International Consultations on the Establishment of the
South Pacific Regional Fisheries Management Organisation

Draft Benthic Assessment Framework

1. Introduction

The SPRFMO Interim Measures adopted at the 4th meeting in Reñaca, Chile, in May 2007, in relation to assessments for bottom fishing operations, require the Science Working Group (SWG) to "*design a preliminary interim standard for reviewing the assessments and develop a process to ensure comments are provided to the submitting Participant and all other Participants*". The SPRFMO Benthic Assessment Standard is intended to guide the SWG in evaluating and commenting on assessments submitted by flag states that wish to continue bottom fishing operations in the SPRFMO Area after the interim measures implementation date of 30 September 2007.

Work is currently underway to develop a detailed SPRFMO Benthic Assessment Standard, but this will only be completed by about mid-2008. Pending the development and adoption of the detailed benthic assessment standard, an initial framework and guideline is required to guide flag states in preparation of assessments, and the SWG in evaluating those assessments, from 30 September onwards. This document contains the proposed draft interim SPRFMO Benthic Assessment Framework, and is intended to serve as that interim guideline pending development of the full standard

2. Purpose

The purpose of this framework is to provide initial guidelines for flag states in preparing assessments and management plans for proposed bottom fishing operations in the SPRFMO area, and to guide the SPRFMO SWG in evaluating and commenting on submitted assessments. This framework provides contextual information to be considered in preparing assessments, including relevant definitions and baseline maps (Sections 1 - 6). Section 7 then lists the sub-sections that are expected to be included in benthic assessments for bottom fisheries, with broad descriptions of the expected contents of each section.

This framework does not, at this stage, provide detailed guidance on the information to be provided under each sub-section of the assessments, what specific assessment methods should be used, or what international best practice procedures should be followed. It is intended that the full SPRFMO Benthic Assessment Standard, which will replace this framework, will fully review relevant international best practices, and provide more specific guidelines under each section.

3. Definition of Vulnerable Marine Ecosystems

The key requirements of the SPRFMO interim measures for bottom fishing relate to implementing measures to either avoid fishing on vulnerable marine ecosystems (VMEs), or to implement fishing practices and / or mitigation methods to "*prevent significant adverse impacts on vulnerable marine ecosystems*" or "*determine that such activities will not have adverse impacts*" on VMEs.

VMEs have not yet been formally defined in the context of deepwater fisheries. They are referred to in UN General Assembly Resolution 61/105 as "*vulnerable marine ecosystems, including seamounts, hydrothermal vents and cold water corals*". The SPRFMO interim measures expand on this to recognise that VMEs "*include seamounts, hydrothermal vents, cold water corals and sponge fields*".

For the purposes of interpretation and implementation of this framework, Table 1 contains a list of geological and biological definitions of VMEs that together constitute a proposed working definition to use in developing and evaluating assessments for bottom fishing operations in the SPRFMO area[1].

Table1. List of proposed geological and biological definitions of vulnerable marine ecosystems, together constituting a working definition of VMEs to use in preparing and evaluating assessments for bottom fishing operations under the SPRFMO Interim Measures.

Geological Definitions
• **Seamounts:** Seamounts should be defined ecologically rather than geologically, and features < 1,000m should also be defined as seamounts. Pitcher *et al* (2007, in press) define a seamount as a topographically distinct seafloor feature that is ≥ 100m and does not break the surface. However, Pitcher *et al* (2007, in press) further define "large" seamounts as exceeding 1,500m in height and it is these whose global distribution can be well resolved using methods such as satellite altimetry. The distribution of smaller seamounts (< 1,500 m) must be inferred from localised acoustic mapping.
Biological Definitions
• **Cold Water Corals:** The main benthic community of concern identified in recent studies are the cold water stony corals. The ecosystem function of cold water corals varies depending on morphology: reef formers vs. non reef formers, with concern focussed on the 'habitat-forming' corals. However, some non-reef formers still represent structurally important habitat in the deep-sea e.g. bubble gum corals (Paragorgiidae), black corals (*Antipatharia*), and should be included.
• **Sponge Gardens:** Sponge gardens also constitute 'habitat forming' communities, and can also represent structurally important components of deep-sea benthic communities.
• **Other Communities:** Other vulnerable communities or species are likely to be identified from information collected by observer programmes on bottom fisheries in the SPRFMO area. The assessment standard should be periodically updated to reflect these.

