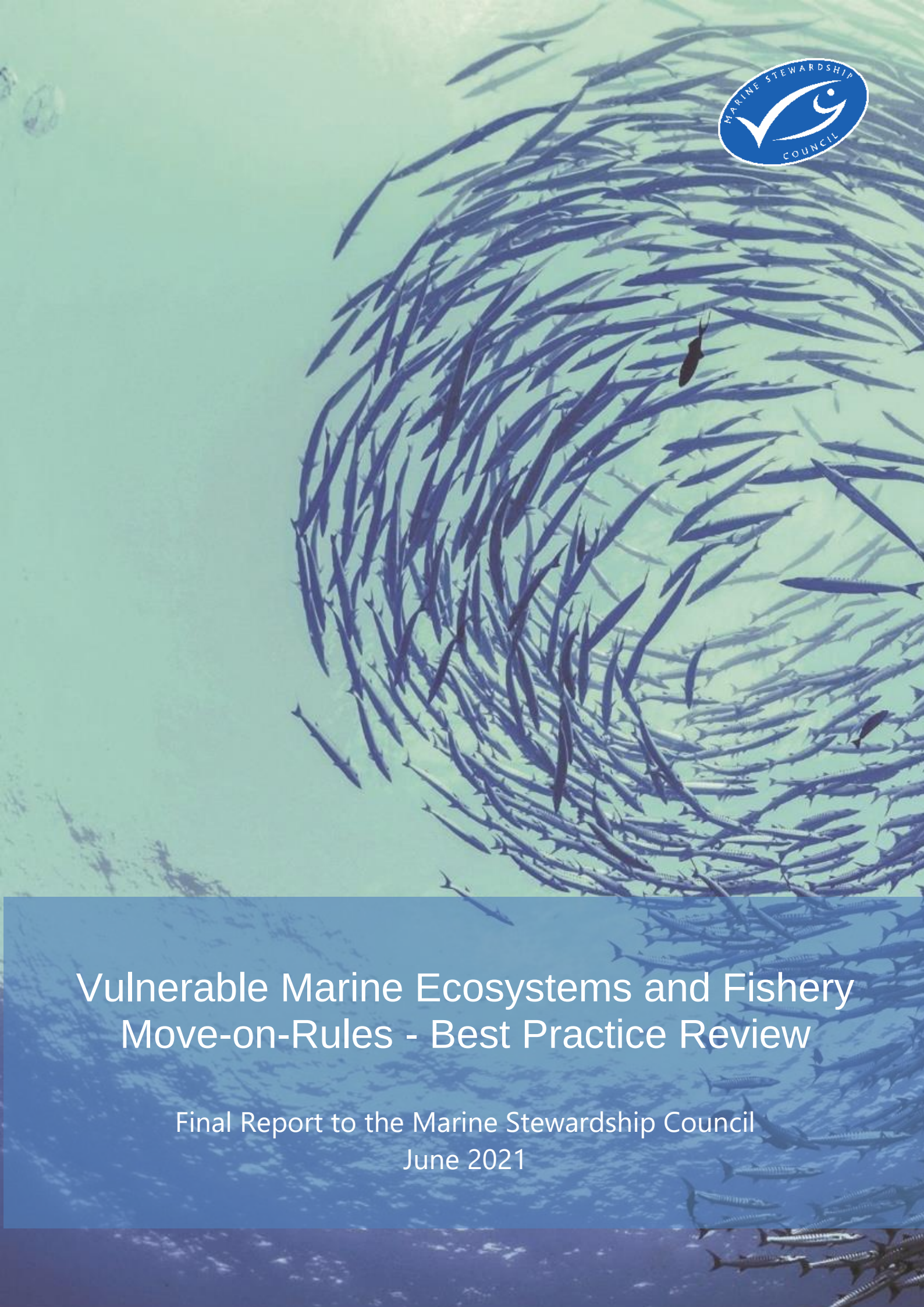

Vulnerable Marine Ecosystems and Fishery Move-on-Rules - Best Practice Review

Final Report to the Marine Stewardship Council

June 2021

Vulnerable Marine Ecosystems and Fishery Move-on-Rules, Best Practice Review

FINAL Report to the Marine Stewardship Council

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Notice

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Executive Summary

The Marine Stewardship Council (MSC) commissioned this review of current practice in relation to vulnerable marine ecosystems (VMEs) and move-on rules to inform the development of options for the Fisheries Standard Review. A wide range of scientific and grey literature relating to VMEs and move-on rules was reviewed, related both to international waters (e.g. through Regional Fishery Management Organisations) and national waters, to identify the state of current practice. A regional comparison of the identification of VMEs in MSC public certification reports was carried out. Contact was established with a selection of RFMOs, and stakeholder consultation was carried out with a selection of fisheries, management agencies, science advisers and NGOs. This explored existing approaches to identification and protection of VMEs in national waters, the strengths and weaknesses of the existing MSC approach to fishery interactions with VMEs, and consideration of the process that fisheries should engage in to progressively identify interactions with VMEs and minimise impacts upon them.

The United Nations Food and Agriculture Organization (FAO) developed the International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (2009), which set out five criteria for the identification of VMEs:

- Uniqueness or rarity
- Functional significance of the habitat
- Fragility
- Life-history traits (slow growth, long-lived)
- Structural complexity

The FAO Guidelines were developed for areas beyond national jurisdiction, and the concept is now firmly embedded in regimes for the management of deep-sea fisheries in the high seas. Most RFMOs use the five FAO criteria and example VME types provided in the FAO Guidelines (certain coldwater corals and hydroids, some types of sponge-dominated communities, dense emergent fauna, and endemic seep and vent communities). They use the 'VME' terminology and have identified VME indicator species. Most have implemented measures to protect VMEs such as freezing existing fishing footprints, area closures, and requirements for impact assessments in advance of exploratory fishing outside of the existing fishing footprint. Most have also established move-on rules with associated thresholds for action, to manage unexpected encounters with high densities of VME indicator species.

Within national jurisdictions, sensitive habitats have been identified and protected, but the 'VME' terminology is not usually used, except where their waters specifically encompass deep-sea environments. Different criteria from the FAO criteria have been used to identify sensitive habitats in national waters. Many of these align with the first four FAO criteria (none were found to have used a criterion analogous to 'structural complexity'), but additional criteria are also used which may result in habitats being identified that would not be considered as 'VMEs' under the FAO criteria. Furthermore, there are varying levels of progress in identifying and protecting sensitive habitats in different jurisdictions. Some (e.g. Canada) have conducted extensive research to define VME species and habitats, with closures in place based on surveys and habitat modelling to identify areas where VMEs may occur. Others have not advanced as far, with minimal knowledge of benthic environments beyond coastal waters.

Move-on rules have been adopted by most RFMOs, but are not common in national jurisdictions. A number of limitations of move-on rules have been observed, documented and researched. Specifically, they imply a tolerance to a level of impact and may encourage cumulative impacts in new fishing areas. Thresholds often lack scientific underpinning, and are rarely exceeded even where impacts are thought

likely, which may be due to thresholds being set too high or fishing gears being poor at sampling benthic fauna; alternatively, it may be because the fisheries are not interacting with VMEs (making a move-on rule redundant). Move-on rules do not usually take into account the range of gear types, configurations and tow durations and speeds and how these could affect catchability of indicator taxa. There was consensus amongst stakeholders that move-on rules are not appropriate in many circumstances, specifically where there is good spatial management, in heavily fished areas, where there are sensitive habitats present, for gears that are unlikely to retain indicator species/taxa, and where there are low levels of observer coverage. Conversely, stakeholders felt that move-on rules could be appropriate in areas where sensitive habitats have not been identified and protected, and in frontier areas where fishing has not previously taken place (although in such areas, a more precautionary approach would be to map and protect VMEs, or locations that are likely to contain VMEs, prior to fishing taking place). It is noted particularly that the MSC's existing requirement for 'commonly accepted' move-on rules for VMEs at SG60 does not reflect the reality that there are no commonly accepted move-on rules for any habitat-gear type combination in national jurisdictions.

Alternative approaches to the use of move-on rules are the development of an understanding of the spatial footprint of a fishery and its interaction with habitats, implementation of frozen footprints, closed areas, impact assessments prior to authorisation of fishing in new areas, and technical measures to reduce seabed interaction.

The current approach in the MSC Standard to identifying VMEs and assessing fishery impacts has resulted in inconsistencies between fisheries operating in the habitat types that are assessed as VMEs in MSC assessments. In the assessments of certified fisheries, the main taxa/features that were identified as VMEs were types of corals and sponges. There was less consistency across fisheries in relation to the identification of sea pens, horse mussel beds, maerl beds, hydrothermal vents and bryozoans as VMEs, sometimes relating to differences in approaches between national jurisdictions. The majority of fisheries used national or regional approaches to define their VME types rather than RFMO approaches. Fisheries which employed the risk-based framework in the habitats assessment tended not to have VMEs identified. This leads to the potential for a non-level playing field between fisheries in different regions and national jurisdictions, due to the lack of consensus over what should be considered as a VME for the MSC assessment (due to national jurisdictions not usually using the 'VME' terminology), and different levels of progress on identifying and protecting VMEs or sensitive habitats in different jurisdictions.

Whilst there are alternative criteria available for identifying vulnerable habitats to those adopted by the FAO, simply providing another set of criteria does not in itself solve the problem of identifying VMEs within MSC assessments. Whichever criteria are used, a scientific and data-driven process for individual regions or jurisdictions would help in establishing which species or habitat types should be considered as VME, and then to determine if and where the VMEs actually occur within the habitat under consideration for the assessment. Where national or regional approaches to identifying VMEs or VME-like habitats have been implemented, these should be used in the MSC assessment process, although national designations often include habitats that would not be considered VMEs (e.g. representative habitats).

Alternative approaches for identifying VME types for MSC assessments include the development of a standard list of VME habitat types for consideration in MSC assessments (rather than a standard list of criteria), or restricting the assessment of VMEs to deep water habitats only, where VMEs are more consistently identified and defined. Each approach has benefits and drawbacks that are discussed in the report.

Any consideration of possible precautionary management approaches to VMEs by the MSC should avoid a one-size-fits-all approach, but should promote a level playing field between fisheries. This means there should be greater consistency in the types of habitats that are considered to be VME, and to be managed in a manner that is consistent with the level of understanding of the VMEs that are or

may be present in its area of operation. In this regard, information and evidence are key, where lower levels of knowledge of habitats and habitat impacts should require more precautionary approaches to management. Prescriptive requirements for particular management measures should be avoided, however, and instead the focus should be on the overall approach to identifying and protecting benthic biodiversity, and its outcome in relation to potential impacts on VMEs.

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1 Introduction

1.1 Background

In 2004, the United Nations General Assembly (UNGA) called on states and regional fishery management organisations or arrangements to apply the precautionary approach in relation to damaging fishing practices, including bottom trawling, that has adverse impacts on vulnerable marine ecosystems (VMEs). Following this, the United Nations Food and Agriculture Organization (FAO) developed the International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO, 2009). The Guidelines provide a reference to help states and RFMOs in 'formulating and implementing appropriate measures for the management of deep-sea fisheries in the high seas'. The Guidelines followed on from, and aim to provide a framework for, the implementation of UNGA Resolutions 59/25 and 61/105 (see box).

VMEs are groups of species, communities or habitats that may be vulnerable to impacts from fishing activities, and have been defined through a set of criteria established by FAO (2009). The VME concept is now firmly embedded in regimes for the management of deep-sea fisheries in the high seas, or areas beyond national jurisdiction (ABNJ). In these areas, once a VME has been identified, management measures are generally put in place to protect the area from the impacts from fishing. Before an area is formally designated as a VME, it is termed a potential VME (pVME). These are areas which could be a VME but further investigations are needed to confirm whether VME indicator species are present in sufficient concentrations and/or diversity to qualify as a VME. Potential VMEs typically include areas where encounters with VME indicator species have occurred or where modelling approaches have identified likely hotspots or suitable areas for VMEs. One of the approaches to the identification and protection of VMEs is the implementation of encounter protocols, such as move-on rules that are triggered when a fishing vessel catches species that are representative of VMEs. Move-on rules are a precautionary management response to the detection of unforeseen encounters with pVMEs requiring a fishing vessel to move a minimum distance from a location where species indicating the presence of a VME were captured.

In the Marine Stewardship Council's (MSC) Fishery Standard, against which fisheries are assessed for certification as a sustainable fishery, VME impacts and management and associated move-on rules are assessed under Principle 2 in Performance Indicators (PIs) 2.4.1–2.4.2 (Box 1).

A number of issues have been logged by the MSC regarding the application of the habitats performance indicators, and various interpretations have been issued to support the Conformity Assessment Bodies (CABs) in their assessments. Most of the issues are focussed on a few scoring issues, primarily within guidance on defining and considering impacts on commonly-encountered habitats and VMEs, and requirements and guidance for defining how move-on rules should be applied (Ichthys Marine, 2020).

The MSC has therefore commissioned this study to carry out a review of current practice in relation to VMEs and move-on rules to inform the development of options for the Fisheries Standard Review (FSR).

Box 1. MSC Fisheries Standard in relation to VMEs and move-on rules

The Fisheries Standard v2.01 requires that:

1 **Performance Indicator (PI) 2.4.1**: fisheries do not cause serious or irreversible harm to habitat structure and function. Under this, scoring issue (b) concerns VME habitat status, and requires it to be *unlikely* (SG60), *highly unlikely* (SG80), or for there to be *evidence* (SG100) that the fishery does not reduce structure and function of VME habitats to a point where there would be serious or irreversible harm. It also requires the FAO VME definition to be applied both inside and outside Exclusive Economic Zones (EEZs) and irrespective of depth (i.e. it extends the FAO definition from high-seas and deep-sea habitats, to shallow waters within national jurisdictions);

2 **Performance Indicator (PI) 2.4.2**: fisheries have a habitats management strategy in place. Under this, scoring issue (a) requires *measures* (SG60), a *partial strategy* (SG80), or a *strategy* (SG100) in place, to manage the impact of fisheries on habitats, and achieve the Habitat Outcome 80 level of performance. At SG60 (the minimum level required for certification), the standard specifies that there must be 'precautionary measures to avoid encounters with VMEs, based on commonly accepted move-on rules'.

1.2 Study objectives and approach

This study had the following aim, which will contribute to the evidence and information for the Habitat Scoring component as part of the FSR:

- To undertake research and analysis to contribute to the development of options to clarify issues for two key policy areas: Vulnerable Marine Ecosystems (VMEs) and move-on rules for fisheries.

The specific study objectives were to:

- Establish whether the FAO VME criteria (as operationalised via SA3.13.3.2) are fit for purpose for application within MSC assessments through:
  - Considering the current status and application of the FAO VME criteria in a global fisheries context, particularly the approach being taken by RFMOs;
  - Considering whether alternative criteria (to those of FAO VME) exist for identification of benthic habitat types which are particularly sensitive or vulnerable to serious/irreversible impact from fishing activity, through consideration of wider scientific literature and approaches taken;
- Assess the latest scientific evidence on the efficacy and use of move-on rules for VME protection in international waters and national waters through:
  - Reviewing evidence of the limitations and effectiveness of move-on rules
  - Identifying whether alternative (and equivalent) precautionary management approaches exist;
  - Give consideration to ease of implementation and potential effectiveness of alternative measures (where move-on rules are not applicable for certain gear types, where VME species have low catchability, where drifting fish aggregating devices (dFADs) are used, and where there is little/no independent monitoring of catches);
- Identify key challenges for stakeholders:
  - Reaffirm the issues faced in inputting to the VME assessment process;
  - Review existing responses to a consultation event held in summer 2020;
  - Consultation with a selection of stakeholders (from science/management, fishery clients and NGOs.

The approach taken for the study was to review a wide range of scientific and grey literature relating to VMEs and move-on rules, both in international waters (e.g. through Regional Fishery Management Organisations or Agencies, RFMOs) and in national waters to identify the state of current practice in this area. Contact was established with a selection of RFMOs to explore their approaches and future direction. Stakeholder consultation was also carried out with NGOs, management agencies, science advisers and MSC client fisheries to explore existing approaches to identification and protection of VMEs in national waters, the strengths and weaknesses of the existing MSC approach to fishery interactions with VMEs in the Fisheries Standard v2.01, and consideration of the process that fisheries should engage in to identify VMEs and minimise impacts upon them.

1.3 Structure of this report

This report is structured as follows:

- Section 1: Introduction (this section)
- Section 2: FAO VME Criteria
- Section 3: Regional Fisheries Management Organisations
- Section 4: National case studies
- Section 5: Current status and application of FAO criteria in a global fisheries context
- Section 6: Use of move-on rules for VME protection
- Section 7: Analysis of VME identification in certified fisheries
- Section 8: Stakeholder consultation
- Section 9: Conclusions

2 FAO VME Criteria

The FAO Guidelines (2009) provide five criteria for identifying VMEs, based on species, habitats and physical characteristics (Box 2).

Box 2. FAO Criteria for identifying VMEs

Paragraph 42 of the FAO Guidelines states that:

A marine ecosystem should be classified as vulnerable based on the characteristics that it possesses. The following list of characteristics should be used as criteria in the identification of VMEs.

- Uniqueness or rarity – an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems. These include:
  - habitats that contain endemic species;
  - habitats of rare, threatened or endangered species that occur only in discrete areas; or
  - nurseries or discrete feeding, breeding, or spawning areas.
- Functional significance of the habitat – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life-history stages (e.g. nursery grounds or rearing areas), or of rare, threatened or endangered marine species.
- Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities.
- Life-history traits of component species that make recovery difficult – ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics:
  - Slow growth rates;
  - Late age of maturity;
  - Low or unpredictable recruitment; or
  - Long-lived.
- Structural complexity – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems. Further, such ecosystems often have high diversity, which is dependent on the structuring organisms.

The Annex in the FAO Guidelines provides examples of types of potentially vulnerable species groups, communities and habitats, along with the features that potentially support them. They are:

- Certain coldwater corals and hydroids e.g. reef builders and coral forest;
- Some types of sponge dominated communities;
- Communities composed of dense emergent fauna where large sessile protozoans (xenophyophores) and invertebrates (e.g. hydroids and bryozoans) form an important structure component of habitat; and
- Seep and vent communities comprising invertebrate and microbial species found nowhere else (i.e. endemic).

Additionally, examples of topographical, hydrophysical or geological features, including fragile geological structures, that potentially support the species groups or communities, referred to above are specified as:

- submerged edges and slopes (e.g. corals and sponges);
- summits and flanks of seamounts, guyots, banks, knolls, and hills (e.g. corals, sponges, xenophyphores);
- canyons and trenches (e.g. burrowed clay outcrops, corals);
- hydrothermal vents (e.g. microbial communities and endemic invertebrates); and
- cold seeps (e.g. mud volcanoes for microbes, hard substrates for sessile invertebrates).

The main objective of the FAO Guidelines (2009) is to prevent significant adverse impacts on VMEs. Significant adverse impacts are defined as impacts that compromise ecosystem integrity (i.e. structure and function) in a manner that:

- Impairs the ability of affected populations to replace themselves;
- Degrades the long-term natural productivity of habitats; or,
- Causes, on more than a temporary basis, significant loss of species richness, habitat or community types.

FAO states that impacts should be evaluated individually, in combination and cumulatively. When determining the scale of the significant adverse impact, consideration is needed in terms of the ability and rate of recovery, spatial extent of the impact, intensity or severity of the impact and timing and duration of the impact.

The FAO Guidelines were established specifically for the management of deep-sea fisheries that occur in areas beyond national jurisdiction (Paragraph 8), but also state that Coastal State 'may' apply the Guidelines within national jurisdictions, 'as appropriate' (FAO, 2009). Consideration of what is 'appropriate' in this sense is considered in later sections of this report.

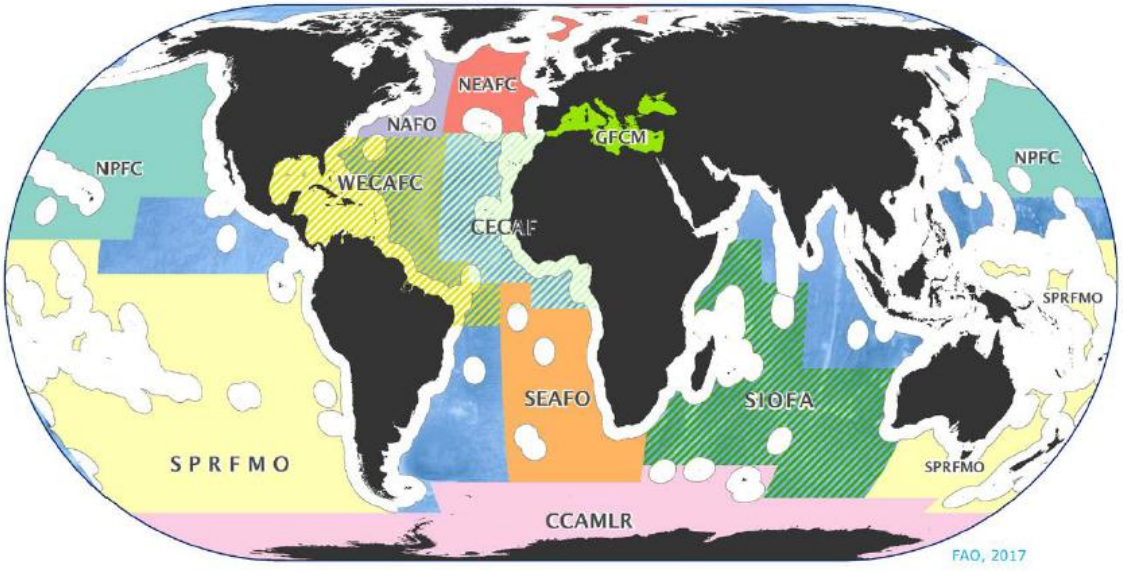
3 Regional Fisheries Management Organisations

Globally, there are ten regional organisations responsible for the management of fisheries for non-migratory species in areas beyond national jurisdiction (Figure 1). Regional Fisheries Management Organisations (RFMOs) have a legal mandate to ensure the sustainable use of marine living resources in these areas, and are the appropriate mechanism for cooperation in managing high seas fisheries under the United Nations Convention on the Law of the Sea (UNCLOS).

The UNGA resolutions on bottom fisheries in areas beyond national jurisdiction call upon States and RFMOs to:

- Conduct assessments of whether individual bottom fishing activities (activities where gears are likely to come into contact with the seafloor during normal fishing operations, including trawls, lines, nets and pots) have significant adverse impacts on VMEs, and to ensure that if so they are managed to prevent such impacts, or not authorised to proceed;
- Identify VMEs and determine whether bottom fishing activities would cause significant adverse impacts to such ecosystems;
- Close areas to bottom fishing where VMEs are known or likely to occur unless the fishing can be managed to prevent significant adverse impacts on VMEs.

Although UNGA Resolutions are not technically binding, in recent years they have nevertheless had considerable traction as a regulatory spur to address the impacts of bottom fishing practices (Caddell, 2020). Each of the RFMOs has adopted a series of measures for the regulation of the impacts of these fisheries on vulnerable benthic habitats; these are reviewed in the following sections.



Source: FAO, 2016.

Figure 1. Map showing the competence areas of regional fishery bodies* with the mandate to manage deep sea fisheries in the ABNJ**

* CCAMLR is a conservation organisation with a mandate to manage fisheries within its area of competence.

** WECAFC (Western Central Atlantic Fishery Commission) and CECAF (Fishery Committee for the Eastern Central Atlantic) are regional advisory bodies that cover fishery resources in the ABNJ.

3.1 CCAMLR

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was established in 1982 with the objective of conserving marine life in the Southern Ocean. The northern boundary of the Convention Area includes areas south of 45°S or 60°S. CCAMLR has 26 members – 25 States and the European Union. It currently manages fisheries for krill, mackerel icefish and toothfish.

3.1.1 VME indicators and identification

Prior to the publication of the FAO 2009 guidelines, CCAMLR (Convention Measure (CM) 22-06) defined VMEs specifically as seamounts, hydrothermal vents, cold water corals and sponge fields. This definition is currently still in place (CCAMLR, 2019). A diverse range of taxa are recognised as VME indicators (Table 1) and are evaluated in terms of their susceptibility to lasting damage from bottom fishing based on the following criteria:

- functional significance of habitat forming taxa
- longevity
- slow growth
- fragility
- larval dispersal potential
- lack of adult mobility
- rare or unique populations

Table 1. VME indicator taxa for the CCAMLR region

Phylum	Level	FAO Code	Taxon/Common Name Examples
Cnidaria	Gorgonacea (Order)	GGW	Isididae (Bamboo)
			Coralliidae (Red / precious)
			Primnoidae (Bottle brush, sea fans)
			Paragorgiidae (Bubblegum)
			Chrysogorgiidae (Golden)
	Anthoathecatae (Order)	AZN	Chrysogorgiidae (Golden)
	Stylasteridae (Family)	AXT	Stylasterids (Hydrocorals)
	Scleractinia (Order)	CSS	Stony corals
	Antipatharia (Order)	AQZ	Black corals
	Zoantharia (Order)	ZOT	Zoanthids
	Actiniaria (Order)	ATX	Anemones
	Alcyonacea (Order)	AJZ	Soft Corals
	Pennatulacea (Order)	NTW	Sea pens
Porifera	Hexactinellida (Class)	HXY	Glass sponges
	Demospongiae (Class)	DMO	Siliceous sponges
Chordata	Ascidiacea (Class)	SSX	Sea squirts
Bryozoan	Byrozoans (Phylum)	BZN	Sea squirts
Chemosynthetic	Various Groups	CXV	Chemosynthetic communities
Brachiopoda	Brachiopoda (Phylum)	BRQ	Lamp shells
Hemichordata	Pterobranchia (Class)	PBQ	Acorn worms
Annelida	Pterobranchia (Class)	SZS	Serpulid tube worms
Xenophyophora	Xenophyophora (Phylum)	XEF	Xenophyophores
Arthropoda	Bathylasmatidae (Family)	BWY	Goose and acorn barnacles

Phylum	Level	FAO Code	Taxon/Common Name Examples
Mollusca	Adamussium colbecki (Species)	DMK	Antarctic scallop
Echinodermata	Stalked crinoid (Order)	CWD	Stalked crinoids (sea lilies)
	Euryalida (Order)	OEQ	Basket and snake stars
	Cidaroida	CDV	Pencil and spine urchins

Source: EASME, 2018.

3.1.2 Protection measures for VMEs

A variety of measures are in place to protect VMEs in the CCAMLR Convention Area:

- Impact assessments for all bottom fisheries;
- Closures of areas to protect VMEs (both inside and outside of existing bottom fishing areas);
- Encounter protocols and move-on rules for fishing in existing bottom fishing areas;
- Potential VMEs which occur in areas where bottom fishing is permitted are given special protection under CM 22-09;
- Prohibition of gillnets and bottom trawling in the high seas and shallow waters.

Impact assessments for all bottom fisheries

Bottom fishing in the high seas areas of the Convention is restricted to areas where there is an established bottom fishery based on 2006-2007 data. All Contracting Parties wishing to undertake bottom fishing must complete a pro forma on their fishing plans, including a preliminary assessment of the known and anticipated impacts of bottom fishing activities on VMEs, and mitigation measures to prevent impacts (CM 22-06). This is assessed by the Scientific Committee and then approved, prohibited or restricted to certain areas or gear types or any other restrictions imposed to prevent serious adverse impacts on VMEs (Fuller *et al.,* 2020). Observers are required on all vessels and exploratory bottom fisheries must carry one additional scientific observer where possible.

Closed areas

The majority of VMEs were designated in 2006, 2012 and 2018, and in total 53 VME areas have been closed. These areas are mainly around the Antarctic Peninsula and Ross Sea. Any closed VMEs are noted on the CCAMLR VME Registry. Marine protected areas (MPAs) have also been established in South Orkney and the Ross Sea which prohibit or restrict commercial fishing (Fuller *et al.,* 2020).

Encounter protocols and move-on rules

Since 2013, Conservation and Management Measure (CMM) 22-07 interim measures have been in place to protect potential VMEs from bottom fishing activities (CCAMLR, 2013).

After an encounter with 10 or more VME indicator units within one line segment, a pVME is identified and a "Risk area" is defined as a one nautical mile (nm) radius from the mid-point of the line segment. The vessel must complete hauling any lines still intersecting the Risk Area without delay. The Secretariat and Flag State must be notified immediately of the midpoint of the line segment where the VME indicators were recovered. The Risk Area remains closed until a review by the Scientific Committee and management actions determined by the Commission. Scientific research is allowed in the Risk Area as agreed by the Scientific Commission.

A 'VME indicator unit' is defined as either one litre of VME indicator organisms that can be placed in a 10-litre container or, 1 kg of VME indicator organisms that do not fit into a 10-litre container (CM 22-07) (CCAMLR, 2013), and does not differentiate between live and dead coral (CCAMLR, 2009a).

If more than 5 VME indicator units are recovered in one line segment, CCAMLR must be informed of the location of a 'possible' encounter. If there are five 'possible' encounters within a 0.5° latitude x 1° longitude rectangle, the Secretariat notifies all fishing vessels of a potential VME, however, bottom fishing activities may continue in the area.

To date, encounters with VME indicator units have led to 76 areas being identified as Risk Areas. The presence of 100% observer coverage on vessels means that all encounters above threshold levels are likely to be reported. Nevertheless, if there are reports indicating a VME threshold was exceeded but the vessel did not notify the Secretariat immediately, the incident is included in the CCAMLR Compliance Evaluation Procedure for consideration at the next CCAMLR meeting.

Gear restrictions

Bottom trawling is prohibited in all high seas areas within the Convention Area since 2006 and there is a complete prohibition of deep-sea gillnets since 2010 (CM 22-05, CM 22-04). Bottom fishing using demersal longlines and pots is prohibited in waters shallower than 550 m around the entire Antarctic continent to protect shelf-based benthic systems.

3.1.3 Future direction and other issues

The Scientific Committee have found that in certain locations there was insufficient evidence of indicator taxa in catches to trigger the 10 kg threshold rule even though video transects provided ample evidence of the presence of a VME. The Committee made particular reference to the fact that 'light' weight taxa are much less likely to trigger the encounter protocol, and a lower threshold should be considered for these taxa (CCAMLR, 2009b). Currently, there are no updated thresholds covering taxa which are considered 'light' weight.

3.2 GFCM

The General Fisheries Council of the Mediterranean (GFCM) was established in 1949 to monitor and manage fisheries in the Mediterranean and Black Seas. GFCM has begun to define VMEs in its waters, with a provisional list of VME indicator features, habitats and taxa being proposed in 2017. In 2019 a resolution was adopted (GFCM/43/2019/6) which aims to progressively implement measures to protect a sub-set of VMEs.

3.2.1 VME indicators and identification

Resolution GFCM/43/2019/6 specifies that the definition of VME is based on paragraphs 42 and 43 of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas. The relevant lists of VME indicator features, habitats and taxa (Table 2 and Table 3) were set out in the Report of the forty-second session of the GFCM. However, the objective of Resolution GFCM/43/2019/6 is to implement transitional measures to prevent significant adverse impacts from deep-sea fishing activities on only a sub-set of those VME indicators, being VME formed by cnidarian (coral) communities. Fifteen species of coral are specified, which are those listed in Annex II of the SPA/BD Protocol of the Barcelona Convention and impacted by fisheries.

Table 2. Mediterranean VME indicator features and VME indicator habitats

VME indicator features	VME indicator habitats
Seamounts and volcanic ridges Canyons and trenches Steep slopes Submarine reliefs (*slumped blocks, ridges, cobble fields, etc.*) Cold seeps (*pockmarks, mud volcanoes, reducing sediment, anoxic pools, methanogenetic hard bottoms*) Hydrothermal vents	Cold-water coral reefs Coral gardens - Hard-bottom coral garden - Soft-bottom coral gardens Sea pen fields Deep-sea sponge aggregations - "Ostur" sponge aggregations - Hard-bottom sponge gardens - Glass sponge communities - Soft-bottom sponge gardens Tube-dwelling anemone patches Crinoid fields Oyster reefs and other giant bivalves Seep and vent communities Other dense emergent fauna

Source: FAO, 2019a.

Table 3. Mediterranean VME indicator taxa

Phylum	Class	Subclass (Order)
Cnidaria	Anthozoa	Hexacorallia (Antipatharia, Scleractinia) Octocorallia (Alcyonacea, Pennatulacea) Ceriantharia
	Hydrozoa	Hydroidolina
Porifera (sponges)	Demospongiae	
	Hexactinellida	Amphidiscophora Hexasterophora
Bryozoa	Gymnolaemata Stenolaemata	
Echinodermata	Crinoidea	Articulata
Mollusca	Bivalvia	Gryphaeidae (*Neopycnodonte cochlear, N. zibrowii*) Heterodonta* (Lucinoida) (e.g. *Lucinomakazani*) Pteriomorphia* (Mytiloida) (e.g. *Idas modiolaeformis*)
Annelida	Polychaeta	Sedentaria (*Canalipalpata*) (e.g. *Lamellibrachia anaximandri*, *Siboglinum* spp.)
Arthropoda	Malacostraca	Eumalacostraca (Amphipoda) (e.g. *Haploops* spp.)

* Only chemosynthetic species that indicate the presence of a cold seep or hydrothermal vent are considered

Source: FAO, 2019a.

The transitional measures identified are not compulsory, but rather voluntary, for example:

- deep-sea fishing vessels *should* be restricted from operating where a VME has been identified;
- *voluntary* pilot projects such as observer coverage to ensure the collection of relevant, timely and accurate data;
- VME indicator taxa taken as a bycatch during fishing activities targeting other species *should* be reported to the competent national authorities;
- Contracting Parties and Cooperating Non-Contracting Parties *should* endeavour to establish an adequate level of scientific observer programme coverage;
- additional spatial/temporal restrictions to those already established *may* be designated.

Some national scientific surveys have been conducted to study the deep-sea benthos, but mostly these are of limited geographical scope (EASME, 2018). The transitional measures aim to gather information to help map encounters with VME indicator taxa and reflect on additional measures required for their protection.

Thresholds have not yet been established, and an 'encounter' is defined as any catch of VME indicator taxa by any deep-sea fishery. In the event of an encounter, the vessel captain shall immediately report the encounter to the flag State, which then forwards the information to the GFCM Secretariat. (FAO, 2019a).

3.2.2 Protection measures for VMEs

There are some existing measures that serve to protect VME-like habitats in the GFCM area:

- Gear restrictions
- Closed areas

Resolution GFCM/43/2019/6 aims to progressively implement of a set of transitional measures to prevent significant adverse impacts (SAIs) of deep-sea fisheries (DSF) activities on VMEs formed by cnidarian (coral) communities protected under Annex II of the SPA/BD Protocol of the Barcelona Convention. However, the measures are voluntary and/or aim to better understand the distribution of VMEs for the development of conservation and management measures.

Gear restrictions

The deepwater Fishing Restricted Area (FRA) prohibits the use of towed dredges and trawl nets at depths greater than 1,000 m throughout the GFCM area (Recommendation GFCM/29/2005/1). Whilst implemented mainly for the precautionary protection of fish stocks, it also makes reference to 'the presence both of unmapped sensitive habitats (deep water coral banks, sea vents, sea mounts, etc.)'. It encompasses around 59% of the GFCM area (FAO, 2016).

