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Report from a series of stakeholder workshops to gather and document stakeholder views on the nature and content of a revised conservation and management measure for bottom fisheries in the SPRFMO Area

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Executive summary

A series of four workshops was held between 13 July 2017 and 15 August 2017 to gather and document the initial views of stakeholders with respect to the use of decision support software to aid the design of spatial management areas for bottom fisheries in the western SPRFMO Area. It is anticipated that the software tool Zonation will be used for this task, and stakeholders also worked with scientists and officials to build capacity in the use of the software and decide on key inputs, settings, and approaches for such analysis. This work contributes to the development of a revised conservation and management measure (CMM) for bottom fisheries on which Australia, New Zealand, Chile, and the EU have been collaborating since 2015. Given this context, the initial views of stakeholders on other matters that should be considered for inclusion in a revised CMM were also discussed and documented. A wide variety of example outputs from preliminary Zonation outputs were presented at the workshops, focusing mainly on priority conservation maps and conservation benefit curves. Many are reproduced in this report as examples. Additional work is required to finalise input data and Zonation runs. It is anticipated this work will be done in the weeks following the fifth meeting of the Scientific Committee and in time for the drafting of a new CMM for the consideration of the Commission in 2018.

1. Purpose of paper

This paper is intended to inform the Scientific Committee on the outcomes of a series of three workshops held in Wellington, New Zealand, in July and August 2017. The aim of these workshops was to gather and document stakeholder views on the nature and content of a revised conservation and management measure for bottom fisheries in the SPRFMO Area.

This paper records the basic results and decisions from the workshops and it assumes a reasonable understanding and knowledge of the subject matter and the software being used. That being the case, this paper may not be readily understood by a lay audience. Rather, this paper represents a record of what was done and agreed at the workshops.

It is important to note that this document does not purport to represent the full views of any stakeholder or interested part in the development of new bottom fishing measures. Indicative views were expressed at the workshops, and care was taken recording them as accurately as possible, but additional consultation will be conducted as and when new measures are proposed.

2. Background to the workshops

The South Pacific Regional Fisheries Management Organisation (SPRFMO) is committed to the long-term conservation and sustainable use of the fishery resources of the South Pacific Ocean and safeguarding the marine ecosystems in which these resources occur[1]. Currently, the main commercial resources fished in the SPRFMO Area are jack mackerel and jumbo flying squid in the Southeast Pacific, and demersal and bentho-pelagic species in the Southwest Pacific. Several SPRFMO Members have historically had such bottom fisheries but Australia and New Zealand are the only two Members with current bottom fisheries in the SPRFMO Area.

The main Australian and New Zealand fisheries use bottom trawls for orange roughy (*Hoplostethus atlanticus*), midwater trawls for alfonsinos (*Beryx* spp.), and bottom longlines for bluenose (*Hyperoglyphe antarctica*), wreckfishes (*Polyprion* spp.), and toothfish (*Dissostichus spp*.). Other species than these main target species are caught, and some bottom fishing is targeted at other species.

Bottom fisheries, including all trawl methods and hook-and-line methods where the gear can be expected to touch the bottom in the normal course of fishing, are governed by CMM-03-2017, the Conservation and Management Measure for the Management of Bottom Fishing in the SPRFMO Convention Area. The objective of CMM-03-2017 is *to promote the sustainable management of bottom fisheries including target fish stocks as well as non-target species taken as bycatch, in these fisheries, and to protect the marine ecosystems in which those resources occur, including inter alia, the prevention of significant adverse impacts on vulnerable marine ecosystems*.

Paragraph 27 of CMM-03-2017 states that *This CMM shall apply until the close of the annual Commission meeting in 2018 unless determined otherwise by the Commission. It shall be*

[1] First paragraph of the SPRFMO Convention

reviewed at the regular meeting of the Commission in 2018. Such review shall take into account, inter alia, the latest advice of the Scientific Committee, including with respect to appropriate catch levels for principal target species and/or appropriate reference periods, in accordance with the objective … of this CMM. To this end, officials from Australia, Chile, the European Union, and New Zealand have been working closely together to develop proposals for revisions to CMM-03.

At the SPRFMO Commission meeting in January 2017, Australia and New Zealand jointly presented paper Comm5-Inf-05 updating the Commission on progress towards the development of a revised bottom fishing CMM. That paper indicated that the revised bottom fishing measure would be comprehensive and based on a spatial management approach, requiring:

- the identification of an appropriate fishing footprint that is implemented consistently across the membership;
- the mapping of the vulnerable marine ecosystem (VME) distribution within the footprint;
- the setting of sustainable catch levels for target species;
- determining precautionary measures to ensure no adverse impacts of fishing on the populations of species taken as bycatch; and
- determination of management measures to prevent significant adverse impacts on VMEs, particularly areas that will be open or closed to fishing within the footprint.

Science processes have been underway for several years to generate the information required to map the distribution of fishing and assess the status of key fish stocks (e.g., Penney 2010, Clark et al. 2010, Roux et al. 2016), map the likely distribution of VMEs (Rowden et al. 2013, Anderson et al. 2016a,b), and develop the decision-support software tools for integrating that information to design candidate spatial management areas (Rowden et al. 2015) to meet the objectives of the SPRFMO Convention in relation to bottom fisheries. These scientific approaches were reviewed at the 3rd SC workshop in Hobart in May 2017. The workshops reported in this paper form the next component in the process to develop proposals for revisions to the CMM for Bottom Fishing in the SPRFMO Area. The prime focus of this initiative is to address the last bullet point above. The workshops were convened to gather and document the views of stakeholders, including the fishing industry, environmental non-governmental organisations (NGOs), science community, and government officials; and to agree data inputs and settings for the spatial decision-support software. Formal Terms of Reference (Appendix 1) were circulated on 7 July 2017.

3. Technical pre-workshop (13 July 2017)

On 13 July 2017, a technical pre-workshop meeting was convened to parameterize a cumulative bottom fishing impact/footprint assessment using the method of Sharp, Parker & Smith (2009) which was originally developed for bottom fisheries in the CCAMLR Convention Area. Seventeen people attended including representatives of the fishing industry and government officials from both Australia and New Zealand. The "CCAMLR method" can be used to estimate the likely cumulative impact of one or more bottom fishing methods on benthic organisms of different levels of fragility, and allow comparisons between fisheries employing different bottom fishing methods. The results of the application of the method also provide an

index of the "naturalness" of the benthic community in given locations affected by fishing, and this can be used as an input layer for spatial decision-support software.

The agreements and results of the technical pre-workshop are described in more detail in a separate paper to SC-05 (Sharp et al., paper SC-05-xx).

4. Stakeholder workshop #1 (14 July 2017)

The first stakeholder workshop was convened on 14 July 2017 and was attended by 19 people, including representatives of the fishing industry and environmental NGOs, a research team from NIWA (Drs Rowden, Lundquist, and Stephenson), and government officials from both Australia and New Zealand (Appendix 2). Apologies were received from three people, including representatives of environmental NGOs. In addition to the documents circulated by the Chair of the workshop, background papers were provided by the Deep-Sea Conservation Coalition (DSCC) and the High Seas Fishery Group (HSFG) to inform the workshops of their respective views.

New Zealand High Seas Fishery Group stated:
Members of the New Zealand High Seas Group (HSG) have a long presence fishing in the SPRFMO area not only in the years 2002 to 2006 which officials decided would be the footprint years but from the late early 80s and early 1990s when a lot of catch was taken outside the New Zealand and Australian EEZs.

Industries' input and unhappiness at the way the interim measures were drafted and the fact that "all best available information "was not utilized is well recorded. Against this backdrop was the formation of the New Zealand High Seas Group. Many papers have been submitted some are listed below

Over the last 2 to 3 years HSG have worked together with MPI and MFAT and now got to a situation where industries' views are being considered and in fact papers now suggest spatial management as a possible way forward.

The round of workshops have been good from our perspective as we feel it has allowed more important information to be utilized and the zonation model supports far better what industry actually experience on the grounds, some has been ground proofed and has shown good model fit on where trawl tracks are and also where VMEs are most likely to be. This has shown what industry has suspected that trawl tracks are away from areas where there is the potential for VMEs to be present.

Papers tabled by HSG:

- Management of Deepwater Fisheries By Seafloor Feature in the South Pacific Ocean. High Seas Fisheries Group. November 2010.
- Alternative Proposal for the Management of Deepwater Fisheries of the South Pacific. New Zealand High Seas Fisheries Group presented to: Commission of the South Pacific Regional Fisheries Management Organization 2nd Meeting of the Commission, Manta, Ecuador: 27-31 January 2014. COMM-02-OBS-01.
- A Reflection on the SPACWG 2014-03's Document. SPRFMO bottom fishing conservation and management overview paper. The New Zealand High Seas Fishing Group Inc. New Zealand September 2014.

- Management by seafloor feature of deepwater fisheries in the South Pacific Ocean. The New Zealand High Seas Fishing Group Inc September 2014.
- Competing Narratives: Getting your VME story heard above the rest August 2015. Presented to 3rd SC meeting Port Villa Vanuatu October 2015

The Deep Sea Conservation Coalition concluded in their paper that any replacement measure for CMM 03-2017 must:

1. Be consistent with articles 10 and 20 of the Convention as well as the objective of SPRFMO Convention;
2. Implement the UNGA resolutions, specifically starting with resolution 61/105 and including the latest resolution 71/123; and
3. Be consistent with the FAO Guidelines, based on the full set of criteria in the Guidelines for identifying VMEs, conducting environmental assessments and determining whether significant adverse impacts were likely or not likely to occur as called for in resolution 71/123.

Following preliminary discussions of these views, the Chair introduced the purpose and timelines for the workshops and then the research team described spatial management design procedures in general terms and the workings of the decision support software (called Zonation) in more detail, including the available data and the multiple switches and options available for analyses. After discussions, the workshop agreed to the following for initial Zonation runs:

Area, scope, and stratification:

- All bottom trawl fisheries (Figure 1) would be included in the analysis (midwater trawling for bentho-pelagic species and all other fisheries would be assessed outside the Zonation framework);
- The Zonation analysis would be confined to an area of the southwest Pacific necessary to encompass all such bottom trawl fisheries (24˚ S to 57.5˚ S, 143˚ E to 146˚ W) – this would be a modest extension to area covered by the New Zealand regional habitat suitability models for VME indicator taxa reported by Anderson et al. (2016b). Interim Zonation analyses would be developed using the existing New Zealand regional habitat suitability models (24˚ S to 57.5˚ S, 157˚ E to 160˚ W) until new habitat suitability models become available;
- Bio-regionalisation (stratification) of the area would be included in the Zonation analysis using a modification of the Watling et al. (2013) biogeographic scheme, with sensitivity analyses using a simpler scheme and no bio-regionalisation. Genetic connectivity would not be formally included but addressed informally through the bio-regionalisations;
- The grid size for the habitat suitability mapping, cumulative bottom impact assessment, and Zonation analyses would be 1 km; this would support the design of candidate spatial management areas at any coarser scale;

- EEZs will be "masked out" for the Zonation analysis (to increase processing speed and because doing so made little difference to the results of preliminary analyses) but all SPRFMO areas within the adopted study area would be included;
- The depth range for the habitat suitability mapping and Zonation analyses would be 3000 m with sensitivity analyses using 1600 m and 2000 m as these are currently the limits of fishable depths;
- Ideally, grid cell boundaries would be aligned with other administrative boundaries such as fish stock boundaries.