[1]The FAO is currently conducting expert consultations with a view to preparing guidelines for management of deepwater fisheries, and the results of this FAO process will be integrated into the SPRFMO Benthic Assessment Standard, when these become available. The FAO process is likely to contribute to definitions of VMEs and vulnerability. The issue of vulnerability relates specifically to the potential threat that fishing might have on such ecosystems. Hydrothermal vents are specifically mentioned in UNGA 61/105 and the SPRFMO interim measures. Similarly, cold-water seeps and seabed canyons are increasingly recognised as supporting vulnerable marine communities. However, no fishing is currently known to occur in association with, or in close proximity to, any of these features, and so they are currently not 'vulnerable' in that sense. For the interim period, these features may be excluded from the working definition of VMEs used by SPRFMO, and the focus of assessments should remain on seamounts (as ecologically defined in Table 1) and the listed biological communities.

4. Mapping of Vulnerable Marine Ecosystems

At this stage, given the limited knowledge of the distribution of deepwater benthic species, seamounts will have to be the main focus for mapping the distribution of potential VMEs. This focus is justified, given the known association of complex deepwater benthic communities with seamounts,. Initially, mapping of VMEs will necessarily amount to mapping of seamounts and other topographic features that have a high probability of supporting the biological communities listed in Table 1. Current maps of seamounts only show the distributions of large seamounts (> 1500m), notably that by Kitchingman & Lai (2004) (Figure 1). Further work is required to identify smaller seamounts, in accordance with the ecological definition in Table 1. Contextual information also needs to be added to GIS VME maps to identify vulnerable or diverse systems, and to provide a scientific basis for moves towards higher levels of protection for the more vulnerable systems, or development of proposals to protect certain proportions of each significant habitat type.

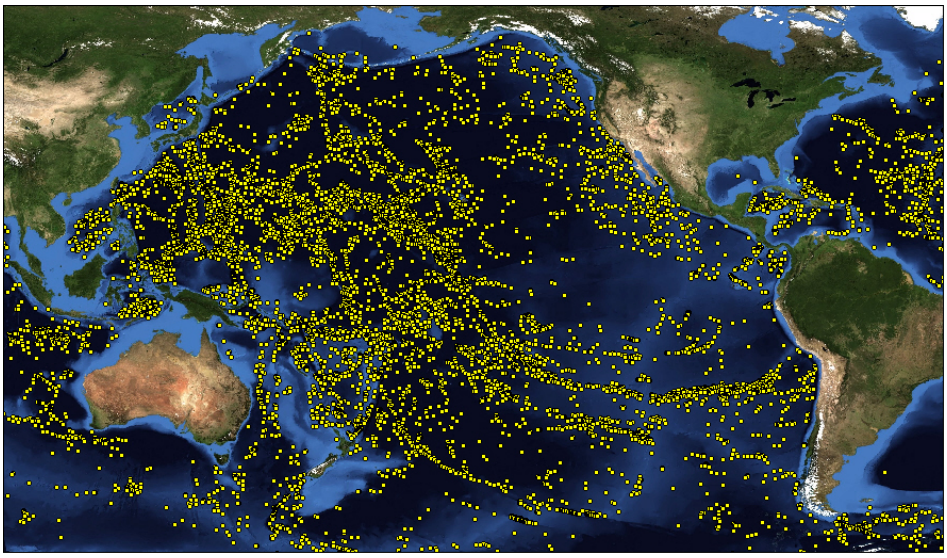

Figure 1. Distribution of potential seamounts predicted by satellite altimetry analyses (from Kitchingman & Lai 2004). This technique is thought able to detect seamount features with an elevation of 1,500m or greater.