In addition, trawling is prohibited within 3 nm of the coast (Recommendation GFCM/36/2012/3) within the 50 m isobath, in order to protect coastal sharks and coastal benthic communities.

Closed areas

The designation of FRAs, for the purposes of the conservation and management of fisheries resources as well as for the protection of specific marine ecosystems, is one of the functions of the GFCM.

In addition to the deepwater FRA, closures to fishing activities have been implemented to protect three areas containing VME-like habitats (GFCM/30/2006/3):

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

Additional closures for essential fish habitat also protect specific areas from fishing impacts (Figure 2). Three of these (East of Adventure Bank FRA, West of Gela Basin FRA and East of Malta Bank FRA) involve closure to bottom trawls (GFCM/40/2016/4), and one (Eastern Gulf of Lion FRA) involves an effort limit for towed nets, bottom and mid-water longlines, and bottomset nets (GFCM/33/2009/1) (FAO, 2016).

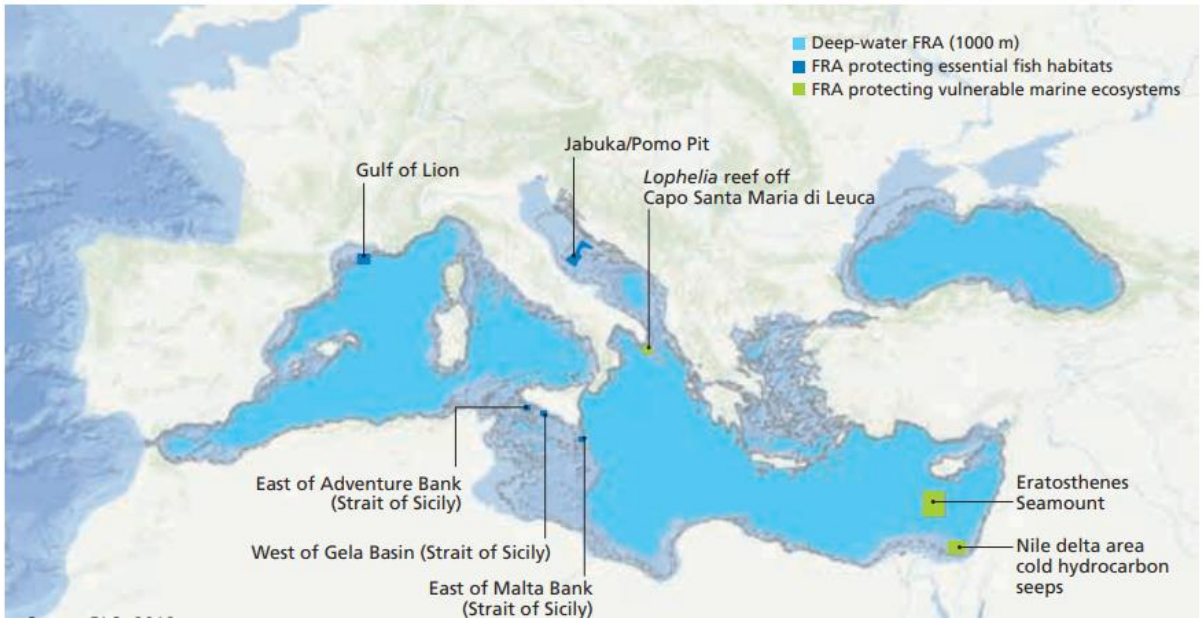


Figure 2. Map of GFCM fisheries restricted areas

Source: FAO, 2020.

3.2.3 Future direction and other issues

No thresholds have been specified by the GFCM. The Working Group on VMEs is in the process of defining them for corals and sponges (Cryer & Soeffker, 2019). The encounter protocol established by GFCM/43/2019/6 requires vessels to report encounters, but no associated move-on rule is in place.

The programme of work for the period 2019-2021 includes:

i. Identify priority areas for the collection of data on VMEs
ii. Compile information on the distribution and abundance of VME indicators
iii. Analyse data, identify VMEs and reflect on additional measures

3.3 NAFO

The Northwest Atlantic Fisheries Organization (NAFO) area covers the northwest Atlantic area and was formed in 1979 following the dissolution of the previous International Commission for the Northwest Atlantic Fisheries (ICNAF), established in 1949, when most of its area came under the jurisdiction of coastal states. The aim of the NAFO Convention is to ensure the long-term conservation and sustainable use of the fishery resources in the Convention Area and, in so doing, to safeguard the marine ecosystems in which these resources are found.

In 2008, a new Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystems (WGFMS-VME) was established, and subsequently a joint Fisheries Commission-Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management, which considers proposals for the reduction of significant impacts on VMEs (FAO, 2016).

3.3.1 VME indicators and identification

NAFO has adopted the FAO definition of VMEs and has developed a list of VME indicator species, grouped into seven categories. A list of physical VME elements is also specified. The list initially focussed only on corals and later sponges. It evolved to also include other species, such as sea pens, crinoids, erect bryozoans and sea squirts, to meet the definitions provided in the FAO Guidelines (FAO, 2016). The VME indicator taxa were identified with consideration of all five FAO criteria (Fuller *et al.,* 2008; NAFO, 2008; Murillo *et al.*, 2011; NAFO, 2020). For example, functional significance (including size of the organism and role in the ecosystem), life history traits (including longevity and slow recovery), were involved in identifying various coral and sponge species as VME indicator species. Black corals were included based on uniqueness/rarity (they are listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES), although their wide distribution at low density means that black coral as a *habitat* is not unique nor rare in the NAFO area (Murillo *et al.*, 2011).

Table 4. VME indicator taxa with example species (full list in Kenchington *et al.,* 2015). Other taxa include actinarians (anemones), crinoids and ascidaceans

Taxa	Example species	Habitat information
Alcyonacea	*Anthomastus* spp. *Gersemina rubiformis* *Paragorgia arborea*	Hard or soft substratum. 170-1400 m Hard or soft substratum. 35-700 m Hard substratum. 200-4100 m. Larger individuals tend to be >800 m.
Antipatharia	*Stauropathes arctica*	Hard substratum. 700-1850 m.
Pennatulacea	*Anthoptilum grandiflorum* *Umbellula* spp.	Soft substratum. 150-2400 m. Soft substratum. 200-2600 m.
Scleractinia	*Lophelia pertusa* *Desmophyllum dianthus*	Hard substratum. 200-1000 m. Hard substratum. 700-1400 m.
Demospongiae	*Cladorhiza* spp. *Geodia* spp. *Spongionella pulchella*	Soft substratum. Hard or gravel substrata. Hard or gravel substrata.
Hexactinellida	*Asconema foliate* *Chonelasma choanoides*	Hard or gravel substrata. Hard or gravel substrata.

Source: EASME, 2018

In terms of considering when occurrences of the 88 VME indicator species form a VME, NAFO has specified that under the structure-forming criterion, a VME is a regional habitat that contains VME indicator species at or above significant concentration levels (NAFO, 2013a). The structural complexity criterion was therefore critical for VME identification (distinct from VME *indicator species* identification) in terms of the density or concentration of individual organisms that together provide the required level of structural complexity to qualify as a VME.

NAFO has endorsed the use of quantitative modelling to determine VMEs and to operationalise the FAO criterion relating to 'significant concentrations' of VME indicators. This is based on biological criteria (aggregative properties) consistent with the identification of structure-forming habitats (FAO, 2016). This requires a level of organisation above the individual (i.e. uniqueness/rarity of individual species is not considered sufficient for categorisation as a VME). The main tool used to determine where significant concentrations occur is kernel density analysis which extrapolates point observations from research trawl survey data to estimate VME biomass and identify hotspots of VME taxa biomass (NAFO SC, 2013a). This highlights key areas that are likely to contain VMEs, although the extent of VME habitat, within which significant concentrations of VME indicator species occur, often extends spatially beyond the boundary of the area defined by "significant concentration" (Kenchington *et al*., 2014).

3.3.2 Protection measures for VMEs

A variety of measures are in place to protect VMEs in the NAFO Convention Area:

- The delineation of the existing bottom fishing footprint, outside of which any exploratory fishing must have an impact assessment and be approved (see section 7.4.3 for information);
- Closures of areas to protect VMEs (both inside and outside of existing bottom fishing areas);
- Encounter protocols for fishing in existing bottom fishing areas and for exploratory fishing.

Existing fishing footprint

Existing bottom fishing areas have been defined, based on data from 1987-2007 (FAO, 2016). Any exploratory fishing outside the existing bottom fishing areas requires a plan and assessment of potential impacts, submitted to NAFO for review and approval, and all exploratory fishing must carry an additional scientific observer (FAO, 2016). No formal applications to start an exploratory fishing using bottom-contact gears has been received (FAO, 2016).

Closed areas

A number of closed areas for bottom fishing have been implemented, starting in 2007 when four seamount areas were closed to bottom trawling as a precautionary measure (FAO, 2016). Extensive work was carried out over a number of years, including various research surveys, to develop a list of seven VME indicator groups and related species, and analysis to identify significant concentrations of VME species. Closed areas have been progressively implemented to protect these areas, with 21 closed areas to protect VMEs and other benthic habitats currently in place (EASME, 2018), 15 of which are wholly or partly within the existing fishing footprint (Figure 3).

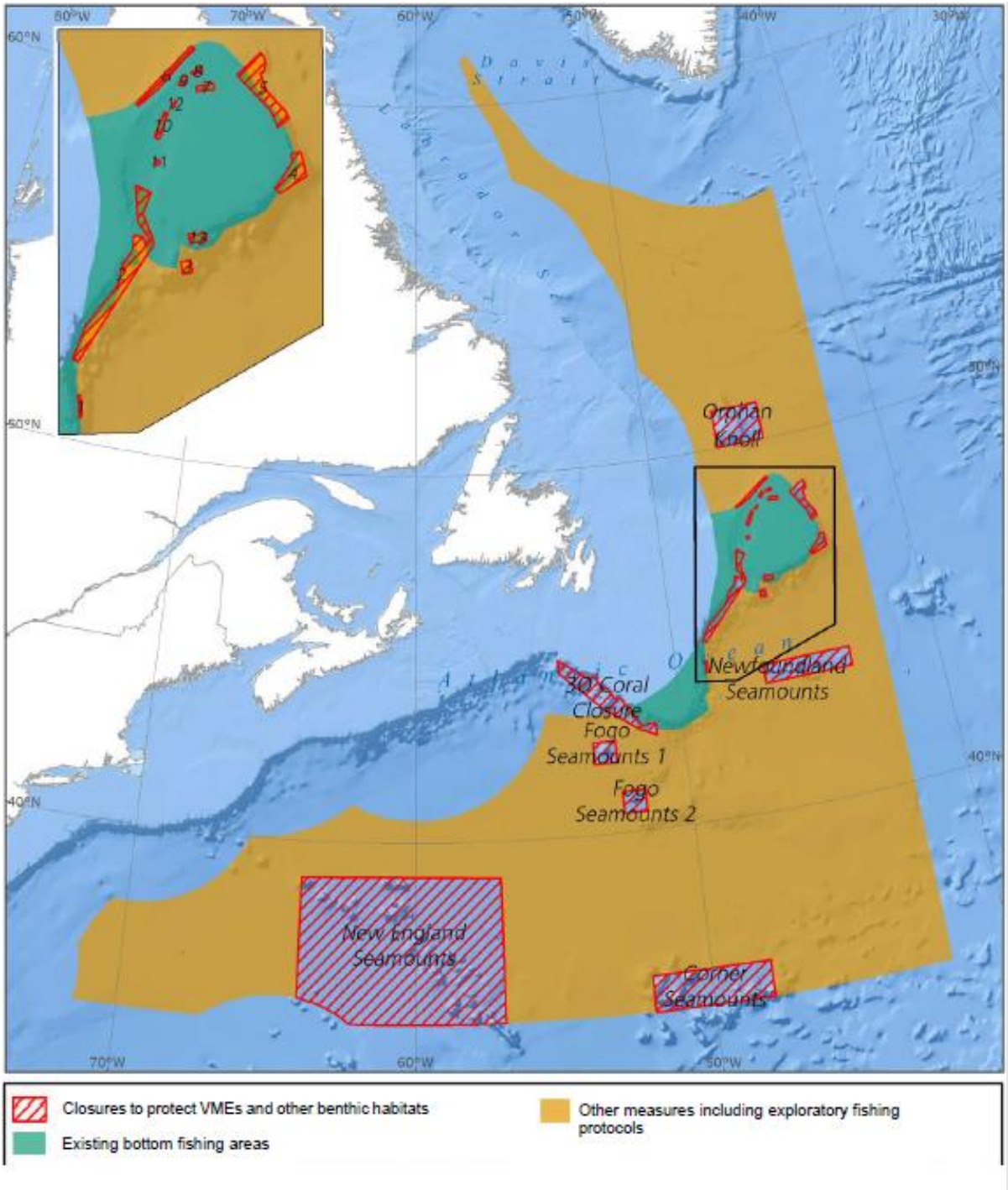


Figure 3. **Areas closed by NAFO to bottom fishing to avoid significant adverse impacts on VMEs and other benthic habitats. Encounter protocols apply throughout the NAFO Regulatory Area**

Source: FAO, 2016

Encounter protocols

An encounter protocol and move-on rule is in place. Catches above threshold levels (Table 5) must be reported, and vessels must move at least 2 nm from the endpoint of the tow/set in the direction least likely to result in further encounters according to the master's best judgement. In new fishing areas, this also results in a temporary closure of 2 nm radius. The Scientific Council then reviews whether the area consists of a VME, and whether conservation and management measures are necessary or is the temporary closure can be reopened.

The threshold levels have been reviewed each year and frequently modified since 2009, with thresholds being revised downwards (Table 5). The threshold levels have been scientifically determined using the known locations of the VME and their depth.

Commercial vessels are required to have an observer on board at all times except those with functional vessel monitoring systems (VMS) for sending electronic observer and catch reports which only require an observer 25% of the time. In practice, this derogation has not been used, as the long periods of time spent at sea make the 25% rule impractical (FAO, 2016).

No encounters above the threshold levels have been reported since they were introduced in 2009 (FAO, 2016). Given the various other protections in place (known locations of VMEs in the fishing footprint, and the location of fishing activity, closures of VMEs), this is not unexpected. The high level of observer coverage also indicates that the lack of reported encounters represents a true lack of encounters above the threshold levels, rather than underreporting, although it could also indicate the threshold levels are set too high.

It has been noted that scientifically-based encounter thresholds and move-on rules become very complicated when dealing with multiple VME types and fisheries which are prosecuted over relatively small areas. Notably, NAFO has the same threshold levels for all gear types (trawl, longline or gillnet), despite the differences in catchability between these gear types. In addition, different threshold levels may be appropriate for different VME types. For this reason NAFO has favoured closed areas within its fishing footprint and surrounding waters rather than relying on move-on rules (FAO, 2016).

Table 5. VME threshold levels in the NAFO area

Year	Gear/unit	Threshold
2009	Catch per set (e.g. trawl tow, long-line set or gill net set)	100 kg coral 1000 kg sponges
2010-2011	Catch per set (e.g. trawl tow, long-line set or gill net set)	60 kg coral 800 kg sponges
2012	Catch per set (e.g. trawl tow, long-line set or gill net set)	60 kg coral 400 kg sponges (new fishing area) 600 kg sponges (existing fishing area)
2013-2015	Catch per set (e.g. trawl tow, long-line set or gill net set)	60 kg of live coral 300 kg of sponges 7 kg of sea pens

3.3.3 Future direction and other issues

NAFO's Scientific Council, in June 2013, stated that:

"management through the closing of areas with significant concentrations of VME indicator species is the most effective measure for protecting VMEs in the NRA [NAFO Regulatory Area] and that the need to implement encounter protocols gradually becomes redundant as the locations of the benthic VMEs becomes increasingly well-defined. This avoids issues associated with the implementation of complex move-on rules"

NAFO SC, 2013b, VII.1.c.v

'Given the available sources of information, and the relatively small areas of the existing fishing footprint, it is probably reasonable to assert that the distribution of key VME indicator species is relatively well understood.' (EASME, 2018).

3.4 NEAFC

The North East Atlantic Fisheries Commission (NEAFC) is an RFMO with jurisdiction over the high seas areas of the North East Atlantic. It was established in 1959, and adopted a new Convention in 1982. In addition to fishery management measures for various fish stocks, and control measures to ensure that they are properly implemented, NEAFC also adopts measures to protect other parts of the marine ecosystem from potential negative impacts by fisheries.

NEAFC started to implement measures to address the possible adverse impacts of bottom fisheries for deep-sea species from 2005, when three deep-sea sites were closed to bottom trawling and fishing with static gear including gillnets and bottom longlines (Recommendation 05–2005). This was based on scientific advice from the International Council for the Exploration of the Sea (ICES) on probable and actual locations of vulnerable habitats. The Recommendation refers to 'vulnerable deep-water habitats' rather than VMEs specifically.

3.4.1 VME indicators and identification

NEAFC has defined VME indicators which include both habitat types with representative taxa and physical elements (Table 6). The list has been modified over the years – physical elements were not initially included, and sponges were only accepted by all Contracting Parties in 2010. In 2014, NEAFC amended their list and added sea pens and tube-dwelling anemone patches after ICES provided advice on the relevant families and habitat types which should be included based on the FAO criteria. ICES advised that in the NEAFC Regulatory Area, VME indicators should be considered by habitat type and/or at the taxonomic level of family rather than by an exhaustive list of all likely species that could be indicators of VMEs. This approach avoids the risk of excluding or misidentifying any potential species, while ensuring that VMEs are appropriately recognised. NEAFC has a recurring request for scientific advice from ICES regarding any new information on the occurrence of VMEs in the Regulatory Area. This has been based on survey information as well as observations and reports of VME indicators and habitats, and identification of areas where VMEs are likely to occur.

ICES provides scientific advice to NEAFC on measures for protecting VMEs, including closures and revisions of existing closures. This is based on information from the Working Group on Deep-Water Ecology (WGDEC) which collates new information, maps the locations of VMEs, and combines with information on bathymetry and fishing activity to assess the risk to VMEs (EASME, 2018). NEAFC generally follows the ICES advice, and a process is underway to review older advice which may not have

been put into action. ICES also provides advice on appropriate threshold levels for different gear types, which has resulted in the threshold levels being progressively reduced.
To identify VMEs, ICES either uses video survey data with high level spatial accuracy or, where data are more limited, uses a multi-criteria assessment method to evaluate how likely a given area of the seafloor represents a VME. This assessment scores each VME indicator group a number between 1-5 based on the number of FAO criteria it fits (ICES, 2019). Scoring was detailed in Morato *et al.* (2018) as:

- Rarity: was scored according to presence on the International Union for the Conservation of Nature (IUCN) red list, and if the indicator was known to be endemic, rare, threatened, or declining;
- Functionality: was scored by evaluating if the indicators were known to create nursery areas for other species, or known for having higher level ecosystem role, such as nutrient cycling and water filtration;
- Fragility: was scored according to the fragility of the indicator against physical contact, the height and complexity of its structure, and the capacity for retraction, retention or re-growth or if being naturally protected in some way;
- Life-history: was scored against the longevity, fecundity, age at maturity, growth rate, and known frequency of recruitment success; and,
- Structural complexity: was scored based on structural habitat created, frame-building, and presence of commensal or closely associated species.

A VME index is then generated based on the mean values of all the VME indicator taxa present in the area, ranking them for vulnerability against the FAO criteria and weighting them in terms of abundance. Areas are then scored in terms of data quality and confidence of how likely a VME exists in the given area (ICES, 2019).

Table 6. VME indicator species and elements adopted by NEAFC in 2014

VME habitat type	Representative taxa
Cold-water coral reef *Lophelia pertusa* reef *Solenosmilia variabilis* reef	 *Lophelia pertusa* *Solenosmilia variabilis*
Coral garden Hard-bottom garden Hard-bottom gorgonian and black coral gardens Colonial scleractinians on rocky outcrops Non-reefal scleractinian aggregations	 Anthothelidae, Chrysogorgiidae, Isididae, Keratoisidinae, Plexauridae, Acanthogorgiidae, Coralliidae, Paragorgiidae, Primnoidae, Schizopathidae *Lophelia pertusa*, *Solenosmilia variabilis* *Enallopsammia rostrate, Madrepora oculata*
Soft-bottom coral gardens Soft-bottom gorgonian and black coral gardens Cup-coral fields Cauliflower coral fields	 Chrysogorgiidae Caryophylliidae, Flabellidae Nephtheidae
Deep-sea sponge aggregations Other sponge aggregations Hard-bottom sponge gardens Glass sponge communities	 Geodiidae, Ancorinidae, Pachastrellidae Axinellidae, Mycalidae, Polymastiidae, Tetillidae Rossellidae, Pheronematidae
Sea pen fields	Anthoptilidae, Pennatulidae, Funiculinidae, Halipteridae, Kophobelemnidae, Protoptillidae, Umbelluidae, Vigulariidae

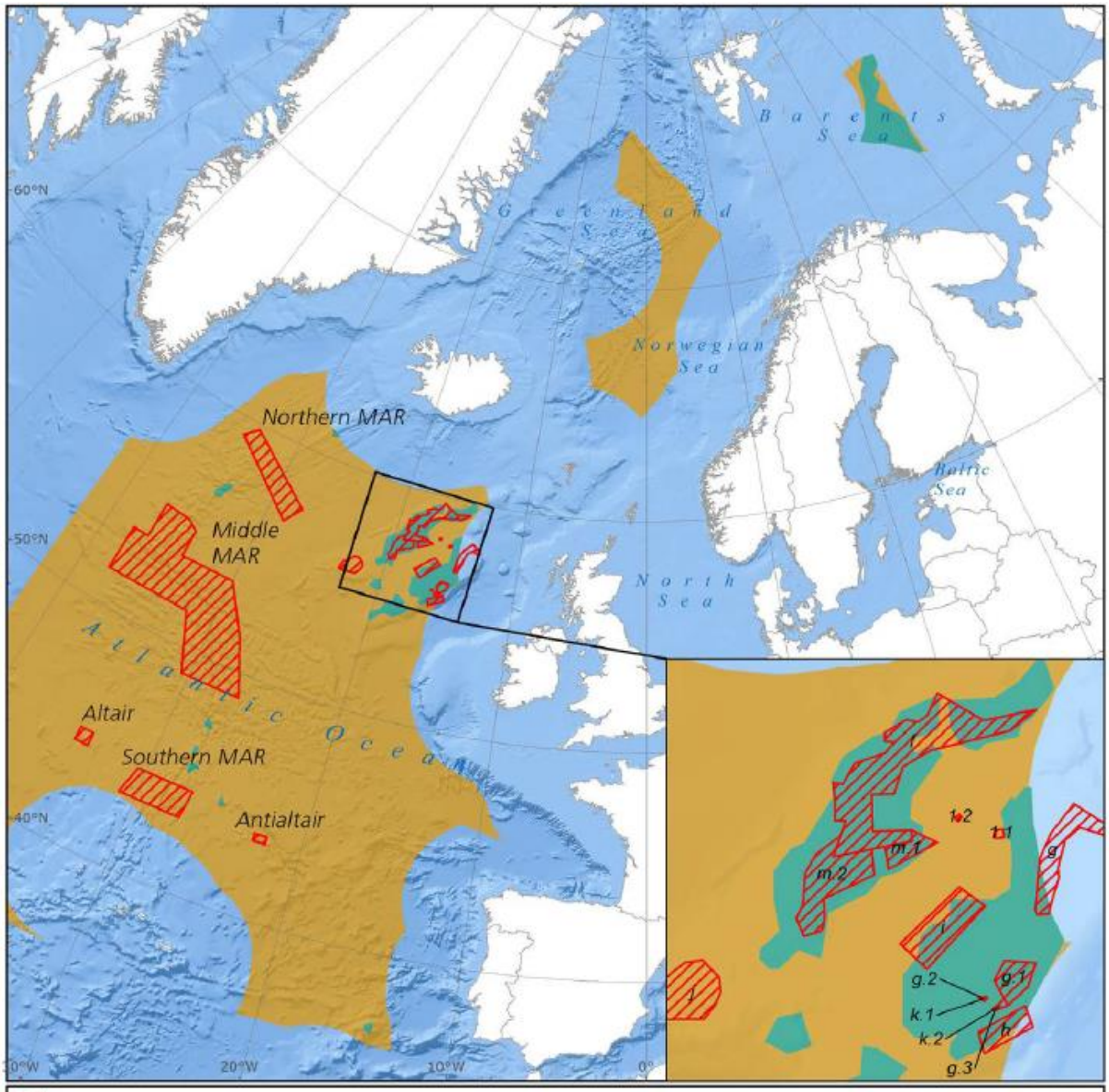
VME habitat type	Representative taxa
Tube-dwelling anemone patches	Cerianthidae
Mud- and sand-emergent fauna	Bourgetcrinidae, Antedontidae, Hyocrinidae, Xenophyophora, Syringamminidae
Bryozoan patches	
Physical elements	
Isolated seamounts	Non-Mid-Atlantic Ridge seamounts
Steep sloped and peaks on mid-ocean ridges	Steep ridges and peaks support coral gardens and other VME species in high density
Knolls	A topographic feature that rises less than 1,000 m from the sea floor
Canyon-like features	A steep-sided "catchment" feature not necessarily associated with a shelf, island or bank margin
Steep flanks >6.4°	Submerged edges and steep slopes support coral and sponge communities (Murillo *et al*., 2011)

3.4.2 Protection measures for VMEs

Measures to protect VMEs are specified in Recommendation 19:2014 (as amended by Recommendation 09:2015 and Recommendation 10:2018) (NEAFC, 2014). VMEs are defined according to paragraphs 42 and 43 of the FAO Guidelines. The dominant VME habitat types are cold water coral reefs, coral gardens and deep-sea sponge aggregations (ICES, 2013), which occur in depths of 450-2000 m (Convention on Biological Diversity (CBD), 2012). The dominant physical elements are seamounts, steep-slopes and peaks, canyons and steep flanks and knolls.

A variety of measures are in place to protect VMEs (NEAFC, 2020):

- The delineation of existing bottom fishing areas;
- Any exploratory fishing outside of existing bottom fishing areas must have an impact assessment and be approved;
- Closures of areas to protect VMEs (both inside and outside of existing bottom fishing areas);
- Encounter protocols for fishing in existing bottom fishing areas and for exploratory fishing;
- Prohibition of the deployment of gillnets, entangling nets and trammel nets in depths greater than 200 m (Recommendation 3/2006).



Hatton Bank 1	f	South-West Rockall Area 3	g.3
North west Rockall	g	South-West Rockall Bank Area 1	k.1
Logachev Mounds	h	South-West Rockall Bank Area 2	k.2

West Rockall Mounds	i	Hatton-Rockall Basin Area 1	l.1
Edora's bank	j	Hatton-Rockall Basin Area 2	l.2
South-West Rockall (Empress of Britain Bank) Area 1	g.1	Hatton Bank 2 Area 1	m.1
South-West Rockall Area 2	g.2	Hatton Bank 2 Area 2	m.2

Figure 4. Spatial management measures adopted by NEAFC in 2015 for the protection of VMEs. Encounter protocols apply throughout the NEAFC Regulatory Area

Source: FAO, 2016

Existing bottom fishing areas

Existing bottom fishing areas were compiled from VMS records from 1987-2007 and have been improved and modified since. Commercial bottom fisheries are only allowed to take place in these areas, which represent around 2% of the total Regulatory Area, and are the areas where the best available scientific information indicates that there are unlikely to be significant adverse impacts by bottom fishing on VMEs.

Exploratory bottom fisheries

Exploratory bottom fisheries (outside the existing bottom fishing areas) must prepare a harvesting plan, mitigation plan, catch-monitoring plan and data collection plan, as well as a preliminary assessment of/ the known and anticipated impacts (including on VMEs). These are submitted to the Contracting Parties and the Permanent Committee on Management and Science (PECMAS) for review. Exploratory fishing can only commence if approved. Vessels involved in exploratory fisheries must carry an observer, and data must be collected on a fine spatial scale (preferably by tows or sets) and to use additional technology (e.g. seabed mapping equipment or cameras on the gear) to identify where VMEs do, or are likely to, occur (NEAFC, 2020). To date, there have not been any requests for exploratory bottom fishing since the protocol entered into force in 2009 (NEAFC, 2020).

Closures of areas to protect VMEs

Closures have been progressively implemented to protect VMEs. This started in 2005 with five closures (Altair Seamount, Antialtair Seamount, Hecate Seamount, Faraday Seamount and Reykjanes Ridge) and now stands at 22 closures covering areas both within and outside existing bottom fishing areas and including large areas on the mid-Atlantic ridge (Figure 4).

NEAFC has followed scientific advice from ICES in these closures, and has now closed the areas where the best available scientific information indicates that VMEs occur or are likely to occur. Therefore, NEAFC concludes that no bottom fisheries should be taking place that will result in significant adverse impacts to VMEs (NEAFC, 2020).

Encounter protocols

Within the existing bottom fishing areas, encounter protocols are in place. Any encounters above the threshold levels (Table 7) must be reported, and a temporary closure is implemented (for bottom trawls, 2 nm on each side of the trawl track, for other gears a 2 nm radius around the location). Seabed mapping should be carried out and information submitted to ICES for evaluation and advice, which may lead to a longer-term closure being implemented if the area is found to have or is likely to have a VME.
Threshold levels have been revised downwards over the years, based on scientific advice from ICES.

No encounters above threshold levels have been reported (NEAFC, 2020), therefore, it is likely the encounter protocols have never been triggered. This is likely to be due to the fact that the areas in which bottom fisheries take place have been fished for decades, fishing effort has declined in recent decades, any areas that contain or are likely to contain VMEs have been closed to fishing, and an enhanced awareness and capability of vessels to avoid VMEs (ICES, 2012). However, vessels are not required to carry an observer on board, so there is a possibility that encounters above threshold levels are not reported (EASME, 2018). Nevertheless, it should be noted that some encounters below threshold levels have been reported by Contracting Parties to ICES for incorporation in the ICES VME database.

In 2012, ICES advised that the existing move-on rule (moving at least 2 nm from the position of the encounter) is not appropriate for new fishing areas, as it has the potential to increase the likelihood of significant adverse impacts (due to the risk of accidentally hitting large and perhaps pristine areas that may be identified as VMEs will be higher in unfished areas than in existing fishing areas). This could lead to cumulative negative impacts. ICES advised that survey information is required for estimating likelihoods of VMEs in new fishing areas. Furthermore, move-on rules are not appropriate for steep slope and seamount areas, where moving a short distance is unlikely to result in lowering the probability of encountering another patch of VME indicator species (ICES, 2012).

Table 7. VME indicator species encounter threshold levels in the NEAFC Regulatory Area

Year	Unit	VME indicator	Measure
2008	Catch	Evidence of VMEs	
2009	Catch per set[1]	Corals: 100 kg live; Sponges: [1000 kg live[2]]	Rec. 11/2009
2010-2012	Catch per set	Corals: 60 kg live; Sponges: 800 kg live	Rec. 11/2010
2013	Catch per set	Corals: 30 kg live; Sponges: 400 kg live	Rec. 12/2013
2014-	Trawl tow, other gears	Corals: 30 kg live; Sponges: 400 kg live	Rec. 19/2014
	Longline set	Presence on 10 hooks per 1000 hooks or per 1200 m line, whichever is shorter	
1 'Set' defined as trawl tow, longline set, or gillnet set 2 Not accepted by all Contracting Parties			

Gear restrictions

There is a prohibition on the use of gillnets, entangling nets and trammel nets in waters greater than 200 m depth, which also serves to protect VME habitats from potential impacts from net fishing, as these habitats usually occur in deeper waters.

3.4.3 Future direction and other issues

A review by NEAFC in 2019 concluded that Recommendation 19:2014 was effective in its aim to protect VMEs as well as areas outside defined fishing areas from bottom fisheries. It found that NEAFC has been advised effectively on area closures to protect VMEs, and has closed most of the areas advised. Compliance with the closed areas was found to have been effective (NEAFC, 2020). The restriction of bottom fishing to limited areas (2% of the Regulatory Area) in which bottom fishing has historically operated, combined with closures to protect known or likely VMEs, and additional encounter protocols, provides effective protection of VMEs. The encounter protocol appears to be the least important of these, given that effective protection measures are in place and no reports of encounters above the threshold levels have been made, although there is a lack of observers onboard vessels to verify this.

3.5 NPFC

The North Pacific Fisheries Commission (NPFC) is the primary deep-seas fisheries regional body in the North Pacific Ocean, north of 10° N. Inter-governmental negotiations of the NPFC Convention started in started in 2006 with Convention text adopted in 2012 before it was entered into force in 2015 (FAO, 2016). NPFC has eight Members: Canada, China, Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, the United States of America and Vanuatu.

The objective of the Convention (Article 2) is "to ensure the long-term conservation and sustainable use of the fisheries resources in the Convention Area while protecting the marine ecosystems of the North Pacific Ocean in which these resources occur."

3.5.1 VME indicators and identification

NPFC define VMEs following the five criteria in the FAO guidelines on uniqueness or rarity, functional significance, fragility, life-history traits and structural complexity. Example species groups, communities and habitat forming species are documented in CMM2019-05 Annex 2.1 (NPFC, 2019), this includes cold-water corals, sponge dominated communities, dense emergent fauna where large sessile protozoans and invertebrates form an important structural component, and seep and vent communities

(Table 8). Physical features include submerged edges and slopes, summits and flanks of seamounts, guyots, banks, knolls and hills, canyons and trenches, hydrothermal vents and cold seeps.

Table 8. Examples of potential VME species groups, habitats and features identified by NPFC

Habitat type or physical feature	Example taxa
a. Cold-water corals	Reef builders and coral forest including stony corals (scleractinia), alcyonaceans, gorgnians (octocorallia), black corals (antipatharia) and hydrocorals
b. Sponge dominated communities	-
c. Communities of dense emergent fauna which form an important structural component of the habitat	Large sessile protozoans (xenophyophores) and invertebrates (e.g. hydroids and bryozoans)
d. Seep and vent communities comprised of endemic invertebrate and microbial species	-

3.5.2 Protection measures for VMEs

Prior to the adoption of the Convention in 2015, voluntary interim measures were in place from 2007 (reviewed and revised annually) to limit fishing effort in bottom fisheries to the existing levels and prohibit bottom fisheries from expanding into areas in the north-western Pacific Ocean where fishing was not currently occurring. Binding measures based on the interim measures came into force in 2016.

A variety of measures are in place to protect VMEs in the NPFC area:

- The delineation of existing bottom fishing areas;
- Any exploratory fishing outside of existing bottom fishing areas must have an impact assessment and be approved;
- Closures of areas to protect VMEs (within existing bottom fishing areas);
- Encounter protocols for fishing in existing bottom fishing areas and for exploratory fishing;
- Prohibition of bottom fishing below 1,500 m and gillnets must be set with the footrope at least 70 cm above the sea floor in the western area only.