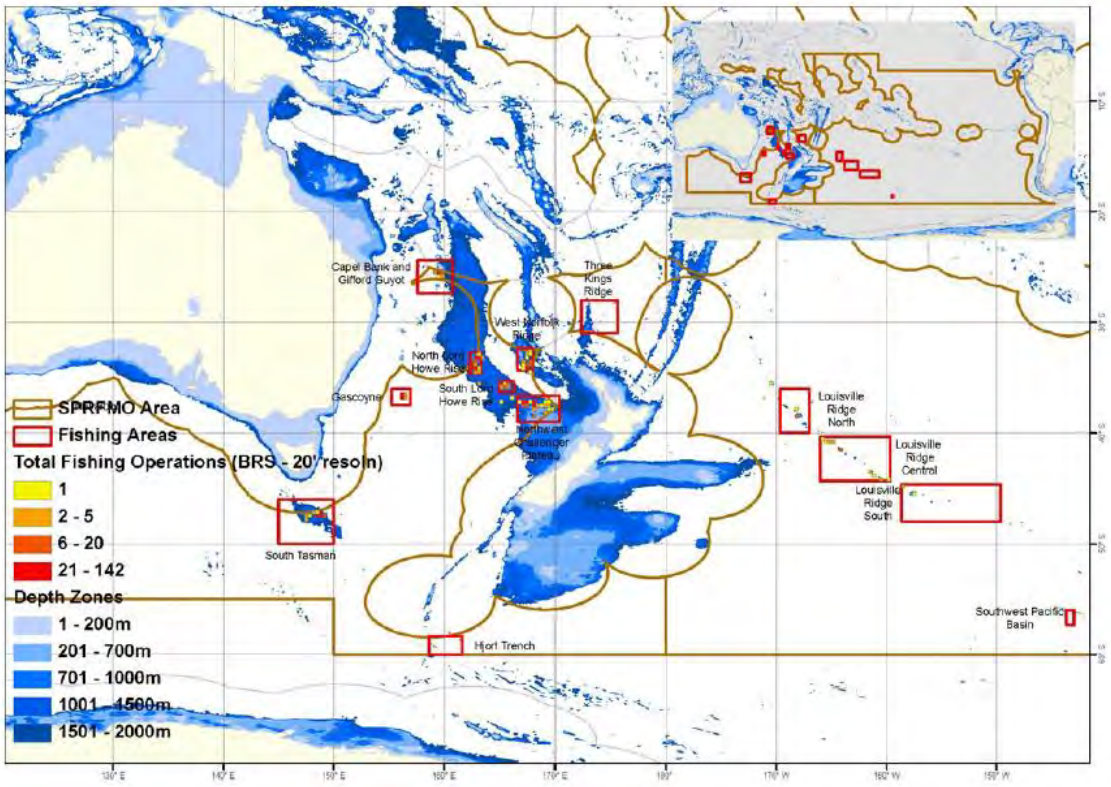

Figure 1: General location of fishing areas in the southwestern Pacific (Figure 3.1.3.1 from Australian bottom fishery impact assessment)

Objectives for the analysis:

- The objectives[2] for the Zonation analysis to identify options for spatial management measures were described as follows:
  - Access to as much economically productive fishing ground as possible,
  - Industry to be acknowledged for responsibly acknowledging the issue and participating in work to achieve more effective protection,
  - UNGA resolutions and Conventions to be implemented including closing area where vulnerable marine ecosystems (VMEs) occur or are likely to occur to

[2] These are not agreed objectives, this is simply a list of all stated objectives from all stakeholders. It is acknowledged that some such objectives will be competing.

bottom fishing unless fishing can be managed to avoid significant adverse impacts (SAI) on VMEs,
- Impacts on VMEs to be minimised,
- Management measures that are easily-understood, practical, enforceable, and without un-necessary complexity and cost (both Australian and New Zealand officials thought that it was not easy to contemplate a tow-level management regime (i.e., management at a very fine spatial scale) but both would seek guidance from their respective organisations);

Data inputs / layers:

- The majority of VME indicator taxa used in previous habitat suitability mapping and Zonation analyses (Table 1), and described to the workshop, would be used for the next set of analyses. The exceptions were the Alcyonacea (soft corals) for which robust regional-scale models could not be generated (Anderson et al. 2016b), and the Crinoidea (sea lilies) and Brisingida (armless seastars) because recent small-scale habitat suitability analysis suggested they were not reliable indicators of VME habitats in this context (Rowden et al. in review);
- Because only four of the five broad criteria for identifying VMEs in FAO's (2009) deepwater guidelines could be assessed using the VME indicator taxa data described by the research team, additional data or analysis might be required to assess "uniqueness or rarity" as described in the deepwater guidelines;
- Scientifically speaking, most deep-sea marine species are rare, and sampling in most High Seas areas has been very sparse. This means that metrics on rarity derived from available data will be unreliable[3]. Other listings or classifications such as those provided by IUCN or CITES could be used to identify taxa well-understood to be rare and/or threatened (Barry Weeber of ECO and DSCC undertook to provide some options);
- Maps of ecologically or biologically significant areas (EBSA) were also available and these would be considered in the analyses;
- The "naturalness" of each grid cell would eventually be indexed using the cumulative bottom fishing impact/footprint assessment parameterised in the technical pre-workshop but interim Zonation analyses can be run using the existing aggregate bottom and midwater trawl effort data;
- The value of each grid cell to the fishing industry would eventually be indexed using a method to be developed by Patrick Cordue and the fishing industry; this could then be used as a Value to fishery or so-called 'cost' layer in Zonation analyses. Catches of orange roughy, alfonsinos, and distance from port may be considered. Interim analyses will be run using the existing aggregate orange roughy catch data;

Model runs for next workshop

[3] It is likely that the limited sampling effort outside EEZs will result in spatial distributions of presence records for rare taxa will reflect sampling effort than actual distributions, and this will lead to biases against poorly sampled areas that may be highly suitable for VMEs

- Each Zonation run would eventually be informed by two distinctly different VME data layers (using the selected VME indicator taxa plus any subsequently identified as "unique or rare"). Initial runs for the next workshop would use only the existing New Zealand regional maps of habitat suitability for selected VME indicator taxa;
- Sensitivities would be run to test and demonstrate the impact on the analyses of:
  - the edge-removal rule and the boundary length penalty function;
  - different bio-regionalisations;
  - weighting of different taxa (especially structural fauna), naturalness, and uncertainty
  - the relative weights of cost and biodiversity data layers;
  - as a lower priority, depth limits of 1600 and 2000 m, versus 3000 m;
  - as the lowest priority, compare results using SPRFMO-wide habitat suitability maps with those generated using the New Zealand regional habitat suitability maps;
- The results of each run would be summarised using colour-coded maps and tables or graphics identifying the utility of different levels of protection within each Zonation run for biodiversity protection and fishing opportunity;

	Taxon	Comments	VME indicator status	Modelling approach
Vulnerable taxa	Porifera (sponges)	If possible, differentiate into demospongiae and hexactinellidae.	No change from Parker et al. 2009 classification	Model demo- and hexactinellid sponges separately if data allow
	Actiniaria (Anemones)	Questionable VME taxon – often occur in isolation.	Review Parker et al. 2009 classification	Model as one group, if retained as VME taxon
	Alcyonacea (Soft corals)	Erect, branching, fragile, and associated with other VME taxa.	No change from Parker et al. 2009	Model as one group
	Gorgonacea (Sea fans)	This group has been revised and subsumed into the Alcyonacea (soft corals). Similar body form in all taxa (erect, branching, fragile)	No change from Parker et al. 2009	Model as one group
	Pennatulacea (Sea pens)	All taxa are similar in form and populations tend to be monospecific stands on soft sediments. Fragile (vulnerable) as a population but not necessarily indicative of presence of other VME taxa.	No change from Parker et al. 2009	Model as one group
	Scleractinia (Stony corals)	Important functional and habitat preference distinctions between colonial, matrix-forming, taxa and solitary taxa. Six genera match VME criteria: *Solenosmilia; Goniocorella; Oculina; Enallopsammia; Madrepora,* and *Lophelia.*	Review Parker et al. classification to include only the six deep-water colonial coral genera.	Model each matrix-forming genus separately, and all collectively. Exclude solitary taxa.
	Antipatheria (Black corals)	All taxa are fragile and associated with habitats that tend to be more diverse (heterogeneous seabed with accelerated current flow)	No change from Parker et al. 2009	Model as one group
	Stylasterida (Hydro corals)	Covers a wide range of taxa from small (cm scale) to massive Macropora reef, but if big enough to be caught by fishing gear, they are indicative of VME	No change from Parker et al. 2009	Model as one group
Habitat indicators	Crinoidea (Sea lilies)	All taxa are fragile and associated with habitats that tend to be more diverse (heterogeneous seabed with accelerated current flow)	No change from Parker et al. 2009	Model as one group
	Brisingida ('Armless' stars)	All taxa are fragile and associated with habitats that tend to be more diverse (heterogeneous seabed with accelerated current flow)	No change from Parker et al. 2009	Model as one group

Table 1: VME indicator taxa identified for the southwest Pacific by Parker et al (2009) as modified by Bowden et al. (in prep.)

Between the first and second workshops, the research team assembled and groomed the data layers (including those provided by other workshop participants) and ran Zonation analyses to allow participants in the second workshop to understand the data being used and the effect of the key switches and options within Zonation.

5. Stakeholder workshop #2 (1 August 2017)

The second stakeholder workshop was convened on 1 August 2017 and was attended by 21 people, including the research team, representatives of the fishing industry, environmental NGOs, and government officials from both Australia and New Zealand (see: Appendix 2). Apologies were received from four people, including a representatives of an environmental NGO and two Australian officials. In addition to the documents circulated by the Chair of the workshop, background papers were provided by the Deep-Sea Conservation Coalition (DSCC) and the High Seas Fishery Group (HSFG) to inform the workshops of their respective views.

The DSCC paper looked at possible options for "uniqueness and rarity" characteristics for identification of VMEs under the UN FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas (2008) (para 42). This includes threatened species listings from CITES, New Zealand threatened species list, New Zealand Wildlife Act and the New Zealand EEZ regulations for sensitive environments which would be relevant to VMEs. It was noted that not all invertebrate groups had been assessed for their threat status in the NZ assessment. A request was made to look further at Australian and IUCN red list.

The Chair reviewed the purpose and timelines for the workshops and then the research team presented the Zonation runs and other analyses conducted since the first workshop. The team started by reminding the workshop of the tasks agreed at the first workshop and that these preliminary runs had been done using the New Zealand regional habitat suitability maps for VME indicator taxa (final runs would be done on an extended New Zealand regional scale to cover all bottom trawl fisheries, line fisheries being dealt with outside the Zonation framework). The Zonation analyses conducted included "base runs", "procedural choices", and "scenario comparisons" to facilitate understanding of the impact of analysis choices, many of which were value judgements. All were done using the "core area" approach Zonation, and the results presented as "priority conservation maps" and "conservation curves" (Figures 4 and 5 show examples of these outputs). No runs could be done that included bio-regionalization because the restricted study area/depth encompasses only 1 biogeographic province. Bioregionalization will be included in Zonation analyses when habitat suitability models for VME indicator taxa are available for the full extent of the identified area of interest.

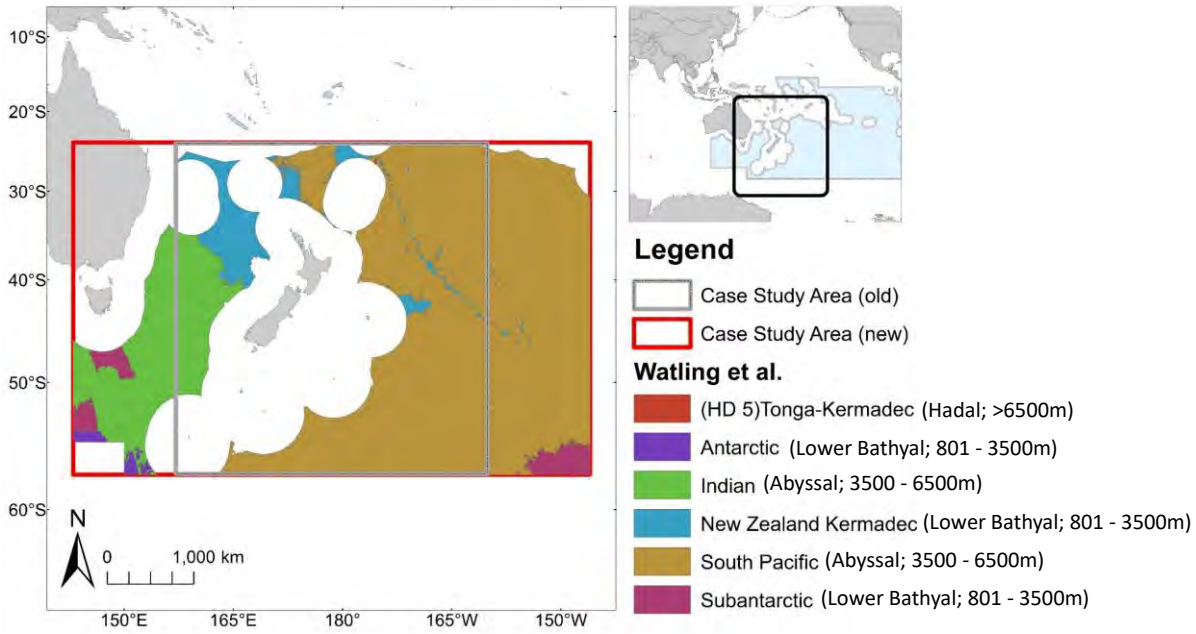

Figure 2: The area encompassed by the New Zealand regional model (grey box) and the wider area to be used for final Zonation runs (red box) overlaid on a bio-regionalisation simplified after Watling et al. (2013).

