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SC-01-07 (01)

# Protection of Vulnerable Marine Ecosystems in the SIOFA Area

*Relates to agenda item: 7* Working paper ☒ info paper ☐


## Delegation of Australia



## Abstract

This paper examines the international requirements for the management of high seas deep sea fisheries and provides a series of recommendations to assist the formulation of a binding measure for the conservation and management of bottom fishing. Additionally, this provides guidance for progressing a scientific workplan for the development of appropriate scientific advice in relation to bottom fishing.

This work will impact those flag States currently engaging in, or wishing to undertake, bottom fishing in the SIOFA Area.


## Recommendations

Australia has produced a range of recommendations for the Scientific Committee relating to:

1. Bottom fishery impact assessments
2. Bottom fishing footprints
3. Vulnerable marine ecosystems: mapping and impact management
4. Stock assessments

See Conclusions and Recommendations (Page 12) for a full list of recommendations.

Australian Government
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# Protection of Vulnerable Marine Ecosystems in the SIOFA Area

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# Contents

# 1 Introduction

Robust fisheries management has evolved to include increasing consideration of the ecological impacts of fishing, not just on target and bycatch species, but on habitats and communities. While coastal States are responsible for the management of the marine environment within their jurisdictional waters, in areas beyond national jurisdiction (ABNJ), or 'high-seas areas', fishing is largely conducted under the supervision of regional fisheries bodies established by international agreements.

This review examines work related to the identification of vulnerable marine ecosystems (VMEs) in the southern Indian Ocean (SIO) and other relevant areas and how this work can be applied to the management of impacts on VMEs by fisheries under the competence of the South Indian Ocean Fisheries Agreement (SIOFA). This work will inform the formulation of a binding measure for the conservation and management of bottom fishing on the basis of the best scientific information available.

Consistent with definitions adopted by other RFMOs, 'bottom fishing' is defined for the purposes of this work as fishing using any gear type likely to come in contact with the seafloor or benthic organisms during the normal course of operations (see SPRFMO 2014).

## International requirements for the management of high seas fisheries

Regional Fisheries Management Organisations (RFMOs) are a mechanism through which States party to international fishery agreements cooperate to adopt and implement scientifically-based conservation and management strategies for transboundary, straddling and highly migratory fish stocks on the high seas. Engagement in RFMOs can be a mechanism for States to give effect to their obligations under the *United Nations Convention on the Law of the Sea* (UNCLOS 1982) and the *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* (UNFSA 1995) to cooperate with other countries in the management of highly migratory, straddling and shared fisheries resources. Further guidance is provided by the many technical guidelines published by the Food and Agriculture Organization of the United Nations (FAO). First of these was the *FAO Code of Conduct for Responsible Fisheries* (1995) which states that:

> States should prevent overfishing and excess fishing capacity and should implement management measures to ensure that fishing effort is commensurate with the productive capacity of the fishery resources and their sustainable utilization. States should take measures to rehabilitate populations as far as possible and when appropriate.

The code of conduct goes on to make a specific mention of habitat degradation as a result of human activity:

> Particular effort should be made to protect habitats from ... significant impacts resulting from human activities that threaten the health and viability of the fishery resources.

Following these UN instruments and FAO Code of Conduct, the United Nations General Assembly (UNGA) has called for RFMOs and flag states to undertake a series of actions to address the impact of fisheries on VMEs.

In 2007, UNGA Resolution 61/105 called upon RFMOs:

> 83 d) To require members of the regional fisheries management organizations or arrangements to require vessels flying their flag to cease bottom fishing activities in areas where, in the course of fishing operations, vulnerable marine ecosystems are encountered, and to report the encounter so that appropriate measures can be adopted in respect of the relevant site.

Paragraphs 67–69 of Resolution 61/105 went further in calling on states and RFMOs to implement appropriate response protocols in cases where VMEs are encountered. However, these UNGA Resolutions are non-binding and it is therefore left up to RFMOs and flag States to give effect to these requirements in the manner most appropriate and effective for each region.

The four key requirements of Resolution 61/105 in relation to protection of VMEs are:

- to assess whether individual bottom fishing activities would have significant adverse impacts on VMEs and act to prevent such impacts from occurring (Paragraph 83a)
- to identify VMEs and to assess whether bottom fishing activities would cause significant adverse impacts to such ecosystems (Paragraph 83b)
- in areas where VMEs are known or likely to occur, 'to close such areas to bottom fishing and ensure that such activities do not proceed unless conservation and management measures have been established to prevent significant adverse impacts on vulnerable marine ecosystems' (Paragraph 83c)
- to implement move-on protocols that require the cessation of fishing operations in cases that VMEs are encountered (Paragraph 83d).

The subsequent *FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas* (2009) state that the two main objectives of the management of deep-sea fisheries are to ensure the 'long-term conservation and sustainable use of marine living resources', and to prevent significant adverse impacts on VMEs (paragraph 11, FAO 2009).

In 2009, the UNGA reaffirmed this requirement for the protection of VMEs with Resolution 64/72, and further called on flag States and RFMOs to conduct impact assessments for exploratory fisheries before fishing operations commence. Resolution 64/72 acknowledged that Resolution 61/105 had not been sufficiently implemented in all cases, and called for flag States and RFMOs to enact the necessary measures before proceeding with bottom fishing on the high seas (Rogers & Gianni 2010, UNGA 2010). More recently UNGA Resolution 66/68 (2012) noted that despite the progress made in recent years, the urgent actions called for in Resolutions 61/105 and 64/72 had not been fully implemented. Additionally, Resolution 66/68 (2012) encouraged marine scientific research, including the use of seabed mapping programmes, to identify VMEs (paragraph 131).