Existing fishing footprint

The existing fishing footprint covers 38.8% of the fishable Convention Area, and 12% of fishable seamounts (Fuller *et al.*, 2020). Areas where only static bottom gear is permitted accounts for 2.2% of the fishable area. CMM 2017-05 states an observer must be present on 100% of bottom fishing vessels in the western area (NPFC, 2017a). Bottom fishing effort on the eastern part of the Convention Area is to be limited to the historical average, once determined by the Scientific Committee (NPFC, 2017b).

Closed areas

Precautionary closures have been in place since 2016 (but were voluntary since 2009), specifically around seamounts where bottom fishing with trawl gear is prohibited. These closures exist around the C-H seamount and south-eastern part of Koko seamount, for VME conservation. Fishing in these areas requires exploratory fishery protocol to be submitted for review (NPFC, 2019). These closures account

for 0.5% of the fishable NPFC area (Fuller *et al.*, 2020). There are no closures in the north-eastern Pacific Ocean (NPFC, 2019). There have been no new closures since 2016.

Exploratory bottom fisheries

Exploratory fishing areas account for 58.5% of the fishable Convention Area and 86.7% of fishable seamounts (Fuller *et al.*, 2020). Since 2009, Members planning bottom fishing activities in new areas (where fishing is currently prohibited in a precautionary manner), or areas where bottom gear has not been previously used, have to follow an exploratory fisheries protocol. The Member of the Commission must submit an impact assessment for review by the Scientific Committee. The Scientific Committee reviews the proposal in accordance with the "Science-based standard and criteria" (Annex 2) which determines the scale of and significance of an impact by considering:

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

Using the best information available, exploratory fisheries are only permitted where the assessment concludes activities will not have a significant adverse impact on marine species or any VMEs (NPFC, 2019). Observers must be present on all exploratory bottom fishing vessels in the western and eastern Convention Areas.

Encounter protocols

In 2016, an encounter protocol came into force is in place when bottom fishing in the existing fishing footprint (Table 9). In any one gear retrieval where 50 kg of cold-water corals are encountered, the Member must cease bottom fishing and move 2 nm from the gear retrieval location. The move-on distance was decreased to 2 nm from 5 nm in 2017. The encounter must be reported to the Secretariat as soon as possible. The Commission will take appropriate action at the location of the encounter, however, there is no mention of temporary closures around the area prior to assessment by the Scientific Commission. Fuller *et al.* (2020) reported that this move-on rule has not been triggered.

Table 9. VME encounter threshold for the NPFC Convention Area

Gear type	Fishing area	Threshold	Taxa	Measure
All gear types	Existing fishing area	50 kg of live cold-water coral	Alcyonacea, Antipatharia, Gorgonacea, and Scleractinia	CMM 2017-05

3.5.3 Future direction and other issues

Unlike other RFMOs which have a broad set of encounter thresholds, NPFC have listed a range of VME indicator taxa but only apply the move-on protocol for cold-water corals. Unlike other RFMOs, NPFC currently has no designated post-encounter treatment except reporting.

3.6 SEAFO

The South East Atlantic Fisheries Organisation (SEAFO) manages fisheries resources in the high seas of the southeast Atlantic. SEAFO was established in 1995 and the SEAFO Convention was entered into force in 2003. The Convention Area includes the Mid-Atlantic Ridge which runs through the entire SEAFO area. There are currently seven contracting parties within SEAFO.

3.6.1 VME indicators and identification

VMEs in the SEAFO area are defined following the criteria in the FAO guidelines on vulnerability, uniqueness, functional significance, fragility, life-history traits and structural complexity. In 2013, SEAFO provided a provisional list of VME indicator species which includes a range of different taxa (Table 10). Although no physical features have been formally identified as part of the VME criteria, the Scientific Committee have based closures on geological features (seamounts).

Table 10. List of VME indicator taxa in the SEAFO Convention Area

Species code	Phylum/Order/Family	Common name
PFR	Phylum Porifera	Sponges
GGW	Order Gorgonacea	Gorgonian corals
AZN	Family Anthoathecatae	Hydrocorals
CSS	Order Scleractinia	Stony corals
AQZ	Order Antipatharia	Black corals
ZOT	Order Zoantharia	Zoanthids
AJZ	Order Alcyonacea	Soft corals
NTW	Order Pennatulacea	Sea Pens
BNZ	Phylum Bryozoa	Erect byrozoans
CWD	Class Crinoidea	Sea lilies
OWP	Class Ophiuroidea	Basket stars
SZS	Family Serpulidae	Annelida
SSX	Family Ascidiacea	Sea squirts

3.6.2 Protection measures for VMEs

A variety of measures are in place to protect VMEs in the SEAFO area:

- Any exploratory fishing outside of existing bottom fishing areas must have an impact assessment and be approved;
- Encounter protocols for fishing in existing and exploratory bottom fishing areas;

Existing fishing footprint

SEAFO defined existing bottom fishing areas based on activities between 1987 and 2011. The existing bottom fishing area is not subject to any gear restrictions. Any bottom fishing outside of the existing fishing areas is considered 'exploratory' (see below). It is compulsory for all vessels fishing in the SEAFO Convention area to carry an observer.

Closed areas

There are 12 precautionary VME closures in the SEAFO Convention Area, accounting for 16% of the fishable area (SEAFO, 2015, Fuller *et al*., 2020). All fishing gear is prohibited in these areas except for on the South Valdivia Bank where pots and longlines are permitted.

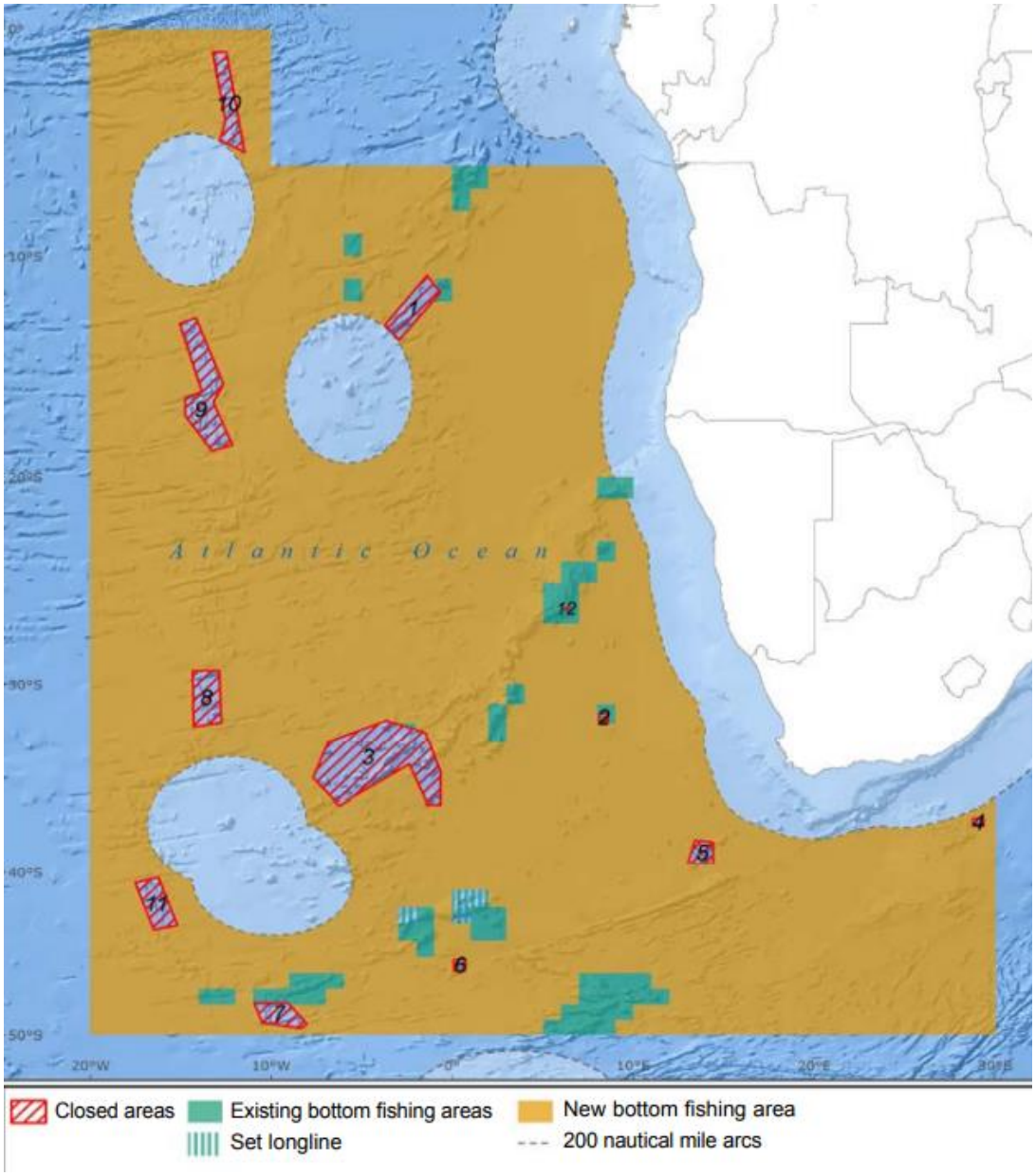


Figure 5. Map of the SEAFO Convention Area showing the existing bottom fishing areas, exploratory ('new') bottom fishing areas and the 12 areas closed to bottom fishing activities

Source: FAO, 2016.

Exploratory bottom fisheries

In 2015, the Scientific Committee adopted procedures in CM 30-15 to consider proposals for exploratory fishing (SEAFO, 2015). Any areas outside of the existing fishing areas are considered exploratory fisheries and are subject to the Exploratory Bottom Fisheries Protocol. An assessment is carried out by the

Contracting Parties and reviewed by the Scientific Committee before the undertaking of exploratory bottom fishing. The assessment must include measures to prevent significant adverse impacts on VMEs and a data collection plan for facilitate the identification of VMEs.

Encounter protocols

Encounters with VMEs trigger a move-on rule when the threshold have been exceeded for live corals and sponges (Table 11). Thresholds are split between trawls and longlines and/or pots with the approach for longlines and pots being adopted from the CCAMLR approach. For trawls, SEAFO have implemented lower sponge thresholds in exploratory bottom fishing areas compared to existing fishing areas. There is no evidence that the lower threshold would reduce the impact of bottom fishing activities on potential VMEs in exploratory areas.

If the thresholds are met, trawling vessels must move at least 2 nm from the end point of the tow in the direction least likely to result in further encounters and define a 2 nm radius. For other gear, the vessel must move at least 1 nm from the position closest to the encounter location and define a 1 nm radius. The Flag State and Secretariat must be notified immediately, and a temporary closure is implemented.

Table 11. VME encounter threshold levels for the SEAFO Convention Area

Gear type	Fishing area	Threshold	Measure
Trawl (per trawl tow)	Existing fishing area	60 kg live coral 600 kg live sponges	CM 30-15
	Exploratory area	60 kg live coral 400 kg live sponges	CM 30-15
Longline (per line segment of 1000 hooks or 1,200 m length)	Existing or exploratory area	10 units of taxa (1 unit = 1 kg or 1 litre of live coral or sponge)	CM 30-15
Pots (in one 1,200 m section of line)	Existing or exploratory area	10 units of taxa (1 unit = 1 kg or 1 litre of live coral or sponge)	CM 30-15

As observers are required on 100% of vessels, there is information on below-threshold encounters of VME organisms. Based on data between 2010 and 2017, there have been catches of VME indicator species within existing bottom fishing areas but none above the thresholds (SEAFO, 2018).

3.6.3 Future direction and other issues

The SEAFO Scientific Committee recommended that the Shannon and Discovery seamounts require precautionary action in the form of closures due to the presence of VME indicators (SEAFO, 2019). The Commission has yet to close these areas in line with recommendations.

3.7 SIOFA

The Southern Indian Ocean Fisheries Agreement (SIOFA) area covers the southern two-thirds of the Indian Ocean between Africa and Australia. It is bound by CCAMLR to the south, SEAFO to the west and SPRFMO to the east. It excludes the Arabian Sea, the Gulf, the Bay of Bengal and the northeast Indian Ocean. SIOFA was established in 2006 and entered into force in 2012. It consists of 10 parties: Australia, China, Cook Islands, the European Union, France (on behalf of its Indian Ocean Territories), Japan, the Republic of Korea, Mauritius, Seychelles and Chinese Taipei.

SIOFA adopted its first measure for the protection of VMEs from bottom fishing in CMM 2016-01 in 2016.

3.7.1 VME indicators and identification

SIOFA define VMEs using the criteria in the FAO guidelines on vulnerability, uniqueness, functional significance, fragility, life-history traits and structural complexity (CMM 2018/01). In 2019, SIOFA adopted a list of VME indicator taxa that is based on the list developed by CCAMLR (Cryer & Soeffker, 2019). These listed in Annex 1 CMM 2019/01 and include a wide range of taxa (Table 12).

Table 12. List of VME indicator taxa for the SIOFA area

Phylum/Order/Family	Common name
Phylum Porifera	Sponges
Phylum Bryozoa	Erect byrozoans
Class Crinoidea	Sea lilies
Class Ophiuroidea	Brittle stars
Family Serpulidae	Annelida
Family Ascidiacea	Sea squirts
Phylum Brachiopoda	Lamp shells
Pterobranchia	Tube worms
Phylum Xenophyophora	Foraminiferans
Phylum Bathylasmatidae	Acorn barnacles
Order Euryalida	Basket stars
Order Cidaroida	Sea urchins

3.7.2 Protection measures for VMEs

A variety of measures are in place to protect VMEs in the SIOFA area:

- Impact assessment for fishing in exploratory areas;
- Closures of areas to protect VMEs;
- Encounter protocols for fishing in existing bottom fishing areas and for exploratory fishing;

When the Scientific Committee is proposing a local area for VME designation, the proposal should clearly demonstrate which criteria were met. This is based on the triggering of encounter protocols from exceeding threshold levels, habitat suitability models or direct/confirmed evidence of VME presence (for example from surveys and camera deployments) (SIOFA, 2019a).

Existing bottom fishing areas

SIOFA have called upon the Scientific Committee to develop a bottom fishing footprint based on historic catch and effort data from 2000–2015 provided by the Contacting Parties (CMM 2018/02) (SIOFA, 2018, 2019). Fishing is currently not restricted to a bottom footprint. Observers are required on 100% of vessels using trawl gear and 20% for any other fishing gear.

Closed areas

Five areas have been provisionally designated as protected areas, where bottom fishing (excluding longline and pot activities) is prohibited (SIOFA, 2018 - Annex 2).

A number of voluntary closures, implemented by the fishing industry, are also in place. In 2006 (prior to the inauguration of SIOFA), the main deep-sea fishing operators established the Southern Indian Ocean Deepsea Fishers Association (SIODFA) and voluntarily designated eleven individual sites in deep waters as Benthic Protected Areas. Additional sites within more orthodox fishing grounds were designated as Benthic Protected Areas in 2013 (reviewed by Caddell, 2020).

Exploratory bottom fisheries

A bottom fishing impact assessment is required to assessment by the Scientific Committee for fishing in exploratory areas, fishing with different gear types or above existing fishing levels. This must be submitted at least 30 days prior to the bottom fishing activity. Advice provided by the Scientific Committee informs the decision by the Commission.

Encounter protocols

An encounter protocol and move-on rules are in place. On an encounter above the threshold levels (Table 13), a trawl vessel must move at least 2 nm from the trawl track, extended by 2 nm at each end. Longline and trap vessels must move at least a 1 nm radius from the mid-point of the line segment that triggered the encounter. Any other bottom fishing gear must move at least 1 nm from the mid-point of the operation. Although move-on rules are in place which cover several gear types, the threshold levels are only specified for trawl and longline gear (SIOFA, 2019b).

Encounters above the threshold levels must be reported to the Secretariat. The Scientific Committee reviews all encounters along with any other benthic bycatch data to provide advice on whether the encounter area should remain closed to all or some gears, or whether fishing activities may resume.

Table 13. VME threshold levels in the SIOFA area

Gear	Threshold	Measure
Trawl (per trawl tow)	60 kg live coral 300 kg live sponges	Art 12, CMM 2019-01
Longline (per line segment of 1000 hooks or 1,200 m length)	10 units of taxa in the VME indicator taxa list (1 unit = 1 kg or 1 litre of VME indicator organisms)	Art 12, CMM 2019-01

3.7.3 Future direction and other issues

The need to establish a bottom footprint has been recognised in SIOFA's first conservation measures in 2016, however, this is still ongoing.

3.8 SPRFMO

The South Pacific Regional Fisheries Management Organisation (SPRFMO) manages fisheries in the high seas of the South Pacific Ocean, a small area of the North Pacific Ocean and the easternmost part of the Indian Ocean. SPRFMO was an interim body between 2006-2011 and was officially established in 2012 after the 2009 Convention on the Conservation and Management of High Seas Fisheries Resources in the South Pacific Ocean. Currently, SPRFMO consists of 15 members with invitations to non-contracting Parties with fishing interests in the Convention Area.

In 2014, the Commission adopted Conservation and Management Measure (CMM) 03 for the management of bottom fishing in the SPRFMO Convention Area, defining VMEs using paragraph 42 and 43 of the FAO 2009 guidelines. Since then, SPRFMO have implemented and measures annually with the most recent measures covered in CMM 03-2021.

3.8.1 VME indicators and identification

SPRFMO have a range of VME indicator taxa which are used for the identification of a VME (Table 14). This list is from Parker *et al.*, (2009) who selected vulnerable groups or indicator taxa in the SPRFMO Convention area, based on the FAO criteria for vulnerability, uniqueness, functional significance, fragility, life-history traits and structural complexity (FAO, 2016). These taxa are any groups identified specifically by FAO, and groups known to be associated with hard substrata in deep water, such as armless stars (Penney *et al.*, 2014).

Habitat suitability modelling has been used to map the potential distributions of VME indicator taxa. These maps underpin their spatial management measures and when new observational data are available, the models are reviewed (SPRFMO, 2019a).

Table 14. Taxonomic groups assessed as vulnerable to bottom trawl fishing in the South Pacific Ocean

Indicator type	Taxonomic level	Common name
Vulnerable taxa	Phylum Porifera	Sponges
	Phylum Cnidaria	
	Class Anthozoa	Anemones
	Order Actiniaria	Soft corals
	Order Alcyonacea	Sea fans
	Order Gorgonacea	Sea pens
	Order Pennatulacea	Stony corals
	Order Scleractinia	Black corals
	Order Antipatharia	
	Class Hydrozoa	
	Order Anthoathecatae	Hydrocorals
	Family Stylasteridae	
Habitat indicator	Phylum Echinodermata	
	Class Crinoidea	Sea lilies
	Class Asteroidea	
	Order Brisingida	Armless stars

Source: Parker *et al.*, 2009.

3.8.2 Protection measures for VMEs

A variety of measures are in place to protect VMEs in the SPRFMO area:

- The delineation of existing bottom fishing areas;
- Any exploratory fishing outside of existing bottom fishing areas must have an impact assessment and be approved;
- Encounter protocols for fishing in existing bottom fishing areas, including a "biodiversity encounter threshold";
- Prohibition of the deployment of gillnets, including deep water gillnets were banned in the Convention Area.

Existing bottom fishing areas

Fishing has been restricted to the bottom fishing footprint since 2014 for all Members and Cooperating non-Contracting Parties (CNCP), based on areas of historical bottom fishing in the Convention Area between the period of 2002–2006 (SPRFMO, 2018). The great majority of the Convention Area is currently closed to bottom trawling, with less than 1% of the SPRFMO area open to bottom fishing activities. Notably, SPRFMO's definition of bottom trawling includes mid-water trawling on seamounts, due to the potential for contact with seabed features even at a more elevated depth (Caddell, 2020).

To underly their spatial management approach, SPRFMO have used habitat suitability models to propose areas likely to support VMEs (Georgian *et al*., 2019; SPRFMO, 2019b).

Observers are mandatory on 100% of vessels using trawl gear, and other bottom fishing gear types require at least 10% coverage each year (SPRFMO, 2014). These minimum observer levels have not changed since 2014 (SPRFMO, 2021b)

Closed areas

There are no designated VMEs or associated closures, however, SPRFMO note that all areas outside the defined fishing areas are essentially closed to protect VMEs (SPRFMO 2019c).

Exploratory bottom fisheries

Members or CNCP can apply to the commission to undertake bottom fishing outside of the fishing footprint. Exploratory areas consist of 75.1% of the fishable area and 94.7% of fishable seamounts (Fuller *et al*., 2020). An assessment of the potential impacts is required, taking into account areas where VMEs are known or suspected to occur in the area using habitat suitability models. Assessments are reviewed by the Scientific Committee and Commission. The Commission has recently established Management Areas where bottom fishing in the Convention area can occur after a proposal by the Member or CNCP (SPRFMO 2021).

Encounter protocols

Up until 2019, interim measures to protect VME through encounters and move-on rules areas were predominately voluntary (FAO, 2016). Advice developed for the Commission by the Scientific Committee in 2017 and 2018 led to the implementation of VME indicator taxa thresholds which trigger move-on rules in 2019 (SPRFMO 2019b). All habitat suitability models have associated uncertainty (e.g. models may overestimate or underestimate the conservation value of areas), therefore, SPRFMO have used move-on rules to provide rapid responses to unexpectedly large benthic bycatch events (Geange *et al*., 2020).

The original encounter thresholds were based on the validated thresholds from Parker *et al*. (2009) which used the 50th percentile of weight from historic observer trawl data to establish an encounter with a VME. Parker *et al*. (2009) stated that whilst a biologically significant level of by-catch was unknown, the median can be used as a trigger for move-on rules. SPRFMO are also the only RFMO to have a "biodiversity threshold", as an increase in the range of indicator taxa increases the likelihood of a VME being present (Table 15). The single species encounter threshold has been revised since 2019 with thresholds levels for sponges, corals, sea fans and anemones being reduced (SPRFMO, 2021a).

Table 15. VME encounter thresholds in SPRFMO Convention Area (trawl gears)

Threshold type	Threshold	Measure
Single species limits	25 kg sponges 60 kg stony coral 5 kg black coral 15 kg sea fans 35 kg anemones 10 kg hexacorals	Annex 6A CMM 03-2021
Biodiversity (any 3 taxa above thresholds)	5 kg sponges 5 kg stony corals 5 kg anemones 1 kg black corals 1 kg soft corals 1 kg sea pens 1 kg hydrocorals 1 kg armless stars 1 kg sea lilies	Annex 6A CMM 03-2021

If a threshold is exceeded, vessels must cease bottom fishing immediately within 1 nm either side of the trawl track and 1 nm at each end. The encounter must be reported immediately to the Member State and the Secretariat. The Secretariat will record the location of the encounter area and notify all Member States within three working days that fishing in the encounter area is suspended.

The thresholds are set for towed gears only, on the basis that the estimated footprints of demersal line gears are orders of magnitude lower than those for demersal trawl gears and are thought to represent a low risk to VME status and habitat protection (SPRFMO, 2020).

SPRFMO have not yet designated any VMEs in the Convention Area, however, VMEs can be identified after an encounter of VME indicator taxa above threshold levels. The Scientific Committee reviews all encounters annually to determine if they were unexpected based on VME habitat suitability models. Advice on management actions must should include:

- Detailed analysis of the encounter from by Member;
- Historical fishing events within 5 nm of the encounter tow, including previous encounters and information on benthic bycatch;
- Habitat suitability model predictions of all VME indicator taxa;
- Details of relevant fishing activity;
- Any other information the Scientific Committee considers relevant.

There are no reports detailing encounter thresholds being exceeded in the SPRFMO area, although a notification of an encounter with a potential VME was received in late 2020, which has not yet been reviewed by the Scientific Committee (SPRFMO, *pers. comm.*). Prior to the use of encounter thresholds by SPRFMO, New Zealand and Australia implemented national encounter protocols. Both used a 5 nm move-on rule, however, New Zealand used encounter thresholds and a biodiversity threshold based on Parker *et al.* (2009), which were subsequently were incorporated into SPRFMO as mentioned above. The Australian encounter protocol was triggered if 50 kg of corals or 10 kg sponges were caught per 1,000 hook section or 1,200 m section of line (FAO, 2016). New Zealand reported that six move-on events were triggered out of 192 tow events between 2008-2013.

Gear restrictions

Gillnets, including deep water gillnets were banned in the Convention Area in 2013 in order to protect fishery resources, bycatch species and deep-sea habitats (SPRFMO, 2013).

3.8.3 Future direction and other issues

In 2019, the SPRFMO Scientific Committee recommended that spatial management measures are the best option to prevent significant adverse impacts on VMEs. In 2017, the Scientific Committee recognised that move-on rules should only be used to complement well-designed spatial closures. They concluded that move-on rules should act as a rapid response mechanism to unexpectedly high bycatch events outside of closed areas, therefore, threshold levels were set high (SPRFMO, 2017). Although SPRFMO have implemented these "high" threshold levels to complement their spatial management strategy, the thresholds are lower than most of those used by other RFMOs.

Catchability of VMEs within the SPRFMO Convention Area was assessed by Geange *et al.* (2019). These authors noted that there is an implicit assumption that the thresholds used to trigger move-on-rules have an ecologically relevant value but that the threshold values in use are not supported by any explicit demonstration of relationships between biomass or density of VME indicator taxa on the seafloor, the catch efficiency of bottom trawl gear, and the biomass of VME indicator taxa retained as bycatch on the deck of fishing vessels. Their analysis determined that the probability of VME indicator taxa being retained by a bottom trawl was variable but generally very low, with estimates of <1% for almost all taxa. Geange *et al.* (2020) then studied the effectiveness of using high encounter thresholds. In line with SPRFMO spatial management measures, high encounter thresholds were estimated based on the 80th and 90th percentiles using bycatch data from 9,771 New Zealand bottom trawls in the SPRFMO Convention Area. They found that high encounter thresholds would have only triggered a move-on event 53 times (<1%) for single species taxa, and only 13 times by the biodiversity thresholds. They argue that additional work is needed to develop ecologically meaningful encounter thresholds to support SPRFMO's spatial management measures. Since this report, SPRFMO have revised the encounter thresholds to lower limits (SPRFMO, 2021a).

SPRFMO is planning to review the move-on distances for potential VME encounters, based on the size and spatial clustering of VME indicator taxa distribution (SPRFMO, 2021c).

3.9 Summary

A summary of RFMO approaches to defining VMEs, existing fishing footprints, closed areas, use of encounter protocols and move-on rules is provided in Table 16. A more detailed summary is provided in Appendix A.

Most RFMOs use all five FAO criteria together to compile their lists of indicator species or taxa. They have also used the example VMEs as a basis for the development of VME species, such as corals and sponges, and/or physical feature indicators, for example sea mounts and hydrothermal vents. Some appear to just use the FAO defaults (e.g., SIOFA and SEAFO), while others had developed different criteria prior to the release of the FAO Guidelines (CCAMLR). All RFMOs use the 'VME' terminology in line with the UNGA resolutions and FAO Guidelines, which were directed primarily at areas beyond national jurisdiction.

The decision on whether a particular site or ecosystem constitutes a VME is made by the RFMO in question, and methods and approaches to identify VMEs differ between RFMOs. NAFO and SPRFMO have used models as a precautionary measure to identify areas where VMEs are likely to occur. Similarly, NEAFC follow ICES advice which is based on a VME weighting algorithm to determine the likelihood

(and confidence) of an area being a VME, based on scientific surveys, encounters and absence information. CCAMLR, NPFC and SEAFO have mostly designated VMEs based on the identification of physical topographical features, such as sea mounts, and scientific surveys. However, overall these RFMOs tend to rely on encounters of VME indicator taxa to identify pVMEs before being assessed by a Scientific Committee for VME designation. It is important to note that reports of encounter protocols being triggered are relatively rare (Table 16).

Table 16. Summary of RFMOs

RFMO	Use FAO criteria?	Defined indicator taxa?	Bottom fishing restricted to existing footprint	Spatial closures in place	Established thresholds for triggering move-on rules	Thresholds are gear-specific	Thresholds incorporate level of fishing effort	Has move-on rule in place	100% observer coverage	Any reports of encounters
CCAMLR	×	✓	✓	✓	✓	×	✓	✓	✓	✓
GFCM	✓	✓	×	✓	×	n/a	n/a	×	×	? [1]
NAFO	✓	✓	✓	✓	✓	×	×	✓	✓	×
NEAFC	✓	✓	✓	✓	✓	✓	✓(lines) ×(other)	✓	×	×
NPFC	✓	✓	✓	✓	✓	×	n/a	✓	✓	? [2]
SEAFO	✓	✓	✓	✓	✓	✓	✓(lines) ×(other)	✓	✓	✓ [3]
SIOFA	✓	✓	×	✓	✓	✓	✓(lines) ×(other)	✓	✓	n/a
SPRFMO	✓	✓	✓	×	✓	×	×	✓	✓ [4]	✓

1 Reporting only required since 2019
2 Not clear but reports of move on rule not triggered
3 Below threshold, move-on rule not triggered
4 100% on bottom trawl vessels, minimum 10% for other gears

Most RFMOs have implemented two main approaches to the protection of VMEs:

- Establish the existing fishing footprint, and any bottom fishing taking place outside of this area must be assessed and approved, and is subject to strict controls (e.g. observer coverage to record encounters with VME indicator species);
- Area closures where bottom fishing is prohibited to protect VMEs.

Additionally, RFMOs seek to manage unexpected encounters with VMEs within existing fishing areas (and in exploratory fishing in new areas) through encounter thresholds and associated move-on rules (with the exception of GFCM, all RFMOs have established encounter thresholds and move-on rules). However, there are a number of issues with the implementation and enforcement of move-on rules (see section 6) and it is notable that reports of above-threshold encounters have generally only been made where there is 100% observer coverage (CCAMLR, SEAFO, SPRFMO). However, NAFO also has 100% observer coverage and there have been no reports of above-threshold encounters, suggesting that once VME distribution is well mapped and appropriate closures are in place, the need for move-on rules becomes redundant. Additionally, most RFMOs have had very few if any above-threshold encounters

reported, despite high levels of observer coverage This also raises the question of whether the thresholds are set at the right level, and whether they are an appropriate mechanism to manage impacts.

Threshold levels are sometimes the same for all gear types (e.g. NAFO, NPFC), despite different catchability between gears. However, some RFMOs now differentiate and set different threshold levels for different gear types (e.g. NEAFC, SIOFA, SEAFO). In addition, SEAFO has set different threshold levels for existing fishing areas and exploratory fishing areas, with a lower threshold for sponges in exploratory fishing areas.

A measure of effort is incorporated into specific longline thresholds (e.g. catch per 1000 hooks or per 1200 m line segment) (CCAMLR, NEAFC, SEAFO, SIOFA), but any quantification of effort or gear details beyond 'trawl tow' or 'gillnet set' is absent from other thresholds (NAFO, NPFC, and trawl thresholds in all areas). Tow duration, trawl size and configuration, including the use of bycatch excluder devices, will all affect the potential for retention of indicator species and for the thresholds to be met or exceeded, but despite the move-on rule concept being most evolved in the RFMOs, these aspects are not incorporated into thresholds.

The threshold levels are generally based on corals and sponges, and other taxa on the VME list are often not represented in the encounter thresholds, e.g. bryozoans, anemones. NPFC lists several VME indicators but only has a threshold for corals. However, some RFMOs are starting to broaden the threshold levels to other taxa — NAFO has also incorporated sea pens to the thresholds, SPRFMO has a wider range of taxa incorporated in its threshold levels, and SIOFA includes all the VME indicator taxa in its longline thresholds.

SPRFMO has developed 'biodiversity thresholds' which acknowledge that if three of more VME indicator taxa are encountered (at much lower threshold levels) then it may be indicative of a VME, and it triggers the move on rule.

There is a potential for cumulative impacts, where a threshold may not be breached but multiple vessels may catch VME indicator species in a particular area, which together would exceed the threshold. CCAMLR has a procedure of reporting 'possible' encounters (5 VME units rather than 10 on a line segment). If there are 5 possible encounters within a 0.5º latitude x 1º longitude rectangle, all fishing vessels are notified of a potential VME, but fishing may continue.

A review of RFMOs on the strategies adopted to manage deep-water fisheries and a particular focus upon measures to limit deleterious impacts upon sensitive benthic ecosystems found that the North Atlantic RFMOs (NEAFC and NAFO), and CCAMLR were the highest scoring organisations (EASME, 2018). The current review reinforces this, with the addition of SPRFMO which has recently implemented significant and forward-looking measures.

4 National Case Studies

4.1 Alaska

The North Pacific Fishery Management Council (NPFMC) is one of eight regional councils established by the Magnuson-Stevens Fishery Conservation and Management Act in 1976 to manage fisheries of the United States of America (US). NPFMC's jurisdiction covers 2,300,000 km^2 of the EEZ off Alaska and is primarily responsible for the groundfish management in the Gulf of Alaska, Bering Sea and Aleutian Islands.

The Aleutian Ridge is recognised as containing some of the world's most diverse and complex deep-sea coral and sponge ecosystems. Reports suggested that between 1990 and 2002, over two million kilograms of coral and sponge bycatch were recorded by observers around the Aleutian Island (Rieser *et al*., 2013). Since then, NPFMC has implemented management measures to protect these sensitive habitats.

4.1.1 Sensitive habitats

Sensitive benthic habitats in Alaska are protected under Fishery Management Plans developed by the NPFMC. For each fishery, Essential Fish Habitats (EFH) are identified and mapped to define the areas necessary for the spawning, breeding, feeding, and growth to maturity of target fish species. Fishery management plans for each EFH requires the identification of Habitat Areas of Particular Concern (HAPC). HAPCs must meet at least two of the following four criteria to be designated:

- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether, and to what extent, development activities are, or will be, stressing the habitat type; and,
- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced degradation;
- Whether, and to what extent, development activities will be stressing the habitat type; and

The rarity of the habitat type (rarity is a mandatory criterion for all Council HAPC proposals - NPFMC, 2010).

The Council calls for HAPC nominations through a proposal that focusses on specific sites consistent with the HAPC priorities. Proposed HAPCs are screened by the Council before being sent for scientific review which evaluate the proposals for ecological merit. After, a socioeconomic review of the proposals is made to identify potential new actions or measures which could be taken to address adverse effects and identify potentially affected fishing communities. All proposals are then reviewed for management and enforceability and ranked in terms of the HAPC's criteria and how much habitat-specific data are available (data certainty) for the HAPC. Proposals with high HAPC criteria scores but low data certainty may warrant consideration as a research priority.

4.1.2 Protection measures

Key protection measures in place to limit the impact of bottom fishing on HAPC are:

- area closures;
- frozen footprint; and
- observer coverage.

Area closures

In 2005, several habitat protection and conservation areas closed to bottom contact fishing (Figure 6). These areas include firstly, the Alaska Seamount Protection area, which encompasses all 16 seamounts in the Federal waters off Alaska, 15 of which are in the Gulf of Alaska. Secondly, the Gulf of Alaska Slope Habitat Conservation Areas which includes 10 areas thought to contain high relief bottom and coral communities. Thirdly, three sites with large aggregations of long-lived Primnoa coral, and lastly, five sites were designated under the Gulf of Alaska Coral Habitat Protection Area after submersible observations. In total, these areas cover approximately 7,500 nm² (NPFMC, *undated*).

