, by acoustic seabed mapping, aerial photography, spectrophotometric sensing (ocean colour), temperature, salinity.	Fjord, banks, canyon, trench, ridge, shelf, slope, seamount, basin, plain, depth zones.
Habitat	A physical environment inhabited by a named species or community over a timescale of years and replicated spatially.	Depends on the species or community of interest. The habitat for a marine mammal, seabird, and fish may be very different in size and physical environment.	*Desmophyllum pertusum* reefs, coral gardens, carbonate mounds, sea-pen and burrowing megafauna communities (OSPAR Agreement 2004-6).
Biogenic habitat	A three-dimensional habitat created		Biomes at a local scale where the species are

Concept	Definition	How is it measured	Examples
	by a species or group of species and occurring over a timescale of years and replicated spatially.		named, e.g., *Zostera marina* meadow.
Assemblage	A group of species found together. Whether they interact or not is not known or assumed.		In practice conflated with community.
Community	An assemblage of interacting species in a particular habitat occurring over a timescale of years and replicated spatially.	Visual observation, photography, samples of substrata and biota	E.g., *Solenosmilia* dominated communities (Rowden et al., 2017)
Region (bio-ecoregion, province, zone, section)	Expert opinion and/or based on ad hoc use of biogeographic, oceanographic or management criteria.	Variously defined depending on the context of the study Bioregions may be defined by Environmental conditions and selected species distributions.	Administrative environmental management areas for fisheries, conservation. Reviewed in Costello (2009) and (Zhao & Costello, 2020).
FAO Guidelines interpretation (ad hoc addition to Costello et al. (2020) review)			
VME indicator	Taxa most likely to occur in habitats or that create biogenic habitats meeting the criteria for VMEs (FAO, 2016). ICES differentiates: 1) 'VME habitats' that are records for which there is unequivocal evidence for a VME (e.g., ROV	Groups of species, communities, habitats, and seascapes such as seamounts.	Cold-water coral reefs, coral gardens from soft-bottoms (e.g., cup corals, cauliflower coral fields, softbottom gorgonians and black coral gardens) and coral gardens from hard-bottoms (hard-bottom (coniunted)gorgonians and black coral gardens, colonial scleractinians, nonreefal scleractinian

Concept	Definition	How is it measured	Examples
	observations of a coral reef). 2) 'VME indicators' are records that suggest the presence of a VME with varying degrees of uncertainty. A weighting system of vulnerability and uncertainty is used to aid interpretation.		aggregations), sponge dominated communities, (e.g., North-East Atlantic Fisheries Commission, FAO, 2016).
VME	Large areas containing habitats, communities, and populations whose life-histories, functional and structural significance characteristics render them susceptible to anthropogenic disturbance.	Area, habitat, ecosystem.	Cold-water coral reefs, hydrothermal vents, seeps.