Despite their strong reliance on the term, the UNGA Resolutions do not directly provide a definition of what constitutes a VME, instead the FAO guidelines for the management of deep-sea fisheries provide five characteristics that may be used in determining the vulnerability of different ecosystems (Box 1).

**Box 1 Guidelines: Vulnerable Marine Ecosystems (VMEs)**

In 2009, the FAO International Guidelines for the management of Deep-sea Fisheries in the High Seas established a set of five criteria to be used in identifying Vulnerable Marine Ecosystems (VMEs). The criteria are as follows:

i. Uniqueness or rarity of the assemblage
ii. Functional significances of the habitat
iii. Fragility
iv. Life-history traits of component species that make recovery slow or difficult
v. Structural complexity characterised by complex physical structures created by biotic and abiotic features

The FAO criteria for identifying VMEs have been used as a foundation with various RFMOs adapting them in establishing region specific criteria.

Source: FAO 2009

These criteria are considered within the context of broad guidelines, with RFMOs and flag States modifying and developing them to identify VME and vulnerable taxa in relevant areas.

RFMOs and flag States have instituted a variety of management procedures to ensure the mitigation of significant adverse impacts on VMEs. These responses have included spatial closures, gear limitations and 'move-on rules' or encounter protocols in which vessels move away from areas in which VME indicators are encountered. Hansen et al. (2013) reviewed these global responses in the context of fisheries in the South Pacific Ocean.

As an emerging management body, SIOFA is yet to respond directly to the requirements of the UNGA resolutions cited above. However, external to SIOFA a variety of methods and criteria have been employed to identify VMEs and other significant habitats within the SIOFA Area (see for example, CBD 2013). Additional work to identify VMEs is also underway in other ocean basins. It may be possible to examine existing work in the southern Indian Ocean, and in the development of robust VME identification processes fit for the purpose of managing SIOFA fisheries.

# 2 Description of fisheries and the SIOFA Area

The SIOFA principles include direct reference to the application of the precautionary approach in the implementation of an ecosystem approach to the management and long-term conservation of fisheries resources on the basis of the best scientific evidence available. These fisheries resources include transboundary or straddling fish stocks (excluding highly migratory species) in areas beyond national jurisdiction (high seas) within the defined SIOFA Area. SIOFA fishery resources are often demersal or bethopelagic (associated with the seafloor), and as such fishing effort in the SIOFA Area is largely focused on or near seamounts and ridges in the southern Indian Ocean. Despite a focus on bottom fishing, there is potential for targeting of some neritic and pelagic species under the SIOFA management mandate. However, more data are needed on the targeting practices of States fishing in the southern Indian Ocean.

There is a need to coordinate with coastal States and adjacent or overlapping management organisations due to the straddling nature and high susceptibility to overexploitation of deep-sea fishery resources under SIOFA management. In addition to sharing boundaries with areas under the fishery jurisdictions of coastal States, the SIOFA Area abuts areas falling under other international management agreements. The southern boundary of the SIOFA Area borders the area managed under the Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention), the eastern boundary abuts the convention area of the South Pacific Regional Fisheries Management Organisation (SPRFMO), and the western boundary abuts the convention area of the South East Atlantic Fisheries Organisation (SEAFO). In the development of SIOFA specific measures it may be may be possible to examine and build upon relevant work completed by the scientific committees of other related management organisations in the establishment of their respective conservation measures (Annex A). While the SIOFA Area geographically overlaps with much of the Indian Ocean Tuna Commission's Area of Competence, each agreement manages different fishing activities.

Deep-sea trawlers have been active in what is now the SIOFA Area since at least the 1960s (Ward et al. 2015). While the combined catch of all deepwater species for all international vessels in the area was estimated to be 40 000 t in 2000 (Bensch et al. 2009), accurate catch and effort data are not available due to the unregulated nature of the high-seas fisheries at that time (Bensch et al. 2009).

# 3 Bottom fishing issues of concern

## Bottom Fishery Impact Assessments

As part of implementing UNGA Resolutions 61/105 and 64/72, flag States wishing to undertake bottom fishing, or that are already undertaking bottom fishing, should prepare bottom fishery impact assessments (BFIAs) for their relevant fishing activities in the region. These BFIAs (including those that have been completed in the past) should be completed to a minimum, rigorous standard and submitted to the SIOFA Scientific Committee for endorsement. The Scientific Committee may develop a BFIA standard that will outline the minimum requirements of future impact assessments. This standard should be developed in consultation with Contracting Parties, be approved by the Scientific Committee and may draw upon similar developments in other relevant RFMOs. The SPRFMO Bottom Fishery Impact Assessment Standard (SC-01-INFO-05; SPRFMO 2012) may provide guidance on the development of a SIOFA-specific standard. A proposed process for the preparation and evaluation of benthic assessments is included in Annex B.

The Australian Fisheries Management Authority commissioned a bottom fishery impact assessment of Australian fishing activity in the SPRFMO Area in 2011 (Williams et al. 2011a). This impact assessment was completed within draft guidelines developed by the SPRFMO interim Scientific Working Group in direct reference to implementing the UNGA resolutions for vessels operating in that region. These guidelines were also used to inform a BFIA of Australia's fishing activities in the SIOFA Area (Williams et al. 2011b). The Australian BFIAs address many of the issues arising from the UNGA Resolutions mentioned above, providing descriptions of proposed fishing activities, data on historical catch and effort, available mapping of fishing grounds and proposed spatial closures and measures to manage and mitigate impacts on VMEs.