It is, however, currently feasible to map the distribution of seamounts estimated to have suitable habitat for stony corals based on Environmental Niche Factor Analysis (ENFA) of global coral data (Clark *et al* 2006, UNEP CenSeam report) (Figure 2). This map provides an initial basis for determining whether proposed bottom fishing operations will impact upon habitat with 50% probability of supporting VMEs[2].

[2] Future work should emphasize options for obtaining additional information on type, characteristics, vulnerability and habitat classifications to improve and extend this identification and classification of VMEs. It is also important to consider the spatial, and possibly temporal, distribution of VMEs, and the associated potential distribution of biota. Typically, VMEs that are more isolated may have an increased likelihood of containing endemic fauna, compared to VMEs that occur as part of a chain, or closer to a land mass. Isolated VMEs should be considered to be more vulnerable to any fishing activities, and worthy of a higher level of protection.

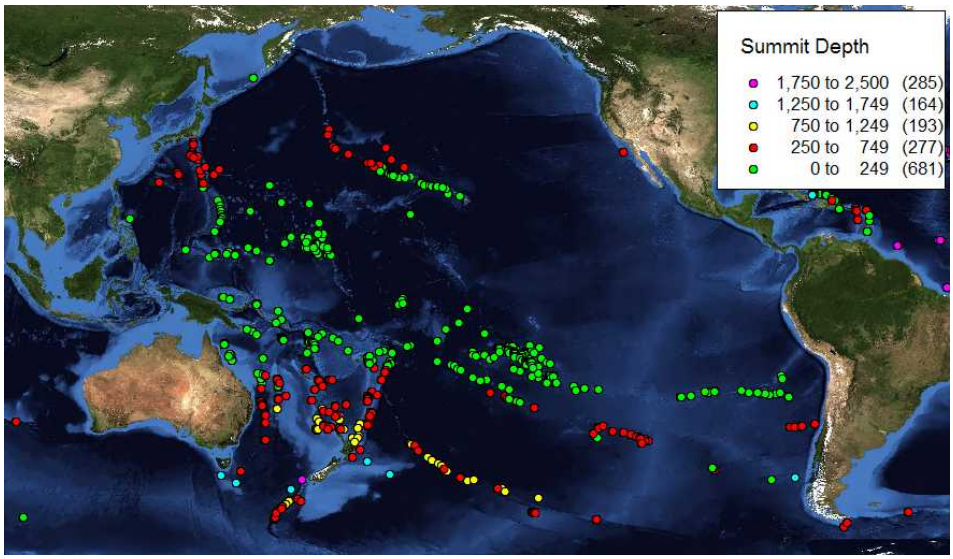

Figure 2. Distribution of seamounts considered to have suitable habitat for stony corals based on ENFA analysis of global coral data (Clark *et al* 2006, CenSeam Report). Seamount data from Figure 1 are used, with those shown here having stony coral habitat suitability 50% or greater. Estimated summit depths of the seamounts are colour coded.

5. Hierarchy of Bottom Fishing Impact

The provisions of the SPRFMO interim measures for bottom fishing apply to all bottom fishing methods. However, not all bottom fishing activities have the same expected severity, magnitude or extent of impact on seabed communities. Benthic communities are therefore differentially 'vulnerable' to the impacts of different bottom fishing gears.

The intent of UNGA Resolution 61/105 and the SPRFMO Interim Measures is clearly to minimise adverse impacts on the types of biological VMEs listed in Table 1. Concerns are mainly focused on the impact of moving fishing gears that are designed to, or are likely to, be dragged across the seabed during fishing, causing direct physical damage to habitat forming benthic species. Table 2 shows the hierarchy of expected impact (magnitude, extent and duration) ranking of the various bottom fishing gears.