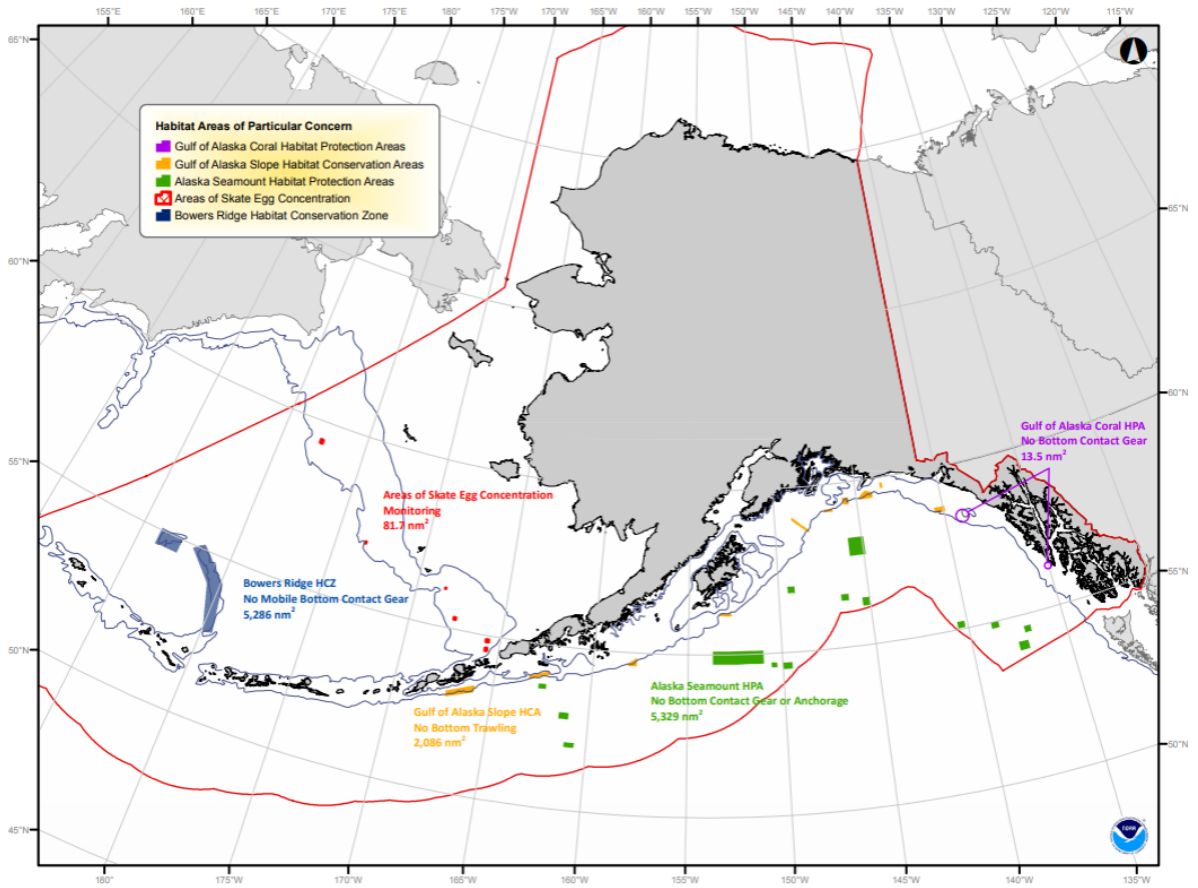


Figure 6. Map of the Habitat Areas of Particular Concern which have been closed to bottom contact gear

Source: NOAA, undated.

The Council closed several areas around the Aleutian Islands both to conserve EFH and to address concerns about the effect of bottom trawling on benthic habitats, specifically coral communities. Bottom trawling is prohibited in all areas expect in "small discrete areas", therefore over 95% of the management area is closed (277,100 nm²). In addition, six Habitat Conservation Zones with high coral and sponge

densities were closed. All vessels in the Aleutian management area are required to have VMS for monitoring and enforcement (NPFMC, *undated*) and fishing is restricted to its historical footprint.

The Northern Bering Sea Research Area was also closed as a precautionary measure to bottom contact gear with the objective for the Council to develop a research plan for data collection to provide a better understanding of the impacts of trawling on several species, including benthic and epibenthic fauna. This closure came into force before any commercial trawling was authorised (NPFMC, 2012).

Frozen footprint

In 2007, the Council adopted a precautionary frozen footprint approach to protect benthic fish habitat in the Bering Sea from bottom trawling by limiting trawl effort only to those areas more recently trawled. Once implemented in 2008, the new measures prohibited bottom trawling in a deep slope and basin area (47,000 nm^2), and three habitat conservation areas (NPFMC, *undated*). Bottom trawl fisheries in the Aleutian Islands are also restricted to a historical footprint, which represents around 5% of the area. If a fishery wants to fish in a new area, an exempted fishing permit would need to be applied for, which requires an assessment of whether corals might be present in an area. Any new fishing activity would require monitoring to ensure there are no encounters with corals.

Observer coverage

Both a full and partial observer program is in place when fishing in Alaska's EEZ. Whether a fishery must use full coverage depends on the target species and area of fishing. All catcher/processing vessels must have 100% observer coverage unless exempt based on a variety of gear or target fish species. The North Pacific Observer Program trains, debriefs and oversees more than 450 observers annually. Data are used to provide the scientific information to manage the fisheries and develop measures to minimise bycatch.

4.1.3 Future direction / other issues

The Council currently is in the process of amending the fishery management plans to more specifically identify EFH, and measures to further identify and protect HAPC which would allow for a more focused application of protection measures to the most sensitive habitat areas.

4.2 Canada

In 2010, Canada committed to the marine conservation targets established under the United Nations (UN) CBD, to conserve 10% of coastal and marine areas through managed networks of protected areas and other effective area-based conservation measures (OECMs) by 2020. In 2019, Canada surpassed the 10% target and set new targets of conserving 25% of marine and coastal areas by 2025 and 30% by 2030.

Tools to achieve these targets include protected areas (MPAs created under the Oceans Act, National Marine Conservation Areas, and marine portions of National Wildlife Areas, Migratory Bird Sanctuaries, National Parks, and provincial protected areas) and OECMs. To date, all areas that qualify as OECM have been fisheries area closures. Fisheries area closures that meet OECM criteria are known as marine refuges and are designed to protect important species and habitats, including unique corals and sponges, from fishing impacts.

A variety of commercial fish and shellfish species are targeted using mobile fishing gear that interact with the seabed including bottom trawls (for species including halibut, redfish, prawn and shrimp), dredges (for scallops) and mechanical dredges (for clams).

4.2.1 Sensitive habitats

The ecosystem considerations included in UNGA Resolution 61/105 and Canada's domestic practices are generally in alignment. Domestically, Canada has implemented the Sustainable Fisheries Framework (SFF) which aims to ensure fisheries are environmentally sustainable while supporting economic prosperity. A key component of the SFF is the Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas (SBAs) established in 2009 (DFO, 2009), which is aimed at addressing the requirements of UNGA Resolution 61/105. This Policy aids the management of fisheries to mitigate impacts of fishing on sensitive benthic areas and avoid impacts of fishing that are likely to cause serious or irreversible harm to sensitive marine habitats, communities, and species (DFO, 2010).

The first step towards establishing SBAs is to identify Significant Benthic Areas (SiBAs). A SiBA is defined as an ecologically and biologically significant habitat type, feature, community or species considered intrinsically sensitive to fishing impacts and slow to recover (e.g. coral and sponge dominated habitats[1]). These aspects of vulnerability (sensitivity and ability to recover) can be assessed through consideration of life history characteristics, recovery times, and other relevant factors (e.g. FAO Guidelines[2]).

The second step in establishing SBAs involves assessing exposure of SiBAs to fishing. The SiBAs, or portions thereof, that are likely to be exposed to proposed or ongoing fishing activities, are then considered SBAs (DFO, 2019). This is achieved through an Ecological risk assessment framework which was developed specifically for coldwater corals and sponge dominated communities.

The SBA policy requires the following key steps for i) marine ecosystem areas with a history of fishing and ii) 'frontier areas'[3] with no history of fishing in Canadian waters:

- Assemble and map existing data and information that would help determine the extent and location of benthic habitat types, features, communities and species; including whether the benthic features (communities, species and habitat) situated in areas where fishing activities are occurring or being proposed are important from an ecological and biological perspective;
- Assemble and map existing information and data on the fishing activity;
- Based on all available information, and using the Ecological Risk Analysis Framework[4] to assess the risk that the activity is likely to cause harm to the benthic habitat, communities and species, and particularly if such harm is likely to be serious or irreversible (analogous to the FAO definition of significant adverse impacts in section 2);
- Determine whether management measures are needed, and implement such management measures; and,
- Monitor and evaluate the effectiveness of the management measure and determine whether changes are required to the management measures following this evaluation.

1 DFO (2017) states " With respect to coldwater corals and/or sponges, a Significant Benthic Area is a regional habitat that contains sponges (Porifera), large and small gorgonian corals (Alcyonacea, formerly classed as Gorgonacea) and/or sea pens (Pennatulacea) as a dominant and defining features

2 DFO (2019 and references therein) states "The concepts of VMEs and SiBAs, in particular, are equivalent. This is driven by the common goal of VMEs and the SBA policy to manage impacts from fishing on vulnerable areas, and the fact that both were developed in response to the same UNGA resolution (2006 UNGA resolution 61/105); SiBAs are used as a first step in this process domestically, while VMEs are identified to protect areas from fishing in international waters."

3 Marine ecosystems deeper than 2000m or in the Arctic where there is no history of fishing and little if any information available concerning the benthic features (habitat, communities and species) and the impacts of fishing on these features

4 In 2010, the Ecological Risk Analysis Framework was developed which uses mapping and data collection to assess the risk of an activity to likely cause harm to the benthic habitat, communities and species, and whether harm is likely to be serious or irreversible. Areas identified as moderate to high risk, based on consequence and likelihood of impact, may or must include management measures that mitigate this risk.

Identification of SBAs in Canada's national waters has been undertaken through predictive habitat modelling using scientific survey or occurrence data, which has been used to predict species habitat preferences over wide geographical areas (e.g. Kenchington *et al*., 2016). These protection efforts also support the Department of Fisheries and Oceans Canada (DFO) Coral & Sponge Conservation Strategy for Eastern Canada, released in 2015[5].
DFO also identify Ecologically and Biologically Significant Areas (EBSA). The EBSA identification framework uses five selected criteria: uniqueness, aggregation, fitness consequence, resilience and naturalness of the area (DFO, 2009), with the latter two being used to prioritise amongst sites (Kenchington, 2014).

4.2.2 Protection measures

Fisheries and Ocean Canada (DFO) has the lead role in managing Canada's fisheries. Canada's Fisheries Act (1985), the Fishery (General) Regulations (1993) and Atlantic Fishery Regulations (1985), as well as the Oceans Act (1996) and the Species at Risk Act (2002) are the main pieces of federal legislation under which marine fisheries are managed. The powers granted via these Acts and Regulations permit the Minister of Fisheries and Oceans to specify licence conditions including those related to vessel type, gear, fishing restrictions, information reporting and vessel monitoring system, as well as to issue Variation Orders that outline fishing seasons and areas (Hiltz *et al*., 2018).

Canada has taken a number of steps to protect benthic ecosystems, primarily by restricting certain fishing practices and activities to eliminate, or limit as much as possible, the destruction of sensitive marine habitat and species. Measures used include:

- gear restrictions
- area closures
- encounter thresholds and move-on rules (voluntarily adopted in two domestic fisheries for compliance with MSC certification).

Area closures

Schram *et al.* (2019) reported that 51 fishery closure areas, known as marine refuges, have been created under the Fisheries Act. These areas cover collectively cover 275,000 km^2 of Canada's ocean area and protect important species and habitats including sensitive coral and sponge aggregations (i.e. closure areas are not limited to protecting sensitive benthic habitats).

The Canada Pacific multispecies groundfish fishery limited bottom fishing to a historical trawling footprint, creating a boundary outside of which trawling was prohibited. Overall, there has been high compliance, with only four boundary infractions over 21,925 tows between 2012 and 2014 (Wallace *et al*., 2015).

In addition to fishery closure area, MPAs in Canada are established through the Oceans Act. There are currently 14 MPAs covering over 350,000 km^2 of Canada's marine and coastal areas[6]. The DFO can establish MPAs with prohibition on specific activities throughout the MPA, within certain zones within the MPA or through temporal restrictions (DFO, 2015).

An example MPA designated to protect sensitive benthic habitats is the Hecate Strait/Queen Charlotte Sound Glass Sponge Reefs MPA was designated in 2017. The MPA's conservation objectives are to conserve the biological diversity, structural habitat, and ecosystem function of the glass sponge reefs.

5 https://www.dfo-mpo.gc.ca/oceans/publications/backgrounder-fiche/corsair-georges-jordan/index-eng.html
6 https://www.dfo-mpo.gc.ca/oceans/mpa-zpm/index-eng.html

Although the reefs were originally closed to groundfish trawl fishing in 2002 the MPA designation provides comprehensive and long-term management and protection for the areas and allows the DFO to effectively manage the broad range of activities that could damage elements of this ecosystem. For example, all fishing, anchoring, and cable installation, maintenance and repair are prohibited in the core protection zones, whilst certain fishing activities are allowed in the adaptive management and vertical adaptive management zones (managed in accordance with integrated fisheries management plans, annual variation orders, regulations and license conditions in a manner consistent with the conservation objective of the MPA). In order to protect the sponge reefs, additional fisheries management measures for bottom contact and midwater trawl fisheries are currently required throughout the MPA.

Encounter thresholds and Move-on rules

To be consistent with the MSC requirements for management of VME habitats, in April 2018 a move-on rule protocol was introduced for the Greenland halibut fishery in specific areas of Canadian waters[7] (see GEAC, 2018). The move on rule requires the following to be applied:

- Apply the following definition of a SiBA when fishing in a defined SiBA:
    - An encounter with SiBA indicator species is defined as catch per set (e.g. trawl tow, longline set, or gill net set) of more than 7 kg of sea pens and/or 60 kg of other live coral and/or 300 kg of sponges.
- Quantify the catch of the sea pens/other live corals/sponges if it could approximate the threshold weights defined above.
- If the quantity is higher than the encounter threshold defined above;
- Cease fishing and move away at least 2 nm from the endpoint of the tow/set in the direction least likely to result in further encounters. Captains shall use their best judgment based on all available sources of information.

The Canada Pacific multispecies groundfish bottom trawl fishery collaborated with NGOs to develop bycatch encounter protocols, which were implemented in 2012. The encounter threshold was based on historic coral and sponge catch frequencies which showed that only 7% of sponge and 5.5% of coral encounters between 2005-2009 were greater than 20 kg. A threshold of 20 kg of coral and sponge combined caught in one tow was adopted. Any vessel hauling more than 20 kg of coral and sponge had to report to the NGO and industry protocol committee. The aim of the protocol is to inform vessels of potential high-risk areas within the historical trawling boundary and to identify areas for potential removal from the boundary (Wallace *et al.*, 2015). No move-on rules are mentioned as part of the encounter protocol.

The fishery also adopted the world's first habitat quota. Termed the Habitat Conservation Bycatch Limit, a fishery-wide quota of 4500 kg of coral and sponge catch was established, with a management aim to keep total bycatch under 884 kg per year across all vessels. They found that the first three years of implementation of these measures led to the lowest recorded bycatch levels ever recorded over the last 17 years. It has also resulted in reduced impacts to sensitive benthic habitat features such as coral and sponge complexes (Wallace *et al.*, 2015). Observers are also present on 100% of vessels.

4.2.3 Future direction / other issues

It can take an average of 7–10 years from the announcement of an Area of Interest to designation of an MPA (Schram *et al.*, 2019). However, the Government has proposed an amendment to the Oceans Act to enable interim protection of critical and unique areas, via the issue of a Ministerial Order, while working towards final MPA designation. The Order would allow the footprint of existing marine activities

[7] Two small areas within the specified divisions were exempted from the move on rule as

in the area to be frozen for up to five years while ongoing science and consultations to establish the area as a permanent Oceans Act MPA are undertaken and completed (Schram *et al*., 2019).

In 2019, the Canadian Government adopted a new protection standard for MPAs which prohibit four key industrial activities in all new federal MPAs: oil and gas activities; mining; dumping; and bottom trawling (including otter trawls, beam trawls, shrimp trawls, hydraulic clam dredges, and scallop dredges). In MPAs where bottom trawling is currently authorised, the activity will be re-evaluated to determine if it is consistent with the specific MPA's conservation objectives. If it is not, the MPA regulations will be amended following consultation with partners and stakeholders.

The Canadian approach to identifying SiBA and SBAs based on nearest neighbour approach and habitat suitability modelling has resulted in large areas being identified as potentially containing sensitive habitats. However when underwater surveys are carried out, the habitats/species in question are not present across the large areas identified. The lack of policy direction in relation to how these areas should be considered, and what proportion of them is expected to be/should be protected, has created difficulty for the industry due to the uncertainty in how these areas should be treated, particularly in relation to MSC assessments.

4.3 Greenland

Greenland has a population of around 57,000 people and an EEZ of over 2.2 million km^2 (Long *et al*, 2020). Protection of the marine environment out to 3 nm is under the jurisdiction of Greenlandic authorities, under the Parliament of Greenland Act no. 15 of 8. June 2017 on the protection of the marine environment. Beyond 3 nm, out to the EEZ limit (200 nm), Denmark has jurisdiction of the marine environment under the Marine Protection Act on Exclusive Economic Zones for Greenland from 2017.

Fishing is the primary industry of the country, accounting for 80–95% of the country's export income, the majority of which is from deep-sea fisheries for prawns (*Pandalus borealis*) and Greenland halibut (*Reinhardtius hippoglossoides*) in west Greenland (Long *et al.*, 2020 and references therein). The offshore fishing for Greenland halibut in west Greenland takes place at depths of between 600 and 1,500 metres on the continental slope adjacent to the deep-sea basins in Baffin Bay and the Davis Strait, respectively, and is carried out mainly by trawlers and occasionally by longline vessels (Government of Greenland, 2021a). Prawn fishing in West Greenland typically occurs by trawling at depths between 200–400 metres. The fishery is distributed with 57% of the total Greenlandic quota in the offshore areas and 43% in the coastal areas (Government of Greenland, 2021b).

4.3.1 Sensitive habitats

Within national waters, Greenland refers to VMEs in its fisheries management plans. VMEs are defined under FAO 2009 criteria, and include:

- Coral reef
- Stony coral
- Black coral
- Possible coral rich areas 'coral gardens'
- Gorgonians,
- Bamboo coral
- Sponges
- Sea pens
- Soft corals.

Preliminary maps of VME species in deeper West Greenland waters were prepared based largely on research trawls from 2010 onwards (Cappell *et al*, 2017 and references therein). This work was continued by the Danish National Institute of Aquatic Resources (DTU Aqua), using a variety of data sources including historical museum records, seabed images from oil and gas exploration, and research trawl data (Cappell *et al*, 2017). Further mapping has arisen from the Greenland Institute of Natural Resources (GINR) integrated 'trawl bycatch-program' on national stock assessment surveys undertaken in East and West Greenland waters between 2015 and 2019 (Blicher and Hammeken-Arboe, 2021).

4.3.2 Protection measures

The Fisheries Act gives the Government of Greenland the right to regulate the Greenlandic fisheries. The Ministry of Fisheries, Hunting and Agriculture (MFHA) has overall responsibility for fisheries policy and the management of fish resources in Greenland, with the Greenland Institute of Natural Resources (GINR) responsible for providing the biological basis for fisheries management advice to the MFHA.

Management plans have been developed by the MFHA for cod, Greenland halibut and prawn fisheries that use bottom-towed fishing gear (Table 17). These management plans include information on technical conservation measures and management of vulnerable marine ecosystems and provide details of any areas closed to these fisheries under these measures (see Area Limitations below).

Table 17. Management plans for fisheries using bottom-towed gear

Species	Area	Status
Cod (offshore)	Southwest and East Greenland. Applies > 3 nm	Validity period 2021-2023
Greenland halibut (offshore)	West Greenland (south west Greenland (Davis Strait) and north west Greenland (Baffin Bay) management areas). Applies > 3 nm	Validity period 2021-2025
Prawn	West Greenland (coastal and offshore)	Validity period 2021-2025

Source: Adapted from Government of Greenland (2021c).

Closed Areas

The Government of Greenland Executive Order No.4, 30 March 2017 on Technical Conservation Measures in Fishing makes provision for the closure of areas to all fishing using bottom towed gears where VMEs are identified in Greenlandic waters (Government of Greenland, 2017). This Order also lays down criteria for closing areas to fishing in the case of the presence of live corals or sponges (see VME encounter thresholds and move on rules).

A number of "Technical Conservation Measures" introduced by Executive Orders have been used to limit the use of bottom-contact fishing gears in some areas, however, of these only two are associated with the presence of VME indicator species. Specifically, there is a ~6.5 km^2 area in southwest Greenland bounding a single observation of *Desmophyllum pertusum* (Government of Greenland, 2017; Kenchington *et al.*, 2017) and 11 discrete areas within the offshore region of Melville Bay closed to bottom trawling "based on significant observations of sea pens" (*Umbellula* spp.). (Cappell *et al.*, 2018).

There are additional closures to certain gear types and fisheries, which may also serve to protect VMEs:

- The area between 64°30'N and 68°N in West Greenland is closed to trawling for Greenland halibut in accordance with the Government of Greenland Executive Order on technical conservation measures in the fishery.
- In order to protect vulnerable and previously untouched marine environmental areas in Melville Bay, a number of areas in Melville Bay are closed to all fishing with bottom trawling gear pursuant to section 13 of Government of Greenland Executive Order no. 4 of 30 March 2017 on technical conservation measures in fishing.
- Prawn fishing with bottom trawl gear in Melville Bay north of 73° 30' N in areas that have not previously been fished may in future only take place after prior application to the Ministry of Fisheries, Hunting and Agriculture."
- Two inshore areas (within 3 nm) are also closed to bottom-contact gear under the 2017 Executive Order (off the west coast of Greenland in the area between 64 ° 10 'N and 65 ° 15' N from the coast and out to a line 3 nm outside the baseline; and in a geographical area in Southwest Greenland, bounded by the coordinates 60˚22.9 N and 48˚25.5W, 60˚22.1 N and 48˚24.9 W, 60˚21.3 N and 48˚25.9 W, 60˚22.1 N and 48˚29.6 W).

Gear restrictions

Entangling nets, gillnets and trammel nets are prohibited from waters beyond 3 nm where the water depth is greater than 200 m (Government of Greenland, 2017). This has the effect of avoiding interactions between nets and VMEs.

Frozen trawl footprint

Offshore fishing for Greenland halibut with bottom trawling in West Greenland is only permitted within two commonly used fishing grounds in the management areas of South-West Greenland and North-West Greenland. These areas have been fished intensively for many years and are not considered to be vulnerable marine areas. In exceptional circumstances, licensees of the MFHA may obtain a permit to fish outside the usual fishing grounds (Government of Greenland, 2021a). The management plan for this fishery states that this area limitation will be revised by the MFHA in consultation with the GINR and the Fisheries Council when there is further documentation [data] concerning the seabed in West Greenland, or when a management plan for the seabed is available.

More generally, all fishing activity in West Greenland in the area north of 74° N and west of 64° W and in East Greenland in waters north of 71° N with bottom-touching gear shall be considered as fishing in new areas (Government of Greenland, 2017).

VME encounter thresholds and move on rules

Under Technical Conservation Measures, if a high incidence of coral, sea sponges or sea pens is found during reporting, scientific studies or inspections, the MFHA must assess, in consultation with the GINR, the Ministry of Science and the Environment and the Fisheries Council, whether this should be considered a vulnerable marine ecosystem and should be closed to fishing with bottom trawling or other bottom contact gear (Government of Greenland, 2021a, b, d; Cappell *et al*., 2017). In the event of an encounter above threshold levels (Table 18), vessels must cease fishing, move a minimum of 2 nm and inform the Greenland Fishery Licence Control Authority (GFLK) (Long and Jones, 2020).

Table 18. Encounter thresholds for Greenland trawl fisheries

Gear	Threshold	Measure
Trawl	300 kg live sponges 60 kg live corals	The Government of Greenland Executive Order No.4, 30 March 2017 on Technical Conservation Measures in Fishing

There are no reports of move-on rules having been triggered. This may indicate that VMEs are absent from this area. Conversely, VMEs may be present and subject to damage without triggering the move-on rules (Long and Jones, 2020), or the low level of observer coverage may mean that underreporting is occurring. The 2021 MSC surveillance audit for the XXX fishery made a recommendation for the "adoption of more stringent move-on rules for corals and sponges, and also to adopt move-on rules for sea pens, that meet or exceed those recommended by NAFO" (Lassen and Chaudhury, 2021). A report of a below-threshold catch of sponges (50 kg) by a Russian trawler in 2016 was made to the ICES database (ICES, 2018).

Monitoring

The fisheries observer programme managed by GFLK is estimated to currently cover around 5 % of fishing activities, which is lower than the intended coverage rate but follows a risk-based approach to coverage (Cappell *et al*, 2017). Control of offshore fisheries is carried out in the following ways:

- Monitoring of notifications, logbook data, first sales data and vessels, including registration and validation;
- Port State Control;
- Observers on board vessels;
- Inspections at sea (Joint Arctic Command)
- Landing inspections.

4.3.3 Future direction and other issues

Further specifications and criteria for the designation or regulation of vulnerable marine areas are expected to be set out in a future seabed management plan (Government of Greenland, 2021a, b, d). The Ministry of Science and the Environment, in collaboration with relevant stakeholders, including the MFHA, is in the process of drawing up the framework for a general management plan for the seabed, which can also form the basis for the protection of particularly vulnerable areas. Revision of fishery area limitations will occur when there is more information on the seabed or the seabed management plan is ready.

4.4 India

India has a coastline of 7,516 km, an EEZ of 2 million km^2, and nearly 20 percent live in the coastal areas (FAO, 2019b).

Regulation of fisheries in India began with The Indian Fisheries Act, 1897, by the then British Administration. India established its EEZ under UNCLOS, and there are various pieces of legislation relevant to marine fisheries and conservation (Parappurathu & Ramachandran, 2018):

- Wildlife Protection Act, 1972;
- The Forest Conservation Act 1980;
- The Environment (Protection) Act 1986;
- The Coastal Regulation Zone (CRZ) notification, 1991;

- New Deep Sea Fishing Policy, 1991;
- Biological Diversity Act, 2002;
- Comprehensive Marine Fisheries Policy, 2004;
- notifications declaring selected coastal areas as MPAs from time to time. The latest development is the National Policy on Marine Fisheries, 2007.

The individual states have jurisdiction to govern fishing in the territorial waters (12 nm) and the union government has jurisdiction in the 12-200 nm zone.

4.4.1 Sensitive habitats

India has defined Ecologically Sensitive Areas (ESA). Coastal and marine ESA are listed under the CRZ Notifications (1991, 2011, 2019, 2021), issued under the Environment Protection Act, 1986, and include:

- mangroves
- corals and coral reefs
- sand dunes
- biologically active mud flats
- national parks, marine parks, sanctuaries, reserve forests, wildlife habitats
- salt marshes
- horse shoe crab habitats
- sea grass beds

The CRZ Notifications afford protection from development pressures, but these are focussed on land-based pressures, and there is no specific mention in the notification about protection from fishing impacts. These ESA have been mapped for the country, through the implementation of surveys which have been done in some places but do not provide full coverage. Some areas, such as the Gulf of Mannar in Tamil Nadu (a Marine National Park and Biosphere Reserve) are extensively studied for their biodiversity.

Protections to individual species are also afforded through the Wildlife Protection Act 1972. In relation to marine species, this includes corals and sea fans (Table 19).

Table 19. Protected marine faunal (habitat) species under the Wildlife Protection Act 1972, India

Faunal group	Number of protected species	Schedule
Porifera		
Calcareous sponges (all species)	10	III
Coelenterata		I
Reef-building corals (all scleractnians)	519	
Black corals (all antipatharians)	8	
Organ pipe coral (*Tubipora musica*)	1	
Fire corals (all millepora species)	5	
Sea fans (all gorgonians)	86	
Note: other groups are also protected, such as arthropods (robber crab, horseshoe crab), molluscs, fishes, reptiles and mammals		

Source: (CEBPOL, NBA, 2018)

Deep-sea VME species also occur within India's waters, e.g. a deep-sea sponge species new to science (Semperellame galoxea sp. nov.) was reported from Andaman waters (CMFRI website http://www.cmfri.org.in/division/biodiversity).

There are several research projects either underway, or having been implemented, that relate to impacts of fishing on biodiversity and vulnerable marine ecosystems (CMFRI, 2021):

- Assessment of fishing impacts on biodiversity loss with reference to threatened species and fisheries management.
- Investigations on vulnerable coral reef ecosystems of Indian waters with special emphasis on formulation of management measure for conservation
- Assessment of fishing impacts on biodiversity loss, with special reference to the Threatened species, to formulate management options for their protection
- Understanding the threatened coral reef ecosystems of southern India and designing interventions aimed at their restoration.

4.4.2 Protection measures

Based on the above, the measures that serve to protect sensitive marine habitats in India are:

- Spatial zoning of fishing activities (gear restrictions)
- Species-level protections
- Protected areas

Spatial zoning

Fishing gear restrictions are implemented through the state-level Marine Fisheries Regulation Act. Spatial zoning is used for two outcomes in Indian fisheries:

- to minimise excessive damage of marine biota through destructive fishing methods (e.g. bottom trawling) in inshore waters); and
- to maintain inter-sectoral distribution of fish catches by reserving the inshore area for traditional/artisanal fishers.

In this regard, several states reserve the inshore area for artisanal fishing (e.g. Tamil Nadu and Odisha, up to 5 km; Andhra Pradesh, up to 8 km). This has the effect of restricting impacts from mechanised fishing (e.g. trawling) on sensitive inshore habitats – for example, in the Gulf of Kutch Marine National Park and Marine Sanctuary, 'mechanised' fishing including by trawlers is prohibited, and 'traditional' fishing is permitted (Ministry of Environment and Forests, 2013). However, research conducted for this study has not identified any substantive gear restrictions in the offshore area and there is no reference to minimising or avoiding impacts on sensitive habitats in areas beyond the inshore area.

Species-level protections

If any scheduled species are caught outside an MPA/ESA, the Wildlife Division/Forest Department should take action as it is considered a crime. However, given that there are no self-reporting or observer programmes in India, it is not clear how effective this enforcement is.

Research updates from the Central Marine Fisheries Research Institute (CMFRI) mention damage to sponges, hard and soft corals and seagrass from 'mini trawls', fish and shrimp trawl nets and bottom set gill nets (CMFRI, no date). No information was found on any management or enforcement actions that stem from such encounters.

Protected areas

MPAs are established under the Wildlife Protection Act, 1972. There are 25 MPAs in peninsular India and 106 in island territories (Andaman & Nicobar Islands and Lakshadweep) (CEBPOL, NBA, 2018). Many of these MPAs appear to focus on coastal ecosystems and coral reef areas, rather than deep-sea habitats.

4.4.3 Future direction / other issues

Several of the fisheries policies are focussed on supporting and boosting fisheries production, rather than on managing impacts of the fisheries on marine ecosystems. For example, the Deep-Sea Fishing Policy of 1991 was developed in response to the full or over-exploitation of inshore fishery resources, aiming to develop fisheries in the offshore area through joint ventures with foreign counterparts (Shajahan, 1996).

Whilst there are some measures in place that protect sensitive habitats, such as gear restrictions (which appear to be in place primarily to protect artisanal fishing rights) and MPAs, these are predominantly in the inshore area and areas in the offshore and deeper waters do not appear to be surveyed or protected.

4.5 New Zealand

New Zealand has one of the largest EEZs in the world and it is estimated that over 90% of the EEZ has never been contacted with bottom trawling gear (Helson *et al.*, 2010; MPI, 2020).

4.5.1 Sensitive habitats

In 2007, New Zealand (supported by the fishing industry) developed a set of criteria for defining benthic protection areas (BPAs) which protects relatively pristine areas with an aim to protect a variety of habitat and environment types. BPAs are defined based on the following criteria (Deepwater Group Ltd, 2018):

- Unmodified – largely unfished or otherwise impacted by human activity;
- Large – both as individual parcels and cumulatively;
- Simple in form – to facilitate ease of interpretation and compliance;
- Consistent with Government policy – to protect not less than 10% of each of the identified marine environments within the EEZ;
- Representative of:
    - Marine environment classification areas and biodiversity areas;
    - Geological and oceanographic regions;
    - Depth ranges; or
    - Underwater topographical features.

New Zealand uses spatial mapping to identify relatively pristine areas. Potentially sensitive benthic areas in the EEZ were firstly identified by mapping key biodiversity areas and features in line with physical variables (depth, temperature, seabed slope and solar radiation) to obtain proxies for marine environments. Whilst this does not predict the specific biota that might be present, it provides an indication of the habitat types which would influence biota. These data were then used together with estimates on the location and extent of trawling within the EEZ to identify BPAs. BPAs were most notably proposed and developed in collaboration with the fishing industry (Helson *et al.*, 2010) with additional BPAs being added after consultation with the public (Deepwater Group Ltd, 2018).

4.5.2 Protection measures

Protection of the benthos within the EEZ is not specifically focussed on protecting VMEs but protecting the benthic environment generally, however, the types of habitats protected by the criteria (for example seamounts and hydrothermal vents) are associated with VME taxa and habitats. BPAs are not specifically recognised as a fisheries management tool in New Zealand but rather are for the protection of a representative range of benthic biodiversity within the EEZ.

New Zealand has one of the largest national networks for protected areas with 32% of its EEZ (1.2 million square kilometres) closed to bottom trawling and dredging. BPAs are closed to bottom-fishing, and strict rules are in place for off-bottom fishing activities. Mid-water trawling can only occur if two government observers are onboard and if an electronic net monitoring system is onboard to record prevent trawl gear does not impact the seabed. Fishing with off-bottom gear is prohibited within 100 m of the seabed and fines are issued if trawl gear exceeds this depth (MPI, 2020). The majority of BPAs are in areas which are too deep to trawl and only 16% of the BPA are in areas with trawlable depths (Leathwick *et al*., 2008), however, with the large spatial extent of the BPAs, 16% still provides a significant level of protection.

Encounter thresholds are not used within the EEZ as adverse effects are more likely to be avoided by restricting bottom fishing to specific areas outside of large BPAs (Helson *et al*., 2010). New Zealand do implement encounter thresholds and move-on rules within the SPRFMO Convention Area.

Many deep-water fisheries have a requirement that a proportion of fishing effort be observed. Fisheries New Zealand considers that 30% is a suitable target but that in some cases the target can be higher or lower than 30% (New Zealand Government, 2019).