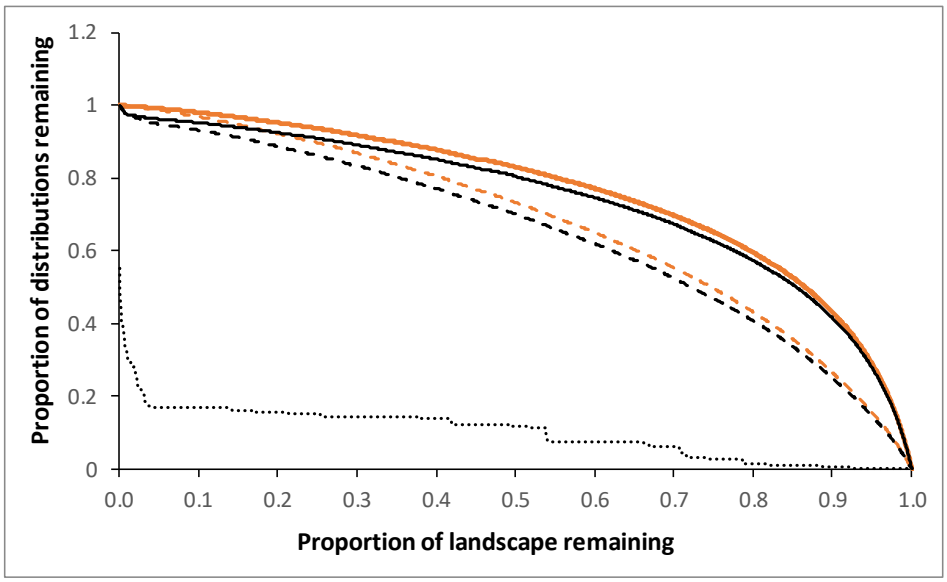

Figure 3: Example "conservation cost curve" for Zonation run 10.1; protected proportion curves are shown for stony corals (dashed) and other VME indicator taxa (line) using the 'base settings' (orange) and a fishing cost layer (black). The proportion of value for fishing lost, based on the preliminary cost layer, is shown as a black dotted line.

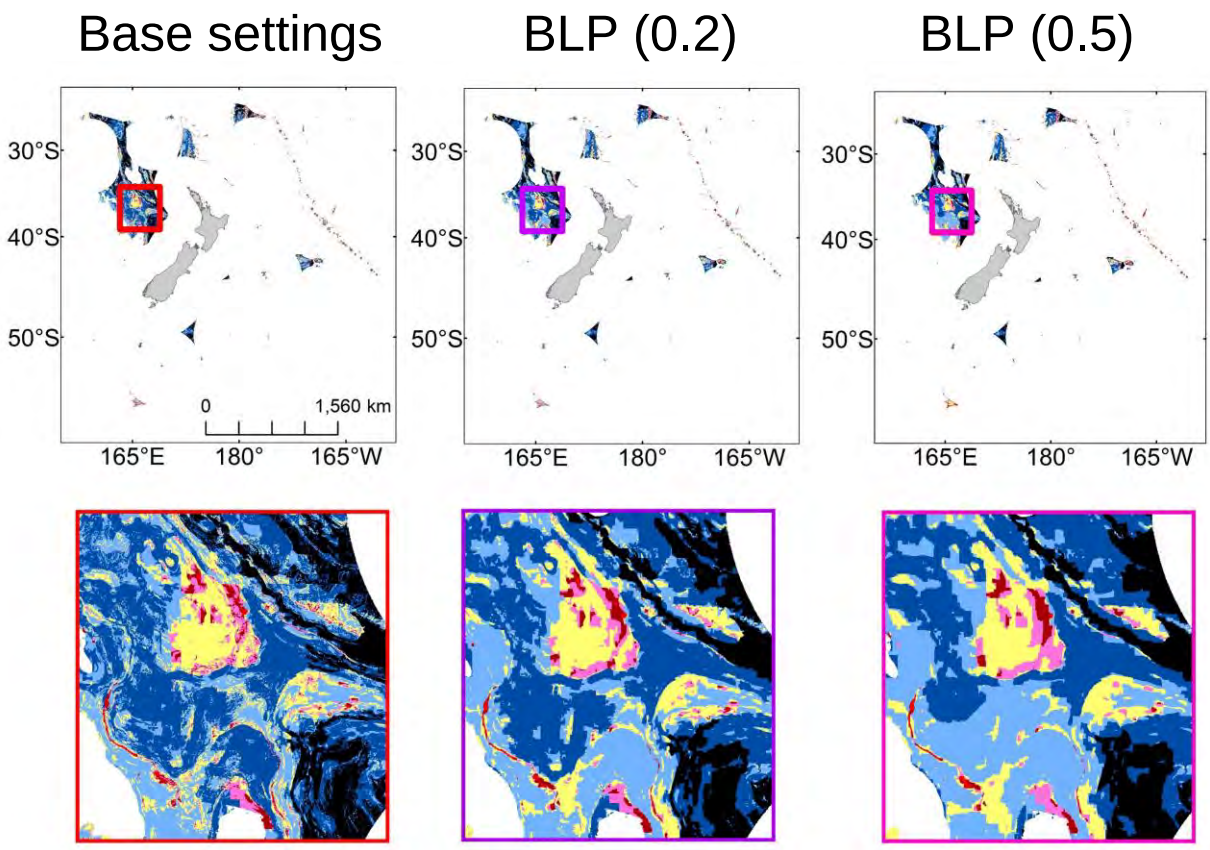

Figure 4: Example Zonation "priority conservation maps"; distribution of priority areas for protection (black and blues, low priority; yellow, pink and red, high priority) for VME indicator taxa in the Tasman Sea as the weighting on the boundary length penalty (BLP) increases from zero (base), to 0.2, or 0.5 within Zonation. The higher BLP settings clearly give more aggregated priority distributions. [See Figure 5 for scale for conservation maps].

After discussions, the workshop agreed to the following for the next batch of Zonation runs:

- The "Core Area" and "Additive Benefit function" approaches in Zonation could have different outcomes, so the core method will be used and checked with a single sensitivity run using additive benefit at the end;
- All EEZs to be excluded from analyses so as to focus on the southwestern SPRFMO area (there is little difference in the outputs with respect to conservation benefits but areas within EEZs are outside the remit of the anticipated management decisions);
- 3000 m depth limit to be used rather than any shallower limits;
- Neither edge removal nor boundary length penalty used so as to avoid loss of detailed spatial information in the Zonation outputs due to procedural algorithms that promote grouping of high priority cells;
- Weighting stony corals higher makes a big difference to the distribution of Zonation's estimates of the most important cells. Need to continue to use sensitivity analyses so as to be able to offer contrasting options to decision-makers for choices that affect the spatial distribution results. Alternative weightings to focus on structural taxa, all taxa equal, etc.;
- Inclusion of other VME indicator taxa to be determined by research team as follows;

    - A new habitat suitability model for the Alcyonacea (or some subset of) would be built (but not for inclusion in Zonation analyses by next workshop);
    - Explore the data available for the taxa suggested by DSCC for records in the southwestern SPRFMO Area, identify taxa that might usefully contribute to the analyses, then consider how to include these as a layer in Zonation (maybe as a single composite layer for unique/rare species) (but not for inclusion in Zonation analyses by next workshop);
  - Including uncertainty makes a big difference to the distribution of most important cells: run sensitivities of ignoring uncertainty and including with a weight of 0.1;
  - Naturalness done so far only using New Zealand catch: should be applied using the new cumulative impact assessment layer wherein a cell from which 99% of VME indicator taxa have been removed has only 1% of its initial estimated conservation value unless the results of that analysis seem to be in error.
  - The naturalness layer should be constructed assuming the most severe level of impact, that on large erect fauna (i.e., assuming high sensitivity and zero recovery in the timescale for these analyses);
  - EBSAs used as a feature tend to distort results on the distribution of most important cells: analysis of implications of candidate spatial regimes on EBSAs will be done outside the Zonation framework;
- Inclusion of a cost layer changes Zonation's estimate of the distribution of the most important cells for protection, and the biggest changes to the conservation value curve occur at low levels of cost to fishing. Preference seems to be inclusion of these data as a Zonation cost layer (not a negative biodiversity feature layer), with sensitivity runs using the maximum and accumulated methods of determining cost, and different weighting of the cost layer. Patrick Cordue would modify his analyses to include the industry value associated with mid-water trawling for bentho-pelagic species (and, ideally, Australian data);
    - In this context, DSCC does not consider a cost-benefit trade-off to be appropriate. The UNGA resolutions requires preventing SAIs on VMEs and it is not a matter of trading fisheries income against the environment.
    - Industry and others thought the use of a cost layer, howsoever applied, was useful.

After discussing and agreeing the settings for Zonation runs, the workshop discussed other matters related to the development of a revised bottom fishing measure. The following matters were raised:

Move-on rules:

- HSFG do not see value in move-on rules and would like to see them phased out – they suggested sufficient VMEs should be protected by closed areas and fishing allowed elsewhere;
- HSFG also thought that a defined process was required whereby new information should be fed in to update understanding (noting that better understanding may or may not affect management settings)
- DSCC see move-on rules as both required by the UNGA resolutions and an essential backstop or insurance against spatial management being inappropriate (especially

because data and model layers are uncertain) or VMEs being surprisingly encountered in open areas;
- DSCC believe the design of current SPRFMO move-on rules is poor, suggesting that something like the CCAMLR two-tier approach would be better;
- It was noted that:
    - Different designs of move-on rule can lead to higher or low impacts on biodiversity relative to no such rules (simulations were required to assess likely performance);
    - More confidence in the biodiversity models and a greater proportion of the fishable area closed to fishing, both reduce the need for move-on rules as a backstop insurance (as SAIs on VMEs are increasingly prevented);
    - SC's advice (starting with SC-01) has been that move-on rules should be viewed as temporary measures until objectively designed spatial management measures are in place;
    - SC-04 thought the spatial management measures designed using the approaches proposed by New Zealand may obviate need for move-on rules.

Treatment of different fishing methods:
- HSFG see midwater trawling for bentho-pelagic species like alfonsino as completely different from bottom trawls and should therefore be treated differently in accordance with its lesser impact;
- It was noted that quantitative analyses to support this should be available from the cumulative impact/footprint assessment;
- It was agreed that the key point is where midwater trawling for bentho-pelagic species should be allowed;
- It was agreed that it may be an option for some open or closed areas to be specific to particular fishing gears;
- It was agreed that bottom fishery impact assessments were required separately (by nation and method) and cumulatively (including all separate components). Something like CCAMLR's "automated" bottom fishery impact assessments approach may provide a reasonable model;
- Officials considered there was a need to "refresh" SPRFMO's current Bottom Fishery Impact Assessment Standard (BFIAS) in the light of these discussions and changes in international practice and guidance since the BFIAS was approved. A paper for SC would be prepared.