Table 2. Hierarchy of expected extent and magnitude of impacts of various bottom fishing gears on the vulnerable marine ecosystems listed in Table 1.

Fishing Gear	Expected Impact
Bottom Dredging	High
Bottom Trawling	High
Midwater Trawling	Med - High
Set, Gill or Tangle Nets	Med - High
Trap and Pot Fishing	Med
Bottom Longlining	Low - Med
Drop Lining	Low

The SWG will explicitly take this hierarchy of expected impact into account when evaluating and commenting on assessments for proposed bottom fishing operations in the SPRFMO area.

6. Mapping of the SPRFMO Trawl Footprint

Trawling (bottom and midwater trawling) is currently the main bottom fishing activity in the SPRFMO area. In terms of the hierarchy in Table 2, these methods are expected to have potentially high impact on VMEs. Efforts to map bottom fishing footprint areas, at least during the interim period, should therefore focus on trawling.

The SWG, working in cooperation with the SPRFMO Secretariat, shall develop and maintain an electronic geo-spatial map of a 'joint trawl footprint' for all participants in bottom fisheries in the SPRFMO area. The Secretariat should include seabed bathymetry and the SPRFMO maps of VMEs in this geospatial database.

This joint footprint map should be developed at the finest resolution practicable, to prevent inclusion of unnecessarily large un-trawled areas into the defined 'trawled footprint'. It is proposed that this footprint be expressed as grid blocks of 10 minute resolution, with a 'fished' block being defined as any grid block partially crossed by at least one trawl track[3]. It is additionally proposed that the period 2002 to 2006 be used as the reference period for developing this joint trawl footprint map.

Participants should provide bottom fishing data at adequate resolution (tow-by-tow, 10 minute resolution) to generate this joint trawl footprint. The Secretariat shall be responsible for requesting these data, and for developing and maintaining the SPRFMO joint trawl footprint geospatial database and map, at the agreed resolution.

Participants in trawl fisheries in the SPRFMO area will be required, in terms of the interim measures, to not fish outside of this joint trawl footprint, until 2010. The SWG will take this into consideration when evaluating the fishing plan component of assessments for proposed trawl fishing activities in the interim period.

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7. Proposed Benthic Assessment Sections

Benthic assessments submitted by flag states for evaluation and comment by the SWG will be expected to contain the following sub-sections:

7.1 Description of the Proposed Fishing Operation

Assessments shall contain a detailed fishing plan, providing a quantified description of the planned fishing operations, including:

- Fishing methods (trawls, hook and lines, traps, gillnets, tangle nets) to be used, including description of relevant aspects of the gear needed to evaluate potential impacts, such as net types, net dimensions, trawl-door type, size and weight, footrope dimensions and type, ground gear (bobbins, rock-hopper gear, etc), fishing height off bottom (for mid-water gear), net opening and any gear selectivity issues.
- Depth range to be fished.
- Target species, and likely or potential by-catch species.
- Intended period and duration of fishing.

[3] See Penney *et al* 2007 for an evaluation of the effect of adopting different resolutions for trawl footprint mapping.

- Effort indices: How many vessels, how many tows (cumulative effects), estimated tow durations or distance (ranges).
- Estimated catch and discard quantities.
- Information on vessels to be used: Vessel numbers, sizes, GRT, horsepower, names, conformation that they appear on the list of approved SPRFMO vessels, flags and callsigns. These vessels should appear on the list of approved vessels submitted by flag states to the SPRFMO Secretariat.

7.2 Mapping and Description of Proposed Fishing Areas

This section should present maps of the proposed fishing areas in relation to available information on VMEs and seabed bathymetry, as well as any additional available information describing the proposed fishing areas, including:

- Maps of the intended fishing areas, in relation to the joint trawl footprint.
- Localised mapping of the VMEs, or topographic features likely to support VMEs, in the proposed fishing areas[4].
- Description of the proposed fishing areas, presenting any available information which might be useful to assessing potential impacts (past history of fishing, seabed type, depth ranges, location / presence of any known seabed topographic features and VMEs).