4.6 Scotland

Scotland's seas host an estimated 6,500 varieties of marine flora and fauna, making them among the most species rich in the world (Scottish Government, 2019). The Scottish EEZ covers an area of 462,315 km^2 and includes waters down to 2,500 m depth (Marine Scotland, 2021).

4.6.1 Sensitive habitats

In July 2014, Scottish Ministers adopted a list of 81 priority marine features (PMFs). PMFs are species and habitats which have been identified as being of conservation importance to Scotland (NatureScot, 2021). They range from flame shell beds in coastal waters to cold-water coral reefs in deeper seas and mobile species such as minke whale and basking shark (NatureScot, 2021b). Most are a subset of species and habitats identified on national, UK or international lists. The National Marine Plan includes a policy (General Policy 9 on Natural Heritage) for safeguarding PMFs whereby "*Development and use of the marine environment must not result in significant impact on the national status of PMFs*" (Scottish Government, 2015).

A criteria-based approach was developed in order to refine the initial long-list of species. This involved considering the following criteria:

- Proportional importance;
- Decline/Threat of decline;
- Functional importance;
- Rarity; and
- International commitment.

Whilst not explicitly based on the FAO criteria, several of them do relate to the FAO criteria (decline/threat of decline, functional importance and rarity).

Table 20. Most vulnerable PMFs for which management measures are proposed

PMF	Other Designation/Protection Lists on Which They Feature
Blue mussel beds (subtidal only)	Habitats Directive (Annex I); OSPAR; BAP
Cold water coral reefs	Habitats Directive (Annex I); OSPAR; BAP; CITES (Appendix II)
Fan mussel aggregations Atrina fragilis	W&C (Schedule 5); BAP
Flame shell beds	BAP
Horse mussel beds	Habitats Directive (Annex I); OSPAR; BAP
Maerl beds	Habitats Directive (Annex I); OSPAR; BAP
Maerl or coarse shell gravel with burrowing sea cucumbers	Habitats Directive (Annex I); BAP
Native oysters Ostrea edulis	OSPAR; BAP
Northern sea fan and sponge communities	N/A
Seagrass beds	Habitats Directive (Annex I); OSPAR; BAP
Serpulid aggregations	Habitats Directive (Annex I); BAP

In addition to PMFs, a nature conservation MPA network has been established to protect a range of features including seabed habitats, low or limited mobility species, mobile species, and large-scale features. These range from VME-like habitats such as northern sea fan and sponge communities, to broad-scale habitat types such as offshore subtidal sands and gravels (Cunningham *et al.*, 2015).

The identification of the location of MPA features and PMFs has predominantly been through scientific surveys, with additional inputs from surveys for specific purposes (e.g. environmental impact assessments) and citizen science, rather than through fishery-based reporting of habitat encounters.

4.6.2 Protection measures

The main protection measures for sensitive habitats in Scottish waters are:

- Gear restrictions
- Protected areas

Gear restrictions

There is a ban on trawling below 800 m depth (European Union (EU) Deep Sea Fisheries Regulation 2016/2336). This regulation also closes vulnerable marine ecosystems to all bottom gear fishing at depths greater than 400 m. The use of gillnets and entangling nets are banned at depths greater than 600 m and restricted at depths between 200 and 600 m, according to EU Regulation 227/2013. These EU Regulations have been retained in UK law under the EU (Withdrawal) Act 2018.

Protected areas

Scotland's MPA network includes 225 sites for nature conservation to protect a broad range of habitats and species (Figure 7). Fisheries management measures have been introduced at a number of inshore sites, but management measures are still to be introduced for many offshore sites (Figure 7). The latter were delayed due to the procedural difficulties of implementing fisheries measures in waters beyond

12 nm under the common fisheries policy. Now the UK has left the European Union, these measures are expected to be forthcoming.

In addition to the existing nature conservation MPAs, a deep sea marine reserve was designated on 25 September 2020 to protect vulnerable deep sea habitats and species.

Many PMFs are already protected through the network of MPAs. Others occur outwith this area. Marine Scotland is currently considering management measures to protect 11 of the most vulnerable PMFs in inshore waters (Table 20). Locations were identified where additional management for bottom contacting gears is needed to ensure there is no significant impact on the national status of PMFs within the 6 nm limit. These locations have been taken forward into the consideration of management measures.

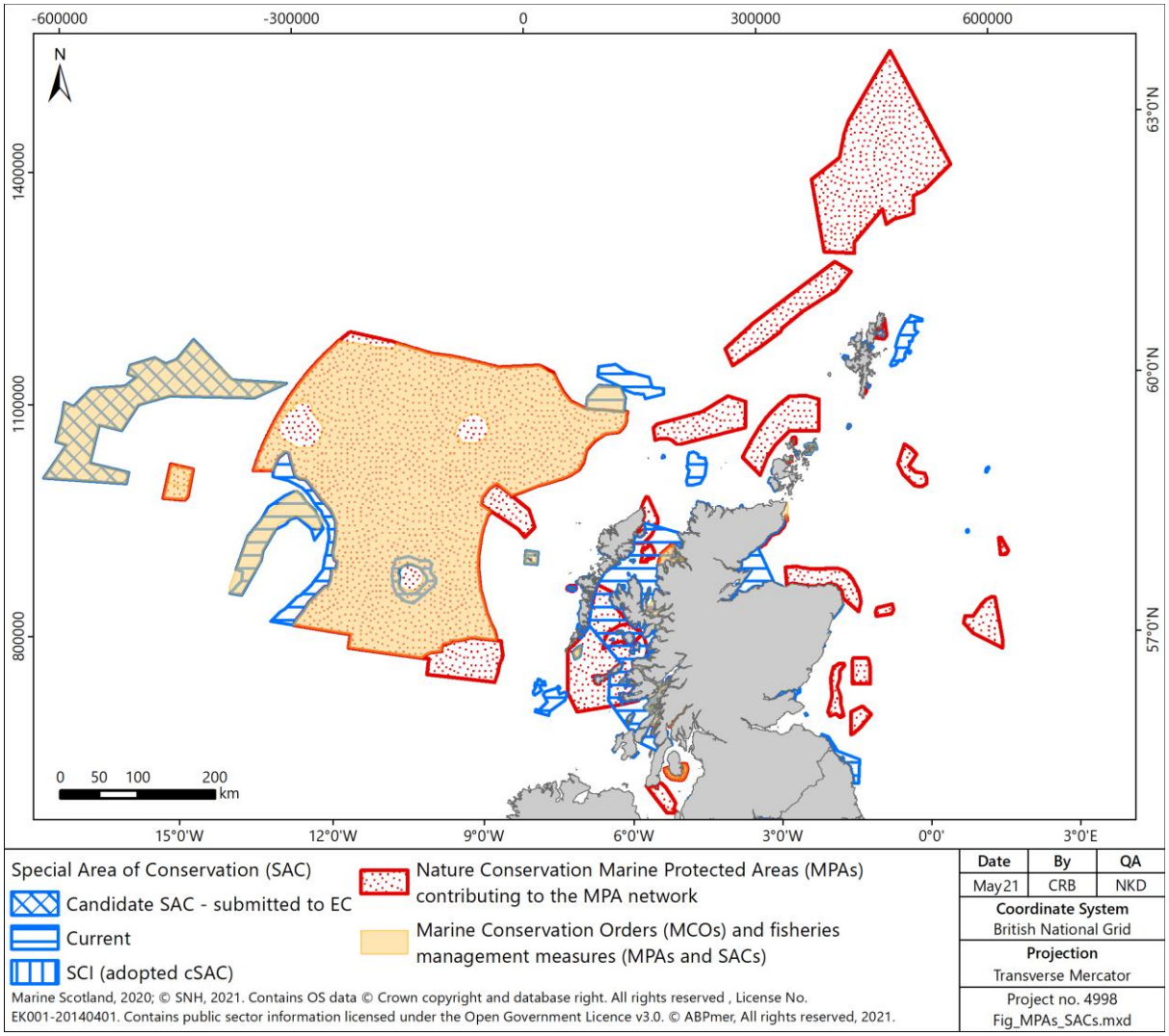


Figure 7. MPAs, SACs and marine conservation orders in Scottish waters

4.6.3 Future direction / other issues

There are no encounter protocols or move-on rules in Scottish waters for habitats. The development of move-on rules has not been a focus for conservation and management measures for sensitive habitats, with mapping and protecting key areas being more effective at avoiding damage. Observers are not required on fishing vessels.

There are a range of management measures already in place to protect the most vulnerable deep sea marine ecosystems, not least through gear restrictions in deep waters, and a range of inshore and offshore MPAs have been designated to protect habitats, species and large-scale features. Fisheries management measures have been introduced in many of the inshore MPAs, which also serve to protect PMFs.

In addition, management measure options are being considered for PMFs outside of the existing MPA network involving no use of bottom-contacting mobile fishing gears:

- in the PMF management areas;
- within a 0.5 nm buffer from the Scottish coastline's mean high-water springs (MHWS) line; and
- within a 0.5 nm buffer from the MHWS line plus the PMF management areas.

Once these, and management measures in offshore MPAs, are in place, there will be a good level of protection for the most sensitive habitats in Scottish waters. These waters are comparatively well surveyed and studied, and the most sensitive and vulnerable habitats have been incorporated into the existing MPA network and forthcoming measures.

4.7 South Africa

Continental South Africa has a coastline of some 3,650 km and an EEZ of over 1 million km^2. Waters in the EEZ extend to a depth of 5,700 m, with more than 65% deeper than 2,000 m (Griffiths *et al.*, 2010). In 2020, the population was estimated to be 59.6 million[8].

South Africa has a fairly large industrial fishing industry, of which the largest fisheries are the pelagic (pilchard and anchovy) and demersal (hake) sectors, both focused on the west and south coasts. The east coast has fewer, smaller commercial fisheries, but a high coastal population density, resulting in intense exploitation of inshore resources by recreational and subsistence fishers (Griffiths *et al.*, 2010).

4.7.1 Sensitive habitats

VMEs in South African national waters are defined under FAO 2009 criteria, and where relevant to the South African sub-Antarctic territory within the CCAMLR region, are referred to as VMEs in the National Biodiversity Assessment (SANBI, 2019). Marine benthic habitats which are likely to support VMEs (and which overlapped with the hake trawl fishery footprint) were identified by Sink *et al.* (2012) and included cold water corals, octocorals, sponges, dense sea pen fields and other biota that constitute complex, structured habitats that support high biodiversity (Sink *et al.*, 2012 cited in Andrews *et al.*, 2021).

Potential VME indicator organisms were defined with reference to the FAO Guidelines, and identified by a VME Task Team established to consider the science, mapping and management of VMEs (Andrews *et al.*, 2021). They include:

- Scleractinia (stony corals),
- Alcyonacea (soft corals),
- Gorgonacea (sea fans),
- Pennatulacea (sea pens),
- Porifera (sponges),
- Anthoathecata (including hydrocorals) and
- Bryozoa (moss animals, seamats)

[8] http://www.statssa.gov.za/?p=13453

4.7.2 Protection measures

Protection of VMEs is provided for the XXX fishery by the following measures which restrict the spatial areas in which trawling can be undertaken and provide a mechanism via which new areas found to have VMEs can be protected:

- Frozen trawl footprint
- VME encounter protocol and move-on rule
- MPA network

Frozen trawl footprint

It is a licence condition for inshore and offshore trawlers to fish for hake only within the historic footprint of the fishery, which restricts trawl operations to a limited depth range and area hence spatially limits impacts on benthic habitats. The trawl footprint has been frozen since 2009 (often referred to as the 'ring-fencing' initiative) and this restriction monitored by the Department of Forestry, Fisheries and the Environment (DFFE) using VMS (Andrews *et al.*, 2021 and references therein).

VME encounter protocol and move on rule

A VME encounter protocol and move-on rule has been developed for the South African Hake Fishery, following a review of move-on provisions applied in other fisheries (Franken, 2019 cited in Andrews *et al.*, 2021). The rule includes the following provisions (SADSTIA, 2019 summarised in Andrews *et al.*, 2021):

- Report of encounters with VME indicator taxa, at or above specified threshold limits;
- Management actions that must occur in response to encounter reports, and associated points of responsibility;
- Defined spatial exclusions from areas in which VME encounters are reported;
- Documentation of encounters; and
- Review of encounter information and the application of move-on rules triggered.

A pilot project to develop a monitoring protocol for VME indicator organisms has been undertaken and subsequently observers conduct invertebrate sampling during one trawl per day. Observers sail on between 5% and 10% of voyages in the hake deep-sea fishery (SADSTIA, 2019). A comprehensive guide to support data collection on marine invertebrates and posters to support VME identification at sea have also been produced (Andrews *et al.*, 2021 and references therein).

The encounter protocol and move-on rule was triggered in January 2020, when a fishing vessel landed sea pens (*Anthoptilum grandiflorum*) (Andrews *et al.*, 2021).

Information on the quantitative thresholds applied within the encounter protocol or the specific move-on rules were not sourced.

MPA network

MPAs in South African waters are established under the Marine and Living Resources Act (1998). The South African National Biodiversity Act (2004) and the Protected Areas Amendment Act (2004) both call for the creation of a representative network of protected areas in the sea. Until late 2018, there were 25 MPAs in the South African EEZ, focussed on the coastal and inshore, in which trawling was prohibited (through inshore licence conditions; except in the extractive-use zone of one MPA). In October 2018, 20 new MPAs were accepted for declaration (SANBI, 2019), a number of which included VMEs (e.g. corals; Andrews *et al.*, 2021). Trawling is prohibited in all of the newly-designated MPAs, six of which included significant areas inside of the 'ring-fenced' hake trawl grounds and fishing activity in relation

to this measure includes monitoring by DFFE using VMS. The trawling prohibition is included in the 2020 fishing permit conditions (Andrews *et al.*, 2021).

4.7.3 Future direction / other issues

There is awareness of the need to review the implementation of the recent encounter protocol and move-on rules to assess their effectiveness and change the measures if they are not effective. There is also an intention to expand the mandate of fisheries observers to include validation of the VME reporting requirements (Andrews *et al.*, 2021 and references therein).

Sink *et al.* (2019) highlight a number of marine ecosystem types outside the current MPA network which may be affected by demersal trawling and would benefit from protection, including areas containing VMEs. Work is underway to map the hake trawl footprint onto the ecosystem types identified by the 2018 biodiversity assessment which will help to identify any gaps in the protection of benthic habitats and VMEs provided by the MPA network and help evaluate the need for additional measures (Andrews *et al.*, 2021).

4.8 Summary

The national case studies indicate that whilst some countries adopt the VME terminology and criteria in their national waters, most do not, using different terminology and mechanisms to define and protect sensitive habitats. The reason for the differences between countries is not clear, however, it is possible to speculate that the adoption of VME terminology in national waters has occurred in countries with very deep waters and close coordination with adjacent RFMOs (e.g. Greenland, South Africa).

In countries that have not adopted the VME terminology in national waters, sensitive habitats are often defined, but not necessarily using the FAO criteria. Other criteria are used, for example the CBD EBSA criteria in Canada, and criteria specific to the national situation (e.g. Priority Marine Features in Scotland, Habitat Areas of Particular Concern in Alaska). In Canada, whilst different terminology is used (Significant Benthic Areas and Sensitive Benthic Areas), the national process is described as being equivalent/aligned to the process of identifying VMEs in ABNJ. Table 21 provides a summary of the approaches for the countries reviewed.

Table 21. Summary of national case studies

Case study	Use FAO criteria?	Use VME terminology?	Have defined sensitive habitats in	Have protections in place for	Established threshold levels of sensitive spp	Has move-on rule in place	100% observer coverage	Any reports of encounters
Alaska	×	×	✓	✓	×	×	✓	n/a
Canada	✓	×	✓	✓	×[1]	×[1]	✓	n/a
Greenland	✓	✓		✓	✓	✓	✓	×
India	×	×	✓	✓[2]	×	×	×	n/a
New Zealand	×	×	✓	✓	×	×	×	n/a
Scotland	×	×	✓	✓	×	×	×	n/a
South Africa	✓	✓	×	✓	✓[3]	✓[3]	✓	✓[4]

1 A threshold level and move on rule has been established for the Canadian Greenland halibut fishery in specific area divisions in national waters to enable compliance with MSC certification standards
2 Some protections in place, but mostly in inshore area
3 Information on the specific thresholds and move on rule were not sourced
4 Refers to the initial encounter that triggered the implementation of the encounter protocol and move-on rule

Some countries adopt the VME terminology in their national waters, but this is constrained to those with very deep waters and close coordination with adjacent RFMOs (e.g. Greenland, South Africa). Most countries do not adopt the VME terminology in national waters. Sensitive habitats are defined, but not necessarily using the FAO criteria. Other criteria are used, in particular the CBD EBSA criteria, and criteria specific to the national situation.

Whilst all countries reviewed have protections in place for sensitive habitats, the process for identifying and protecting these habitats are at varying levels of completeness. For example: Scotland's national waters are comparatively well surveyed and studied providing good understanding of the presence of sensitive habitats, and a range of protections are in place (MPAs, Special Areas of Conservation (SACs), gear restrictions in deep waters, forthcoming fisheries measures to protect PMFs outside of MPA network). Similarly Canada has undertaken extensive research to identify sensitive benthic habitats in national waters and has a range of measures to enable the protection of these areas including MPAs and marine refuges in which areas may be closed to all or specific fisheries for the protection of sensitive benthic habitats. In contrast, India has a number of protections in place for inshore habitats, but the identification and protection of sensitive habitats in offshore areas appears less developed.

Alaska took a slightly different approach to protecting sensitive habitats by firstly identifying Essential Fish Habitats (EFH) before identifying Habitat Areas of Particular Concern (HAPC) within these areas. Extensive work has been done to identify HAPC with a framework developed to review potential HAPC. As a result, several area closures have been made to protect these habitats.

Both Greenland and South Africa have a number of mechanisms for protecting VMEs in their national waters including closed areas and/or MPAs, 'frozen footprints' for specific trawl fisheries and a requirement for gain permission prior to fishing new areas.

Encounter thresholds and move on rules did not appear to be employed by countries to manage impacts on habitats in national waters. Nevertheless, MSC certified fisheries in South Africa, Greenland and Canada have voluntarily adopted encounter protocols and move on rules to ensure compliance with the MSC Standard. In both Canada and South Africa the encounter protocols and move on rules have only recently been implemented, so there is no evidence relating to the efficacy of these measures. There are also no reports of move-on rules for the XXX fishery having been triggered and it is noted that the thresholds are not as stringent as those recommended by NAFO (beyond national waters).

In some countries, there may be further need for development of protection covering the range of sensitive marine habitats, across the range of shallow or deeper waters. Capacity development in the Biodiversity Beyond National Jurisdictions process could be linked to EEZ capacity development for developing states (Cicin-Sain *et al.*, 2018).

5 Current Status and Application of FAO VME Criteria in a Global Fisheries Context

The FAO Guidelines were developed for ABNJ, and the concept is now firmly embedded in regimes for the management of deep-sea fisheries in the high seas, with good progress having been made in addressing the requirements of UNGA Resolution 61/105 in high seas areas through RFMOs and other regional management bodies (FAO, 2016). Section 3 provides a comprehensive review of the use of the FAO criteria by RFMOs. The RFMOs mostly use the FAO criteria (the exception being CCAMLR which developed its criteria in advance of the Guidelines being published). .Section 4 provides case studies of a range of national jurisdictions and whether and how they have used the FAO criteria to identify VMEs. Many coastal states identify and protect sensitive habitats in their waters. However, these are not usually termed VMEs unless they specifically occur in deep waters (i.e. the waters under national jurisdiction encompass deep sea areas).

Paragraph 10 of the FAO Guidelines says that 'Coastal States may apply these Guidelines within their national jurisdiction, as appropriate.' However, it may be considered that the *appropriate* habitats and fish stocks to apply the Guidelines to, would be those that correspond to the scope for which the Guidelines were developed, i.e. deep-sea fisheries. These are defined in paragraph 8 of the Guidelines as fisheries with the following characteristics:

- where the total catch (everything brought up by the gear) includes species that can only sustain low exploitation rates; and
- the fishing gear is likely to contact the seafloor during the normal course of fishing operations.

Therefore, this study considers that there is not an expectation that the Guidelines and associated criteria for identifying vulnerable habitats would be applied to shallow, inshore and more dynamic environments.

Within national waters, coastal states that do not use the VME terminology also do not use FAO criteria, but have developed other (often similar) criteria for defining sensitive habitats. In some cases, there are similarities to the Convention of Biological Diversity (CBD) Ecologically or Biologically Significant Marine Areas (EBSA) criteria (further detail in Appendix C) However, additional criteria are used in national waters that are not covered by either the FAO or CBD criteria. Canada has developed an EBSA identification framework which uses five criteria (see section 4.2). Although Canadian guidelines for the identification of EBSAs were developed prior to the establishment of the CBD criteria (DFO, 2004), there is some similarity between them. In 2017, 236 EBSAs had been identified in Canadian waters (Canada, 2017). The Oslo-Paris Agreement (OSPAR) criteria that were used to develop the list of threatened and/or declining species and habitats (OSPAR, 2019) also align well with the first four FAO criteria (uniqueness/rarity, functional significance, fragility and life history traits), but not structural complexity, whilst additional criteria relating to global and regional importance and status of decline are considered.

A table comparing the criteria used under different approaches is provided in section 9.2 (Table 22).

The EBSA criteria predate the FAO VME criteria but are similar, with the exception of biological productivity and naturalness, which do not have corresponding characteristics in the FAO criteria. Ardron *et al.* (2014) concluded that whilst the FAO and CBD have slightly different objectives and terminology, similar data can be used for both VME and EBSA criteria and the two approaches complement each other.

The CBD criteria have been globally applied throughout coastal and offshore areas through a series of regional workshops. More than 300 EBSAs have been described around the world (Johnson *et al.*, 2019), although there is a notable gap in the North East Atlantic region (CBD, 2021).

The CBD highlights that relevant measures to avoid degradation or destruction of EBSAs include area-based management tools such MPAs, environmental impact assessments (EIAs) and strategic environmental assessments (SEAs) (CBD, 2010). The authors of this report were not able to find evidence that move-on rules have been called for or implemented in EBSAs identified within national jurisdictions.

6 Use of Move-on Rules for VME protection

6.1 Background to the requirements for move-on rules

The FAO Guidelines (2009) specify that states and RFMOs should 'adopt conservation and management measures to achieve long-term conservation and sustainable use of deep-sea fish stocks, ensure adequate protection and prevent significant adverse impacts on VMEs' (Paragraph 70). Such measures may include:

- Effort controls and/or catch controls (relevant to management of deep-sea fish stocks);
- Temporal and spatial restrictions or closures;
- Changes in gear design and/or deployment or operational measures, including reduction of contact between the fishing gear and the seabed;
- Other relevant measures necessary to achieve the objective of paragraph 70.

Until a functioning regulatory framework is developed to prevent significant adverse impacts on VMEs and to ensure the long-term sustainability of deep-sea fisheries, conservation and management measures should include, at a minimum (Paragraph 63):

- Closing of areas to deep sea fisheries where VMEs are known or likely to occur;
- Restricting the level or spatial extent of effort of vessels involved in deep sea fisheries to previous levels; and
- Reducing effort in specific fisheries, as necessary (relevant to management of deep-sea fish stocks).

Move-on rules are not included in either of these requirements, but are mentioned in Paragraph 67, which specifies that states and RFMOs should have an appropriate protocol identified for how fishing vessels in deep-sea fisheries 'should respond to encounters with a VME, including defining what constitutes evidence of an encounter' and that vessels should cease fishing activities at the site and report the encounter. The implication is that the application of move-on rules should not be the first port of call for minimising impacts on VMEs, but rather that spatial closures and gear adaptations to reduce bottom contact are the key means of preventing significant adverse impacts on VMEs.

It is recognised that there is a need to account for the existence of unknown VMEs inside and outside of the existing fishing areas (FAO, 2016). Given the large areas of the high seas, and a lack of empirical data on the distribution of VMEs within them, move-on rules can provide immediate responses when spatial management measures may not be providing the expected conservation benefits (Geange *et al*., 2020).

6.2 Implementation in global fisheries

Move-on rules have been adopted by most RFMOs (with the exception only of GFCM which is at an early stage in addressing the UNGA requirements) (Table 16). However, there has been very limited implementation in national waters. Whilst there are countries with move-on rules in place for encounters with species indicative of deep-sea VMEs, these are found in countries with deep waters within their national jurisdiction that have followed the RFMO path of implementation of the FAO Guidelines for such areas and ecosystems. Additionally, the adoption of move-on rules in national waters appears to have been based mainly on the requirements of MSC certification for particular fisheries, which requires move-on rules to be in place to achieve the minimum SG60 level for certification. In essence, this review

identified no relevant examples of move-on rules that are established to manage impacts of fisheries on shelf or coastal habitats, for example, in seagrass or kelp.

A recent review of best practices for managing, measuring and mitigating the benthic impacts of fishing did not include move-on rules as one of the measures or approaches under consideration (Grieve *et al.,* 2015). As such, and with respect to the concept that good/best practice is "not only a practice that is good, but a practice that has been proven to work well and produce good results and is therefore recommended as a model. It is a successful experience, which has been tested and validated, in the broad sense, which has been repeated and deserves to be shared so that a greater number of people can adopt it." (FAO 2013), the authors were not able to identify good / best practice for the use of move-on rules in such areas. This is particularly important where the PI 2.4.2 SIa SG60 requirement for fisheries that encounter VMEs is for "implementation by the UoA of precautionary measures to avoid encounters with VMEs, based on commonly accepted move-on rules." In essence, there is no best (or commonly accepted) practice to follow here with respect to move-on rules.

6.3 Limitations

A number of limitations of move-on rules have been observed, documented and researched:

- Tolerance of a level of impact, and cumulative impacts in new fishing areas
- Catchability of VME species in fishing gears
- Setting thresholds at appropriate levels
- Level of effort in thresholds
- Enforcement and observer coverage

6.3.1 Tolerance of a level of impact, and cumulative impacts in new fishing areas

A long-standing objection to 'move-on' approaches remains the tacit toleration of a documented degree of environmental harm incumbent in the process (Caddell, 2020). ICES (2012) also concluded that move-on rules were not appropriate for new fishing areas. In such areas, the risk of accidentally hitting large and perhaps pristine areas that may be identified as VMEs is increased. Implementing a move-on rule in the event of such an encounter could result in multiple instances of fishing impacts on a VME as a vessel is required to move 1 or 2 nm before resuming fishing. Similarly, move-on rules were thought not to be appropriate for steep slope and seamount areas, where moving a short distance is unlikely to result in lowering the probability of encountering another patch of VME indicator species (ICES, 2012). Where a sensitive habitat may be fished by accident because of an error of navigation or because of strong tides or poor weather, it may also be argued that forcing fishers away from favoured grounds may ultimately result in additional impacts on the seabed, either because their effort will be spread more widely, or through forcing fishers to target sub-optimal areas for longer (Rijnsdorp *et al.* 2017).

6.3.2 Catchability of VME species in fishing gears

Fishing gear is designed exclusively to catch the target species and is therefore not conducive to the effective sampling of non-target benthic species and habitats. The catch efficiency of VME indicator species by bottom fishing gear has been reviewed several times in the literature and is described as being relatively low and unlikely to be representative the true abundance and distribution of VME taxa (, Rogers & Gianni, 2010, Auster *et al.*, 2011, Baco *et al.,* 2020). This may especially be the case where gear modifications to reduce bycatch are in place, for example Nordmor sorting grids or benthic selection panels.

Geange *et al*. (2019) reported that the catchability in trawls of VME taxa is taxa-dependent and generally low, typically below 1%, although it is recognised that these estimates may underestimate the catchability of VME indicator taxa in areas where VME density is high. Freese *et al*. (1999) quantified catch efficiency of invertebrates in trawls off Alaska and showed that densities of asteroids, echinoids and molluscs based on catches were <1%, and holothurians <5% than those compared with photographic estimates. No quantifiable estimates of octocorals or sponges were possible due to fragility and size of the species.

Freese *et al*. (1999) noted that light, flexible and fragile species (such as sponges and soft corals) tended to be fragmented and likely lost through the net and any species which are retained in the nets must be resistant to abrasion by the gear to be representative of the abundance.

In 2008, the NAFO Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) determined significant concentrations of corals from research vessel tows. They found that large catches of sea pens and gorgonians were rare and that 90% of catches had less than 0.5 kg of sea pens, 0.1 kg of small gorgonians and 2 kg of large gorgonians (WGEAFM, 2008). Precautionary encounter thresholds of 1.6 kg of sea pens, 0.2 kg of small gorgonians and 2 kg of large gorgonians per tow were suggested to signify a significant concentration of corals. The thresholds implemented exceeded these recommendations by one to two orders of magnitude, albeit that a stakeholder commented to this study that such small quantities of an indicator species may be missed or only identified caught in a trawl several tows after it was actually taken, with the effect that there would be considerable potential to mis-identify the location from which the indicator was taken. In a review of move-on rules by Auster *et al*. (2011), it was concluded that without further consideration of catch efficiency and gear configuration, the likelihood of triggering move-on rules is unlikely.

To counter this issue, some studies have recommended the use of video surveys as tools for the identification of VMEs, and to provide a more robust estimate of true abundance and distributions of VME taxa (Baco, *et al*., 2020, Long *et al*., 2020).

6.3.3 Setting thresholds at appropriate levels

Threshold values are not supported by any explicit demonstration of the relationships between biomass or density of VME indicator taxa on the seafloor, the catch efficiency of bottom trawl gear, and the biomass of VME indicator taxa retained as bycatch on the deck of fishing vessels (Geange *et al.*, 2019). A study on the effectiveness of thresholds in the SPRFMO area found that additional work is needed to develop ecologically meaningful encounter thresholds (Geange *et al.*, 2020).

The encounter thresholds which trigger move-on rules have been criticised as being too large compared to the catches of specific VME indicator species and large quantities of VMEs might be destroyed before exceeding encounter thresholds (Auster *et al*., 2011). In the CCAMLR area, it was noted that threshold values were not exceeded even when video transects showed evidence of VMEs (FAO, 2016). This is connected with the issue of catchability of VME species in fishing gear described in section (6.3.2).

The 2016 five-year review of progress against implementation of the UNGA resolutions 64/72 and 66/68 found that problems remained on whether or not existing encounter protocols, including threshold levels, are providing sufficient protection for VMEs (UNGA, 2016). Whilst most of the debate surrounds encounter thresholds being too high to trigger the move-on rule, if a threshold is too sensitive, move-on rules would be triggered frequently and have the potential to move fishing effort away from preferred, long-impacted fishing grounds (Auster *et al*., 2011; Geange *et al*., 2020). Expanding the trawling footprint in this way may lead to an increase in trawling effort in adjacent areas due to lower catch rates of target species and thus increase overall impacts to the seabed (Kenchington *et al*., 2011; McConnaughey *et al*., 2019).

Thresholds are often based on live by-catch (e.g. NAFO, NEAFC, SEAFO, SIOFA), but cold-water reefs (which represent a substantial proportion of VMEs) habitually comprise a framework of primarily dead coral. As a result, significant damage may be legitimately inflicted upon a VME without triggering the 'move-on rule' (Caddell, 2020, citing UN Document A/66/307 (n.96), para 46.).

There has been discussion as to whether the "bucket" approach to the move-on rule (i.e. where a VME indicator unit is one litre of VME indicator organisms that can be placed in a 10-litre container, as in CCAMLR), adequately protects smaller and lighter VME indicator species. In 2019, a case study was undertaken on the "number of specimens and average weight of specimens using sea pens" from an area off the East Antarctic where the XXX fishery operated. This work showed that the probability of reaching a 5 VME-unit threshold for sea pens was likely to be zero, whereas the probability of reaching a 2.5 VME-unit threshold would be much higher and more appropriate for the sea pen assemblage. (Fuller *et al*., 2020).

The catchability of VME indicator taxa varies by gear type and configuration (section 6.3.2). As a result, different thresholds are likely to be appropriate for different gear types. Some RFMOs have now developed gear-specific thresholds, but other RFMOs have a single set of thresholds across all gear types. Nevertheless, it seems extremely unlikely that setting a single threshold will be effective where similar gears may or may not employ selectivity measures, such as Nordmor grids and benthic release panels.

Appropriate thresholds may also differ for different VME types. Catchability varies between taxa (Geange *et al*., 2019), therefore thresholds may need to be different for different VMEs depending on their composition. The complexity in implementation of move-on rules was noted as one of the reasons that NAFO has favoured closed areas within its fishing footprint and surrounding waters rather than relying on move-on rules (FAO, 2016).

6.3.4 Level of effort in move-on rule thresholds

Encounter thresholds are mostly expressed as a quantity of VME indicator species and levels used by RFMOs are generally set on "best judgement" as opposed to scientifically valid thresholds specific to taxa, gear type and tow time (Auster *et al*., 2011; Geange *et al*., 2020).

The quantity of any species retained in fishing gear is likely to be dependent on various factors related to the level of fishing effort, e.g. duration of trawl tow, net width, footrope configuration, mesh size, as well as other gear configuration details such as the use of bycatch excluder devices. Auster *et al*. (2011) suggested that the smaller nets being towed require significantly more biomass per unit area of VME indicator taxa to trigger move-on rules compared to larger nets towed for the same amount of time/distance. Equally, shorter tow times due to seabed morphology and patterns of catch could lead to less bycatch per tow but have a more widespread impact. There is also potential for more VME indicator species to be retained at the end of the trawl, when the net is full of fish, than at the start where the net is empty (Weaver *et al*., 2011). Waver *et al*. (2011) also described that tows may be as long as 5-20 nm in length, therefore, it is not possible to identify the exact location of the VME encounter, or whether bycatch was a result of a single or multiple encounters. There is also a possibility that an indicator caught high in the net may go unnoticed for several trawls until making its way down to the cod end, by which time the actual location of the impact could be many miles away.

6.3.5 Enforcement and observer coverage

Effective implementation of move-on rules through reporting of above-threshold encounters requires extensive (or complete) observer coverage (Hansen *et al.,* 2013). In the absence of observers, there is

little incentive for fishing vessels to report above-threshold encounters knowing that it will result in a closure of an area of fishing grounds, both for them and for other vessels in the fishery. It is notable that reports of above-threshold encounters have generally only been made in RFMO areas where there is typically 100% observer coverage (see section 3).

An evaluation of fishing vessels observer programs by Ewell *et al*. (2020) highlighted the pressures and safety concerns of observers who can be "at odds" with the fisheries crew and the potential for corruption (WCPFC, 2014). It is suggested that Remote Electronic Monitoring (REM) could be used on-board fishing vessels which has been shown to closely match observer accuracy in terms of large by-catch species (Ewell *et al*., 2020), however VME indicator species likely need a skilled observer for accurate identification, and it seems extremely unlikely that small quantities (i.e., as suggested by WGEAFM, 2008) could be identified reliably with REM.

