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Assessment on how ID guides for VME taxa could be developed

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1. Purpose

The purpose of this paper is to propose steps for the development of a user-friendly identification (ID) guide and training videos that can be used by observers and fishers to identify benthic bycatch landed during bottom fishing activities. It is intended that this work will enable fishers, observers and researchers to recognize benthic bycatch taxa more readily, and to improve the quality of catch records from the South Pacific Regional Fishery Management Organisation (SPRMO) Convention Area.

2. Background

The United Nations General Assembly Resolution 61/105 (UNGA, 2006) calls upon Regional Fisheries Management Organizations (RFMOs), such as SPRFMO, to identify vulnerable marine ecosystems (VMEs) in the high seas and to adopt protective measures for those in danger of significant adverse impact from fishing gear. The Fisheries and Agriculture Organization (FAO) of the United Nations has responded to this request by preparing technical guidelines to assist States and RFMOs in formulating and implementing the appropriate measures for the management of deep-sea fisheries (FAO, 2009). The FAO Guidelines provide examples of VME indicator taxa - species groups, communities and habitat-forming species that are documented or considered sensitive and potentially vulnerable to fishing activities in the high-seas.

Within the SPRFMO Convention Area, where VME indicator taxa are encountered in any one tow at or above the threshold limits in Annex 6A of CMM03-2021, or three or more different VME indicator taxa at or above the weight limits in Annex 6B, Members and Cooperating Non-Contracting Parties (CNCPs) shall require any vessel flying their flag to:

> a) cease bottom fishing immediately within an encounter area of one (1) nautical mile either side of the trawl track extended by one (1) nautical mile at each end;
>
> b) report the encounter immediately to the Member or CNCP whose flag the vessel is flying and the Secretariat, in accordance with the Guidelines for the preparation and submission of notifications of encounters with potential VMEs, contained in Annex 7.

The identification of VME indicator taxa is aided by all vessels using bottom trawl and mid-water trawl gear, and all vessels using bottom line gear pursuant to CMM03-2021 having to ensure 100% and 10% scientific observer coverage, respectively, for all trips. Observers collect and report data on benthic bycatch as per Section I in Annex 7 of CMM 02-2021 (Data Standards):

1. For all bottom fishing events, including trawl, bottom line, and potting, the following data are to be collected for all benthic taxa caught:
    a. Species (or accompanied by a photograph where identification to genus or species level is difficult);
    b. An estimate of the quantity (to the nearest 0.1 kg) of each listed benthic taxon caught in the fishing event;
    c. The method of weight estimation (e.g., visual estimate, weighed in full, accurate count of bins multiplied by number of bins) (note this information is not collected by the SPRFMO Secretariat but should be available upon request);

d. Where possible, and particularly for newly encountered or relatively rare benthic species which do not appear in ID guides, whole samples should be collected and suitably preserved for identification on shore;

e. Wherever possible, observers should collect samples and images according to pre-determined specific research programmes implemented by the Scientific Committee or other national scientific research.

2. For all bottom fishing events, the following data are to be collected for all taxa identified as VME indicators as defined in Annex 5 of CMM 03-2021 (Bottom fishing):

    a. An estimate of the quantity (to the nearest 0.1 kg) of each VME indicator taxon caught in the fishing event;

    b. Wherever possible, a photograph of a representative sample of each VME indicator taxon caught in the fishing event, archived by the Member or CNCP through the SPRFMO Observer Programme in a way that allows the photograph to be linked to the specific weight record for the fishing event;

    c. Wherever possible, a photograph of the entire quantity of each VME indicator taxa caught in the fishing event, archived by the Member or CNCP through the SPRFMO Observer Programme in a way that allows the photograph to be linked to the specific weight record for the fishing event.

3. For each observed trawl, the following data are to be collected for all taxa identified as VME indicators in Annex 5 of CMM 03-2021 (Bottom Fishing) using the appropriate VME Encounter template:

    a. A record of whether the weight of any of the VME indicator taxa in the trawl catch exceeded taxa-specific weight thresholds as defined in Annex 6A of CMM03-2021 (Bottom Fishing);

    b. A record of whether three or more VME indicator taxa in the trawl catch exceeded taxa-specific weight thresholds as defined in Annex 6B of CMM 03-2021 (Bottom Fishing).

These reporting requirements necessitate the identification and weighing of bycatch onboard commercial fishing vessels by observers and fishers (for example in bottom longline fisheries where observers are not onboard). However, extensive morphological variation and diversity in benthic bycatch, and damage incurred by fishing gear, can make it challenging at sea to identify specimens at taxonomic levels below the rank of order and family. These issues mean that generic reporting codes that represent multiple genera or species are often used for recording the bycatch. In some cases, for some VME indicator taxa, resolving cryptic diversity cannot be achieved without expert identification.