Treatment of new and exploratory fisheries:
- HSFG were not clear whether fishing within parts of a nation's overall footprint that were closed because of the criterion years or other management settings constitute New Fisheries. They believe that there should be no need to apply for a New or Exploratory Fishery in areas that have been fished before (but outside criterion years 2002 to 2006);
- DSCC believe it is appropriate for applications to be required for New or Exploratory Fisheries for areas that have been fished before (but outside criterion years 2002 to 2006) and that this is required by article 22 of the Convention;

- Other stakeholders wanted officials to consider the following:
    - Was there potential to have a tiered approach to New or Exploratory Fisheries within and outside a nation's footprint;
    - Approaches to dealing with vessels flagged to Members or CNCPs other than those currently bottom fishing wanting to fish within open areas identified in the bottom fishing measure.

Other:

- Australian and New Zealand officials stated they would like to incur only those management and compliance costs that were commensurate with the size and risks associated with the fisheries;
- The views and analyses discussed at these workshops relate primarily to the southwestern part of the SPRFMO Area but the bottom fishing CMM would have to cover all bottom fisheries in some way.

6. Stakeholder workshop #3 (15 August 2017)

The third stakeholder workshop was convened on 15 August 2017 and was attended by 13 people, including the research team, representatives of the fishing industry, environmental NGOs, and government officials from both Australia (via video) and New Zealand (see: Appendix 2). Apologies were received from 7 people, including representatives of industry groups and environmental NGOs.

The Chair reviewed the purpose and timelines for the workshops, and then the research team presented the Zonation runs and other analyses conducted since the second workshop, reminding the group that these runs had still been done using the New Zealand regional habitat suitability maps for VME indicator taxa and without using an interim "naturalness" layer (which had only been completed just before the workshop). Final runs would be done (probably after SC-05 meets) on an extended New Zealand regional scale model to cover all bottom trawl fisheries, and a naturalness layer including Australian data. Line fisheries will be dealt with outside the Zonation framework using the cumulative bottom impact/footprint analyses. A series of Zonation analyses were then displayed to show the impact of the various choices that had been made by the group. A series of scenarios were explored, all using the "core area" approach in Zonation. Each scenario was presented as "prioritization conservation maps" and "conservation curves".

In response to a request at the last meeting, DSCC reported that neither IUCN nor Australian processes had assessed deepwater invertebrates for threat status.

Scenario 1: "Base" model using VME Habitat Suitability models

Grouping of biodiversity features:
Group 1: Stony corals (weight = 1)
Group 2: Other VME indicator taxa (weight = 1)
Group 3: Brisingids and Crinoids (weight = 0) [these taxa included to illustrate how information on protection afforded to non-target taxa can also be obtained by the tool]
Group 4: EBSAs (weight = 0)

Zonation settings:
Depth <=3000m
Exclude EEZs
No 'Edge removal'
No aggregation (e.g. no Boundary Length Penalty 'BLP ')
No cost layer

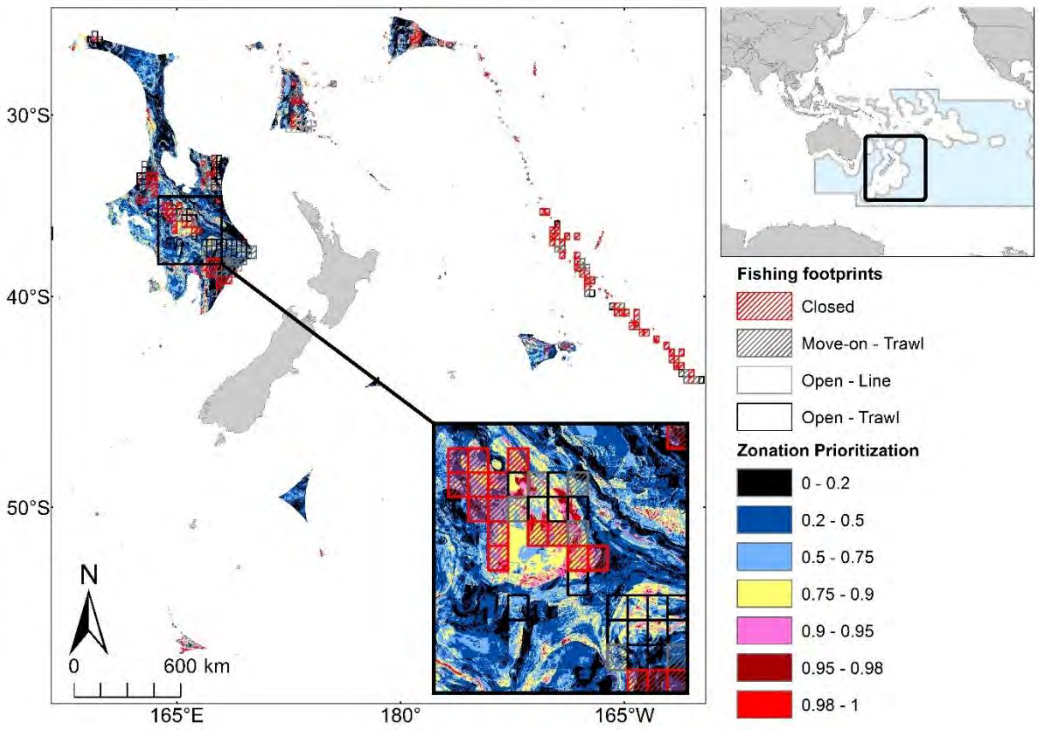

Figure 5: Zonation prioritization conservation maps for SPRFMO study area using 'base settings' (Scenario 1) The current open, closed and move-on blocks for New Zealand and Australia are overlaid. Zonation prioritizes the cells with the highest conservation priority given the settings for the analysis and any cost layers included.

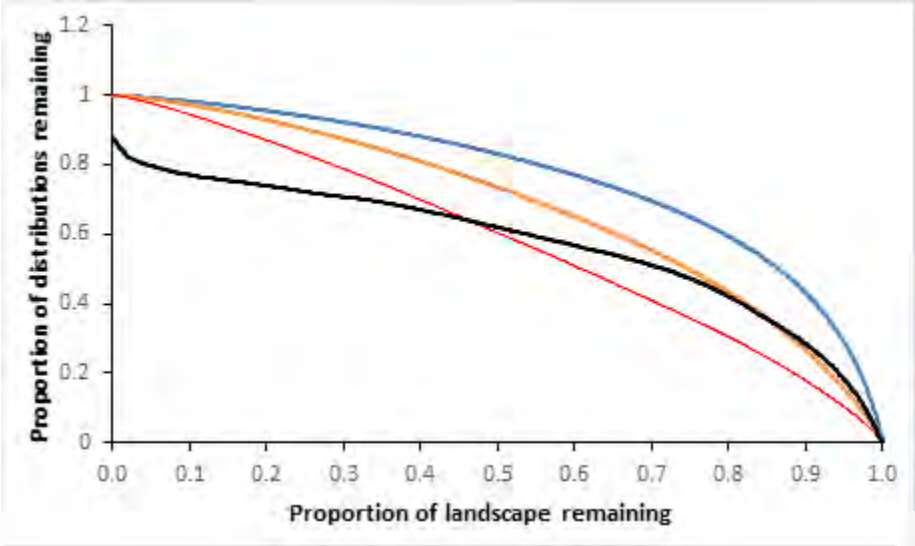

Figure 6: Mean conservation benefit curves as a function of geographical protection of the New Zealand regional habitat suitability model area using 'base settings' *(Scenario 1) for Group 1 (stony corals, blue line), Group 2 (other VME indicator taxa, orange line), Group 3 (brisingids and crinoids, red line) and Group 4 (EBSAs, black line).

Scenario 2: As for Scenario 1 but using Additive Benefit Function instead of Core Area

The prioritization conservation maps were somewhat sensitive to choice of the Additive Benefit compared the Core Area function, but the general patterns were quite similar (Figure 7). However, the differences can be used as a vehicle for exploring ways of presenting and visualizing that sensitivity. For instance, the two prioritization maps in Figure 7 can be compared mathematically by subtracting one result from the other and plotting the results as a map of the distribution of differences (Figure 8). The group discussed different ways of visualizing the differences, and the research team explored some of these after the workshop (e.g., Figure 10). These are simply visualization tools and the choice of a particular percentage of top priority cells for a visualization implies no judgement about the appropriateness of that percentage as a target for protection.

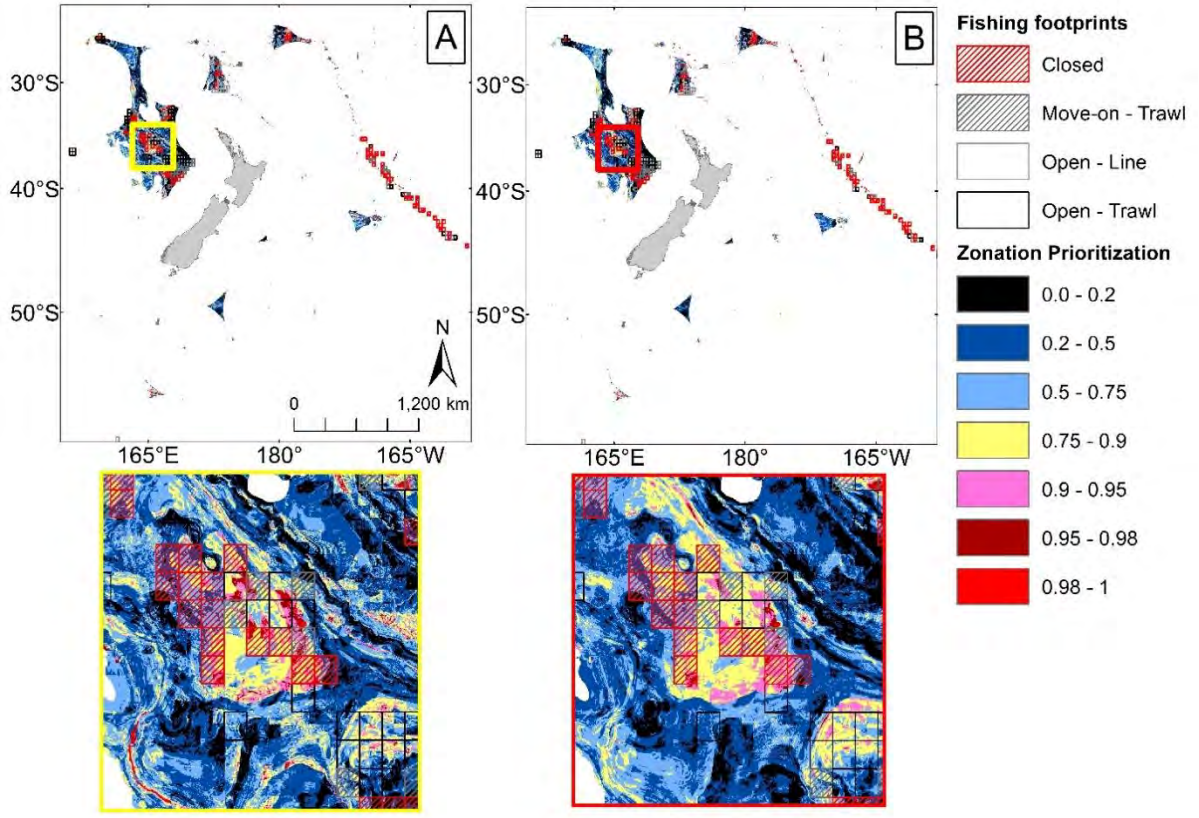

Figure 7: Zonation prioritization maps for SPRFMO area using 'base settings' and the core area (A) or additive benefit (B) algorithm. The current open, closed and move-on blocks are overlaid. Zonation prioritizes the cells with the highest conservation priority given the settings for the analysis and any cost layers included.