The Australian BFIA drew on established work regarding the impacts of bottom fishing gears to assess the impacts of the Australian fishery on VMEs. While there are many bottom fishing methods employed in the SIOFA Area, demersal trawling has the most contact with the seabed, and therefore has the potential to cause the most damage to VMEs (Table 1; Chuenpagdee et al. 2003). The Australian BFIAs for the SPRFMO and SIOFA Areas utilised the Chuenpagdee hierarchy, with suggested considerations of impact ratings related to gear types used by the Australian fishing fleet (Table 1). The considerations proposed by Williams et al. (2011b) may have implications for SIOFA fisheries that actively employ demersal longlines and midwater trawls. While the BFIAs focused on the impacts of demersal trawl and auto-longline fishing, other methods (such as trapping) were considered, but not assessed, due to their apparent lower impact and negligible effort in the areas of concern.

**Table 1 Ratings of benthic habitat and bycatch impacts for each gear class. Ratings scale from 1 (very low) to 5 (very high)**

| Gear class | Benthic habitat | | Suggested consideration |
|---|---|---|---|
| | Physical | Biological | |
| Dredge | 5 | 5 | Not assessed |
| Gillnet – bottom | 3 | 2 | Not assessed |
| Gillnet – midwater | 1 | 1 | Not assessed |
| Hook and line (dropline) | 1 | 1 | None proposed |
| Longline – demersal | 2 | 2 | Impact on biological habitat likely higher than previously recognized |
| Longline – pelagic | 1 | 1 | Not assessed |
| Pots and traps | 3 | 2 | None proposed |
| Purse seine | 1 | 1 | Not assessed |
| Trawl – demersal | 5 | 5 | None proposed |
| Trawl – midwater | 1 | 1 | Some mid-water trawls targeting bentho-pelagic species come in contact with bottom |

Sources: impact ratings were by Chuenpagdee et al. (2003) with rating considerations proposed by (Williams et al. 2011b), who only assessed and proposed considerations for gear types used by the Australian fishing fleet in the SPRFMO area.

## Recommendations relating to bottom fishery impact assessments

1) Contracting Parties, Cooperating Non-Contracting Parties and Participating Fishing Entities currently undertaking bottom fishing that have prepared a BFIA should submit this to the second meeting of the Scientific Committee for consideration.

2) Contracting Parties, Cooperating Non-Contracting Parties and Participating Fishing Entities wishing to undertake bottom fishing, or that are already undertaking bottom fishing, should prepare and submit a BFIA to the Scientific Committee for consideration.

3) The SIOFA Scientific Committee should work in the 2016–17 intersessional period to develop a bottom fishing impact assessment standard and assessment criteria to apply to all subsequent entrants into SIOFA's bottom fisheries. This may include standards for the amendment of current BFIAs for those States looking to undertake fishing operations using methods not covered by their current assessment. The development of a standard would assist in the formulation of scientifically robust assessments and ensure the Meeting of Parties receives consistent and transparent advice from the Scientific Committee.

4) The SIOFA Scientific Committee should consider preparing a workplan for the development and evaluation of bottom impact fishery assessments and implementation of a bottom fishing measure for consideration by the Meeting of Parties. Noting that a draft measure will be presented at the first Scientific Committee meeting (SC-01-07 (02)).

# Bottom fishing footprints

The formulation of historical footprints and effort levels can enable different approaches to management and mitigation measures to be implemented based on level of past impacts. This has been employed in the SPRFMO Area with bottom-fishing effort restricted to historical fishing grounds (based on a reference period 2002 to 2009). Further, New Zealand has implemented a tiered management regime as part of their domestic management arrangements to mitigate future impacts on areas with little historical fishing effort. By restricting fishing effort to historical fishing grounds, SIOFA will give effect to some of its international obligations outlined above, including the application of the precautionary approach in preventing expansion of fishing effort into new fishing grounds (although the implementation of effective exploratory fishing measures may allow this expansion should impact assessments and appropriate mapping etc. be completed).

In the SPRFMO measure (and Australian high seas fishing permits), fishing footprints are defined at a spatial resolution of 20' latitude x 20' longitude (≈20 nautical miles). Finer spatial resolutions should be used where appropriate. However, it is important that commercial sensitives are observed, as operators may not wish to make exact fishing ground locations known. Further, practical issues, such as the complexity of management arrangements, should also be considered when assessing the implications of fine scale mapping. Finer scale mapping provides for a better resolution of where fishing occurs within bathomes and on individual seamounts, and also shows where un-impacted areas may remain on fished seamounts (Williams et al. 2011b).

The Meeting of Parties will need to establish a reference period used to define the historic fishing footprint. These reference periods have varied amongst RFMOs, from five-years in SPRFMO (2002-2006; UNGA 2007, SPRFMO 2014), to nearly 15-years in SEAFO (1987–July 2011; SEAFO 2015). It should however be noted that the reference period used in defining the footprint and historic catch is independent of the reference period that may be used in any allocation of resources amongst parties.

## Recommendations relating to bottom fishing footprints

5) The Scientific Committee should recommend the following definition (as adopted by SPRFMO) of bottom fishing for adoption by the Meeting of Parties:

> 'Bottom fishing' is defined as fishing using any gear type likely to come in contact with the seafloor or benthic organisms during the normal course of operations.

6) The Scientific Committee should recommend to the Meeting of Parties that, consistent with interim spatial management implemented by management organisations, SIOFA manage its bottom fisheries through the application of bottom fishing footprints (where bottom fishing is limited to within that fishing footprint).

7) Bottom fishing footprints should be established using an appropriate reference period and spatial resolution.

8) All Contracting Parties, Cooperating Non-Contracting Parties and Participating Fishing Entities wishing to undertake bottom fishing, or that are already undertaking bottom fishing, should submit a bottom fishing footprint to the SIOFA Scientific Committee for consideration at its second ordinary meeting in 2017.