Assessments by Macpherson et al. (2021) of the accuracy of coral bycatch identifications made by observers in the New Zealand EEZ suggest that accuracy, not surprisingly, increases at higher taxonomic levels (with an Order-level accuracy of 72% during the most recent fishing year). A

previous assessment in 2011 of identification accuracy also observed this pattern (Tracey et al. 2011). The overall observer identification accuracy level across all taxonomic levels was 66%, which represents an improvement from prior assessments in 2011, when 54% of observer records from within the New Zealand EEZ were incorrect (Tracey et al. 2011). Of misidentified specimens, in both studies, some were not identified to lower taxonomic levels and generic reporting codes were used, or alternatively, were misidentified to an incorrect taxon at the same taxonomic level. It is therefore important to ensure that identification occurs at an appropriate level of classification to be as informative as possible but avoiding misclassification by observers at sea, but also to include and compare easily confused species. In their report, Tracey et al. (2011) recommended that in developing observer ID guides:

a) Species descriptions are needed to help observers improve the accuracy of their identifications;
b) Experts should be involved developing recorded briefings on how to use the ID guides, including providing clear and targeted instructions on specimen identification, what samples to retain, and what to record on the benthic forms and labels. An emphasis during the briefing on the appropriate taxonomic level to record for difficult to identify species will help reduce the proportion of misidentifications;
c) Clear instructions should be provided to observers on sub-sampling to enable the use of records in any future analysis;
d) Samples should be collected and returned for expert identification (and ideally molecular verification) to help monitor the reliability of the observer data (improvements or declines).

The Macpherson et al. (2021) report also reiterates the importance of appropriate image labelling, and timely assignment of reporting codes to reflect recent taxonomic delineations in order to avoid excessive use of generic reporting codes.

There are several existing ID guides used by RFMOs. These guides vary from quick-reference, on-deck guides to aid in the classification of macroscopic marine invertebrate bycatch into the required VME groupings (e.g., guides used by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR 2009; Figure 1) and the South East Atlantic Fisheries Organization (Ramos et al. 2009)) to large pictorial identification guides that describe key morphological features and other information of bycatch taxa (e.g., guides used by the North Pacific Fisheries Commission (NPFC 2009; Figure 2) and the Northwest Atlantic Fisheries Organization (Kenchington et al. 2009; Best et al. 2010).