6.4 Alternatives

This review has identified a number of alternative approaches to move-on rules that can or should be used to minimise or mitigate impacts on VMEs. Identifying the list of species that should be considered as VME indicator species is the first step. But then developing an understanding of the distribution of potential VMEs, either through modelling or survey, is the next key step in identifying appropriate measures. Where the distribution of VME habitats is well understood and appropriate protections are in place to avoid impacts, move-on rules gradually become redundant. We consider that move-on rules should be used as an interim measure or a back-up to other protection measures, rather than being a minimum acceptable level of protection for VMEs. This is further exemplified by the lack of move-on rules for fisheries in many waters under national jurisdiction, where protection of vulnerable and sensitive habitats has progressed on a different path from that on the high seas.

Alternative approaches to move-on rules include the following, all of which may be informed by impact assessments to identify potential risks:

- Closed areas
- Frozen footprints
- Prior authorisation for new fishing activities
- Technical measures

In reality there is no one single approach that should be adopted, but rather a combination of approaches are likely to be appropriate, according to the specific circumstances, fisheries and habitats in question (for example, Box 3).

Box 3. Combination of approaches to protecting VMEs in the EU

The European Union has implemented regulations to mitigate the impacts of bottom trawling on VMEs in EU waters. Since 2016, trawls below 800 m are banned and areas with VMEs are closed to bottom fishing below 400 m (EU, 2016). Fishing of deep-sea fish is restricted the historical 'fishing footprint' to ensure that pristine environments remain untouched. In 2021, ICES advised the EU on areas where VMEs are known to occur or are likely to occur along with areas of existing deep fishing areas identified using VMS/logbook data (ICES, 2021). Suggested scenarios are put forward to mitigate potential significant impacts on VMEs by either prioritising protection of VMEs irrespective of fishing activities, identifying areas where VMEs are likely to occur or to implement VME indicator thresholds (ICES, 2021).

6.4.1 Closed areas (based on survey, or precautionary)

Closing areas with significant concentrations of VME indicator species is the most effective means of protecting VMEs (McConnaughey *et al*., 2019) and the need for encounter protocols gradually becomes redundant as the locations of VMEs become increasingly well-defined (NAFO SC, 2013). This is also the conventional approach to protecting sensitive habitats in coastal waters, and consistent with the CBD commitment to have 10% of the world's oceans within MPAs by 2020, or the IUCN-approved 30% by 2030 approach[9].

Implementation of closed areas requires VMEs to first be identified in order to design and implement appropriate closed areas. This can be through scientific surveys to collect observational data or modelling approaches such as those used in Canada (Kenchington *et al*., 2016), and RFMOs such as NAFO (Kenchington *et al*., 2014) and SPRFMO (Georgian *et al*., 2019) which have used maps to facilitate precautionary closures to protect pVMEs. SIOFA have also mentioned habitat suitability models as part of their protocol for designating VMEs (SIOFA, 2019a). Ardron *et al*. (2014) recognised that development of habitat models are important for predicting where VME taxa and habitats may occur and should be implemented into frameworks for the identification of VMEs.

The use of habitat suitability models and density estimations have been extensively used in the literature, and are widely recognised as useful tools for estimating where VMEs or sensitive habitats are likely to occur in the absence of extensive survey data, or to infill areas with limited data. For example, Rowden *et al*. (2017) used high-resolution habitat suitability models to show areas of the Louisville Sea Mount Chain in the SPRFMO area which were suitable for stony corals to exist. They are relatively cheap and easy to run and are particularly useful in areas where extensive VME data do not exist, which is common the deep sea. In the absence of information on distribution of known or likely VMEs, closures would need to be precautionary and may cover large areas (although other approaches such as frozen footprints and impact assessments are also applicable, see next sections).

Protection of VMEs by area closures has led to recovery. For example, in 2003, extensive fishing damage was observed on a cold-water coral reef on the Scotian Shelf, Canada, from bottom fishing activities. Since the designation of the *Lophelia pertusa* Coral Conservation Area (LCCA) in 2004, an increase in the density and abundance of epibenthic megafaunal species has been observed and recruitment activity of *L. pertusa* suggests that recovery is occurring (Beazley *et al*., 2021).

6.4.2 Frozen footprint

A frozen footprint approach can be taken to confine the impacts of bottom fishing gear to historic fishing areas which are previously disturbed. In this way, the negative effects on the seabed from displacement of fishing effort to previously untrawled areas is avoided as impacts from bottom fishing are restricted to already fished areas, and new impacts in previously unfished or pristine areas are also avoided (McConnaughey *et al*., 2019). There are several examples of frozen footprints being implemented by RFMOs as well as in national waters. The majority of RFMOs restrict bottom fishing to existing fishing areas with exploratory fishing areas requiring an assessment and review by Scientific Committees before fishing can take place.

A licence condition now restricts the South African hake fishery to its footprint as identified in 2007 (Andrews *et al*., 2021), and in 2016, Norwegian cod trawlers in the Barents Sea voluntarily froze the trawling footprint to historically affected ground and committed to mapping sensitive habitats in line with MSC requirements (FiskerForum, 2016).

[9] https://mpanews.openchannels.org/news/mpa-news/iucn-members-approve-30-2030-goal-mpas-most-ambitious-target-so-far-mpa-coverage. Accessed 17 May 2021.

An important consideration for the frozen footprint approach is the evolution of the fishery and the baseline used to determine the fishing footprint. For example, where fishing activity has been relatively stable in a particular area, the determination of the baseline is relatively straightforward, with a recent 10- or 20-year period being appropriate (as has been implemented in RFMOs). However, if the spatial footprint of a fishery has expanded significantly in recent years, the baseline period requires more careful consideration. In this case, reduction of the existing footprint to grounds that have been fished historically, may allow marginal fishing grounds to recover and fishing effort to be focussed on core grounds without significant loss to the fishery. This is also supported by ICES work to evaluate regional benthic pressure and impact indicators from bottom fishing (ICES, 2017). Conversely, in some fisheries the modern footprint may be considerably smaller and more refined than the legacy footprint due to on-board technology enabling the precise targeting of fishing areas.

6.4.3 Impact assessments and prior authorisation

Before expanding fishing activities to new areas (for example, outside the existing fishing footprint of a particular gear type), an impact assessment can be required, to assess whether fishing activities are likely to cause a significant adverse impact on VMEs or other sensitive habitats (ICES, 2012). This is similar to the approach to exploratory fishing protocols outside existing fishing areas required by various RFMOs. Any such exploratory fishing that is authorised should also be required to carry a scientific observer to collect data on encounters (at any level) of VME indicator taxa, as well as implementing high-tech monitoring and registration of habitats on a high spatial resolution e.g. electronic records of bottom contact and exact tracks of individual tows, headline cameras to monitor tows, record catch and bycatch, which can contribute to mapping and assessments (ICES, 2012).

A requirement to carry out an impact assessment of proposed activity is in line with the requirements for other marine sectors. These are typically required to invest significant resources in carrying out an environmental impact assessment to characterise the environment, identify potential impacts of the proposed activity and assess their likely significance and any mitigation measures. A licence is only issued for the project to proceed if it can be shown that the anticipated environmental impacts are acceptable and can be adequately monitored and managed. Impact assessments used by RFMOs typically require details such as:

- Detailed description of the fishing activities taking place (including the vessels and gear to be used, seabed depth range, target species and likely bycatch species);
- Maps of the fishing area and maps/habitat suitability models of VMEs and VME indicator taxa; and
- Identification of the potential impacts and mitigation/management measures, using a risk and impact assessment framework.

6.4.4 Technical measures

Technical measures can be implemented to reduce the risk of significant adverse impact by minimising the extent of bottom contact (ICES, 2012). Some fisheries are voluntarily adopting gear adaptations which reduce their benthic impact as this can also reduce fuel consumption (e.g. adjustment of the warp-length-to-depth ratio and use of manoeuvrable semi-pelagic trawl doors reduce the bottom contact area of otter trawls, McConnaughy *et al.,* 2019). A number of RFMOs have implemented measures of this type, for example in SPRFMO, bottom-set gillnets must be set with the footrope at least 70 cm above the seafloor in the western area of NPFC. However, the practicalities of monitoring and enforcement of such measures should also be considered.

7 Analysis of VME Identification in Certified Fisheries

The aim of the analysis was to identify common themes or inconsistencies relating to the taxa and habitat types used for scoring of VMEs by the MSC. The MSC VME database provided on the 28 May 2021 contained a list of certified fisheries, the regions in which the fishery is located, the gear types deployed, how the VMEs are defined and the rationale behind the MSC scoring against PI 2.4.2. Not all MSC certified fisheries were included in the database, and the selection of fisheries for inclusion in the database was carried out by MSC. Both certified and certified (suspended) fisheries were included. The database contained a number of duplicate entries (likely to be where an individual fishery has several different target species). Duplicate entries in the database were removed because the status of individual target species was not relevant to this analysis. After removal, the database contained information on 69 fisheries and 93 fishery/gear combinations (i.e. one 'fishery' may include several individual gear types, which are scored separately under Principle 2, Environmental impact of fishing).

Out of 93 fishery/gear combinations, 76 of them had VME indicator taxa and/or physical features listed. There were two where VMEs were stated as not identified in the certification reports but VME indicators were listed, such as seagrass (Burry Inlet cockles) and gorgonians, sponges and sea pens (Scotian Shelf snow crab trap). After review of the certification reports, it was found that VMEs had been identified and scored against for certification, therefore, the entries in the database were changed for the purpose of this analysis.

The most common VME indicator taxa/physical features listed were sponges and sea pens accounting for 21% and 13% of the VME indicators listed, respectively (Figure 8).

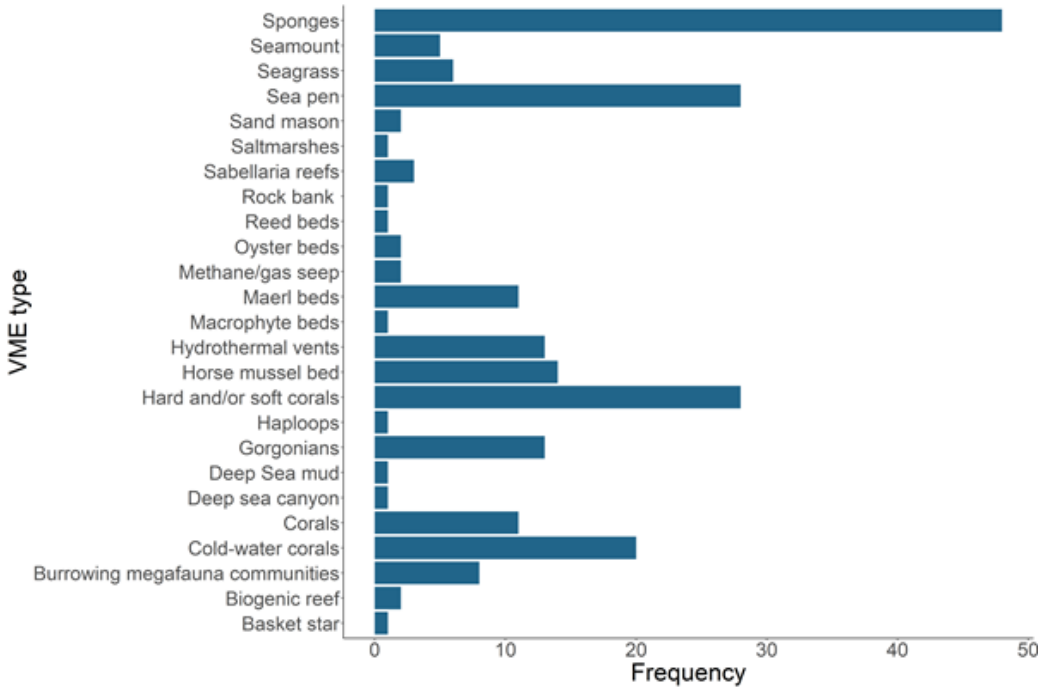


Figure 8. Types of VMEs and the number of fisheries for which they have been listed.

When taken together, corals (including corals, hard and/or soft corals, gorgonians and cold-water corals) were the most frequently identified VMEs across all fishery/gear combinations, accounting for 32% of all VMEs listed.

7.1 Benthic and pelagic fisheries

The fishery/gear combinations were split into either bottom (benthic) or pelagic fisheries to assess for consistencies in where VMEs had been identified. Pelagic fisheries were identified based on the target fish species, this included those targeting blue whiting, herring, mackerel, pout, sandeel, sprat and tuna. All others were assigned to the bottom fisheries group.

The majority of bottom fishery/gear combinations had VME indicator taxa/physical features identified under MSC assessment performance indicator 2.4.2 (Figure 9). Only 14% of bottom fisheries had no VME taxa or physical indicators identified. These included three fisheries where the Risk-Based Framework was mentioned as being used. Other fisheries had no information regarding the identification of VME indicators within the MSC assessment reports.

The most common gear type used in the pelagic group was midwater trawls. There were inconsistencies in whether VME indicators were identified and managed under the performance indicator 2.4.2 for pelagic fisheries. Overall, 25% had no VMEs identified (Figure 10), which is appropriate for cases where gears do not come into contact with the seabed. It was observed that some fisheries for pelagic species had bottom gears associated with them, for example XXX, which have both bottom trawls and mid-water trawls. It is likely that where VMEs were identified in relation to bottom contact gear, the VMEs were also considered in relation to the pelagic gears. However, XXX only had pelagic gears and VMEs had been identified (although it was noted that no VMEs were impacted by the pelagic gear). Conversely, XXX only has pelagic gears but no VMEs were identified.

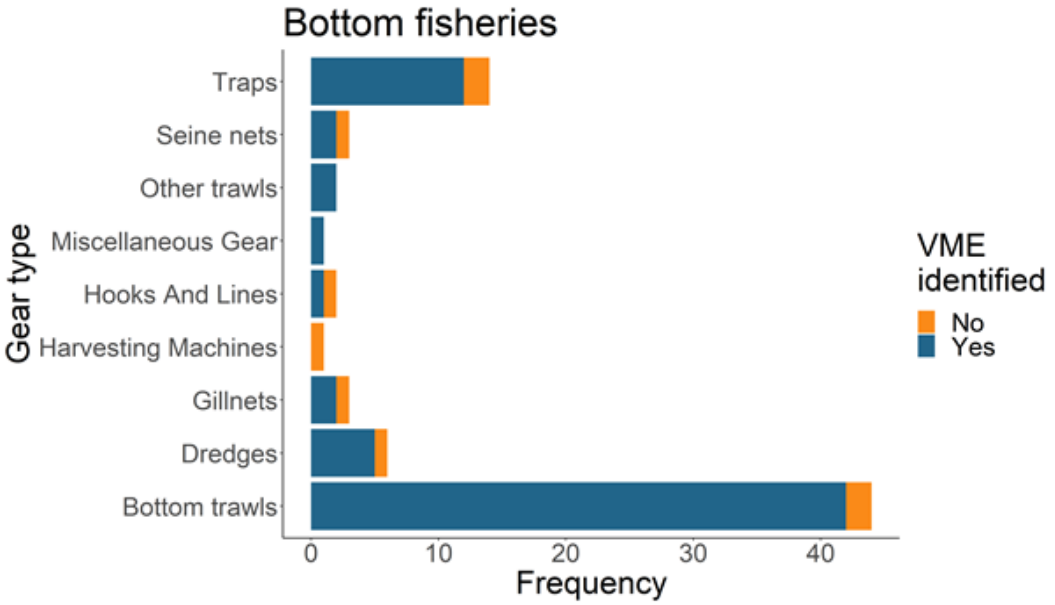


Figure 9. The identification of VMEs for each gear type in bottom fisheries (n=76).

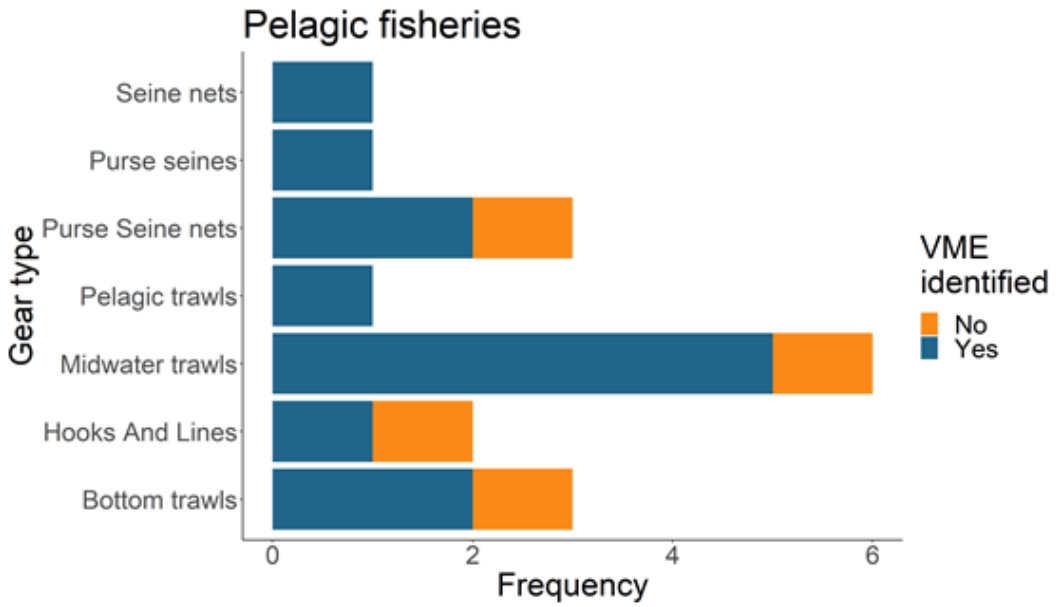


Figure 10. The identification of VMEs for each gear type in pelagic fisheries (n=17).

7.2 Regional fishery comparisons

This section presents region-by-region detail on the VME types identified in assessments (as listed in the MSC Database) and provides a comparison between fisheries within the same region. Tables showing the individual VME types identified for each fishery are provided in Appendix D. These present the VME types as they are specified in the MSC Database, which is drawn from the public certification reports. However, it should be noted that descriptive text in the assessment reports (and included in the database) for scoring justification sometimes provides different terminology (e.g. deep-sea mud for VME type, and seapens in burrowed mud in the 2.4.2a rationale text). Suspended fisheries are included in this analysis if they were present in the Database.

7.2.1 North Sea and Baltic Sea

For certified fisheries operating in the North Sea and Baltic Sea, VMEs were identified for the certification process using national (MPAs) or regional (OSPAR, Baltic Marine Environment Protection Commission (HELCOM), Natura 2000) regulations (Table D.1). There was significant divergence between fisheries in the identification of VMEs. The XXX had identified the most VME species and features (11 types), covering a range of both deep-sea and coastal species/habitats. These were defined against regional intergovernmental organisations, national and also fisheries management authority guidelines.

Other fisheries have far fewer VME types identified. The XXX did not identify any VMEs. This is understandable since these fisheries target pelagic species and have minimal interaction with the seabed. In contrast, XXX used a mixture of pelagic and bottom gears, and two VME taxa were identified (sea pens and burrowing megafauna), which is likely to be indicative of the specific areas in which the fisheries operate, and the potential for VME-like habitats to be found there.

The other demersal fishery had four VMEs identified – sponges, biogenic reefs, gas seeps and deep-sea mud. These differ from XXX, which did not identify deep-sea mud, but did identify haploops, corals, coral gardens. seapens and burrowing megafauna. There is also difference in terminology between the

two assessments, with XXX identifying 'biogenic reefs', and XXX identifying individual biogenic reef types (oyster beds, maerl beds, horse mussel beds and *Sabellaria* reefs). Additionally, seapens were not specifically identified in the fishery, although they are covered by deep-sea mud (burrowed mud) and the fishery has implemented a voluntary closed area to protect sea pens in the XXX. This represents a bringing-forward of protection measures that are likely to be put in place by a Nature Conservation MPA, which has been designated but for which management measures have not yet been introduced.

7.2.2 Barents Sea

Overall, there was relatively high consistency between fisheries regarding the taxa and habitat types listed as VMEs (Table D.2). All fisheries in the Barents Sea had identified corals, with the majority listing cold water coral reefs and coral gardens. The majority of the fisheries defined their VMEs based on NEAFC (with the exception of XXX). XXX were the only fisheries not to list sponge aggregations as a VME.

The fisheries which operate shrimp trawls were consistent with each other and had the same VME types listed. Equally, they defined their VME habitats using the OSPAR and NEAFC regulations.

The XXX fishery only mentioned sponges and gorgonids as possible VMEs but that there was no definitive map available for the area of the fishery. The public certification report highlights that the main habitat type is soft sedimentary bottom but there appears to be a paucity of information available.

7.2.3 Central Atlantic Ocean

XXX fishery were the only certified fisheries in the central Atlantic Ocean region and identified VMEs or sensitive habitats using a risk-based framework or national MPA designations, respectively (Table D.3). The fisheries use different gear types, however, both had identified rock habitats (hard-bottom habitats or rock banks) as VME types. The XXX fishery had also identified coral reefs and sea grasses. XXX had "sensitive taxa" listed as a VME, however the assessment of 2.4.2a stated that VME habitats (such as coral reefs and seagrasses) are found in deeper waters or in a no-trawling zone and therefore the fishery is unlikely to come into contact with these VMEs.

7.2.4 North East Atlantic Ocean

The North East (NE) Atlantic Ocean contained the highest proportion of fisheries in the MSC database, totalling 15 fisheries and 30 UoCs. Of these, there were two fisheries which had no VMEs identified due to pelagic gears not coming into contact with the seabed. However, other fisheries which used a combination of mid-water and bottom gears had VMEs listed which may have due to the need to identify VMEs for bottom fishing gears (Table D.4).

Overall, there was fairly high consistency among fisheries in terms of identifying corals (identified variously as corals, coral gardens, hard and/or soft corals, and cold water corals) and sponges as VMEs. Other VME types (sea pens, horse mussel beds, maerl beds) were more variable across the fishery assessments; this may be related to the different areas in which the fisheries occur, and therefore the habitat types they are likely to come into contact with.

The majority of fisheries defined VMEs in line with OSPAR (list of threatened and declining species). Only one fishery used different criteria (national regulations and the FAO criteria). Further investigation into the Public Certification Report revealed that this assessment considered the VME taxa contributing

to the ICES VME index as well as taxa identified through other literature (e.g. bryozoans – the only fishery in the region to consider this VME type).

Sponges and types of corals were listed as VME types across all fisheries which had identified VMEs. Other VME types which do not fall under the FAO examples were identified, likely in line with regional and national regulations, such as horse mussel beds (four fisheries) and maerl beds (three fisheries). Hydrothermal vents were recognised for six fisheries, five of which consisted of XXX. Bryozoans were considered for only one fishery.

The only bottom trawling fishery to have no VME types listed in the Database, was XXX. Although there was no justification of this in the database, further investigation into the Public Certification Report for the fishery revealed that 'OSPAR VMEs' were considered.

7.2.5 North West Atlantic Ocean

In the North West (NW) Atlantic, VMEs/sensitive habitats were defined predominately based on national approaches with the exception of XXX which used NAFO as well as national (Table D.5).

Sponges were the most widely considered VME type and were identified in all the fisheries apart from the XXX, possibly reflecting the areas in which the fishery operates (XXX fisheries operate in relatively shallow water), although this fishery was also the only one in the region to identify geographical features in the form of deep-sea canyons as VME indicators.

There were six fisheries which were certified to use traps in this region, all of which use the DFO guidelines to define their sensitive benthic areas. This is likely the reason for general consistency in the identification of sponges and sea pens in nearly all six of these fisheries. XXX was the only fishery to list seagrass as a VME taxa – this is likely to be due to the more inshore location of this fishery.

7.2.6 South West Atlantic Ocean

Only XXX fisheries were certified in the South West (SW) Atlantic. Both use mobile bottom contact gear, however, only the XXX fishery had listed VME taxa, including corals, anemones, sponges and the Chilean basket star (Table D.6).

7.2.7 Bering Sea

There was overall consistency across the certified fisheries in the Bering Sea with regard to how VMEs are defined and the VME indicator types listed (Table D.7). Apart from the XXX fishery, all fisheries use bottom trawls, define their VMEs using the National Marine Fisheries Service, Habitats of Particular Concern and Essential Fish Habitats to define VMEs, and have listed hard and/or soft corals and sea pens as the only VME types. XXX used a similar national guideline, the North Pacific Fishery Management Council's Habitats of Particular Concern, to define VME types which included cold water corals and seamounts. The consistency in approach among fisheries in this region is facilitated by all fisheries being under US jurisdiction.

7.2.8 Eastern Pacific Ocean

Four fisheries in the Eastern Pacific Ocean were included in the Database, ranging from the north-east Pacific to the south-east Pacific. Of these, three have identified VMEs, all using national guidelines or

MPA features (Table D.8). The XXX fishery lists cold water corals, sponges, sea pens and seamounts as VME types, however, the Chilean fisheries have only identified seamounts.

VMEs were not specified for the XXX fishery. Upon further inspection of the assessment report, it was noted that the gear types, trolling lines, gillnets and seine nets, are all "operated without intentional contact with the seafloor" and any interaction or gear loss would result in highly localised impacts. There were no direct strategies to prevent habitat impacts.

7.2.9 South West Pacific Ocean

The XXX was the only fishery in the SW Pacific Ocean included in the Database. It had no VME types listed. The MSC assessment report specified that no VMEs are impacted by this fishery. It is likely that this is due to the use of pelagic gears being unlikely to come into contact with the seabed (Table D.9), and thus it is not clear why it was included in the Database.

7.2.10 Indian Ocean

In the Indian ocean XXX fisheries are included in the Database. The former was included on the request of the study team, due to the potential for dFADs to interact with coral reefs. Neither fishery assessment had identified VMEs. The XXX assessment report listed coral reefs as a VME type. XXX had no VME types identified even though it employs bottom trawls. Under performance indicator 2.4.2a it was stated that this fishery had identified VMEs and had already protected them using spatial closures such as MPAs, concluding therefore that there are no VMEs or pVMEs within the fishing areas (Table D.10).

7.2.11 Inshore areas

All fisheries in the database which use bottom fishing gear in inshore areas were grouped together for comparison; these were all in European waters (Table D.11). Most of the fisheries used traps or dredges. VME and sensitive habitats were defined by national (MPAs, Sites of Special Scientific Interest (SSSI)) or regional (OSPAR, Natura 2000) approaches, or by risk-based frameworks. The species and features identified as VMEs were generally different compared to the other fisheries in the database (due to being in shallow inshore waters rather than deeper offshore waters) but are generally recognised on national and regional levels as sensitive or ecologically important habitats (such as seagrass beds, biogenic reefs and reed beds in freshwater). Identification of these habitat types likely arose from knowledge of the local fauna and flora in the fishing area.

Seagrass was the most recognised VMEs within these fisheries, followed by sand masons and biogenic reefs. A total of four inshore fisheries which used risk-based frameworks to define VMEs had no clear definition and had no associated VME indicator types.

7.3 Summary

There was a general consensus that the main taxa/features identified as VME types in the database were types of corals, sponges and sea pens. Corals and sponges were the most consistently identified. This mirrors recommendations made in the FAO Guidelines on the vulnerable species and features most likely to require VME status. There was less consistency across fisheries in relation to the identification of other habitat types, including sea pens, horse mussel beds, maerl beds, hydrothermal vents and bryozoans as VMEs.

The majority of fisheries used national (e.g. DFO, MPA, NOAA) or regional (e.g. OSPAR, Natura 2000) approaches to define their VME types rather than RFMO approaches. It was also evident that inshore fisheries have identified VME taxa and physical features which are shallow-water species, such as seagrass, sand masons and biogenic reefs. Fisheries which used risk-based frameworks tended not to have VMEs identified. It was therefore unclear whether sensitive/VME habitats were being appropriately identified and managed by these fisheries, or assessed in the assessment process. Not all fisheries for benthic species, which typically deploy bottom contact gear such as bottom trawls, dredges and traps, had identified VMEs. However, it was generally unclear why this was the case. A higher proportion of fisheries for pelagic species had not identified VMEs, with most stating under PI 2.4.2 that VME habitats are not impacted by the fishing gear as it does not come into contact with the seabed.

8 Stakeholder Consultation

8.1 MSC Stakeholder Workshop

MSC held two online stakeholder consultation events on VMEs in July 2020. This section provides a summary of the views put forward by different stakeholder groups at those events. Stakeholder groups were determined based on the 'Clarifying the MSC's habitat requirements Consultation Summary Report' (MSC, 2020).

8.1.1 Academic/Scientific

Academic/scientific stakeholders highlighted that more detailed information is needed for why VMEs need to be specifically defined within the MSC Standard compared to other types of protected habitats. Equally, it was acknowledged that clarity is also needed on what habitats constitute a VME as VMEs may be different in national waters compared to in the deep-sea. Additionally, there is a debate in different organisations between the difference between a VME and a pVME and more clarity is needed on the definition of both.

One stakeholder commented that having VMEs assessed separately in the standard is helpful and that VMEs should be considered within the standard. However, this was dependent on clarity of what constitutes a VME/VME taxa.

There were concerns that there was no scientific backing acknowledged in Principal 2 (SA3.13.4) which describes that reductions in habitat structure and function should not fall below 80% of the unimpacted level. This level was described as being high compared to other protection thresholds such as the aim to protect 30% of the ocean in MPAs by 2030.

It was recognised that scoring of fisheries was easier for fisheries which have clearly identified VME indicator taxa.

8.1.2 Commercial wild harvest fisheries

Stakeholders identified issues with the definition of a VME in the MSC Standard. Confusion was also acknowledged over how to identify a VME and which habitats need protecting with respect to the structure and function of a habitat. Several individuals mentioned it was unclear who was responsible for determining VMEs in the fishing areas and that it should be the responsibility of the management authorities to identify and implement acceptable management.

It was suggested that more information was needed in the Standard over what should be done when there are already expansive protections in place but VME taxa are identified elsewhere.

The stakeholders stated that how VMEs are identified and scored should be clearer to ensure it is comparable between jurisdictions and that any scoring should be based on the level of habitat information/data collected. It was acknowledged, however, that this could be difficult for developing countries. There was also concern regarding how reductions below 80% of structure and function was scored and if the 80% was cumulative across the whole fishing area.

It was highlighted that although VMEs and the FAO criteria might not be "fit for purpose for MSC", the link to the FAO criteria and UNGA resolution is helpful as it is recognised by management agencies and the implementation of non-recognised criteria could be difficult.

8.1.3 Conformity assessment/accreditation

It was acknowledged by conformity assessment/accreditation stakeholders that there is ambiguity around how VMEs are defined and that the definition should be supported by comprehensive guidance and examples. This included one stakeholder asking for a review of the requirements of serious or irreversible harm in terms of how to determine the fragility of a habitat to eliminate ambiguity of how to define a VME. It was also mentioned that clarity is needed on why VMEs are assessed separately from other types of protected habitats.

There were questions over how to assess the 'function' of a VME as part of Principal 2 (SA3.13.4) in the MSC Standard. Whilst assessing serious or irreversible harm to habitat *structure* was described as being easier, there should be guidance on how to assess habitat structure and function and how they may change compared to baseline levels.

A comment was made regarding the compliance of fisheries to VME protection. The identification of VMEs could cause conflict between government bodies and conservation groups with fisheries which may lead to fisheries avoiding VMEs altogether or avoiding reporting encounters.

8.1.4 Governance/Management

One governance/management stakeholder described a disjunct between their guiding legislation, which was implemented before the FAO guidelines, and the FAO guidance, which has led to a lack of consistency.

It was repeated on several occasions that VMEs/pVMEs should not need to be identified where effective management and protection was already in place. The stakeholders also mentioned that scoring of fisheries should consider the amount of habitat data and information the fisheries have, however this could be challenging for developing countries which may not have the necessary resources.

It was stated that MSC should avoid absolving particular fishery types from addressing VMEs.

8.1.5 NGO

NGO stakeholders called for scientific-based approaches in the identification and protection of VMEs. It was acknowledged that the use of survey data was useful, however, it was difficult to determine appropriate densities for the management or closure of a VME from habitat suitability models. It was also recognised that it is difficult to identify a historic baseline with which to compare fishing impact in terms of serious or irreversible harm.

8.1.6 Other: Consultant

The stakeholder described that there was no justification from MSC for applying deep-sea guidelines to shallow water habitats and how guidance about what shallow water species or habitats should be included. Confusion was also expressed over what is an acceptable amount of habitat to designate.

8.1.7 Standard setting

A standard setting stakeholder described that some organisations, areas and fisheries have "no interest" in VMEs. Other criteria such as ecologically and biologically sensitive areas might play a larger role in understanding impacts of fisheries.

8.1.8 Summary

One of the main themes identified by nearly all stakeholder groups (apart from government/management and standard setting) was that the definition of a VME needs further clarification in the MSC Standard. This includes confusion over:

- The definition of VMEs and pVMEs (academic/scientific, commercial wild harvest fisheries, conformity assessment/accreditation);
- How to identify VMEs based on species or habitat types, particularly in national jurisdictions and shallow water areas where VME terminology is often not specifically used (academic/scientific, commercial wild harvest fisheries stakeholders);
- Why VMEs are included in the Standard and how they differ to other protected sensitive areas (conformity assessment/accreditation, and other: consultant).

Further, commercial wild harvest fisheries stakeholders acknowledged that there was confusion over who is responsible for determining VMEs and whether it should be the responsibility of the management authority of the fishery.

Whilst most stakeholders were in agreement over the need for clarity, it was raised by a commercial wild harvest fisheries stakeholder that the use of the UNGA resolution and FAO criteria are helpful as they are recognised by management agencies and highlighted it would likely be difficult to implement non-recognised criteria.

There was a call for clarity over Principal 2 (SA3.13.4) in which "the team shall interpret serious or irreversible harm as reductions in habitat structure and function below 80% of the unimpacted level". Academic/scientific and conformity assessment/accreditation stakeholders questioned how the "function" of a habitat or ecosystem could be assessed. This included a conformity assessment/accreditation stakeholder suggesting there is no easy way to assess the function of a habitat and whether it is impacted by fishing operations. In addition, an academic/scientific stakeholder questioned the 80% threshold and asked for an acknowledgement of the science behind the value. Similarly, commercial wild harvest fisheries stakeholders expressed confusion if the 80% threshold was cumulative across the whole area or for separate VMEs, and NGOs suggested that there are difficulties in establishing an unimpacted baseline with which to compare the disturbance.

8.2 Stakeholder Interviews

A series of interviews with stakeholders were conducted during the course of this study. Eight interviews were conducted, covering:

- Four different fisheries (2 in Europe, 2 in US/Canada);
- Fishing interests (4);
- Management/governance interests (2);
- NGOs (2).

8.2.1 FAO criteria and VME terminology

Stakeholders supported the use of the FAO criteria, as they are internationally recognised. Fishery stakeholders, in particular, would not support the use of criteria that are not internationally recognised, preferring that all fisheries are assessed against criteria that are common to everyone.

VME terminology is not widely used in national waters (see also national case studies in section 4). Stakeholders highlighted that this makes it difficult to align with the MSC Standard requirements, and results in differences between jurisdictions in relation to which habitats are considered as VMEs for the purposes of MSC assessment.