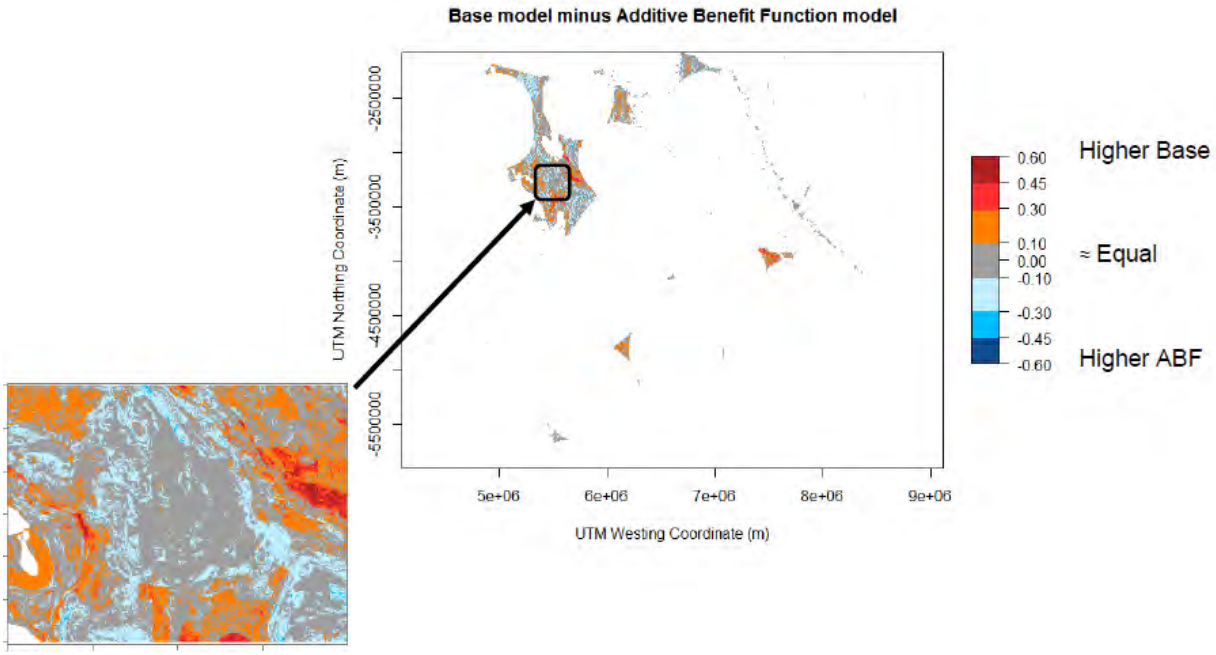

Figure 8: Map showing the difference in priority scores for each cell between Zonation prioritization conservation maps for the SPRFMO study area using 'base settings' with (A) the Zonation algorithm 'Core Area Zonation' (Scenario 1) and (B) with the Zonation algorithm 'Additive Benefit Function' (Scenario 2). (based on maps in Figure 7). Orange and red hues represent areas where Scenario 1 gave higher priority scores, whereas blue hues represent areas where Scenario 2 gave higher priority scores.

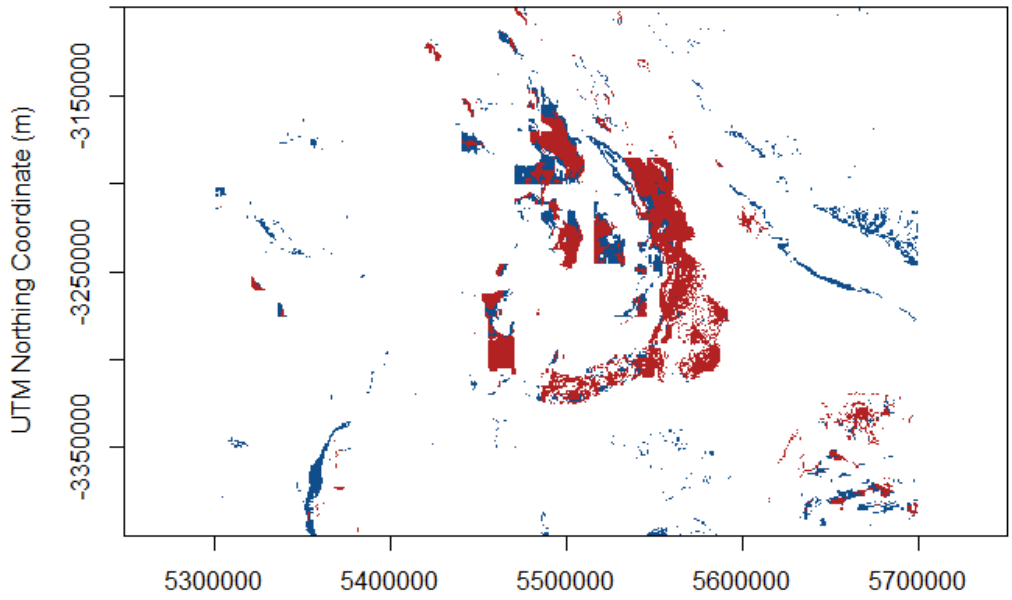

Figure 9: Maps showing the overlap of the 10% mostly highly prioritized conservation cells in scenarios 1 and 2. Red shows the overlap between the two maps, blue shows where scenario 1 prioritized a given area, and orange shows where scenario 2 prioritized a given area (rare in this particular area).

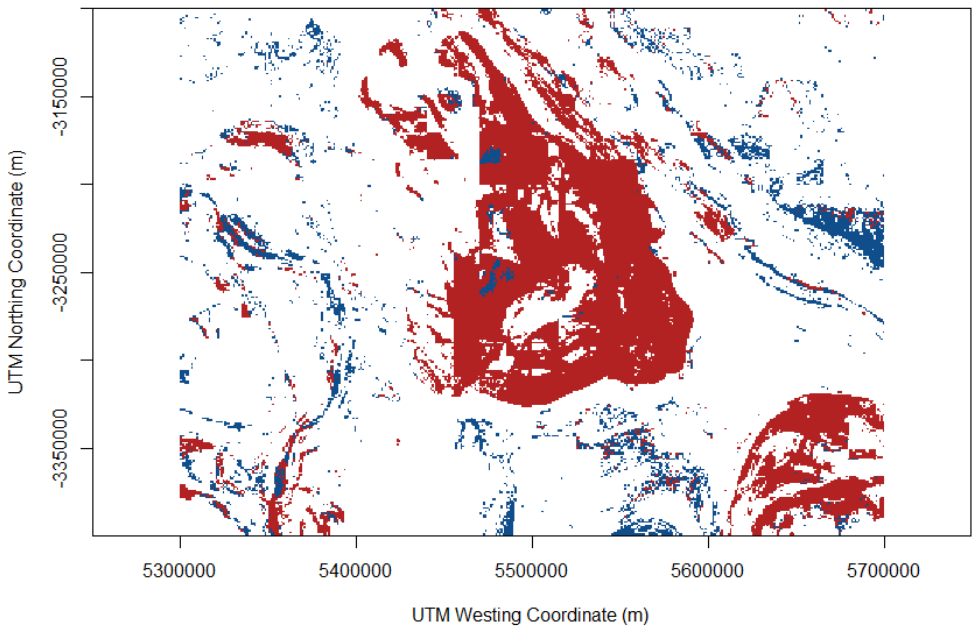

Figure 10: Maps showing the overlap of the 25% mostly highly prioritized conservation cells in scenarios 1 and 2. Red shows the overlap between the two maps, blue shows where scenario 1 prioritized a given area, and orange shows where scenario 2 prioritized a given area (rare in this particular area).

Scenario 3: Weighting of biodiversity features

As expected, weighting the analysis more heavily in favour of ecologically important structural, emergent fauna (in this case stony corals) increased the steepness of the conservation curve for such taxa in that part of the graph where the first few cells are prioritized. Cells where stony corals were predicted to occur were preferentially included first in the prioritization (Figures 11 and 12).

Increasing the weighting of coral taxa beyond 3 (relative to other VME indicator taxa) increased the inclusion of corals in prioritized areas only marginally at the expense of fairly substantial declines in the inclusion of other VME indicator taxa. For instance (Table 2), for a scenario in which 20% of the cells are prioritized, increasing the weighting of corals from 3 to 5 leads to only a 2% increase in the (already high) inclusion of corals in those prioritized areas but to a 10% decrease in the (quite low) inclusion of other taxa.

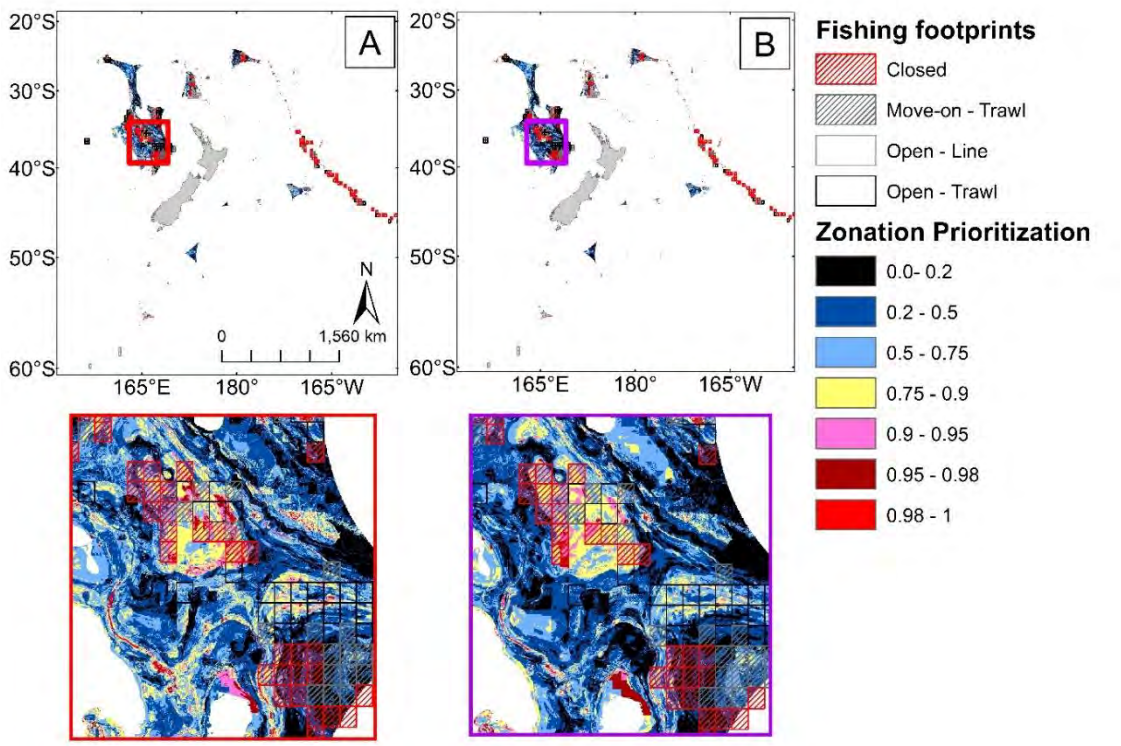

Figure 11: Zonation prioritization conservation maps for SPRFMO study area using 'base settings' and the base weightings (Scenario 1) (A) or where a higher weighting of 3 is given to the four stony coral taxa (Scenario 3) (B). The current open, closed and move-on blocks are overlaid. Zonation prioritizes the cells with the highest conservation priority given the settings for the analysis and any cost layers included.