# Vulnerable marine ecosystems: mapping and impact management

The UNGA Resolutions call for fishery closures of areas in which VMEs are known to occur, or are likely to occur, unless conservation and management measures have been established to prevent significant adverse impacts on VMEs. In order to implement these UNGA Resolutions, RFMOs would ideally have completed extensive mapping and predictive habitat modelling and implemented robust spatial management plans. However, while the habitat modelling and mapping can provide broad indications of VME distributions, high-resolution techniques necessary to ground truth these predictions are likely to be resource intensive. Therefore, in the absence of the desired VME mapping (and spatial management), some fisheries have instituted reactive management procedures that identify the presence of VMEs through the presence of bycatch indicator taxa. These procedures require fishing vessels to cease fishing in an area and move to a new fishing ground when predetermined thresholds of indicator taka are encountered. These procedures, known as 'move-on rules' or encounter protocols were reviewed by Hansen et al. (2013) in the context of bottom fisheries in the South Pacific.

While these encounter protocols are capable of providing short-term protection of VMEs, in requiring immediate reporting and temporary closure of a fishing area, they should only be considered as an interim measure in the absence of more robust spatial management plans. These protocols are reactive, and may be inadequate to ensure the long-term conservation of VMEs (see Rogers & Gianni 2010) in part due poor implementation and the reliance on the presence of fragile indicator species in trawl catches despite the demonstrably poor nature of demersal trawl gear as a sampling tool of attached benthic species (Rogers & Gianni 2010, Kenchington 2011). Despite these issues, SIOFA should consider establishing move-on protocols (with appropriate thresholds, closure distances and periods) until such time as more robust spatial management plans can be developed and adopted by the Meeting of the Parties.

There has been considerable bathymetric mapping and habitat delineation completed in the SIOFA Area. As part of the Australian BFIA, fine resolution (0.1' latitude x 0.1' longitude) depth mapping of the SIOFA Area was examined and classified into six bathomes (ecologically meaningful depth ranges within fishable depths; Table 2). These bathomes were selected as depth-related surrogacy for VME fauna, with large invertebrate benthic fauna typically most diverse and most abundant in depths <1500 m (Williams et al. 2009) while the dominant mesh building stony coral (*Solenosmilia variabilis*) exists in depths <1400 m (Clark et al. 2010). Further global studies have demonstrated the very high habitat suitability for seamount stony corals at depths 0-750 m and moderate suitability at depths <1500 m (Tittensor et al. 2009, Davies & Guinotte 2011).

**Table 2 The overlap of the Australian footprint (20' grid, 1999-2009) in the SIOFA Area with the five ecologically meaningful bathomes (see Last et al. 2010) and their size in relation to the areas in each bathome for the SIOFA Area.**

| Bathome | Name | Footprint area (km²) **a** | SIOFA Area (km²) **a** | Overlap of footprint with total bathome in SIOFA Area (%) |
|---|---|---|---|---|
| 0–200 m | Continental shelf | 272 | 37 402 | 0.73 |
| 201–700 m | Shallow upper continental slope | 2 773 | 32 101 | 8.64 |
| 701–1000 m | Deep upper continental slope | 11 307 | 25 133 | 44.99 |
| 1001–1500 m | Shallow mid-continental slope | 26 677 | 110 781 | 24.08 |
| 1501–2000 m | Deep mid-continental slope | 33 795 | 260 633 | 12.97 |
| >2000 m | [unfished depths] **b** | 151 074 | 26 414 597 | 12.97 |
| All depths | | 225 899 | 26 880 647 | 0.84 |

Notes: **a** All areas given are 'plane areas' and therefore do not account for underlying topography. **b** Coarse resolution grid (20' grid) mapping results in the footprint overlapping some areas of unfishable depths
Source: Williams et al. 2011

A regional workshop convened under the Convention on Biological Diversity (CBD) identified a number of 'ecologically or biologically significant marine areas' (EBSAs) in the southern Indian Ocean (CBD 2013). This work may provide guidance on where to focus scientific work in the SIOFA Area. The CBD EBSA criteria were developed in a separate, but parallel, process to those developed as part of the FAO guidelines for the management of deepwater fisheries. The criteria are not incompatible, and may act in complimentary ways due to their overlapping objectives (CBD 2009).

### Box 2 Convention on Biological Diversity: Ecologically or Biologically Significant Marine Areas (EBSAs)

In 2008 the Parties to the Convention on Biological Diversity adopted a set of seven criteria to be used in identifying Ecologically or Biologically Significant Marine Areas (EBSAs). The CBD EBSA criteria differ from the FAO Guidelines criteria for identifying VMEs, in requiring consideration of naturalness (natural condition as a result of the lack of or low level of human-induce disturbance or degradation) and biological diversity. The criteria are as follows:

i. Uniqueness or rarity
ii. Special importance for life history stages of species
iii. Importance for threatened, endangered or declining species and/or habitats
iv. Vulnerability, fragility, sensitivity, or slow recovery
v. Biological productivity
vi. Biological diversity
vii. Naturalness

The CBD Secretariat has collaborated with Parties, other Governments and a range of partners in convening regional workshops to identify EBSAs in different regions.

Source: CBD 2008

In addition to international processes and work completed by flag States, industry has completed significant work in identifying deepwater fragile habitats, with some members observing voluntary closures of these areas. The Southern Indian Ocean Deepsea Fishers

Association (SIODFA) has identified 12 areas within the SIOFA Area which they have designated as 'benthic protected areas' (BPAs). SIODFA members have observed voluntary closures of these areas, and two flag States (Australia and the Cook Islands) have incorporated these closures into their High Seas Permit conditions (SIODFA 2013a). These existing voluntary closures are pertinent to the Scientific Committee deliberations but do require independent assessment.