There were differences in opinion in relation to what habitats should be considered as 'VME' for the purposes of assessment. On the one hand, where national authorities have identified good lists of sensitive and protected habitats, it was felt that these should be used. However, it was also highlighted that national designations are not necessarily equivalent to VMEs (and some can withstand a degree of impact from fisheries), and the original VME definition should be used to determine what to consider. There was a strong desire for a 'level playing field' in this respect, so that fisheries operating in jurisdictions that have made different levels of progress in identifying and protecting sensitive habitats are assessed against the same overall benchmark, particularly in relation to which habitat types are considered. This was also highlighted as a concern where modelling approaches result in large areas being considered a 'potential' VME but further validation or ground-truthing, and necessary protection measures, have not been put in place. One fishery stakeholder suggested using the list of specific corals and features in the FAO Guidelines.

8.2.2 Move-on Rules

Stakeholders agreed that in national waters, move-on rules are generally not used, with spatial management being used instead to protect sensitive habitats. Where move-on rules have been introduced in national waters, this has generally been in response to the requirement to meet the MSC Standard. It was also noted that there is generally a better understanding of the distribution of inshore sensitive habitats compared to offshore (making move-on rules redundant where adequate protections are in place). It was also highlighted that move-on rules should not be used as the basis for understanding the distribution of VMEs – rather, that should be done through surveys and mapped information.

Fishery stakeholders identified two instances when move-on rules might be appropriate:

- Where sensitive habitats have not been identified and protected; and
- In frontier areas (new areas that have not been fished before by any bottom-contact fisheries, e.g. ice-retreat areas).

In relation to the second point, conservation stakeholders felt generally that move-on rules were not appropriate, and rather there should be a requirement to map and protect VMEs *before* any fishing begins in such areas.

There was consensus amongst fishery, management/science and conservation stakeholders that there are many situations where move-on rules are *not* appropriate, specifically[10]:

- In areas where there is good spatial management through protected areas for sensitive habitats (fishing stakeholders);
- In heavily fished areas (fishing should be allowed to continue in these areas) (fishing and conservation stakeholders);
- In areas where there are sensitive habitats – these should be protected through spatial closures and frozen footprints (management/science and conservation stakeholders);

[10] Note, the identification of stakeholder groups against each point identifies the groups that brought up those points, unprompted by the interviewers. It is possible that they would also agree with points raised by other stakeholders – this was not explored.

- In fisheries where gears are unlikely to bring indicator species onto deck (management/science and conservation stakeholders);
- Where there is no observer coverage (management/science stakeholders); and
- Where they would encourage cumulative impacts on sensitive habitats through the serial moving on of damaging fishing activity, e.g. if a fishery takes place in a small proportion of the available area (fishery and management/science stakeholders).

Other points raised in relation to move-on rules were: that thresholds can appear arbitrary, and need to be set at an appropriate level; high observer coverage is needed for records of encounters to be considered reliable; recording encounters can be difficult where the net/catch is very large; where observer sampling protocols mean the whole catch is not recorded, extrapolation of a single occurrence can result in thresholds being breached (when in fact it may be a single occurrence in the whole haul); it may be impossible to determine the tow in which an indicator was caught when it may initially be tangled high in the trawl and then only subsequently make its way to the cod end after several tows; and move-on rules are ineffective where the tow length exceeds the move-on distance.

8.2.3 Alternatives to move-on rules

The two main alternatives to move-on rules identified and explored by stakeholders, were the frozen footprint approach, and spatial management and spatial closures for sensitive habitats.

There was consensus across all stakeholder groups that spatial closures are the most appropriate approach in areas where sensitive habitats/VMEs are known to be present. Conservation stakeholders also suggested that individual fisheries should have a spatial management plan that identifies where the fishery *can* go as well as where it *cannot*. Setting out where a fishery can go is similar to a frozen footprint approach (although it might also identify non-sensitive areas outside of the current footprint).

Fishery and management/science stakeholders were generally supportive of the frozen footprint approach, which they considered appropriate in areas with sensitive habitats, although with caveats. Conservation stakeholders highlighted the need for relevant data to be publicly available, and for the scale/resolution at which the footprint is identified to be fine-scale (to not permit fishing expanding into previously unfished areas within large-scale 'fished' blocks).

Caveats in relation to the footprint approach were:

- It needs to build in flexibility to address climate-driven distributional changes to fish stocks, allowing the fishery to modify its footprint over time, potentially with a risk assessment to inform the movement, although consideration should be given to the active footprints of other fisheries (i.e. because the movement may not be into virgin, unimpacted ground);
- Not appropriate to all fisheries – some are highly variable spatially, driven by environmental variables that affect fish abundance/distribution;
- Even if not a 'frozen' footprint, regular review of a fishery's footprint can identify potential for impacts on benthic habitats and enable these to be addressed;
- Careful consideration of the 'baseline' for the frozen footprint is needed, and whether it is the modern footprint, or a legacy footprint. In some fisheries the former may be smaller (due to reducing effort, more accurate targeting of fishing grounds), or larger (if there has been uncontrolled expansion of effort in recent years). Additionally, regulatory measures (not environment-related) may have resulted in the fishery developing outside of otherwise important fishing grounds.

8.2.4 Implications for the MSC Standard

All stakeholder groups agreed that information and evidence are essential. If VMEs have not been identified within a jurisdiction, fisheries should not get a 'free pass' to the VME scoring requirement. There should be a requirement for *evidence* that there are no VMEs, i.e. proof of absence, rather than an absence of evidence of their presence. This could be considered under the information criterion, and where there is no information this would not meet the SG60 level.

In making any changes to the Standard, a one-size-fits-all approach should be avoided in relation to the requirements. It should focus on delivering the output (minimising impacts on sensitive habitats) rather than on specific input requirements (move-on rules). In this respect, fishery stakeholders felt that if the SG80 requirements are met (e.g. through identification of VMEs and spatial protection measures being in place), there should not be a requirement for move-on rules at SG60. In this respect, it was felt that the MSC process has not done well at capturing the broader policy landscape of biodiversity protection at a national level, and that fishery impacts on sensitive habitats should be considered within this broader context, rather than requiring specific approaches to be implemented. It was also felt that the assessment should involve a review of the area management system in place for the fishery from the ground up – what is known about where sensitive habitats are, and how fishing has been zoned around them.

Although a one-size-fits-all approach should be avoided, stakeholders also felt that fisheries should be assessed on a level-playing field, regardless of the jurisdiction they operate within (and the associated level of identification of sensitive habitats, i.e. fisheries should not be penalised because there is good information on habitats, compared to fisheries operating in jurisdictions where no attempt has been made to identify and map sensitive habitats.

Science/management stakeholders felt there where work has been done nationally to identify and protect sensitive habitats, these should be considered for the assessment, since assessors are not able to identify relevant habitats more effectively than national bodies. In the absence of any national process to identify VMEs, the MSC could create a list of habitats to be considered, and assessors then consider whether the fishery comes into contact with them. Fishery stakeholders also expressed a desire for fisheries in all jurisdictions to be assessed against a common/standardised list of habitats, perhaps based on the list of species/habitats in the FAO Guidelines.

8.2.5 Minimum requirements for sensitive/VME habitats

Stakeholders felt that minimum requirements for fisheries in relation to sensitive habitats should be to consider whether information is being collected, both on sensitive habitats and to develop an understanding of the habitats that the fishery interacts with. There should be a process in place to use those data to develop measures to minimise the risk of a fishery having a significant negative impact on a VME. This could involve spatial closures, or the fishery itself could take actions to freeze its footprint, or avoid marginal fishing grounds to reduce its footprint. The fishery could also use acoustic technology to start to develop maps of habitat types (e.g. hard/soft bottom initially), which can be refined over time. Conservation stakeholders felt that the minimum requirement for a sustainable fishery should be that the fishery does not have a significant impact on VMEs, or conversely, that it only has a marginal impact.

Progression of this approach would see mapping of sensitive habitats and closure of key areas that would be irrevocably damaged if impacted by fishing, and enforcement of those areas. This should be an ongoing process, incorporating new information as it arises, and requires a good dialogue between fisheries, management and conservation interests.

9 Conclusions

The FAO Guidelines were developed for ABNJ, and the concept is now firmly embedded in regimes for the management of deep-sea fisheries in the high seas, with good progress having been made in addressing the requirements of UNGA Resolution 61/105 in high seas areas (UNGA, 2016). In contrast, national authorities have often identified and protected sensitive habitats using a range of criteria, but rarely refer to them as VMEs unless their waters specifically encompass deep-sea environments.

Protection and management of VMEs embody the cross-cutting issues of conservation and fisheries management. CCAMLR was one of the first management bodies to develop approaches to protecting VMEs in high seas areas, and it is notable that its mandate is to ensure the conservation of Antarctic marine living resources, giving it a wider remit to the RFMOs which are focused on managing fisheries resources. Through the UNGA Resolutions, the requirement for RFMOs to manage impacts that fisheries have on the environment has been strengthened.

In national waters, approaches to the identification and protection of sensitive habitats are generally progressed through conservation legislation, rather than fisheries management. As a result, consideration of measures which are in place to manage impacts of fisheries on the environment need to be sought not just in fisheries legislation and fisheries management plans, but in conservation regulations and environmental protection measures, as these have often taken into consideration the impacts of fisheries but are not necessarily captured within fisheries management plans.

The following sections address the specific questions raised in the study objectives.

9.1 Are the FAO VME criteria fit for purpose for application within MSC assessments?

The FAO VME criteria are appropriate for application in high seas areas, but their application has been limited in national waters (with the exception of deep-water environments). Instead, national authorities have used a variable range of criteria to identify sensitive habitats requiring protection, that often incorporate concepts of 'productivity' and 'naturalness' (i.e. that may not be equivalent to the VME concept), and some approaches to MPA networks aim to protect 'representative' habitats as well as specifically vulnerable/sensitive habitats. Therefore, all designated habitats in national waters should not necessarily be considered VMEs.

The FAO VME criteria are specifically designed to be implemented in deep-sea waters which may not be appropriate for certain MSC fisheries which are in inshore or coastal areas. Whilst paragraph 10 of the Guidelines says that Coastal States may apply them within national waters 'as appropriate', the appropriateness of application should be considered in relation to the scope for which the Guidelines were developed. The Guidelines were developed specifically for deep-sea fisheries, and Paragraph 8 defines these as fisheries where the total catch includes species that can only sustain low exploitation rates, and where the fishing gear is likely to contact the seafloor.

The FAO criteria list important aspects to consider such as the uniqueness or rarity, functional significance, fragility, life-history traits and structural complexity. The Guidelines also provide suggestions of the VME types such as cold-water corals, sponges and hydrothermal vents. In high seas areas, the FAO criteria have generally been applied as set out in the FAO Guidelines, with RFMOs considering all five criteria to identify VME indicator taxa. The criteria have generally been considered in aggregate rather than individually, and individual taxa have been considered in relation to which of

the criteria they fulfil. This appears appropriate, where functional significance or fragility, for example, may be interpreted very broadly.

In national jurisdictions, criteria used are often similar to the first four FAO criteria (with structural complexity not usually being considered), but also incorporate additional criteria which may result in habitats being identified that would not be considered as 'VMEs' under the FAO criteria (see section 9.2). Furthermore, within national waters, the term 'VME' is not usually used, resulting in confusion and inconsistency over what habitats are considered as VMEs for MSC assessments. This was further reinforced by stakeholder views which highlighted that clarity was needed on what habitats constitute a VME, particularly since these may differ between national waters and the deep sea.

The current approach in the MSC Standard to identifying VMEs and assessing fishery impacts has resulted in inconsistencies between fisheries in which habitat types are assessed as VMEs in MSC assessments. In some regions, VME taxa identified are fairly consistent (e.g. NE Atlantic, where NEAFC VMEs are identified and the OSPAR list of threatened and declining habitats provides some consistency for assessments on a regional level). Even in this region, though, beyond corals and sponges, there are differences between fisheries in whether sea pens, maerl beds, horse mussel beds and bryozoans are considered as VMEs; this may in part be due to the specific areas in which the fisheries operate, but it was not possible to confirm this in this review. In other regions, there are large discrepancies in identification of VMEs between fisheries (e.g. SW Atlantic, where one fishery identified four VME types, and the other fishery identified none). Benthic fisheries in the MSC Database with no VME taxa identified tended to be those that used the Risk-Based Framework (i.e. those where there is limited information on identifying VMEs from management authorities). This leads to the distinct potential for a non-level playing field between fisheries in different regions and national jurisdictions, due to the lack of consensus over what should be considered as a VME, and different levels of progress on identifying and protecting VMEs in different jurisdictions.

This study concludes that simple consideration of the FAO criteria is not sufficient for assessment teams or fishery clients to identify VMEs. A scientific and data-driven process for individual regions or jurisdictions should be conducted in order to determine which species or habitat types qualify as VMEs under the criteria (and to consider where significant aggregations of indicator taxa occur to qualify as a VME). This process inevitably requires significant time, resources and expertise, potentially also accounting for the societal valuing of habitats of different types and qualities (i.e. which habitats should be considered VME, and what is the threshold at which an aggregation of VME indicators should be considered to be a VME). This is clearly beyond the scope of individual assessors carrying out a fishery certification. This process has been fairly comprehensively implemented across RFMO areas, but not across national jurisdictions, which have used a range of different criteria and are at different stages in the process of identification and protection of sensitive or VME-like habitats.

An alternative approach needs to be considered. Options include:

- The MSC Standard could specify that species/habitats afforded protection under national law should be taken into account;
- The MSC could initiate a process to develop guidance that specifically lists the types of inshore and offshore habitats/ecosystems that should be considered as VMEs for the purposes of assessment. This could consider FAO criteria and/or alternative criteria (see section 9.2);
- The MSC could restrict the consideration of VMEs to only deep-water habitats and ecosystems (i.e. those for which the FAO Guidelines were developed), with other inshore habitats considered against the commonly encountered or minor habitats scoring issues.

Each of these options has drawbacks. The first is complicated by the fact that some national MPA networks seek to protect *representative* habitats (i.e. not specifically *sensitive* habitats) which do not correspond with a common understanding of VMEs, and also approaches and the level of protection afforded differ substantially between national jurisdictions depending on the level of resources available and invested into identifying and protecting such habitats. The second risks setting out an inflexible list that may not be appropriate to all jurisdictions. However, it is suggested that based on the analysis conducted for this report, which covers both high seas and coastal, tropical and temperate fisheries, an initial list could be compiled that captures the main habitat types considered to represent VMEs for the purposes of assessment. This could be refined through a consultation process to develop region-specific lists of relevant habitats. The benefit would be that assessments of fisheries in different jurisdictions at varying stages of identifying and protecting such habitats would be consistent in the habitats considered as VMEs. The third would mean that inshore habitats are not assessed against the high bar that VMEs are assessed against, which may meet resistance from conservation interests and NGOs. If sensitive habitats are not included in the 'commonly encountered' habitats, they may not be assessed at all unless scoring issue (c) is assessed at SG100.

9.2 Do alternative criteria to the FAO VME criteria exist for identification of benthic habitat types which are particularly sensitive or vulnerable to serious/irreversible impact from fishing activity?

The FAO VME criteria have been applied across most ABNJ by RFMOs, however they have not been widely applied within national jurisdictions where the term 'VME' is not commonly used.

Within national jurisdictions, a range of criteria have been used to identify and protect benthic habitats (Table 22). In some cases, there is good read-across between national criteria and the FAO and CBD EBSA criteria (e.g. Scotland's PMF criteria, Canada's EBSA criteria), but not in others (New Zealand's BPA criteria). Notably, the FAO criteria for uniqueness or rarity, functional significance and fragility (including relevant life-history traits) appear to be fairly consistently addressed in the CBD EBSA criteria, Scotland's PMF criteria and Canada's EBSA criteria. However, it is important to note that the one FAO criterion that is **not** covered by these other approaches – structural complexity – is the criterion that NAFO highlighted as being key when identifying VMEs (rather than individual VME indicator species or taxa) (NAFO, 2013a).

The CBD EBSA criteria are an example of an international set of criteria which could be considered as an alternative to the FAO criteria for the identification of vulnerable and sensitive habitats. They have been applied globally in coastal and offshore areas. Over 300 EBSAs have been described around the world through a series of regional workshops, although there is a notable gap in the North East Atlantic region, and these criteria have not always been taken up at a national level. The EBSA criteria appear to have been used as a basis for some national criteria to define sensitive habitats, but national approaches vary significantly, whilst some EBSAs have been identified for features other than physical habitat, such as seabird feeding areas. Adoption of these criteria by the MSC would not solve the current issue of what habitats to consider as sensitive habitats or VMEs in MSC assessments – national jurisdictions in general do not have a list of habitats that they consider to comply to the CBD EBSA criteria.

The MSC database showed that most MSC assessments of inshore fisheries have considered species or features not listed in the FAO VME criteria, but rather those based on national (for example SSSI) or regional (for example, OSPAR) lists covering regionally important taxa or habitat types.

These species include seagrasses, biogenic reefs (including *Sabellaria* reefs and coral reefs) and mussel and oyster beds. The majority of fisheries, however, tended to protect sponges, corals, sea pens and seamounts, based on the FAO criteria.

Stakeholders expressed the desire that there should be a level playing field across different jurisdictions when considering the VME issue. For example, if one jurisdiction has carried out extensive work to map and identify VMEs/sensitive habitats, under the current standard this means that they are held to a higher bar than a fishery in a jurisdiction that has not done any mapping and has no sensitive habitats designated in national legislation. This points towards the definition of a standard list of VME habitat types for consideration in MSC assessments, rather than a standard list of criteria.

An analysis of the strengths and weaknesses of different criteria and approaches to identifying VMEs for MSC assessments is provided in Table 23.

Table 22. Comparison of criteria for identifying and protecting habitats

FAO criteria	CBD EBSA criteria	OSPAR criteria (2019)	Scotland's PMF criteria	Canada (EBSAs)	Alaska HAPC (must meet 2 criteria)	New Zealand (BPAs)
Uniqueness or rarity	Uniqueness or rarity	Rarity	Rarity	Uniqueness	Rarity (mandatory)	
Functional significance of the habitat	Special importance for life history stages of species	Keystone species Ecological significance (of habitats)	Functional importance	Fitness consequence	Importance of ecological function	
Fragility	Vulnerability, fragility, sensitivity or slow recovery	Sensitivity (easily adversely affected and slow recovery)		Resilience (inverse of vulnerability)	Sensitivity to human-induced degradation	
Life-history traits (slow growth, long-lived)						
Structural complexity						
	Importance for key species/habitats[1]					
	Biological productivity					
	Biological diversity					
	Naturalness			Naturalness of the area		Unmodified
		Global importance Regional importance	Proportional importance			
		(Status of) Decline	Decline or threat of decline		Whether activities are/ will be stressing the habitat	
			International commitment			
				Aggregation		
						Large
						Simple in form
						Consistent with protection policy[2]
						Representative

1 Importance for threatened, endangered or declining species and/or habitats; 2 Policy to protect 10% of each identified marine environment

Table 23. Strengths and weaknesses of different approaches to identifying VMEs

Approach/ criteria	Strengths	Weaknesses
FAO Criteria	▪ International process and global set of criteria ▪ Wide uptake on the high seas – most RFMOs have identified VMEs and use VME terminology ▪ Easy to apply and assess in ABNJ	▪ Most national jurisdictions do not use VME terminology, so it is not clear which habitats to consider for the assessment ▪ Difficult to apply in national jurisdictions/inshore waters, resulting in inconsistency between assessments ▪ Inconsistency with national approach may lead to strong criticism and /or lack of management/ regulator engagement. ▪ Inconsistency with national approach may lead to strong criticism and /or lack of engagement from other (non-MSC) fishery operators.
CBD EBSA	▪ International process and set of criteria ▪ Developed to be relevant to both inshore waters and open seas ▪ EBSA areas have been identified for many regions of the world	▪ EBSA areas do not appear to have been widely incorporated into national policy/protections ▪ No areas identified for NE Atlantic ▪ EBSA terminology not used in national waters, so the problem of identifying which habitats correspond to EBSAs remains ▪ EBSAs may be identified for more than just benthic habitat features, so still requires assessor interpretation of habitats to be scored.
National designations	▪ Relevant to specific fisheries and regions ▪ Takes into account those habitats/species considered important at national level. ▪ Will have management/ regulator engagement. ▪ Should have engagement from other (including non-MSC) fishery operators.	▪ National approaches do not always focus on *vulnerable/ sensitive* habitats (sometimes on representative habitats), therefore not in line with the intention of scoring issue 2.4.2(a) ▪ Different jurisdictions have made different progress in identifying and protecting habitats, meaning that fisheries in areas with few designations will score higher more easily than fisheries in areas with many designations (the converse of the intention of the scoring issue)

Approach/ criteria	Strengths	Weaknesses
Bespoke list of habitats for MSC assessments to consider, by region	▪ Assessment for all fisheries would consider the same list of sensitive/vulnerable habitats – level playing field	▪ Would require investment and stakeholder consultation to develop such a list ▪ List could be considered inflexible and may not be appropriate to all jurisdictions ▪ Inconsistency with national approach may lead to strong criticism and /or lack of management/regulator engagement. ▪ Inconsistency with national approach may lead to strong criticism and /or lack of engagement from other (non-MSC) fishery operators.
Apply scoring issue 2.4.2(a) only to deep-water habitats/ ecosystems	▪ In line with the original intent of the UNGA Resolutions and FAO Guidelines ▪ Identification of relevant habitats more straightforward, in line with Guidelines	▪ Inshore/ shallow water habitats would not be assessed against the same bar as deep-water VMEs. ▪ Sensitive habitats that are vulnerable to damage from fishing may not be accounted for adequately within assessments. ▪ Likely to be considerable concern from stakeholders.

9.3 Are move-on rules effective for protection of VMEs in national and international waters?

Move-on rules are an approach to account for the existence of unknown VMEs inside and outside of existing fishing areas. However, there are key limitations of encounter thresholds and move-on rules and they should not be considered as a minimum or only requirement for avoiding potential impacts on VMEs in national and international waters. Indeed, it is recognised that move-on rules cannot be considered in isolation, but are often one component of a package that includes spatial closures, impact assessments, and limits on catches or fishing effort (Hansen *et al.,* 2013). Furthermore, move-on rules are generally not used in national waters, where spatial management and closures are more commonly used to protect sensitive habitats.

Key limitations of move-on rules include, first, that thresholds lack scientific underpinning (apart from SPRFMO) and are criticised for being too high (Auster *et al*., 2011; Hansen *et al.,* 2013; Geange *et al*., 2020). This is likely one of the main reasons why move-on protocols have been triggered in only two out of eight RFMO Convention Areas (CCAMLR and SPRFMO, those with lower thresholds compared to other RFMOs). Second, VME indicator taxa tend to be delicate and are easily broken, damaged or not contained in the bottom fishing gear. Therefore, thresholds for move-on rules are not a reliable measure of the abundance and diversity of VME taxa, leading to inconsistent application of move-on rules, if they are triggered at all (Freese *et al.*, 1999, Auster *et al*., 2011). Third, no thresholds take into account the vast array of gear types, gear configurations and tow durations and speeds, and how these could vastly impact catchability of VME indicator taxa.

Finally, the distance that vessels are required to move on by is often inadequate (sometimes representing around 10% of the length of a trawl track) (Hansen *et al.*, 2013) and multiple encounters can result in cumulative impacts on potential VMEs (ICES, 2012; Caddell, 2020).

There was consensus amongst stakeholders that move-on rules are not appropriate in many circumstances, specifically where there is good spatial management, in heavily fished areas, where there are sensitive habitats present, for gears that are unlikely to retain indicator species/taxa, and where there are low levels of observer coverage). An additional concern raised by stakeholders relates to observer protocol that samples portions of the catch, rather than the whole catch. In these cases, where VME taxa appear rarely in a sampled portion of the catch, extrapolation of the sampled weight to the whole haul can result in unusually high weights being calculated, which may not represent the actual catch weight of indicator taxa in the haul.

Overall, it is evident that vigorous testing is needed to create effective and appropriate thresholds to trigger move-on rules in the presence of a VME (Auster *et al.*, 2011; Geange *et al.*, 2020). It is also likely these would have to be location-, gear- and VME taxa-specific. Scientific and societal input is needed for defining robust and tested thresholds for when an encounter with VME indicators should be considered a pVME. This includes the use of ground-truthing methods such as video surveys, and evaluation of retention of different taxa with different gear types, configurations and speeds which would be costly and time consuming.

It is important to note, however, that the use of encounter thresholds should not be disregarded entirely; their use has led to the identification of VMEs and pVMEs, particularly in the CCAMLR region where encounters which exceed threshold levels have led to 76 areas being identified as 'Risk Areas'. CCAMLR has the lowest encounter thresholds of any of the RFMOs which likely increases the chances for move-on rules to be triggered. In particular, stakeholders felt that move-on rules could be appropriate in areas where sensitive habitats have not been identified and protected, and in frontier areas where fishing has not previously taken place (although in such areas, a more precautionary approach would be to map and protect VMEs prior to fishing taking place).

In the MSC context, these key concerns have to be put into the context of the need to balance protection for sensitive habitats with support for activity within existing fisheries, as well as to allow for some exploration or spatial displacement of effort by fisheries when circumstances require it. In this light, it seems unlikely that the appropriate balance could be struck by MSC clients operating in national waters without the support of relevant scientists and managers.

Move-on rules are common in RFMO measures but are not widely implemented in national waters. In accordance with this, the CBD highlighted that relevant measures to avoid degradation or destruction of EBSAs include area-based management tools such MPAs, environmental impact assessments (EIAs) and strategic environmental assessments (SEAs). Move-on rules have not been called for, nor specifically implemented, in EBSAs outside of those considered to be VMEs under the jurisdiction of RFMOs.

9.4 Do alternative (and equivalent) precautionary management approaches exist?

A number of alternative approaches to move-on rules exist. The ideal situation is for benthic habitats to be well surveyed and understood, and sensitive areas protected from fishing (and other) impacts. Many shelf areas within national jurisdiction have a relatively good coverage of scientific surveys and extensive work has been undertaken to identify and protect relevant areas, as well as sensitive habitats outwith protected areas (e.g. Scotland). This is reinforced by Hansen *et al.* (2013) who highlight that it is 'necessary for RFMOs to initiate processes to develop reliable predictions and analyses of VME evidence

and VME distribution, and to then design and implement permanent spatial closures applicable to all participants, to protect key VME areas'.

Any consideration of possible precautionary management approaches to VMEs by the MSC should avoid a one-size-fits-all approach, but should promote a level playing field. This means there should be consistency in the habitats that are considered, and consistency in the requirement for a fishery to have an understanding of the VMEs in its area of operation. However, it should avoid prescriptive measures for addressing impacts (e.g. a requirement for move-on rules).

Consideration of the range of RFMOs and national case studies investigated for this report, as well as consultations with stakeholders, highlights that as a minimum, a fishery should have an understanding of its spatial footprint and the potential interaction with sensitive habitats, and there should be a process and some measure in place to mitigate the risk of significant negative impacts. The prescription of a particular type of management measure should be avoided, as there are a range of ways in which impacts on sensitive habitats can be avoided or reduced, and move-on rules are not always an appropriate approach. Importantly, relying on move-on rules to protect sensitive habitats may provide false security if their application is not robust and/or based on gear- and habitat-specific encounter thresholds that are appropriate. In this regard, there are no 'commonly accepted' move-on rules for many habitats that may be considered as VME within MSC assessments. The range of alternative measures identified in this report are considered in relation to their applicability for demersal gear types, whether they are robust to issues of low catchability of VME species, appropriateness for drifting gear types, and to situations of low observer coverage, in Table 24.

Minimum requirements should be that information is being collected on sensitive habitats and that there is an understanding of the fishery's interaction with them. There should be a process to use data to develop measures to minimise the risk of a fishery having a significant negative impact on a VME, and in this respect, the broader context of the policies and measures in place to protect benthic biodiversity should be considered in MSC assessments. Fisheries should be managed in a manner that is consistent with the level of understanding of the VMEs that are or may be present in its area of operation. In this regard, information and evidence are key, where lower levels of knowledge of habitats and habitat impacts should require more precautionary approaches to management.

Table 24. Assessment of precautionary measures for protecting VMEs

Measure	Applicable/ appropriate to all demersal gear types	Robust to issues of low catchability of VME spp by fishing gears	Appropriate for drifting gear (dFADs, pelagic driftnets and longlines)	Appropriate to situations of low observer coverage or little/no independent monitoring of catches
Move-on rule	No	No	No	No
Footprint approach (could be frozen, or remove marginal areas)	Yes (but need to take care over baseline)	Yes	No	Yes
Prior authorisations informed by impact assessments for fishing in new areas (combined with frozen footprint approach)	Yes	Yes/No: Yes (if benthic surveys are carried out to identify potential VMEs prior to fishing) No (if VMEs are expected to be identified through encounters during fishing)	No	No (activity in new fishing areas would be expected to require scientific observer to record encounters with indicator species)
Benthic surveys to identify VMEs, and implementation of spatial closures	Yes	Yes	Maybe (could identify areas where gear should not be deployed, to minimise risk of ocean currents taking them into sensitive areas. Would need additional controls e.g. GPS tagging, retrieval, biodegradable)	Yes
Technical measures (reduce benthic impact of fishing gears)	No (varies by gear type)	Yes	N/a	Depends on gear modification (i.e. if it requires observer coverage to ensure correct deployment)

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11 Abbreviations/Acronyms

ABNJ	Areas Beyond National Jurisdiction
AGARBA	Spanish Association of Cod Fishing Ship Owners
BAP	Biodiversity Action Plan
BBNJ	Biodiversity Beyond National Jurisdiction
BENTHIS	Benthic Ecosystem Fisheries Impact Study
BPA	Benthic Protection Areas
BSAI	Bering Sea and Aleutian Islands
CAB	Conformity Assessment Body
CAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CEBPOL	Centre for Biodiversity Policy and Law
CECAF	Committee for the Eastern Central Atlantic
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CM	Convention Measure
CMFRI	Central Marine Fisheries Research Institute
CMM	Conservation and Management Measures
CNCP	Cooperating non-Contracting Parties
CRZ	Coastal Regulation Zone
dFAD	Drifting Fish Aggregating Device
DFFE	Department of Forestry, Fisheries and the Environment
DFO	Department of Fisheries and Oceans Canada
DSF	Deep-Sea fisheries
DTU Aqua	Danish National Institute of Aquatic Resources
EASME	Executive Agency for Small and Medium-sized Enterprises
EBSA	Ecologically or Biologically Significant Areas
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIA	Environmental Impact Assessment
ESA	Ecologically Sensitive Area
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FRA	Fisheries Restricted Areas
FSR	Fisheries Standard Review
GEAC	Groundfish Enterprise Allocation Council
GFCM	General Fisheries Council of the Mediterranean
GFLK	Greenland Fishery Licence Control Authority
GINR	Greenland Institute of Natural Resources
GOA	Gulf of Alaska
GPS	Global Positioning System
HAPC	Habitat Areas of Particular Concern
HELCOM	Baltic Marine Environment Protection Commission
ICES	International Council for the Exploration of the Sea
ICNAF	International Commission for the Northwest Atlantic Fisheries
ISF	Icelandic Sustainable Fisheries
IUCN	International Union for the Conservation of Nature
JDF	Joint Demersal Fisheries
JNCC	Joint Nature Conservation Committee

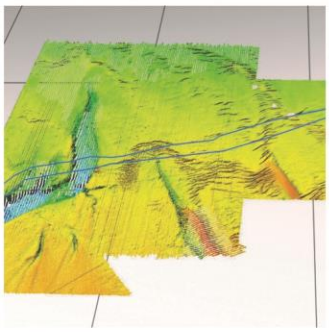
LCCA	*Lophelia pertusa* Coral Conservation Area
MAREANO	The Sea in Maps and Pictures
MESH	Mapping European Seabed Habitats
MFHA	Ministry of Fisheries, Hunting and Agriculture
MHWS	Mean High-Water Springs
MPA	Marine Protected Area
MPI	Ministry of Primary Industries
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSC	Marine Stewardship Council
NAFO	North Atlantic Fisheries Organization
NBA	National Biodiversity Assessment
NEAFC	North East Atlantic Fisheries Commission
NFA	Norwegian Fish Auction
NGO	Non-Governmental Organisation
NIPSG	Northern Ireland Pelagic Sustainability Group
nm	Nautical miles
NOAA	National Oceanic and Atmospheric Administration
NPFC	North Pacific Fisheries Commission
NPFMC	North Pacific Fisheries Management Council (US)
NRA	NAFO Regulatory Area
OECM	Other Effective area-based Conservation Measures
OSPAR	Oslo-Paris Agreement
PECMAS	Permanent Committee on Management and Science
PI	Performance Indicator
PINRO	Polar Research Institute of Marine Fisheries and Oceanography
PMF	Priority Marine Features
pVME	Potential Vulnerable Marine Ecosystem
RBF	Risk Based Framework
REM	Remote Electronic Monitoring
RFMO	Regional Fisheries Management Organisation or Agency
SAC	Special Area of Conservation
SADSTIA	South African Deep-Sea Trawling Industry Association
SAI	Significant Adverse Impact
SANBI	South African National Biodiversity Institute
SBA	Sensitive Benthic Area
SC	Scientific Council
SEAFO	South East Atlantic Fisheries Organisation
SEAs	Strategic Environmental Assessment
SFF	Sustainable Fisheries Framework
SFSAG	Scottish Fisheries Sustainable Accreditation Group
SiBA	Significant Benthic Areas
SIODFA	Southern Indian Ocean Deepsea Fishers Association
SIOFA	Southern Indian Ocean Fisheries Agreement
SPA/BD	Specially Protected Areas and Biological Diversity
SPRFMO	South Pacific Regional Fisheries Management Organisation
SSSI	Sites of Special Scientific Interest
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNGA	United Nations General Assembly
UoA	Unit of Assessment
UoC	Unit of Certification

US	United States (of America)
VME	Vulnerable Marine Ecosystem
VMS	Vessel monitoring system
WCPFC	Western and Central Pacific Fisheries Commission
WECAFC	Western Central Atlantic Fishery Commission
WGDEC	Working Group on Deep-Water Ecology
WGEAFM	Working Group on Ecosystem Approach to Fisheries Management
WGFMS	Working Group of Fishery Managers and Scientists

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices


Innovative Thinking - Sustainable Solutions

ABP mer

A Summary of RFMO Approaches

A summary of RFMO approaches to the VME habitat types, encounter thresholds and move-on rules is provided in Table A.1.

Table A.1. Summary of VME habitat types, encounter thresholds and move-on rules in RFMOs

RFMO	Habitat Types	Designation Criteria	Encounter Thresholds	Move-on Rules	Observers	VME Protection
CCAMLR	Biological: corals, sponge fields, Physical indicators: seamounts and hydrothermal vents	Scientific Committee reviews encounters in the 'risk area' to advise the Commission. Scientific studies undertaken in areas considered to have high diversity.	Longline or pots – 10 VME indicator units (1=1 litre of VME organism that fits in a 10 litre bucket, or 1 kg that does not fit in a 10 litre bucket) per line segment. Longline or pots – must report if 5 or more indicator units are collected but may continue fishing.	1 nm radius from midpoint of a line segment (1,000 hooks or 1,200 m line whichever is shorter) from which VME indicators are recovered.	100% on all vessels, Exploratory bottom fisheries must carry one additional scientific observer where possible.	Enforced area closures. Fishing footprint – bottom trawling in high seas areas of the Convention Area are restricted and only permitted where there was an established bottom fishery in 2006-2007. Gear restrictions – gillnetting not permitted. Bottom fishing for toothfish prohibited <550 m in exploratory fishing areas. VMEs which occur in areas where bottom fishing is permitted are given special protection under CM 22-09.