The SPRFMO Secretariat will make the SPRFMO geospatial maps of VMEs, bathymetry and joint trawl footprint available to facilitate mapping of proposed fishing operations in context with this baseline geo-spatial information.

To facilitate evaluation of the relationship between proposed fishing areas, the joint trawl footprint and existing VME maps, Flag States should provide their maps for proposed fishing operations to the Secretariat in a compatible GIS format, for inclusion in the SPRFMO geo-spatial database.

7.3 Evaluation of Expected Interaction with VMEs

This section should specifically address the expected and potential interaction and impacts of the proposed fishing gear on VMEs. Recognising that information may be limited, an attempt should nonetheless be made to address the following questions:

- What impacts are likely to occur ? All impacts should be identified, characterised and ranked. All interactions of fishing gear with the seabed will have some impact, but the nature and severity will be species / habitat dependant.
- What will the probability, likely extent (% of habitat targeted) and magnitude of the interaction between the proposed fishing gear / targeting practices on the VMEs in the proposed fishing areas be ?

[4] Initially, data may be limited to the VME baseline maps maintained by the SPRFMO Secretariat. However, over time, industry may be able to provide additional information to update the Secretariat VME maps based on industry acoustic surveys or observer information. These modifications may include addition of VMEs, or removal of areas incorrectly identified as likely VMEs. Flag states may also conduct more detailed bathymetric surveys. These may be followed with spot > regular > systematic sampling to assess the presence or absence of potentially vulnerable benthic fauna. The introduction of remote technologies may also be considered, such as towed camera platforms as a means of surveying prospective fishing grounds.

- Are the VMW habitats which may be impacted biogenic (produced by living organisms or biological processes) or geological ? What areas do the habitat cover ? How widespread or rare are the habitats ? How fragile are the habitats ? What are the rates of natural disturbance in those habitats ?
- As far as possible, characteristics of the biota should be evaluated, including target species, by-catch species and benthic fauna. What are the key species in the VME ? How diverse is the system, and will the fishing activity affect just one faunal group or many ? What is the population structure of the faunal groups present - how will fishing activity impact on recruitment, age classes etc ? Are there any threatened species present, and what are the levels of endemism - could fishing lead to localised / global extinctions ? Are there any life history characters which may lead to fauna being more susceptible / sensitive to fishing - slow growing, long lived ?
- What are the likely consequences of interaction with fishing gear ? Consider both physical (damage to environment, loss of habitat) and biological (loss of keystone species, extinctions) impacts.
- What is the likely temporal scale of the consequences ? The scale of the consequence will be defined by the constituent parts of the VME. Loss of substantial areas of habitat forming coral could have a prolonged impact on the environment, whereas other faunal groups may be able to recover quickly. To the extent possible, rates of recovery, regeneration and re-colonisation should be quantified.
- Are there any other hazards: gear loss or ghost fishing, catch discards, effects on ecosystem functioning ?

7.4 Management and Mitigation Measures

This section should detail proposals for how the fishing operation will be conducted to avoid or minimise significant adverse impacts on VMEs[5], including:

- Description of gear selection, design, modification or deployment to prevent or reduce adverse impacts.
- The process to be used to detect evidence of fishing on VMEs, and the procedure to adhere to the SPRFMO requirement to move 5 nautical miles away from any VME detected while fishing. If this will be monitored by observers, then this should be cross-referenced in the section on monitoring, and details provided on the information to be recorded by observers to document the presence of VMEs.

7.5 Monitoring and Reporting

This section should detail all data and information gathering and reporting systems that will be used to monitor the proposed fishing operations, catches and interactions with VMEs, including:

- Details of VMS systems to be operated on vessels, including who these will report to, reporting frequency and reporting accuracy (as required in terms of the SPRFMO VMS Standard).
- Catch and effort monitoring systems to be used, including catch and effort reporting systems to the flag states concerned, and additional systems to be implemented

[5] See Shotton *et al*. (2006), Management of Demersal Fisheries Resources of the Southern Indian Ocean

specifically for the proposed operation. These monitoring systems should specifically address how retained and discarded by-catches are to be monitored and reported. There should also be reporting systems in place to record whether a VME has been encountered during fishing.