Existing bathymetric mapping of the SIOFA Area may be augmented by the considerable work which has been completed recently in the search for Malaysian Airlines Flight 370 in the Indian Ocean. There are likely to be sensitivities in access to mapping data collected in this search, however there may be benefit in the SIOFA Secretariat, once established, making contact with the appropriate search-and-rescue coordination agencies (including the Australian Maritime Safety Authority) to explore potential access arrangements.

### Recommendations relating to VME mapping and impact management

9) The SIOFA Scientific Committee should work in the 2016–17 intersessional period to prepare advice and recommendations on bottom fishing measures such as move-on protocols.

10) The SIOFA Scientific Committee should consider recommending the establishment of measures that implement UNGA Resolution 61/105 and establish a workplan that will assist in the development of robust spatial management measures.

11) The Scientific Committee should recommend to the Meeting of Parties that, consistent with interim spatial management implemented by management organisations, SIOFA establish move-on protocols (with appropriate thresholds, closure distances and periods) until such time as more robust spatial management plans can be developed and adopted by the Meeting of the Parties.

12) The SIOFA Scientific Committee should assess the merits of the various processes underway to identify vulnerable benthic habitats.

13) The SIOFA Secretariat should contact relevant search-and-rescue agencies to explore access to recently collected bathymetric mapping data.

## Stock assessments

Resolution 64/72 called for stock assessments and conservation measures to ensure the long-term sustainability of deep-sea fish stocks and non-target species, and the rebuilding of depleted fish stocks [para 119–120].

Fishery resources targeted by deep-sea bottom fishing typically display traits that make them more susceptible to fishing impacts. 'Deep-sea species' (generally characterised as those that live below 400-500 m deep, Koslow et al. 2000, Villasante et al. 2012) are typified by life history traits such as high longevity (life spans in excess of 100 years), slow growth, low fecundity and late maturation (Villasante et al. 2012). Moreover, deep-sea target species tend to aggregate on seamount areas, often supporting fragile habitats (Althaus et al. 2009, Clark et al. 2010), and are therefore susceptible to the physical impacts of bottom fishing and prone to overfishing (Villasante et al. 2012). It is therefore crucial to develop robust stock assessments to ensure the long-term sustainability of harvests. However, the design and implementation of abundance surveys on seamounts can be resource intensive and difficult to execute. Further, given the small and localised nature of the fish stocks on seamounts, dedicated research surveys may not be cost-effective (Clark et al. 2015). In these cases catch-per-unit effort analyses can be useful,

although the variable nature of high-seas fisheries and a paucity of historical catch and effort records can limit the statistical value of these methods (Clark et al. 2015).

High-seas fisheries in the SIOFA Area have a history of serial depletion, yet there are few data available for the assessment of Indian Ocean target or bycatch stocks (Rogers & Gianni 2010). At the first Meeting of Parties in 2013, the Southern Indian Ocean Deepsea Fishers Association (SIODFA) provided an update on progress made towards the development of a conservation and management measure in the Southern Indian Ocean. This included information regarding the acquisition, collation and reporting of historical fishing data, collection regimes for biological data, acoustic stock assessment and considerations on bycatch species (SIODFA 2013b). With the establishment of a SIOFA Scientific Committee and formalisation of data collection standards, the SIOFA Scientific Committee should move towards collaborative stock assessments, with particular focus on high-value, high-risk stocks such as orange roughy in the SIOFA Area.

In 2015, New Zealand provided an overview to the SPRFMO Scientific Committee of research relevant to the assessment of orange roughy stocks in the South Pacific (Clark et al. 2015). This work has involved meta-analysis, associated predictive modelling (to examine trends in seamount fisheries) and life history characteristics of the stock in concert with analysis of physical attributes of fisheries and the seamounts targeted to investigate their potential as predictors for long-term catch on newly found fishing grounds (Clark et al. 2015). This work has informed estimates of unfished biomass and revisions of stock discrimination. The SIOFA Scientific Committee should examine this work and consider the potential for the implementation of its methods in the assessment of stocks in the Indian Ocean.

With the finalisation of SIOFA Data Standards, the Scientific Committee will gain greater understanding of current and historical catch and effort levels in the SIOFA Area. Once available, the Scientific Committee can examine species specific catch data, and regional catch levels, to prioritise assessments for high risk or high catch stocks. The Scientific Committee should also confirm with Contracting Parties relevant stock assessments completed in other areas that may be expanded to include SIOFA stocks.

## Recommendations relating to stock assessments

14) The SIOFA Scientific Committee should establish a workplan to undertake stock assessments in the SIOFA Area.

15) The SIOFA Scientific Committee should examine catch and effort data as they become available and prioritise assessments of high catch or high-risk stocks.

16) The SIOFA Scientific Committee should examine stock assessments completed in similar, data-poor fisheries and explore the potential for the implementation of their methods in the assessment of stocks in the Indian Ocean.

17) The SIOFA Secretariat should pursue cooperative agreements with relevant adjacent or overlapping management organisations to facilitate the conservation and management of straddling fishing stocks. This may include the expansion of relevant stock assessments to include SIOFA stocks.

# 4 Conclusions and Recommendations

The SIOFA Scientific Committee should support the development of a robust bottom fishing conservation and management measure with a sound scientific basis. The measures should include consideration of bottom fishing impact assessments, establishment of historic fishing footprints and interim VME encounter protocols. The Scientific Committee should develop a scientific workplan, designed to advance relevant research to ensure best-practice management of SIOFA fisheries. The bottom fishing measure should be periodically reviewed to incorporate progress in the workplan.