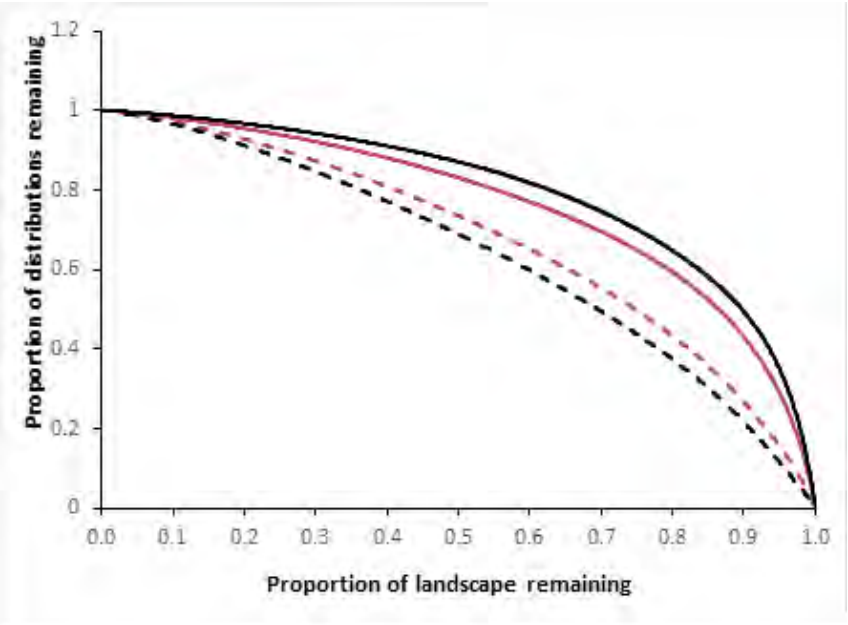

Figure 12: Mean conservation benefit curves as a function of geographical protection of the New Zealand regional habitat suitability model area using Scenario 1 with 'base settings' (red lines) and Scenario 4 with higher weighting of stony coral taxa (black lines). The curves for stony corals are shown as solid lines, the curves for other VME indicator taxa are shown as dashed lines.

Table 1: Relationship between the proportion of stony corals and other VME taxa included in the most highly prioritized cells as the weighting for stony corals increases

Prioritized cells (%)	Scenario 1: Base weightings (all = 1)		Scenario 3A: Coral weight = 3		Scenario 3A: Coral weight = 5	
	Corals	Other	Corals	Other	Corals	Other
20	0.593	0.432	0.647	0.374	0.661	0.338
15	0.523	0.357	0.581	0.301	0.596	0.269
10	0.430	0.266	0.493	0.216	0.506	0.192

Scenario 4: Accounting for uncertainty in the VME habitat suitability models

Accounting for uncertainty in the habitat suitability models decreased the likelihood that cells with a highly uncertain prediction of VME indicator taxa would be prioritized. The effect of discounting the uncertain predictions can be seen in the top two panels of Figure 14 and the bottom two panels show the subtle changes to the Zonation prioritization maps. The group agreed that it was important to understand the implications of accounting for uncertainty in the habitat suitability maps but did not think heavier weighting of uncertainty than using an uncertainty parameter of 0.1 was appropriate.

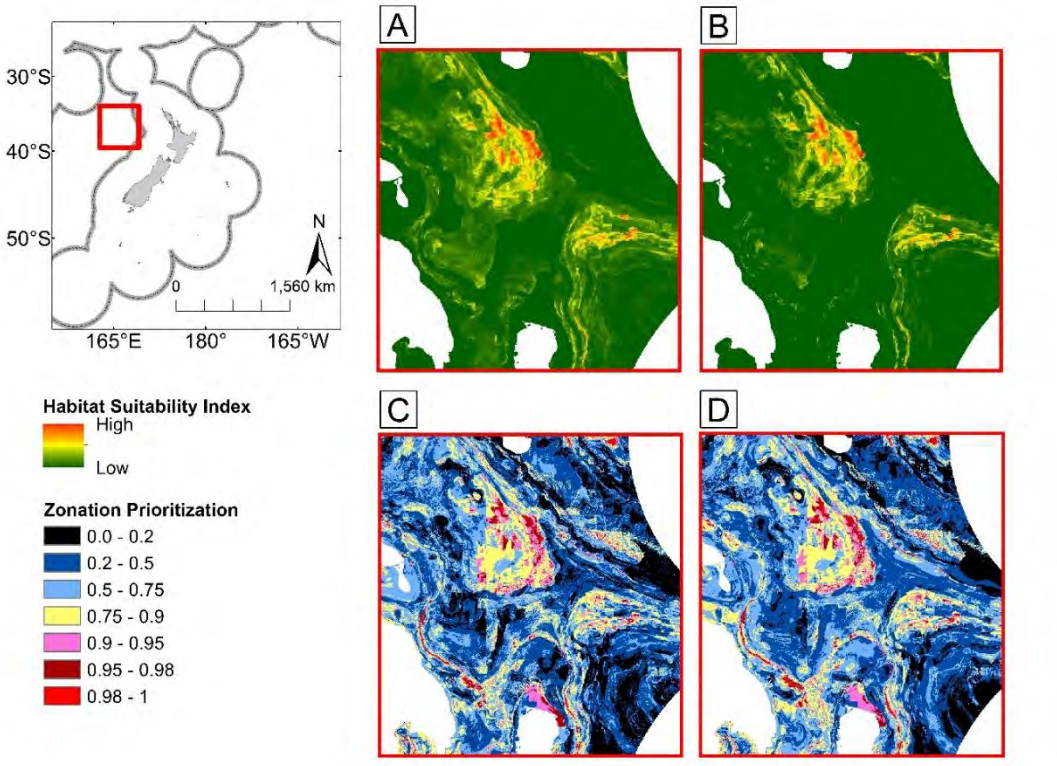

Figure 13: Habitat suitability maps for an example VME indicator taxon Pennatulacea from ensemble modelling with no uncertainty (panel A) and after discounting using an uncertainty parameter of α = 0.1 in Zonation (panel B). Zonation prioritization conservation maps (using all discounted VME indicator taxa) using these two maps are shown in, respectively, panels C (Scenario 1) and D (Scenario 4).

Scenario 5: Accounting for the expected naturalness of benthic fauna in a cell

The group agreed that it was useful to use a naturalness layer to "discount" the conservation value of cells where the benthic fauna, specifically VME indicator taxa, was likely to be degraded. A separate workshop parameterized a cumulative bottom fishing impact/footprint assessment using the method of Sharp, Parker & Smith (2009), originally developed for bottom fisheries in the CCAMLR Convention Area. The group agreed this approach was the best basis for a "naturalness" layer for Zonation analyses. Some provisional results of the cumulative bottom fishing impact/footprint assessment were shown and discussed at the third workshop (for examples, see Figure 14) but final layers will not be available until after the deadline for SC papers. The provisional results were not available in time for inclusion in Zonation runs for the third workshop but, because naturalness and commercial fishing effort are negatively correlated, Zonation runs accounting for naturalness would be qualitatively similar to those where fishing value is included as a cost layer (see scenario 6).

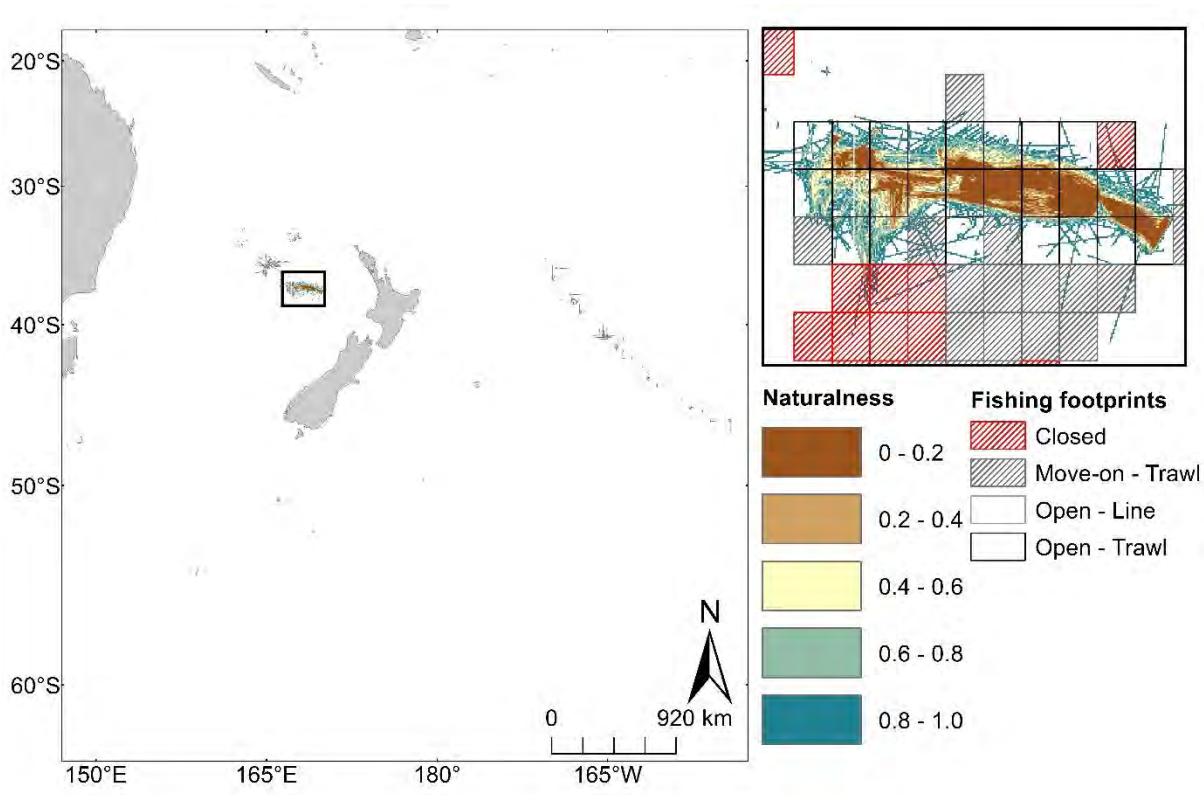

Figure 14: The distribution of estimated "naturalness" from the cumulative bottom fishing impact / footprint assessment using New Zealand trawl bottom and mid-water trawl data only. The inset shows the north-western Challenger plateau where trawling has been most intense; naturalness of 0–0.2 (dark brown) implies the density of emergent and fragile VME indicator taxa is less than 20% of its initial density.

Scenario 6: Including a "cost layer" for the value of fishing

A detailed analysis was conducted by Patrick Cordue to estimate the relative value of each cell for the fishing industry. Two separate analyses were conducted estimating value as the highest catch within a cell or as the total accumulated catch across all years. In both cases, some spreading of the value to adjacent cells was applied to account for the need to tow towards a fishing location as the trawl sinks in the water. An example plot is shown in Figure 15. The results of Zonation analyses for the two layers were not very different, and industry stakeholders agreed that the accumulated catch analysis was appropriate to represent their value at a site; it matched their own analyses and documentation.

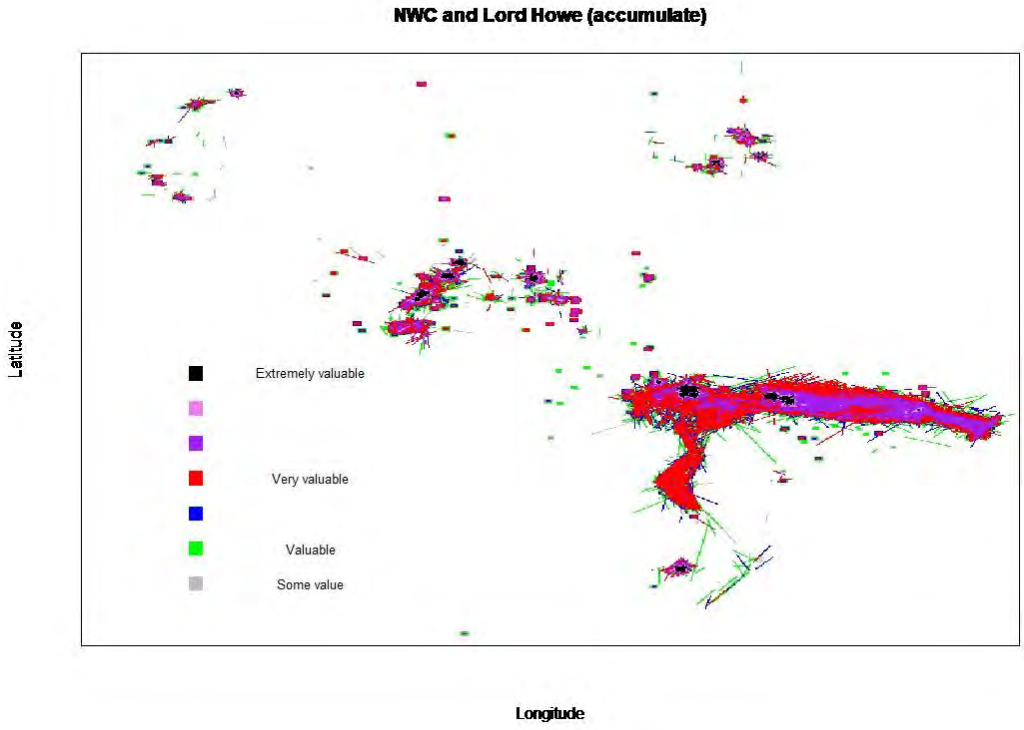

Figure 15: Distribution of value for the fishing industry on the northwest Challenger Plateau (estimated as the accumulated catch within each cell after accounting for the need to tow towards a fishing location as the trawl sinks in the water). This was used as a "cost layer" in scenario 6 Zonation analyses.