- Details of the scientific observer coverage planned for the proposed fishing operation, including levels of coverage, how deployments will be designed to achieve statistically representative coverage of the proposed fishing operations, and what information observers will be collecting. This section should detail how the SPRFMO Observer Programme standard will be implemented for the proposed fishing operations, noting that the SPRFMO Observer Programme standard recommends 100% observer coverage for bottom-trawl fishing, and 20% - 30% coverage for other methods.
- Description of the data that will be provided to the SPRFMO Secretariat for the fishing operation including, as a minimum, the data required in terms of the SPRFMO Data Standards and Observer Programme Standard, but also describing any other information (seabed bathymetry or mapping, VME identification and characterization) that may be provided.

7.6 Environmental Impact Assessment

A concluding Environmental Impact Assessment (EIA) section should present an overview and summary EIA, identifying all likely impacts on VMEs at each stage of the proposed fishing operation, and ranking each impact in terms of factors such as expected extent, severity and duration of the proposed fishing activity on VMEs. For all impacts ranked as being above moderate, proposed monitoring, mitigation and management measures to detect, measure, minimise, manage or prevent significant adverse impacts should be described.

The detailed SPRFMO Benthic Assessment Standard will provide recommendations on specific environmental assessment approaches and best practices to use in developing this EIA section[6]. In the interim, participants should refer to the following of EIA approaches, noting that this list is neither prescriptive nor exhaustive:

- ICES: There have been two main approaches to assessing the sensitivity of habitat to fishing: i) ranking sensitivity of habitat units (physical and biological) to disturbance; and ii) ranking the impacts of the gear. ICES conclude that these should be combined.
- NOAA EIS: Spatial and temporal analysis of the distribution of habitat type, distribution of biota, habitat use, habitat sensitivity, dynamics of fishing effort.
- MarLin: Approach consists of i) Identify “key / important” species in habitat/biotype; ii) Assess biotype sensitivity based on key species; iii) Assess recoverability of key/important species (Tyler-Walters *et al.* 2001).
- Sensmap: A sensitivity index for benthic species or habitat to physical disturbance from fishing has been adapted to include chemical contamination and other environmental disturbance. Sensitivity is assessed based on intolerance to the disturbance (fragility of biota and intensity of fishing) as well as ability to recover.

[6] The primary role of the SWG will be to critically evaluate this impact assessment against the standard, and to comment on whether the indicated impact rankings are appropriate or not. The SWG will need to work towards adopting an appropriate ranking system for these EIAs, and to identify the best risk management technique. Definition of a habitat classification system for SPRFMO area deepwater habitats will contribute substantially to developing an effective final standards framework.

Sensmap uses the UK Marine Habitat Classification (MacDonald *et al.* 1996). Similar to MarLin.

- Canadian and US Framework: Damage schedule approach which ranks the severity of fishing gear impacts on a binary questionnaire (Chuenpagdee *et al.* 2003).
- CSIRO Ecological Risk Assessment for Effects of Fishing: ERAEF is a hierarchical framework that moves from a Level 1 qualitative analysis through to a more focussed semi-quantitative Level 2 to Level 3 which is model based and fully quantitative. This approach leads to a rapid identification of high risk activities, and evaluation of how fishing impacts on ecological systems (Hobday *et al.* 2007).
- UK Department for Environment, Food & Rural Affairs (DEFRA) Guidelines for Environmental Risk Assessment and Management.

The effects of frequency of disturbance may have been overlooked to some extent in prior frameworks, and may require specific consideration. Additionally the use of Strategic Environmental Assessments (SEA), which focus on larger-scale programmes rather than individual operations, could be considered.

6. References

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