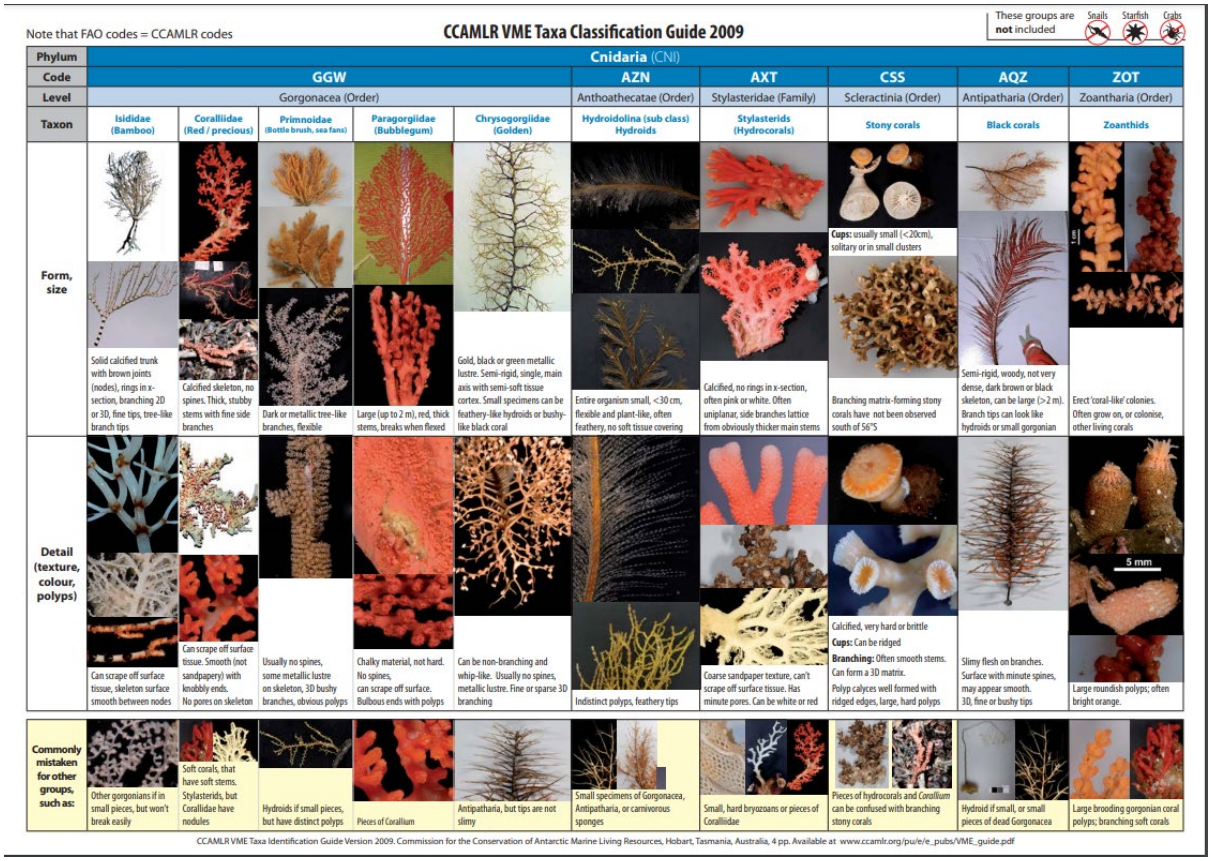

Figure 1 | Page 1 of the CCAMLR VME Taxa Classification Guide.

The current classification guide for potentially vulnerable invertebrate taxa in the SPRFMO Convention Area (Tracey 2008) is based on the CCAMLR guide that includes ten of the thirteen VME indicator taxa included in Annex 5 of CMM03-2021 (see Appendix 1). The guide provides some information on taxonomic designation, the form and size of different taxa, details the texture, colour and shape of taxa, and identifies other taxa that could commonly be mistaken. However, it does not include any instructions on how to use the guide or when and how to collect sub-samples to aid with expert identification, and refers to Fisheries New Zealand codes rather than FAO codes.

Several pieces of information have been reviewed by the SPRFMO Scientific Committee that could help inform the development of updated ID guides. These include reviews of VME indicator taxa (SC7-DW13) and candidate VME taxa (SC8-DW11) for the SPRFMO Convention Area, and reviews of benthic bycatch within the SPRFMO Convention Area (SC8-DW13). Together these pieces of work identify which VME indicator taxa are known from within the Convention Area, and what their prevalence is within historic bycatch records. This information could be used to prioritize the inclusion of VME indicator taxa most commonly retained as benthic bycatch in an updated ID guide.

This working paper is a response to the need for practical keys for use by fishers, observers and others at sea for identifying VME indicator taxa. Below we propose steps for the development of an updated SPRFMO-specific user-friendly ID guide and associated training videos that would enable information provided to observers to be standardized, accurate, and clear. The ID guides would not

be intended to be used as taxonomic guides, as those are available elsewhere and can be referred to separately.