*Bottom fishery impact assessments:*

1) Contracting Parties, Cooperating Non-Contracting Parties and Participating Fishing Entities currently undertaking bottom fishing that have prepared a BFIA should submit this to the second meeting of the Scientific Committee for consideration.

2) Contracting Parties, Cooperating Non-Contracting Parties and Participating Fishing Entities wishing to undertake bottom fishing, or that are already undertaking bottom fishing, should prepare and submit a BFIA to the Scientific Committee for consideration.

3) The SIOFA Scientific Committee should work in the 2016–17 intersessional period to develop a bottom fishing impact assessment standard and assessment criteria to apply to all subsequent entrants into SIOFA's bottom fisheries. This may include standards for the amendment of current BFIAs for those States looking to undertake fishing operations using methods not covered by their current assessment. The development of a standard would assist in the formulation of scientifically robust assessments and ensure the Meeting of Parties receives consistent and transparent advice from the Scientific Committee.

4) The SIOFA Scientific Committee should consider preparing a workplan for the development and evaluation of bottom impact fishery assessments and implementation of a bottom fishing measure for consideration by the Meeting of Parties.

*Bottom fishing footprints*

5) The Scientific Committee should recommend the following definition (as adopted by SPRFMO) of bottom fishing for adoption by the Meeting of Parties: 'Bottom fishing' is defined as fishing using any gear type likely to come in contact with the seafloor or benthic organisms during the normal course of operations.

6) The Scientific Committee should recommend to the Meeting of Parties that, consistent with interim spatial management implemented by management organisations, SIOFA manage its bottom fisheries through the application of bottom fishing footprints (where bottom fishing is limited to within that fishing footprint).

7) Bottom fishing footprints should be established using an appropriate reference period and spatial resolution.

8) All Contracting Parties, Cooperating Non-Contracting Parties and Participating Fishing Entities wishing to undertake bottom fishing, or that are already undertaking bottom fishing, should submit a bottom fishing footprint to the SIOFA Scientific Committee for consideration at its second ordinary meeting in 2017.

*Vulnerable marine ecosystems: mapping and impact management*

9) The SIOFA Scientific Committee should work in the 2016–17 intersessional period to prepare advice and recommendations on bottom fishing measures such as move-on protocols.

10) The SIOFA Scientific Committee should consider recommending the establishment of measures that implement UNGA Resolution 61/105 and establish a workplan that will assist in the development of robust spatial management measures.

11) The Scientific Committee should recommend to the Meeting of Parties that, consistent with interim spatial management implemented by management organisations, SIOFA establish move-on protocols (with appropriate thresholds, closure distances and periods) until such time as more robust spatial management plans can be developed and adopted by the Meeting of the Parties.

12) The SIOFA Scientific Committee should assess the merits of the various processes underway to identify vulnerable benthic habitats.

13) The SIOFA Secretariat should contact relevant search-and-rescue agencies to explore access to recently collected bathymetric mapping data.

*Stock assessments*

14) The SIOFA Scientific Committee should establish a workplan to undertake stock assessments in the SIOFA Area.

15) The SIOFA Scientific Committee should examine catch and effort data as they become available and prioritise assessments of high catch or high-risk stocks.

16) The SIOFA Scientific Committee should examine stock assessments completed in similar, data-poor fisheries and explore the potential for the implementation of their methods in the assessment of stocks in the Indian Ocean.

17) The SIOFA Secretariat should pursue cooperative agreements with relevant adjacent or overlapping management organisations to facilitate the conservation and management of straddling fishing stocks.

# 5 References

Althaus, F, Williams, A, Schlacher, TA, Kloser, RJ, Green, MA, Barker, BA, Bax, NJ, Brodie, P, Hoenlinger-Schlacher, MA 2009, 'Impacts of bottom trawling on deep-coral ecosystems of seamounts are long-lasting', *Marine Ecology Progress Series,* vol. 397, pp. 279–294.

Bensch, A, Gianni, M, Greboval, D, Sanders, J, Hjort, A 2009, *Worldwide review of bottom fisheries in the high seas*, FAO Fisheries and Aquaculture Technical Paper 522, Food and Agriculture Organization of the United Nations, Rome, Italy.

CBD 2008, *Report of the conference of the parties to the convention on biological diversity on the work of its ninth meeting*, UNEP/CBD/COP/9/29, Convention on Biological Diversity, Bonn, Germany.

CBD 2009, *Report of the expert workshop on scientific and technical guidance on the use of biogeographic classification systems and identification of marine areas beyond national jurisdiction in need of protection*, UNEP/CBD/EW-BCS&IMA/1/2*, Convention on Biological Diversity, Ottawa, Canada.

CBD 2013, *Report of the southern Indian Ocean regional workshop to facilitate the description of ecologically or biologically significant marine areas*, UNEP/CBD/RW/EBSA/SIO/1/4, Convention on Biological Diversity, Flic en Flac, Mauritius.

Chuenpagdee, R, Morgan, LE, Maxwell, SM, Norse, EA, Pauly, D 2003, 'Shifting gears: assessing collateral impacts of fishing methods in US waters', *Frontiers in Ecology and the Environment,* vol. 1, no. 10, pp. 517–524.

Clark, M, Roux, M-J, Cryer, M 2015, *New Zealand research relevant to the assessment of stocks of orange roughy*, SC-03-DW-02, SPRFMO 3rd Meeting of the Scientific Committee, Port Vila, Vanuatu.

Clark, MR, Rowden, AA, Schlacher, T, Williams, A, Consalvey, M, Stocks, KI, Rogers, AD, O'Hara, TD, White, M, Shank, TM, Hall-Spencer, JM 2010, 'The Ecology of Seamounts: Structure, Function, and Human Impacts', *Annual Review of Marine Science,* vol. 2, no. 1, pp. 253–278.