The prioritization conservation maps with and without a cost layer were different because cells with a substantial value for the fishing industry were rarely prioritized for protection (Figure 17), even without a naturalness layer in the Zonation analysis. However, high prioritization conversation areas did occur outside of the areas of high value for fishing.

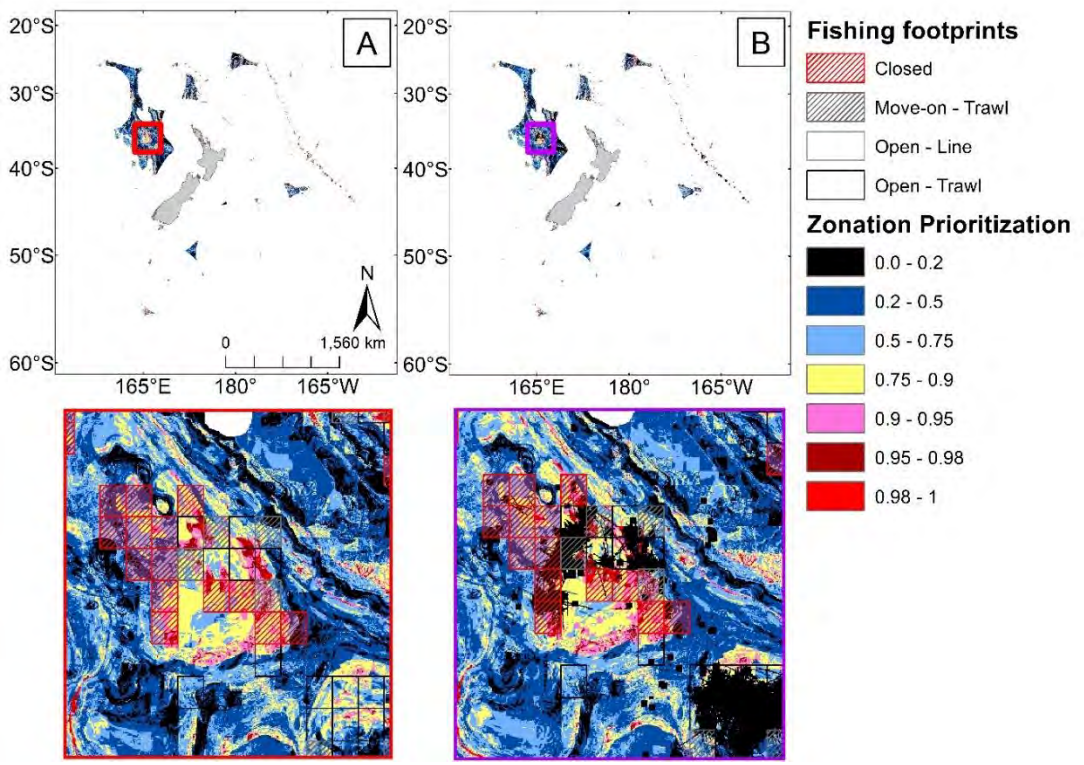

Figure 16: Zonation prioritization conservation maps for SPRFMO study area using 'base settings' (Scenario 1) (A) or where the accumulated catch of trawling in a cell is used as a "cost layer" (Scenario 6) (B). Cells with high value for fishing are generally not prioritized for protection (see the substantial black areas in the inset under panel B).

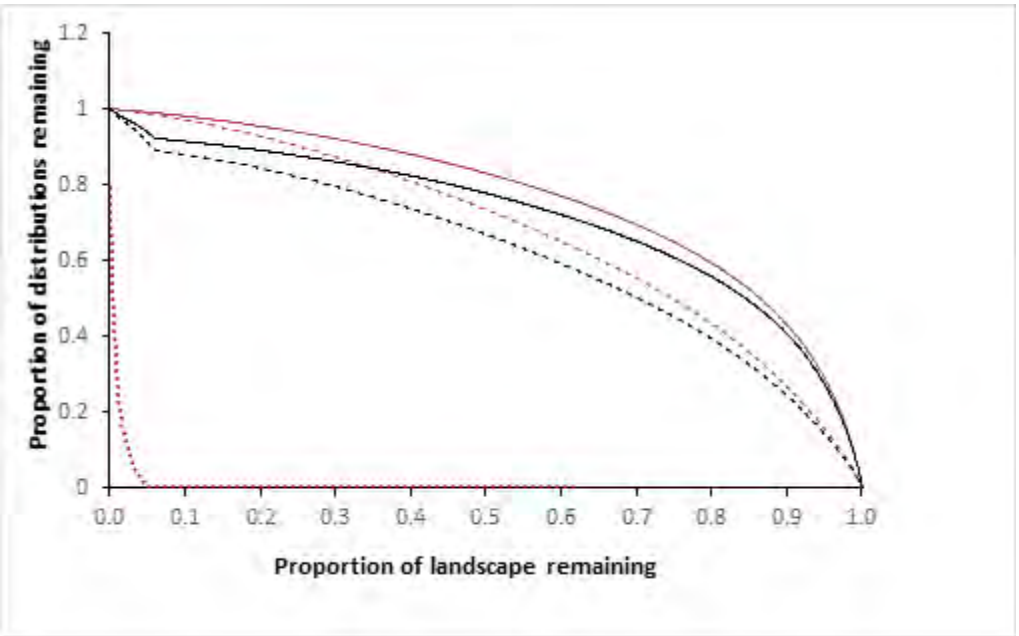

Figure 18: Mean conservation benefit curves as a function of geographical protection of the New Zealand regional habitat suitability model area using 'base settings' (red) and incorporating accumulated catch as an index of value for the fishing industry as a cost in the Zonation analysis (black). Curves for stony corals are shown as solid lines. Curves for other VME indicator taxa are shown as dashed lines. Cost (estimated as the proportion of the aggregate estimated value of cells included in the area prioritized for protection) is shown as a red dotted line.

The conservation curves for Scenario 6 (Figure 18) suggest that very high protection for VMEs can be achieved when prioritization of high-value fishing areas for conservation are discouraged using a cost layer in a Zonation analysis. If a highly granular spatial management regime were to be acceptable (and the habitat suitability maps are accurate) then protection of roughly 90% of VME taxa within the western SPRFMO Area may be possible with minimal cost to the fishing industry in terms of useful space and catch. In practice, this may be only theoretically achievable and performance will be progressively degraded by coarser and coarser management blocks.

7. Discussion and next steps

Stakeholders from the fishing industry and environment NGOs have worked with government officials and researchers to come to a common understanding of the workings of the Zonation decision-support tool, and agree on some of the key settings of this tool for the development of management measures in the SPRFMO area. The key agreements have been:

- The area, depth, and fishing methods to be included
- The taxa to be included as relevant indicators of VMEs
- Exclusion of EEZs from the Zonation analyses (but not from the underlying habitat suitability modelling)
- Use of the Core Area algorithm
- Use of a naturalness layer (and the method for estimating such a layer)
- Recognition of uncertainty in habitat suitability models
- No use of edge removal or boundary length penalties in the prioritization conservation maps for initial assessment by decision-makers, so as to avoid the loss of spatial information that occurs when using procedural algorithms that promote aggregation of cells; however, later options to include such aggregation functions in order to help guide the identification of management areas at scales >1 km.

There remain some disagreements on whether it is appropriate to “trade off” protection for VMEs and fishing opportunities, and the values of stakeholders vary. However, the understanding and agreements made so far should provide a solid platform on which to base further work to design a spatial management regime. It is anticipated that further workshopping will be required once all the final data layers and analyses have been assembled; new habitat suitability models for the wider region are still to be built, minor changes to the industry value layer may be required (pending some checks), and the naturalness layer has not yet been finalised.

Once final Zonation models have been built and prioritization conservation maps developed, an additional process will be required to design a spatial management regime which can contribute to meeting the objectives of the SPRFMO Convention. The Zonation prioritization conservation maps will be pixelated at a scale of 1 km but it is likely that management areas will be substantially coarser (the finest scale so far contemplated by the Scientific Committee is 6-minute blocks, approximately 10 km on a side). The Zonation software can be used to assess the likely performance of management regimes consisting of such coarser blocks, and some iteration and design fine tuning is likely to be required. This work is likely to occur

between Scientific Committee and the deadline of papers for Commission and the Compliance & Technical Committee (~7 December 2017).

8. Recommendations

It is recommended that the Scientific Committee:

- **Notes** the series of workshops convened by New Zealand to include industry and environmental stakeholders together with researchers and officials from both Australia and New Zealand;
- **Notes** the substantial progress made in capacity development and agreement on analytical methods that can be used in the design of candidate spatial management areas to meet the objective of the SPRFMO Commission;
- **Agrees** that the analytical approach using Zonation decision-support software is scientifically defensible and appropriate;
- **Agrees** to support, if necessary, an additional deepwater working group in October or November 2017 to finalise the Zonation analyses and oversee scientific analyses required to underpin the design of candidate spatial management areas.

9. References

Anderson, O.F., Guinotte, J., Rowden, A.A., Clark, M.R., Mormede, S., Davies, A.J. (2016a). Field validation of habitat suitability models for Vulnerable Marine Ecosystems in the South Pacific Ocean: implications for the use of broad-scale models in fisheries management. *Ocean and Coastal Management* 120: 110-126.

Anderson, O.F., Guinotte, J.M., Rowden, A.A., Tracey, D.M., Mackay, K.A., Clark, M.R. (2016b). Habitat suitability models for predicting the occurrence of vulnerable marine ecosystems in seas around New Zealand. *Deep-Sea Research I*, 115: 265-292.

Clark M.R.; Dunn M.R.; Anderson O.F. (2010). Development of estimates of biomass and sustainable catches for orange roughy fisheries in the New Zealand region outside the EEZ: CPUE analyses, and application of the "seamount meta-analysis" approach. *New Zealand Fishery Assessment Report 2010/19*, 46 p

Penney, A.J. (2010). An approach to estimation of sustainable catch limits for orange roughy in the SPRFMO Area. Paper SWG-09-DW-02 for the SPRFMO Science Working Group, 11 p.

Roux, M-J, Clark, M.R., & Cryer, M. (2016). Preliminary stock assessments for stocks of orange roughy (*Hoplostethus atlanticus*) in the western SPRFMO Area using spatially disaggregated CPUE and Bayesian biomass dynamic models. Paper SC-04-DW-03 for the 4th meeting of the SPRFMO Scientific Committee, The Hague, Kingdom of the Netherlands, 10-15 October 2016.

Rowden, A.A.; Guinotte, J.M.; Baird, S.J.; Tracey, D.M.; Mackay, K.A.; Wadhwa, S. (2013). Developing predictive models for the distribution of vulnerable marine ecosystems in the South Pacific Ocean region. *New Zealand Aquatic Environment and Biodiversity Report No. 120.* 70 p.