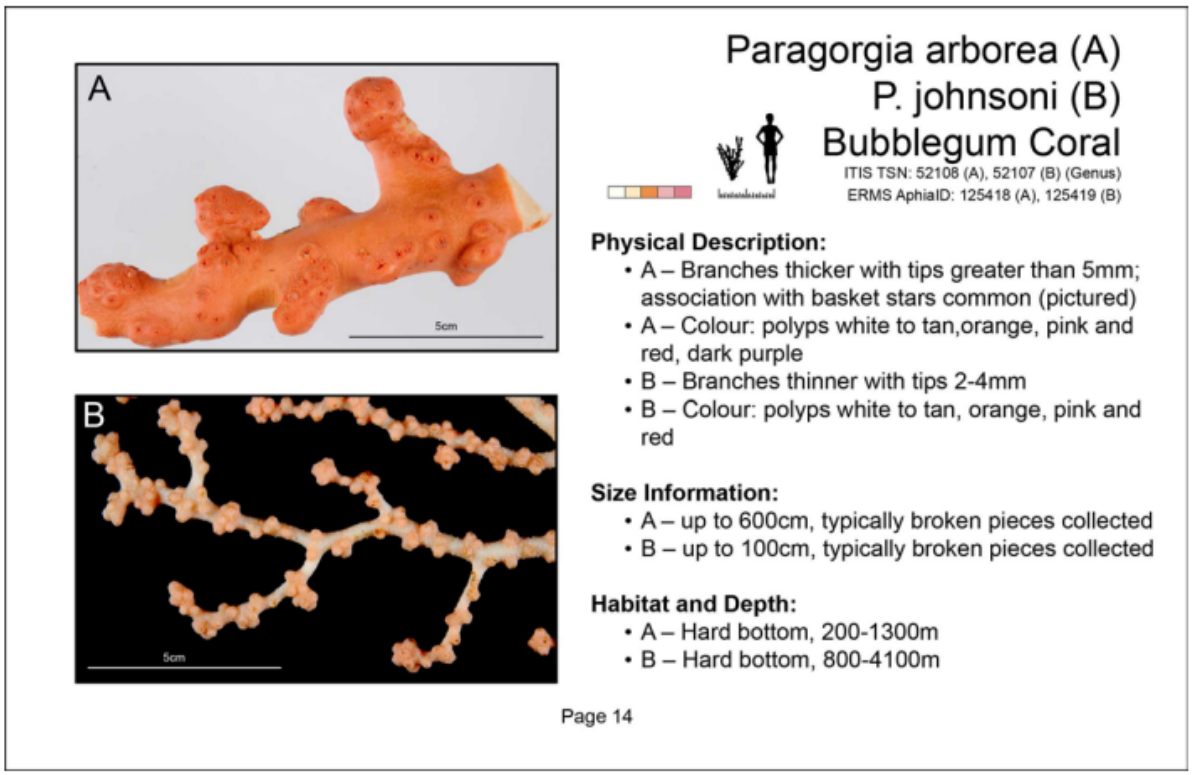

Figure 2 | Page 1 of the NAFO Coral Identification Guide.

3. Proposed steps for the development of ID guides

4.1 Determine the purpose of the ID guides

The ID guides should enable observers and fishers to identify benthic bycatch at sea, with an emphasis on VME indicator taxa as defined in CMM03-2021. The guides should also be developed with the view of improving the quality of data received by Members, CNCPs and the SPRFMO Secretariat.

4.2 Determine which taxa to include

Determining which taxa to include within the guide will need to take into consideration the purpose of the guide. If the purpose is to aid the identification of VME taxa commonly caught by bottom fish gear, identifying which taxa to include can be achieved by cross referencing lists of taxa presented in SC8-DW11 against historic bycatch records to determine which are the most frequently retained as bottom fishing bycatch. Alternatively, if the focus of the guide is on identifying VME taxa that meet combinations of FAO criteria for the identification of VMEs, irrespective of their prevalence in benthic bycatch, scoring of taxa against FAO criteria in SC8-DW11 could be used to identify priority taxa for inclusion.

4.3 Determine the taxonomic resolution required to inform management

Within the context of CMM03-2021, the current taxonomic resolution required to inform management is outlined in Annex 5. The required level of resolution varies between VME indicator taxa and is variously required at the level of Phylum (e.g., Porifera), Class (e.g., Crinoidea), Order (e.g., for the Antipatharia, Actiniaria, Pennatulacea, Zoantharia, and for the qualifying taxa for within the Phyllum Bryozoa and Class Hydrozoa), Suborder (for qualifying taxa gorgonian Alcyonacea), Family (e.g., Stylasteridae) or Genera (for qualifying taxa within the Order Scleractinia).

4.4 Determine the taxonomic resolution required to improve data quality and avoid misclassification

The lack of finer-resolution taxonomic information is impeding our understanding of the diversity, and distribution of benthic taxa and interactions with particular fisheries. One of the aims of developing ID guides is to improve the quality of data received by Members in order to expand the information base available to inform Scientific Committee (SC) work programmes, including the potential development of abundance-based species distributions models, or estimates of catchability, both of which would benefit from better species- or genus-level information. However, in improving the availability of species- and genus-level information consideration should be given to the potential for misidentification. If species-level identification requires microscopic or expert identification, then the taxon should be represented at a higher taxonomic level to avoid incorrect reporting. Based on an evaluation of the accuracy of identifications of benthic bycatch made by observers on bottom fishing vessels from within the New Zealand EEZ, the accuracy of identifications was much improved at taxonomic identification levels higher than genus (Tracey et al. 2011, Macpherson et al. 2021). If species within a genus can be easily distinguished, then they should be included at the species-level in the ID guide to obtain more detailed bycatch data and to enable users to distinguish morphologically-similar related species. The initial list of taxa under consideration for inclusion in the ID guide could be collapsed according to these criteria.