RFMO	Habitat Types	Designation Criteria	Encounter Thresholds	Move-on Rules	Observers	VME Protection
GFCM	Features: Seamounts and volcanic ridges, Canyons and trenches, Steep slopes, Submarine reliefs, Cold seeps, Hydrothermal vents Habitats: Cold-water coral reefs, Coral gardens, Sea pen fields, Deep-sea sponge aggregations, Tube-dwelling anemone patches, Crinoid fields, Oyster reefs and other giant bivalves, Seep and vent communities, Other dense emergent fauna	Not yet in place. Envisaged that the Scientific Committee will collate and analyse all available data sources and provide advice on areas where VME indicator taxa are known or likely to occur	Not yet in place, any encounters of VME indicator taxa must be reported	Not yet in place	Not yet in place	Three area closures for VMEs Ban on using towed dredges and trawl nets below 1000 m Additional restrictions (trawling ban within 3 nm of coastline, essential fish habitat measures) may also serve to protect some VMEs
NAFO	Biological: sponges, corals, sea pens, tube-dwelling anemones, bryozoan, sea lilies, sea squirts Physical: seamounts, canyons, knolls,	VME areas reviewed by a Scientific Committee, based on biological criteria (aggregative properties) consistent with the identification of structure-forming habitats (FAO, 2016).	All gear – 300 kg sponges and/or 60 kg live coral and/or 7 kg sea pens	At least 2 nm from the endpoint of the tow/set in direction least likely to result in further encounters.	100% on all vessels 25% on vessels with VMS (in practice, the derogation has not been used)	Enforced area closures. Fishing footprint – based on existing bottom areas (1987-2007). Fishing outside these areas requires assessment

RFMO	Habitat Types	Designation Criteria	Encounter Thresholds	Move-on Rules	Observers	VME Protection
	Southeast shoal, steep flanks >6.4°	The use of quantitative modelling using kernel density analysis to detect VMEs.				and review by the Commission.
NEAFC	Biological: corals sponges, sea pens, tube-dwelling anemones, mud- and sand-emergent fauna, bryozoans Physical: isolated seamounts, steep-slopes and peaks on mid-ocean ridges, knolls, canyon-like features, steep flanks >6.4°	Seabed mapping using echo-sounders or multi-beam sounders of the encounter areas should be conducted and submitted to ICES for its evaluation and advice to PECMAS	Trawls – 400 kg of live sponge and/or 30 kg live coral Longline – 10 VME indicators per 1,200 m section of line or 1,000 hooks (whichever is shorter)	Trawl – 2 nm wide band on both sides of the track, extended by two nm at each end Other gear – 2 nm from encounter position based on best judgement.	100% in exploratory areas	Enforced area closures. Fishing footprint – Bottom contact fishing is restricted to 'existing fishing areas', effectively only 2% of the Regulatory Area. Gear restrictions – gillnets, entangling nets and trammel nets prohibited in waters >200 m depth.
NPFC	Biological: corals, sponges xenophyophores, hydroids, bryozoans, specialist invertebrate species associated with seeps and vents.	Determine the sale of potential significant adverse impact on VMEs based on: - Types of vessel, gear, fishing area, fishing effort and	50 kg corals	2 nm from the gear retrieval location	100% on all vessels	Enforced area closures. Prohibition of bottom fishing below 1500 m unless undertaken under an exploratory fishing

RFMO	Habitat Types	Designation Criteria	Encounter Thresholds	Move-on Rules	Observers	VME Protection
	Physical: Submerged edges and slopes, seamounts, guyots, banks, knolls, hills, canyons, trenches, hydrothermal vents, cold seeps	potential by-catch species; -Current state of fishery resources and baseline habitat/ecosystem data; -Identification and mapping of VMEs known or likely to occur; -Data and methods used to identify describe and assess impacts; -Assessment of the occurrence, scale and duration of likely impacts on VMEs; -Risk assessment of likely impacts; -Proposed mitigation and management measure to ensure long-term conservation and sustainable fishing operations (NPFC 2017).				protocol in the north-western Pacific Ocean. Gear restrictions – gillnets must be set with the footrope at least 70 cm above sea floor in northwest Pacific.

RFMO	Habitat Types	Designation Criteria	Encounter Thresholds	Move-on Rules	Observers	VME Protection
SIOFA	Biological: corals and sponges	Proposal for VME should demonstrate which of the criteria are met, based on the list below, in no particular importance (SIOFA, 2019a/b): 1. VME indicator species - thresholds have been triggered in the proposed location, indicating a significant concentration; of VME indicator species. 2. Habitat suitability models (risk maps) to predict the proposed area; 3. The proposed area has direct/confirmed evidence (e.g. scientific surveys, camera deployments) of VME presence.	Trawls – 300 kg sponges and/or 60 kg live coral All gear – 10 VME indicator units (1=1 litre of VME organism that fits in a 10 litre bucket, or 1 kg that does not fit in a 10 litre bucket) per line segment	Trawls – 2 nm either side of the trawl track and extended either end by 2 nm, Longline – 1 nm from the midpoint of a segment (1,000 hooks or 1,200 m section, whichever is shortest) Other gear – 1 nm from the midpoint of any other operation.	100% on trawls 20% other gear	Enforced area closures – designations of protected areas where bottom fishing activities are prohibited (excluding longline and pot activities). Fishing footprint – in development Temporary closures remain in place until reviewed by the Scientific Committee.

RFMO	Habitat Types	Designation Criteria	Encounter Thresholds	Move-on Rules	Observers	VME Protection
SEAFO	Biological: sponges, corals, sea pens, erect bryozoans, sea lilies, annelids, sea squirts tube-dwelling anemones	Seabed mapping sing echo-sounders and multi-beam sounders should be used to identify a VME by the Scientific Committee (SEAFO, 2016)	Trawls – Existing areas: 600 kg live sponge and/or 60 kg live coral New areas: 400 kg live sponge and/or 60 kg live coral Longline and pots – 10 VME indicator units (1=1 kg or 1 litre) per 1,200 m section of line or 1,000 hooks (whichever is shorter)	Trawls – at least 2 nm from the end point of the tow in the direction least likely to result in further encounters and define a 2 nm radius. Other gear – vessel must move away at least 1 nm from the position closest to the encounter location, defining a 1 nm radius on the master's best judgement.	100% on all vessels	Enforced area closures. Maintain temporary closures until sufficient evidence is available. Fishing in exploratory areas requires an 'exploratory fishing protocol' for review and approval by the Commission.
SPRFMO	Biological: sponges, corals, sea pens, anemones	Scientific Committee undertakes review: -Historic fishing/bycatch events with 5 nm of encounter tow; -Current fishing activities in the area; -Habitat suitability models to identify areas likely to contain VMEs (Georgian *et al.*,	In any one tow – Single species limits: 25 kg sponges, 60 kg stony coral, 5 kg black coral, 15 kg sea fans, 35 kg anemones, 10 kg hexacorals Three or more species limits (biodiversity threshold) in any one	1 nm either side of the trawl track extended by 1 nm at each end	100% on trawls ≥10% other gear	Enforced area closures. Fishing footprint – fishing restricted to national bottom fishing footprints (2002-2006) covering <1% of SPRFMO area. Fishing in exploratory areas

RFMO	Habitat Types	Designation Criteria	Encounter Thresholds	Move-on Rules	Observers	VME Protection
		2019, SPRFMO, 2019b);	tow – 5 kg sponges/stony corals/anemones, 1 kg black corals/soft corals/sea pens/hydrocorals/armless stars/sea lilies			requires an 'exploratory fishing protocol' for review and approval by the Commission.

B UNGA Resolutions

The FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas were adopted in 2008 and provide recommendations on governance frameworks and management of deep-sea fisheries with the aim of ensuring long-term conservation and sustainable use of marine living resources in the deep sea and to prevent significant adverse impacts on vulnerable marine ecosystems (VMEs). The Guidelines followed on from, and aim to provide a framework for the implementation of UN General Assembly Resolutions 59/25 and 61/105 (see box). VMEs are now firmly embedded in regimes for the management of deep-sea fisheries in the areas beyond national jurisdiction (ABNJ).

The Deep-Sea Fisheries Guidelines also address major concerns about VMEs and provide: 1) an internationally agreed-upon set of criteria for identifying a VME, and 2) detailed suggestions for management actions to take once a marine area is designated as vulnerable.

UNGA Resolutions

UNGA Resolution 59/25 (2004)[11], called upon States (Art. 66) and regional fisheries management organisations or arrangements (RFMO/As) (Art. 67) to take urgent action to protect VMEs in ABNJ from destructive fishing practices, including bottom trawling, until such time as appropriate conservation and management measures have been adopted.

UNGA Resolution 61/105 (2006)[12], called for a series of specific actions to be taken by States and RFMO/As (para. 83) in relation to VMEs and bottom fisheries:

- To assess individual high seas bottom fisheries to ensure that significant adverse impacts on VMEs would be prevented or else prohibit bottom fishing (not authorise bottom fishing to proceed);
- To identify VMEs and determine whether bottom fishing activities would cause significant adverse impacts to such ecosystems and the long-term sustainability of deep-sea fish stocks;
- Close areas of the high seas to bottom fishing where VMEs are known or likely to occur unless bottom fisheries can be managed in these areas to prevent significant adverse impacts on VMEs;
- Require bottom fishing vessels to move out of an area of the high seas where VMEs are encountered and to report the encounter so that appropriate measures can be adopted.

UNGA Resolution 64/72 (2009), following a review of the actions taken by states and RFMOs in response to Resolution 61/105, called for further action in ABNJ to (para. 119), inter alia:

- Conduct the assessments specified above (of individual high seas bottom fisheries) and ensure vessels do not engage in bottom fishing until such assessments have been carried out;
- Conduct further scientific research to identify where VMEs are known or are likely to occur and adopt conservation and management measures;
- Establish protocols for requiring vessels to move out of an area where VMEs are encountered, including definitions of what constitutes evidence of an encounter with a VME, in particular threshold levels and indicator species.

11 https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/59/25
12 https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/61/105

C EBSA Criteria

In 2008, the CBD defined an Ecologically or Biologically Significant Area (EBSA) as a *"geographically or oceanographically discrete areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics, or otherwise meet the [EBSA] criteria"*. The CBD outlined seven scientific criteria for identification of EBSA in Annex I of Decision IX/20 (CBD, 2008, Annex 1):

- Uniqueness or rarity;
- Special importance for life history stages of species;
- Importance for threatened, endangered or declining species and/or habitats;
- Vulnerability, fragility, sensitivity or slow recovery;
- Biological productivity;
- Biological diversity; and
- Naturalness.

The scientific criteria for identifying EBSAs in need of protection in open-ocean waters and deep-sea habitats are set out in Table C.1.

Table C.1. EBSA Criteria, definitions, rationale, examples and consideration in application

Criteria	Definition	Rationale	Examples	Consideration in application
Uniqueness or rarity	Area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic feature	Irreplaceable loss would mean the probable permanent disappearance of diversity or a feature, or reduction of the diversity at any level.	*Open ocean waters* Sargasso Sea, Taylor column, persistent polynyas. *Deep-sea habitats* endemic communities around submerged atolls; hydrothermal vents; sea mounts; pseudo-abyssal depression	▪ Risk of biased-view of the perceived uniqueness depending on the information availability ▪ Scale dependency of features such that unique features at one scale may be typical at another, thus a global and regional perspective must be taken
Special importance for life-history stages of species	Areas that are required for a population to survive and thrive	Various biotic and abiotic conditions coupled with species-specific physiological constraints and preferences tend to make some parts of marine regions more suitable to particular life-stages and functions than other parts	Area containing: (i) breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; or (ii) habitats of migratory species (feeding, wintering or resting areas, breeding, moulting, migratory routes)	▪ Connectivity between life-history stages and linkages between areas: trophic interactions, physical transport, physical oceanography, life history of species ▪ Sources for information include: e.g. remote sensing, satellite tracking, historical catch and by-catch data, vessel monitoring system (VMS) data. ▪ Spatial and temporal distribution and/or aggregation of the species

Criteria	Definition	Rationale	Examples	Consideration in application
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species	To ensure the restoration and recovery of such species and habitats	Areas critical for threatened, endangered or declining species and/or habitats, containing (i) breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; or (ii) habitats of migratory species (feeding, wintering or resting areas, breeding, moulting, migratory routes)	▪ Includes species with very large geographic ranges. ▪ In many cases recovery will require reestablishment of the species in areas of its historic range. ▪ Sources for information include: e.g. remote sensing, satellite tracking, historical catch and by-catch data, vessel monitoring system (VMS) data.
Vulnerability, fragility, sensitivity, or slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery	The criteria indicate the degree of risk that will be incurred if human activities or natural events in the area or component cannot be managed effectively, or are pursued at an unsustainable rate	*Vulnerability of species* ▪ Inferred from the history of how species or populations in other similar areas responded to perturbations. ▪ Species of low fecundity, slow growth, long time to sexual maturity, longevity (e.g. sharks, etc). ▪ Species with structures providing biogenic habitats, such as deepwater corals, sponges and bryozoans; deep-water species. ▪ Vulnerability of habitats ▪ Ice-covered areas susceptible to ship-based pollution. ▪ Ocean acidification can make deep-sea habitats more vulnerable to others, and	▪ Interactions between vulnerability to human impacts and natural events ▪ Existing definition emphasizes site specific ideas and requires consideration for highly mobile species ▪ Criteria can be used both in its own right and in conjunction with other criteria.

Criteria	Definition	Rationale	Examples	Consideration in application
			increase susceptibility to human-induced changes	
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity	Important role in fuelling ecosystems and increasing the growth rates of organisms and their capacity for reproduction	▪ Frontal areas ▪ Upwellings ▪ Hydrothermal vents ▪ Seamounts polynyas	▪ Can be measured as the rate of growth of marine organisms and their populations, either through the fixation of inorganic carbon by photosynthesis, chemosynthesis, or through the ingestion of prey, dissolved organic matter or particulate organic matter ▪ Can be inferred from remote-sensed products, e.g., ocean colour or process-based models ▪ Time-series fisheries data can be used, but caution is required
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.	▪ Important for evolution and maintaining the resilience of marine species and ecosystems	▪ Sea-mounts ▪ Fronts and convergence zones ▪ Cold coral communities ▪ Deep-water sponge communities	▪ Diversity needs to be seen in relation to the surrounding environment ▪ Diversity indices are indifferent to species substitutions ▪ Diversity indices are indifferent to which species may be contributing to the value of the index, and hence would not pick up areas important to species of special

Criteria	Definition	Rationale	Examples	Consideration in application
				concern, such as endangered species ▪ Can be inferred from habitat heterogeneity or diversity as a surrogate for species diversity in areas where biodiversity has not been sampled intensively.
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation	▪ To protect areas with near natural structure, processes and functions ▪ To maintain these areas as reference sites ▪ To safeguard and enhance ecosystem resilience	Most ecosystems and habitats have examples with varying levels of naturalness, and the intent is that the more natural examples should be selected	▪ Priority should be given to areas having a low level of disturbance relative to their surroundings ▪ In areas where no natural areas remain, areas that have successfully recovered, including reestablishment of species, should be considered. ▪ Criteria can be used both in their own right and in conjunction with other criteria.

D Regional Tables of VMEs Identified in MSC Certified Fisheries

Table D.1. North Sea and Baltic Sea

Fishery	Gear type	How VMEs or sensitive habitats are defined	Corals	Coral gardens	Sponges	Sea pens	Burrowing megafauna	Biogenic reefs	Oyster beds	Maerl beds	Horse mussel beds	Sabellaria reefs	Haploops	Gas seeps	Deep sea mud
XXX	Traps, trawls	HELCOM MPAs, Natura 2000													
XXX	Trawls and misc. gear	HELCOM MPAs, Natura 2000, Management Authorities	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
XXX	Midwater trawls, purse seine nets	N/A													
XXX	Midwater trawls, purse seine nets, bottom trawls	OSPAR, MAREANO				✓	✓								
XXX	Trawls, bottom trawls	OSPAR, Natura 2000, MPA features			✓			✓						✓	✓

Table D.2. Barents Sea

Fishery	Gear type	How VMEs or sensitive habitats are defined	Coral gardens	Hard and/or soft corals	Cold water coral reefs	Sponge aggregations	Sea pen fields/ communities	Burrowing megafauna
XXX	Bottom trawls	OSPAR		✓		✓	✓	
XXX	Bottom trawls	NEAFC, ICES	✓		✓		✓	
XXX	Bottom trawls	NEAFC, ICES	✓		✓		✓	
XXX	Bottom trawls (shrimp trawls)	OSPAR, NEAFC, Maereno Programme	✓		✓	✓	✓	✓
XXX	Bottom trawls (shrimp trawls)	OSPAR, NEAFC	✓		✓	✓	✓	✓
XXX	Traps (pots), gillnets	ICES, NAFO, NEAFC, Norway Government	✓		✓	✓		
XXX	Bottom trawls (shrimp trawls)	OSPAR, NEAFC	✓		✓	✓	✓	✓
XXX	Traps (pots)	OSPAR, MAREANO, PINRO, Russian literature		✓[1]		✓[2]		

1 Sponges (rather than sponge aggregations)
2 Gorgonids specifically

Table D.3. Central Atlantic Ocean

Fishery	Gear type	How VMEs or sensitive habitats are defined	Coral reefs	Seagrass	Hard-bottom habitats	Rock banks	Sensitive taxa
XXX	Bottom trawls (shrimp trawls)	Risk Based Framework (RBF)				✓	✓
XXX	Traps (pots)	MPA	✓	✓	✓		

Table D.4. NE Atlantic Ocean

Fishery	Gear type	How VMEs or sensitive habitats are defined	Corals	Coral gardens	Hard and/or soft corals	Cold water corals	Sponges	Sea pens	Horse mussel beds	Maerl beds	Hydrothermal vents	Bryozoans
XXX	Bottom trawls	OSPAR, Faroe Islands (MPA)				✓	✓		✓			
XXX	Bottom trawls (pair trawls)	OSPAR, Faroe Islands (MPA)				✓	✓	✓	✓			
XXX	Midwater trawls, bottom trawls	OSPAR, Faroe Islands (MPA)		✓		✓	✓				✓	
XXX	Bottom trawls – shrimp and otter trawls	OSPAR				✓	✓	✓				
XXX	Bottom trawls (nephrops and otter trawls), Gillnets	MESH (OSPAR/JNCC)		✓		✓	✓		✓	✓	✓	
XXX	Bottom trawls (including nephrops trawls)	OSPAR			✓	✓	✓					
XXX	Bottom trawls, hooks and lines (longlines)	OSPAR			✓	✓	✓					
XXX	Seine nets, bottom trawls (nephrops and otter trawls)	OSPAR		✓		✓	✓		✓	✓	✓	
XXX	Midwater trawls, seine nets, bottom trawls, hooks and lines (handlines and poles	OSPAR		✓		✓	✓					

Fishery	Gear type	How VMEs or sensitive habitats are defined	Corals	Coral gardens	Hard and/or soft corals	Cold water corals	Sponges	Sea pens	Horse mussel beds	Maerl beds	Hydrothermal vents	Bryozoans
XXX	Seine nets, bottom trawls (including nephrops and otter trawls)	OSPAR, Iceland Government		✓		✓	✓		✓	✓	✓	
XXX	Bottom trawls	OSPAR			✓	✓	✓			✓	✓	
XXX	Bottom trawls	N/A										
XXX	Midwater trawls	N/A										
XXX	Midwater trawls	N/A										
XXX	Bottom Trawls	Habitats Directive, FAO guidelines, ICES VME index, other literature	✓		✓		✓	✓				✓

1 The MSC Database did not indicate any VME types for this fishery. However, the Public Certification Report for the XXX fishery identified 'OSPAR VMEs' that are found in Icelandic waters as cold water corals, soft corals, sponge aggregations, and mentioned that other VME such as maerl beds and hydrothermal vents are found in Icelandic coastal waters.

2 VME types have been identified from the Public Certification Report for this fishery, as none were listed in the MSC Database.

Table D.5. NW Atlantic Ocean

Fishery	Gear type	How VMEs or sensitive habitats are defined	Corals	Coral gardens	Hard and/or soft corals	Cold water corals	Gorgonians	Sponges	Sea pens	Seagrass meadows	Deep sea canyon
XXX	Bottom trawls	DFO (SBAs)					✓	✓	✓		
XXX	Bottom trawls (otter trawls), Traps	DFO (SBAs)					✓	✓	✓		
XXX	Bottom trawls (otter trawls)	DFO (SBAs), NAFO, Greenland Institute of Natural Resources				✓	✓	✓	✓		
XXX	Traps (pots)	DFO (SBAs)						✓[1]	✓[1]		
XXX	Trawls (otter trawls)	DFO (SBAs)						✓	✓		
XXX	Traps (pots)	DFO (SBAs)	✓					✓		✓	
XXX	Traps (pots)	DFO (SBAs), Coral and Sponge Conservation Strategy					✓	✓	✓		
XXX	Traps (pots)	DFO (SBAs)					✓	✓	✓		
XXX	Dredges	NOAA, National Marine Fisheries Service, Habitats of Particular Concern				✓					✓
XXX	Bottom trawls	NOAA, National Marine Fisheries Service, Habitats of Particular Concern, Magnuson-Stevens Fishery				✓					

Fishery	Gear type	How VMEs or sensitive habitats are defined	Corals	Coral gardens	Hard and/or soft corals	Cold water corals	Gorgonians	Sponges	Sea pens	Seagrass meadows	Deep sea canyon
		Conservation and Management Act (MSA)									
XXX	Bottom trawls	NAFO, Greenland Institute of Natural Resources	✓	✓	✓			✓	✓		
1 MSC Database specifically refers to 'sea pen aggregations' and 'sponge aggregations' rather than just 'sea pens' or 'sponges' as in the other fisheries.											

Table D.6. SW Atlantic Ocean

Fishery	Gear type	How VMEs or sensitive habitats are defined	Corals	Anemones	Sponges	Basket star
XXX	Bottom trawls	N/A	✓	✓	✓	✓
XXX	Bottom trawls	N/A				

Table D.7. Bering Sea

Fishery	Gear type	How VMEs or sensitive habitats are defined	Corals	Cold water corals	Hard and/or soft corals[1]	Sea pens	Seamounts
XXX	Traps (Barriers, fences, weirs etc)	North Pacific Fishery Management Council's Habitats of Particular Concern		✓			✓
XXX	Bottom trawls (beam trawls)	National Marine Fisheries Service, Habitats of Particular Concern, Essential Fish Habitats	✓		✓	✓	
XXX	Bottom trawls (otter trawls)	National Marine Fisheries Service, Habitats of Particular Concern, Essential Fish Habitats	✓		✓	✓	
XXX	Bottom trawls (otter trawls)	National Marine Fisheries Service, Habitats of Particular Concern, Essential Fish Habitats	✓		✓	✓	
XXX	Bottom trawls (otter trawls)	National Marine Fisheries Service, Habitats of Particular Concern, Essential Fish Habitats	✓		✓	✓	
XXX	Bottom trawls	National Marine Fisheries Service, Habitats of Particular Concern, Essential Fish Habitats	✓		✓	✓	
XXX	Bottom trawls	National Marine Fisheries Service, Habitats of Particular Concern, Essential Fish Habitats	✓		✓	✓	

1 Corals specified as sea whips.

Table D.8. Eastern Pacific Ocean

Fishery	Gear type	How VMEs or sensitive habitats are defined	Cold water corals	Sponges	Sea pens	Seamounts
XXX	Hooks and lines (trolling lines), gillnets, seine nets	N/A				
XXX	Trawls (otter trawls), bottom trawls (otter trawls)	NOAA, National Marine Fisheries Service, Rock Conservation Areas	✓	✓	✓	✓
XXX	Midwater trawls, bottom trawls	MPA features				✓
XXX	Bottom trawls	MPA features				✓

Table D.9. SW Pacific Ocean

Fishery	Gear type	How VMEs or sensitive habitats are defined	VMEs listed
XXX	Hooks and lines (trolling lines)	N/A	None

Table D.10. Indian Ocean

Fishery	Gear type	How VMEs or sensitive habitats are defined	Coral reefs
XXX	Purse seines	N/A	✓
XXX	Bottom trawls	N/A	

Table D.11. Inshore areas

Fishery	Gear type	How VMEs or sensitive habitats are defined	Seagrass	Sand mason	Biogenic reefs	Sabellaria reefs	Macrophyte beds	Reed beds	Saltmarshes
XXX	Traps	UK Government, Natura 2000, SAC features	✓						
XXX	Dredges	Natura 2000, SAC features	✓	✓		✓			
XXX	Traps	RBF							
XXX	Harvesting machines	N/A							
XXX	Bottom trawls (beam trawls)	OSPAR, Natura 2000		✓		✓			
XXX	Dredges	Natura 2000			✓				
XXX	Traps	RBF					✓		
XXX	Harvesting machines (mechanised dredge)	Natura 2000, MPAs	✓						
XXX	Dredges	OSPAR, Natura 2000, SSSI	✓					✓	✓
XXX	Dredges	RBF							
XXX	Traps	RBF							

E Stakeholder Consultation

This Appendix provides details of the opinions expressed by stakeholders in interviews carried out for the purposes of this study, grouped by theme and identified by stakeholder type. The interviews followed a semi-structured approach, so not all aspects of each theme were covered by all stakeholders or stakeholder types.
The following tables by theme are provided:

- Table E.1. Stakeholder opinions on FAO criteria and VME terminology
- Table E.2. Stakeholder opinions on move-on rules
- Table E.3. Stakeholder opinions on alternatives to move-on rules
- Table E.4. Stakeholder opinions related to the MSC Standard
- Table E.5. Stakeholder opinions on minimum requirements for sensitive/VME habitats

Table E.1. Stakeholder opinions on FAO criteria and VME terminology

Aspect	Fishery stakeholders	Management/ science stakeholders	Conservation stakeholders
Use of FAO criteria	▪ National criteria do not always follow FAO criteria, but are similar ▪ Habitats protected in national waters do not always appear to align with VME definition/criteria ▪ FAO/UNGA criteria are good as they are recognised by management agencies	▪ n/a	▪ The word 'vulnerable' may focus on the wrong habitats – a 'vulnerable' habitat could be present everywhere, and so the scale of impact of the fishery is negligible overall
Alternative criteria	▪ Use of criteria that are not internationally recognised should be avoided ▪ Internationally recognised criteria should be used so that fisheries are assessed against criteria that are common to everyone	▪ n/a	▪ n/a
Use of VME terminology in national waters	▪ VME terminology not used, therefore difficult to align with MSC requirements ▪ National designations are not necessarily equivalent to VMEs	▪ Some designated habitats in national waters can withstand a degree of impact from fisheries – if considered as 'VME' under the MSC Standard, this should not preclude any interaction of the fishery with the habitat	▪ Should go back to the VME definition to determine what to consider ▪ There is generally a better understanding of the distribution of inshore sensitive habitats than offshore
Lists of VME habitats/species	▪ Could focus VME consideration on the specific list of hard and soft corals in the FAO Guidelines	▪ n/a	▪ Where national authorities have identified good lists of sensitive and protected habitats, MSC assessment should use these
VME and pVME	▪ Approaches to identifying potential areas of VME/sensitive habitat (e.g. based on nearest neighbour approach or habitat suitability monitoring) can identify broad areas that are not necessarily all representative of VMEs. This can cause difficulty for fisheries where there is no clarity on how these areas should be considered for MSC assessments, nor any policy goal in relation to the proportion that needs to be protected	▪ n/a	▪ n/a

Table E.2. Stakeholder opinions on move-on rules

Aspect	Fishery stakeholders	Management/ science stakeholders	NGO stakeholders
Use of	▪ Not generally used in national fisheries, which instead use spatial management and protection of sensitive habitats	▪ Move-on rules not used in national waters ▪ Should not be used as the basis for understanding the distribution of VMEs – that should be through surveys and mapped information	▪ n/a
When they are appropriate	▪ Where a fishery is not well managed, and sensitive habitats have not been identified and protected ▪ May be appropriate if there is not much information or other management to protect sensitive habitats ▪ In frontier areas	▪ n/a	▪ n/a
When they are not appropriate	▪ In areas where there is good spatial management through protected areas ▪ In heavily fished areas – fishing should be allowed to continue in these areas ▪ In areas where the indicator species are unlikely to be encountered (which may coincide with heavily fished areas)) ▪ When they are likely to move fisheries on to new areas, increasing the fishery footprint and impacts (e.g. if a fishery takes place in a small proportion of the available area) ▪ In a highly managed fishery, with clear spatial management, where they can do more harm than good	▪ Where they would encourage cumulative impacts on sensitive habitats ▪ In areas where there are sensitive habitats – these should be protected through frozen footprints and spatial closures ▪ When gears are unlikely to bring up indicator species onto deck (i.e. most gears – not a good sampling mechanism for benthic habitats) ▪ Where there is no observer coverage	▪ Where any impact on sensitive habitats/species would have a significant impact on their overall status ▪ For some gear types ▪ In heavily fished areas ▪ In frontier areas – should have to map and protect VMEs before fishing starts in a new area
Thresholds	▪ Need to be set at an appropriate level ▪ Appear arbitrary	▪ n/a	▪ n/a

Aspect	Fishery stakeholders	Management/ science stakeholders	NGO stakeholders
Recording protocol/sampling / observers	▪ Difficult of recording encounters (e.g. where net/catch is very large) ▪ Observer sampling protocols can result in a single small encounter being extrapolated up and appearing to exceed thresholds ▪ NGOs expect move-on rules to be ineffective unless there is >100% observer coverage	▪ n/a	▪ n/a
Move-on distance	▪ n/a	▪ Move-on rules are ineffective where tow lengths exceed the move-on distance	▪ n/a

Table E.3. Stakeholder opinions on alternatives to move-on rules

Aspect	Fishery stakeholders	Management/ science stakeholders	NGO stakeholders
Frozen footprint	▪ Generally support the approach ▪ Needs to consider climate change and allow potential for fisheries to need to move to follow fish distributions ▪ Even if not a 'frozen' footprint, should review the footprint periodically, if changes are identified, the potential for impacts on benthic habitats should be addressed ▪ Not appropriate to all fisheries – some fisheries are highly variable spatially, driven by environmental variables that affect fish abundance/ distribution	▪ Support the approach, although need to build in flexibility to address climate-driven distributional changes ▪ Appropriate in areas with sensitive habitats	▪ Footprint of a fishery may not be known (at least publicly) ▪ Difficult to determine for small-scale vessels without VMS ▪ Need to consider the scale/resolution at which it is identified (should be fine-scale, not too coarse)
Baseline for frozen footprint	▪ Modern fished footprint, or a legacy footprint? In some fisheries the former may be smaller (due to reducing effort, more accurate targeting of fishing grounds), or larger (if there has been uncontrolled expansion of effort) ▪ Should take account of regulatory measures (not environment-related) that have forced fisheries to develop in a particular way (potentially outside of otherwise important fishing grounds)	▪ n/a	▪ n/a
Fishing in frontier/new areas	▪ Consideration of expansion of an individual fishery's footprint should consider whether it is expanding into areas already fished by other fisheries, or a new/frontier area	▪ n/a	▪ n/a
Spatial closures	▪ More appropriate than move-on rule where a VME is known to be present	▪ Appropriate in areas with sensitive habitats	▪ Most appropriate approach for particularly sensitive habitats
Spatial management	▪ n/a	▪ n/a	▪ Fisheries should have a spatial management plan that identifies where they can go as well as where they cannot

Table E.4. Stakeholder opinions related to the MSC Standard

Aspect	Fishery stakeholders	Management/ science stakeholders	NGO stakeholders
Information	▪ If VMEs are not identified, there should be a requirement for *evidence* that there are no VMEs (proof of absence, rather than absence of evidence of their presence) ▪ Fisheries should not get a 'free pass' if management authorities have not done any work to identify VMEs	▪ Where there is weak management and less data, and VMEs have not been identified, fisheries should not get a 'free pass'	▪ If VMEs have not been identified, that should be considered under the information criterion (and should not pass at SG60)
Move-on rules at SG60	▪ If you meet the SG80 requirements, there should not be a requirement for move-on rules	▪ n/a	▪ n/a
Global considerations	▪ Avoid a one-size-fits-all approach. A variety of measures may be appropriate depending on the context	▪ n/a	▪ n/a
Overall goal	▪ If MSC is too ambitious in its requirements it risks alienating fisheries ▪ Should focus on delivering the output rather than on specific requirements	▪ MSC assessment process has not done well at capturing the broader policy landscape of biodiversity protection at national level	▪ n/a
Who should determine what are VMEs for the assessment?	▪ Could have a list of specific species/habitats to consider, e.g. the hard and soft corals specified in the FAO Guidelines	▪ Where extensive national work has been carried out to identify and protect sensitive habitats, these should be used for MSC assessments – CABs cannot do that more effectively than national bodies.	▪ In the absence of a data-driven national process to identify VMEs/sensitive habitats, MSC could create a list of vulnerable/sensitive habitats to be considered, and assessors then consider whether the fishery comes into contact with them

Table E.5. Stakeholder opinions on minimum requirements for sensitive/VME habitats

Aspect	Fishery stakeholders	Management/ science stakeholders	NGO stakeholders
General approach	▪ Review the area management system in place for the fishery from the ground up – what is known about where sensitive habitats are, how fishing has been zoned around them	▪ n/a	▪ n/a
Minimum requirement	▪ Is information being collected? ▪ Is there a system/process in place to use those data to define management measures to protect key habitats? ▪ Consideration of habitat and ecosystem types ▪ Closure of key areas that would be irrevocably damaged if impacted ▪ Enforcement ▪ If sensitive habitats have not been identified, could freeze the fishing footprint to prevent further damage	▪ If no protections in place, fisheries should learn more about the habitats they are fishing on. If the management authority does not have resources, could the fishery develop maps using acoustic technology – hard/soft bottom etc., and refine over time ▪ Fishery has identified its interactions with habitats as something it wants to avoid, there is a mechanism in place to do something about it, process that allows evolution, review, incorporation of new information ▪ Fishery has considered spatially its interaction and there is some (spatial) measure to mitigate the risk of the fishery having a significant negative impact on a given VME, e.g. avoid marginal grounds to reduce footprint	▪ The fishery does not have a significant impact on VMEs, or only has a marginal impact
Progressive implementation	▪ Determine extent of habitats, protect sensitive ones ▪ Consider functionality – has enough been protected to maintain productivity and protect unique environments? ▪ Need good dialogue between fisheries, management, and environmental groups	▪ n/a	▪ n/a

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