Davies, AJ, Guinotte, JM 2011, 'Global Habitat Suitability for Framework-Forming Cold-Water Corals', *PLoS ONE,* vol. 6, no. 4, pp. e18483.

FAO 1995, *Code of Conduct for Responsible Fisheries*, Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO 2009, *International guidelines for the management of deep-sea fisheries in the high seas*, Food and Agriculture Organization of the United Nations, Rome, Italy.

Hansen, S, Ward, P, Penney, A 2013, *Identification of vulnerable benthic taxa in the western SPRFMO Convention Area and review of move-on rules for different gear types*, SC-01-09, SPRFMO 1st Meeting of the Scientific Committee, La Jolla, USA.

Kenchington, TJ 2011, *Encounter protocols for avoidance of harm to Vulnerable Marine Ecosystems: A global review of experience to 2010*, Department of Fisheries and Oceans Canadian Science Advisory Secretariat, Nova Scotia, Canada.

Koslow, JA, Boehlert, GW, Gordon, JDM, Haedrich, RL, Lorance, P, Parin, N 2000, 'Continental slope and deep-sea fisheries: implications for a fragile ecosystem', *ICES Journal of Marine Science: Journal du Conseil,* vol. 57, no. 3, pp. 548–557.

Last, PR, Lyne, VD, Williams, A, Davies, CR, Butler, AJ, Yearsley, GK 2010, 'A hierarchical framework for classifying seabed biodiversity with application to planning and managing Australia's marine biological resources', *Biological Conservation,* vol. 143, no. 7, pp. 1675–1686.

Rogers, AD, Gianni, M 2010, *The Implementation of UNGA Resolutions 61/105 and 64/72 in the Management of Deep-Sea Fisheries on the High Seas*, International Programme on the State of the Ocean, London, UK.

SEAFO 2015, *Conservation Measure 30/15 on Bottom Fishing Activities and Vulnerable Marine Ecosystems in the SEAFO Convention Area*, South East Atlantic Fisheries Organization, Swakopmund, Namibia.

SIODFA 2013a, *Origin of the SIODFA Benthic Protected Areas Programme and Information Relating to these Areas*, SIODFA Technical Report, SIOFA First Meeting of Parties, Melbourne, Australia.

SIODFA 2013b, *Progressing Conservation and Management Measures for the Deepwater Fisheries of the Southern Indian Ocean: Views and Recommendations of the Southern Indian Ocean Deepsea Fishers Association*, SIODFA Technical Report, SIOFA First Meeting of Parties, Melbourne, Australia.

SPRFMO 2007, *SPRFMO IV Report - Annex D: Proposed process for the preparation and evaluation of benthic assessments for proposed bottom fishing operations in the SPRFMO Area*, SPRFMO Fourth International Meeting on the Establishment of the proposed South Pacific Regional Fisheries Management Organisation, Noumea, New Caledonia.

SPRFMO 2012, *Bottom fishery impact assessment standard*, Third Session of the Preparatory Conference, Santiago, Chile.

SPRFMO 2014, *CMM 2.03 Conservation and management measure for the management of bottom fishing in the SPRFMO Convention Area*, CMM 2.03, South Pacific Regional Fisheries Management Organization, Wellington, New Zealand.

Tittensor, DP, Baco, AR, Brewin, PE, Clark, MR, Consalvey, M, Hall-Spencer, J, Rowden, AA, Schlacher, T, Stocks, KI, Rogers, AD 2009, 'Predicting global habitat suitability for stony corals on seamounts', *Journal of Biogeography,* vol. 36, no. 6, pp. 1111–1128.

UNCLOS 1982, *United Nations Convention on the Law of the Sea*, United Nations, Montego Bay, Jamaica.

UNFSA 1995, *The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*, United Nations, New York, USA.

UNGA 2007, *Resolution 61/105 Sustainable fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments*, UNGA A/RES/61/105, United Nations General Assembly, New York, USA.

UNGA 2010, *Resolution 64/72 Sustainable fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments*, UNGA A/RES/64/72, United Nations General Assembly, New York, USA.

UNGA 2012, *Resolution 66/68 Sustainable fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments*, UNGA A/RES/66/68, United Nations General Assembly, New York, USA.

Villasante, S, Morato, T, Rodriguez-Gonzalez, D, Antelo, M, Österblom, H, Watling, L, Nouvian, C, Gianni, M, Macho, G 2012, 'Sustainability of deep-sea fish species under the European Union Common Fisheries Policy', *Ocean & Coastal Management,* vol. 70, pp. 31–37.

Ward, P, Hansen, S, Georgeson, L 2015, High-seas fisheries for non-highly migratory species. In: Patterson, H, Georgeson, L, Stobutzki, I, Curtotti, R (eds) Fishery status reports 2015. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, Australia.

Williams, A, Althaus, F, Fuller, M, Klaer, N, Barker, B 2011a, *Bottom Fishery Impact Assessment: Australian report for the South Pacific Regional Fisheries Management Organisation (SPRMO)*, CSIRO Marine and Atmospheric Research, Hobart, Australia.

Williams, A, Althaus, F, Fuller, M, Klaer, N, Barker, B 2011b, *Bottom Fishery Impacts Assessment: Australian report for the Southern Indian Ocean Fisheries Agreement (SIOFA)*, CSIRO Marine and Atmospheric Research, Hobart, Australia.

Williams, A, Bax, NJ, Kloser, RJ, Althaus, F, Barker, B, Keith, G 2009, 'Australia's deep-water reserve network: implications of false homogeneity for classifying abiotic surrogates of biodiversity', *ICES Journal of Marine Science: Journal du Conseil,* vol. 66, no. 1, pp. 214–224.