4.5 Determine what taxon-specific information to include

It is expected that users will want pages to be uncluttered, simple and provide quick and accurate reference. At a minimum, we suggest the following information should be included for each taxon includes in the ID guide:

a) Common and scientific names
b) FAO reporting codes
c) Images
d) Distinguishing characteristics
e) Size information
f) Known/typical habitat and depth
g) Species or genera that can also be commonly confused

Additional information that could be included:

a) Ecological information
b) Relevant fisheries
c) Aphia ID

d) Reporting codes used by Members or CNCPs

4.6 Engage with fishers and observers to determine what format and properties the ID guide should have

It is expected that most of the intended users (fishers and observers) will use pictures to identify taxa as they appear on deck and will want to minimize reading time associated with identification. Consequently, we expect users will prefer a guide that includes clear photos of the specimens taken on deck (i.e., limited underwater photos) and illustrates those features that help to distinguish the taxon using current taxonomic descriptors (which may necessitate the inclusion of a glossary within the guide).

Format considerations should take into consideration hierarchies of information. For example, the first few pages of the guide could present information at a level similar to that contained in the existing CCAMLR and SPRFMO guides (e.g., see Figure 1 and Appendix 1), with subsequent pages providing more detailed species or genera level information as contained in the NAFO coral identification guide (e.g., see Figure 2).

We expect there will be a preference for small (e.g., A5 – 148 x 210 mm) ID guides produced on waterproof plastic paper. In determining the properties of the ID guide, consideration should be given to how readily updatable the guide may be. For example, A5 pages compiled in a ring-binder potentially allows individual pages to be updated or additional pages to be added to the guide.

4.7 Determine procedures for subsampling

Occasionally the quantity of bycatch is too large to allow weighing in full. Clear instructions should be included for identifying and weighing sub-samples to enable the use of records in any future analysis.

4.8 Determined procedures for when samples should be collected and returned for expert identification

Clear instructions should be included for when and how the collection and preservation of samples for expert identification (and ideally genetic verification) should be undertaken to help improve data quality and to monitor the reliability of the observer data (e.g., to detect improvements or declines in observer identification accuracy).

4.9 Expert technical review of ID guides

Experts should conduct a technical review of the ID guides to check content accuracy prior to final publication of the guides.

4.10 Co-development of ID guides

The end-users of the ID guides should be consulted iteratively at various stages of guideline development to ensure the ID guides will be useful/usable.

4. Proposed steps for the development of training video

Having developed ID guides, a training video incorporating existing material (photos and videos) collected by observers, and voiced over by experts, should be produced to aid in training observers and fishers in how to use the ID guide. The training video will include:

- Identification of benthic bycatch commonly caught by bottom fishing methods within the SPRFMO Convention Area;
- The scope of the guide and how the guide should be used;
- How benthic bycatch should be weighed at sea;
- How large amounts of benthic bycatch should be sub-sampled and weighed;
- How and when to collect and preserve samples for expert identification.

5. Discussion

We have proposed 10 steps for the development of an updated SPRFMO-specific user-friendly ID guide for benthic bycatch commonly caught by bottom fishing gear within the SPRFMO Convention Area. Additionally, we have proposed the development of training videos to familiarise users with the ID guides, and enable information provided to observers to be standardized, accurate and clear, paying particular attention to the identification, weighing, subsampling and collection of benthic bycatch samples.

An additional consideration should be the lifespan of the document and if, or when, it will be reviewed. Any review should allow for the collection of data on the usability of the guide and the reliability of identifications based on information provided within the guide (e.g., see step 4.8 above).

A similar process for updating fisheries observer ID guides for protected corals is currently underway for use within New Zealand's domestic bottom fisheries. Using that process as an example to estimate the time and resources required to develop a similar observer guide for the SPRFMO Convention Area, we estimate it would take approximately 12 months to develop the guide following the proposed steps outlined above, with an estimated cost of approximately NZ$60,000 to NZ$70,000.

6. Recommendations

It is recommended that the Scientific Committee:

- **Notes** that steps have been proposed for the development of an updated SPRFMO-specific ID guide for benthic bycatch and the development of associated training videos.
- **Recommends** that the development of ID guide for benthic bycatch, following the steps proposed in this paper, and associated training videos, are added to the SC Multi-annual Work Plan with a 2022+ timeframe.

7. References

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Appendix 1

Classification guide for potentially vulnerable invertebrate taxa in the SPRFMO Area.
https://www.sprfmo.int/assets/Meetings/Meetings-before-2013/Scientific-Working-Group/SWG-08-2009/SP-08-SWG-DW-03-SPRFMO-VME-ID-Guide-v2-Nov-2009.pdf