# Annex A Conditions of relevant conservation measures in other RFMOs

**Table A1 Overview of selected conditions of conservation measures established by other regional fisheries management organisations relevant to the protection of VMEs.**

| RFMO | Year in force | Conservation Measure | Conditions |
|---|---|---|---|
| SPRFMO | 2014 | CMM 2.03 | Requirement for Members (and Cooperating Non-Contracting Parties) to define and limit activities to their reference period bottom fishing footprint and limit catch to reference period levels (procedures in place for fishing outside footprint or above reference period levels).<br>Requirement for bottom fishing assessments to be completed.<br>Requirement for minimum levels of observer coverage.<br>Establishes VME encounter protocols.<br>Establishes data collection and reporting requirements.<br>Establishes performance review of measure two years after implementation.<br>Outlines a work request for the Scientific Committee to com |
| SEAFO | 2016 | Conservation Measure 30/15 | Establishes spatial closures to protect VMEs.<br>Establishes 'existing bottom fishing areas' on a reference period 1987-July 2011.<br>Establishes exploratory fishing application procedures.<br>Establishes VME encounter protocols.<br>Establishes data collection and reporting requirements. |
| CCAMLR | 2008 | Conservation Measure 22-05 | Restricts the use of bottom trawling gear to areas for which the Commission has established other conservation measures for bottom trawling gear. |
| | 2012 | Conservation Measure 22-09 | Establishes spatial closures to protect VMEs. |
| | 2013 | Conservation Measure 22-07 | Defines VME indicators and establishes VME encounter protocols for line and pot vessels. |

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|---|---|---|---|
| | 2015 | Conservation Measure 22-06 | Outlines bottom fishing area (which applies to other CCAMLR bottom fishing CMs.<br>Requirement for bottom fishing assessments to be completed.<br>Establishes VME encounter protocols.<br>Establishes data collection and reporting requirements.<br>Establishes periodic performance review of bottom fishing and VME CMs. |
| NAFO | Rolling updates since 2009 | Conservation and Enforcement Measures 2016: Chapter II | Establishes spatial closures to protect VMEs.<br>Establishes exploratory fishing application procedures.<br>Establishes VME encounter protocols.<br>Establishes data collection and reporting requirements.<br>Establishes need for review of the Conservation and Enforcement measure and periodic review of bottom fishing activities. |

# Annex B Proposed Bottom Fishery Impact Assessment Process

**Table B1 Proposed process for preparation and evaluation of bottom fishery impact assessments for proposed bottom fishing operations in the SIOFA Area**

| Category | | Task | Timeframe | Responsibility |
|---|---|---|---|---|
| Preparatory phase | 1 | • Agree that the Scientific Committee is to be responsible for conducting intersessional evaluations of bottom fishery impact assessments<br>• Develop and agree upon an interim SIOFA Bottom Fishery Impact Assessment Framework to be implemented | Done at the third Meeting of the Parties (July 2016) | SIOFA SC and flag States |
| | 2 | • Preparation of the SIOFA geospatial VME, joint trawl footprint, bathymetric and EEZ boundary geospatial database | Following the third Meeting of the Parties, pending establishment of the Secretariat | SIOFA Interim Secretariat (Assisted by the SC and Meeting of Parties) |
| Annual assessment and review process | 3 | • Preparation of benthic impact assessments for proposed bottom fishing operations in the SIOFA Area, in accordance with the SIOFA Benthic Assessment Framework (or the Bottom Fishery Impact Assessment Standard, once adopted)<br>• Submit benthic impact assessments (including those previously completed) to the SIOFA Secretariat, for forwarding to the SC | Required for any bottom fishing after (July 2019)<br>To be prepared and submitted before fishing commences.<br>Fishing may proceed in accordance with the management and mitigation measures proposed in the assessments while the assessments are evaluated by the SC | Flag States wishing to commence bottom fishing |

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| | 4 | • Assessments submitted to the SC for evaluation and comment | Immediately upon receipt from flag States. | SIOFA Secretariat |
| | | • Assessments also to be posted on the [SIOFA website] for public comment, and notification of each posting to be sent to other SIOFA flag States | Comments required within (30 days) of posting | |
| | | • Receive, collate and provide public comments on benthic assessments back to the SC | Comments received are to be provided to the Secretariat and transmitted to the SC immediately after (30 day) commentary period. | |
| | 5 | • Evaluate and prepare comments on submitted assessments | Within (60 days) of receiving flag State assessments from the Secretariat | SIOFA SC |
| | | • Provide written comments back to flag States, through the Secretariat | | |
| | 6 | • Provide SC comments back to the flag State, and notify other flag States of the SC comments on each assessment | Immediately upon receipt of comments from the SC | SIOFA Interim Secretariat |
| | | • Post SC comments on assessments on the [SIOFA website] | | |
| Flag State response | 7 | • Respond to comments or questions received from the SC | At subsequent SC meeting | Flag States |
| Ongoing improvement and review process | 8 | • Agree on detailed SIOFA Bottom Fishery Impact Assessment Standard | Once this has been drafted (Second meeting of the SC, July 2017) | SIOFA SC |
| | | • Periodically review and update the Bottom Fishery Impact Assessment Standard and Process | At annual SC meetings | |
| | 9 | • Review performance of the SC Bottom Fishery Impact Assessment Standard and Process, and SC assessment evaluations conducted | | SIOFA Meeting of the Parties |
| | | • Determine objectives for SC to use in future evaluation of bottom fishing benthic assessments | | |

Note: Provisional dates are offered in parentheses.
Source: Adapted from the SPRFMO Proposed Process (SPRFMO 2007)