Rowden A.A., Clark M.R., Lundquist C.J., Guinotte J.M., Anderson O.F., Julian K.A., Mackay K.A., Tracey D.M., Gerring P.K. (2015). Developing spatial management options for the protection of vulnerable marine ecosystems in the South Pacific Ocean region. *New Zealand Aquatic Environment and Biodiversity Report No. 155.* 76 p.

10. Appendices

APPENDIX 1: TERMS OF REFERENCE FOR A SERIES OF STAKEHOLDER WORKSHOPS TO GATHER AND DOCUMENT STAKEHOLDER VIEWS ON THE NATURE AND CONTENT OF A REVISED CONSERVATION AND MANAGEMENT MEASURE FOR BOTTOM FISHERIES IN THE SPRFMO CONVENTION AREA

1. Background

The South Pacific Regional Fisheries Management Organisation (SPRFMO) is committed to the long-term conservation and sustainable use of the fishery resources of the South Pacific Ocean and safeguarding the marine ecosystems in which these resources occur. Currently, the main commercial resources fished in the SPRFMO Area are jack mackerel and jumbo flying squid in the Southeast Pacific, and demersal and bentho-pelagic species in the Southwest Pacific. Several SPRFMO Members have historically had such bottom fisheries but Australia and New Zealand are the only two Members with bottom fisheries approved in the SPRFMO Area.

The main Australian and New Zealand fisheries use bottom trawls for orange roughy (*Hoplostethus atlanticus*), midwater trawls for alfonsinos (*Beryx* spp.), and bottom longlines for bluenose (*Hyperoglyphe antarctica*) and wreckfishes (*Polyprion* spp.). Many more species than these main target species are caught, and some bottom fishing is targeted at other species.

Bottom fisheries, including all trawl methods and hook-and-line methods where the gear can be expected to touch the bottom in the normal course of fishing, are governed by CMM-03-2017, the Conservation and Management Measure for the Management of Bottom Fishing in the SPRFMO Convention Area. The objective of CMM-03-2017 is *to promote the sustainable management of bottom fisheries including target fish stocks as well as non-target species taken as bycatch, in these fisheries, and to protect the marine ecosystems in which those resources occur, including inter alia, the prevention of significant adverse impacts on vulnerable marine ecosystems*.

Paragraph 27 of CMM-03-2017 states that *This CMM shall apply until the close of the annual Commission meeting in 2018 unless determined otherwise by the Commission. It shall be reviewed at the regular meeting of the Commission in 2018. Such review shall take into account, inter alia, the latest advice of the Scientific Committee, including with respect to appropriate catch levels for principal target species and/or appropriate reference periods, in accordance with the objective … of this CMM*. To this end, officials from Australia, Chile, the European Union, and New Zealand have been working closely together to develop proposals for revisions to CMM-03.

At the SPRFMO Commission meeting in January 2017, Australia and New Zealand jointly presented a paper updating the Commission on progress towards the development of a revised bottom fishing CMM. That paper indicated that the revised bottom fishing measure would be comprehensive and based on a spatial management approach, requiring:

- the identification of an appropriate fishing footprint that is implemented consistently across the membership,
- the mapping of the vulnerable marine ecosystem (VME) distribution within the footprint,
- the setting of sustainable catch levels for target species;
- determining precautionary measures to ensure no adverse impacts of fishing on the populations of species taken as bycatch; and
- determination of management measures to prevent significant adverse impacts on VMEs and, in particular, areas that will be open or closed to fishing within the footprint.

The workshops described in these Terms of Reference form part of the process of developing proposals for revisions to the CMM for Bottom Fishing in the SPRFMO Area.

2. Terms of Reference for the Workshops

- A series of four workshops will be convened starting in mid-July 2017. The first of these workshops will entail a technical discussion to describe the dimensions and patterns of use of bottom fishing gear in the western SPRFMO Area so as to parameterize an assessment of the impacted area using the method of Sharp et al. (2009). The three remaining workshops will be used to seek and document stakeholder views relevant to revising SPRFMO's bottom fishing measure.

- The workshops will be open to all interested parties and notifications have been sent to all those signed up to the mailing list for SPRFMO stakeholders held by the New Zealand Ministry of Foreign Affairs and Trade (MFAT), all those signed up to the New Zealand Ministry for Primary Industries' (MPI) South Pacific Working Group, other parties in New Zealand and Australia who it is suspected may have an interest, key contacts in Chile and the European Union, the Chair of SPRFMO's SC, and the SPRFMO Secretariat. The workshops will be chaired by MPI.

- The primary objective for the workshops is to seek and document stakeholder views on changes that they consider should be made to SPRFMO's current conservation and management measure for bottom fisheries CMM 03-2017. Such matters could include:
    - The scale and granularity of spatial management settings;
    - The preferred locations for areas open to fishing and closed to fishing;
    - The utility of, and settings for, move-on rules;
    - The treatment of different fishing methods, primarily bottom trawl, midwater trawl for benthopelagic species, and bottom longline;
    - The treatment of new or exploratory fisheries (consistent with CMM-13-2016).

- The workshops will be run relatively informally so as to gain as much insight as possible into stakeholders' views. However, participants will be expected to: participate constructively in the discussion; respect the views of others; resolve issues that arise; contribute to an atmosphere of honesty, openness and trust; follow up on agreements and tasks (if any); respect the role of the Chair; and contribute to the workshop report in a timely manner.

- The Chair of the workshops will: facilitate open and constructive discussions; ensure agreed intersessional work is conducted; and document stakeholder views in a report from the workshops, including any agreements and, where agreement cannot be reached by stakeholders, any differences of opinion.

- The report from the workshop will be submitted as a formal paper to SPRFMO's Scientific Committee which convenes on 20 September 2017 in Shanghai China. The deadline for such papers is 20 August 2017. This paper will be part of a suite of papers related to the new bottom fishing measure that will be submitted by New Zealand, some of which will be developed jointly with Australia and, potentially, other Members.

- Development of a new bottom fishing measure and the mandate to propose such a measure to SPRFMO's Commission or any of its subsidiary bodies (SC, Compliance & Technical Committee) lies with interested SPRFMO Members. Members that have already indicated their interest include Australia, Chile, the European Union, and New Zealand. Thus, although stakeholder views are important and the workshop outputs will be valued, the final decisions on proposals to SPRFMO must be made by the governments of the respective Members.

3. Background documents

The following documents are relevant and are hyperlinked:

- SPRFMO Convention;
- Current CMM on Bottom Fishing in the SPRFMO Convention Area, CMM-03-2017;
- Information paper submitted to the 2017 SPRFMO Commission on progress toward a revised Bottom Fishing CMM (COMM5-INF05, submitted jointly by New Zealand and Australia);
- SPRFMO's Bottom Fishery Impact Assessment Standard 2012;
- Australian Bottom Fishery Impact Assessment 2009;
- New Zealand Bottom Fishery Impact Assessment 2009;
- FAO guidelines for the management of deep-sea fisheries in the high seas 2008;
- New Zealand's draft summary of matters that might be considered in the development of a new bottom fishing measure SCW3-INF01;
- New Zealand's National Report to SPRFMO-SC4, including information on progress with VME mapping and testing of Zonation decision-support software, September 2016;
- Current CMM on Management of New and Exploratory Fisheries in the SPRFMO Convention Area, CMM-13-2016.
- Published paper by Ben Sharp, Steve Parker, and Neville Smith (2009) describing the impact assessment framework for bottom fishing methods in the CAMLR Convention Area.

Additional documents may be required, depending on the discussions.

4. Timetable

The first two workshops are set down for 13 and 14 July 2017 and will be held at the National Institute for Water and Atmospheric Research (NIWA), Greta Point, Wellington, New Zealand. The timing of subsequent workshops will depend on the amount of inter-sessional work required and stakeholders' availability. It is anticipated that Martin Cryer from the Fisheries Science Team at MPI, will chair the sessions.

Thursday 13 July	Technical workshop to parameterize a spatially explicit bottom fishery impact	09:30, NIWA Boardroom, Wellington
Friday 14 July	First stakeholder workshop to parameterize Zonation analyses	09:30, NIWA Conference Room, Wellington
End of July?	Second stakeholder workshop to review initial Zonation analyses and runs	Room to be confirmed, Wellington
Early-mid-August?	Third stakeholder workshop to review final Zonation runs and any other analyses	Room to be confirmed, Wellington
Sunday 20 August	Papers for SC, including report from the workshops, due with SPRFMO Secretariat	(stakeholder input will be required by 17 August)
Wednesday 20 September	Scientific Committee (SC) convenes in Shanghai, China	

It is anticipated that the workshops will be concluded by 4pm on Thursday 10 August leaving about a week to finalise a report for submission to SPRFMO's Scientific Committee.

More detailed draft agendas were attached to the Terms of Reference but these are not reproduced here because they have been superseded by the finalized agendas in Appendix 2.

APPENDIX 2: AGENDAS, NOTES, ATTENDEES, APOLOGIES, AND GUIDANCE FOR THE RESEARCH TEAM FROM THE FOUR WORKSHOPS

Technical Pre-Workshop to Parameterise Spatially Explicit Impact Assessments for SPRFMO Bottom Fisheries

Timing: Thursday 13 July, 09:30 to 17:00 (if needed)

Location: Allen Boardroom, NIWA, Greta Point, Wellington

Present (* = via video): Martin Cryer (Chair), William Emerson, Ben Sharp, Tiffany Bock (MPI),), Shane Geange, Kris Ramm (DOC), Ashley Rowden, Malcolm Clark, *Steve Parker (NIWA), Craig Loveridge (SPRFMO Secretariat), Geoff Tingley (SFP), Barry Weeber (ECO & DSCC), Jack Fenaughty (Sanford), *Andy Smith (Talley's), Patrick Cordue (HSG), Simon Nicol (ABARES), Ryan Keightley, Brodie Macdonald (AFMA)

Apologies: none received

Agenda as circulated:

1. Brief introduction from the Chair (Martin Cryer);
2. Confirm area of coverage (SW Pacific Ocean within the SPRFMO Convention Area);
3. Confirm fisheries to be considered (bottom trawl, midwater trawl for bentho-pelagic species, bottom longline, others?);
4. Parameterise spatially explicit impact assessments using the CCAMLR method, including uncertainties (led by Ben Sharp);
5. Agree next steps (Chair).

Workshop participants worked through the agenda for all bottom-contacting trawl fisheries and agreed parameters for the cumulative footprint/impact assessment. Participants also agreed to use parameters applied in the CCAMLR assessment for bottom line fisheries. The analysis will be conducted as soon as possible and will be reported in a separate paper to SC-05. The results will be useful as a quantitative layer for "naturalness" in the Zonation analyses to be covered by stakeholder workshops 1 to 3.

First Stakeholder Workshop to Discuss Potential Changes to the SPRFMO Bottom Fishing Measure

Timing: Friday 14 July, 09:30 to 17:00 (if needed)

Location: Main Conference Room, NIWA, Greta Point, Wellington

Present (* = via video): Martin Cryer (Chair), William Emerson, Ben Sharp, Tiffany Bock (MPI), Ashley Rowden, Malcolm Clark, *Carolyn Lundquist, *Fabrice Stephenson (NIWA), Craig Loveridge (SPRFMO Secretariat), Geoff Tingley (SFP), Shane Geange, Kirstie Knowles (DOC), Barry Weeber (ECO & DSCC), Jack Fenaughty (Sanford), *Andy Smith (Talley's), Patrick Cordue (HSG), Simon Nicol (ABARES), Ryan Keightley, Brodie Macdonald (AFMA)

Apologies: Bronwen Golder, Duncan Currie (DSCC)

Agenda as circulated:

1. Brief introduction from the Chair (Martin Cryer);
2. Note the requirements of the UNGA, SPRFMO Convention, and other guiding documents and agree on the scope of analysis and discussions for the workshop within the constraints of those documents;
3. Seek views on what questions other than spatial management planning (see SCW3-INF01) could be addressed within or outside the workshops;
4. Seek views on the phasing and coordination of work on stock assessment, spatial management planning, national or coordinated bottom fishery impact assessments (under SPRFMO's BFIAS), and development of new management measures;
5. Introduction to spatial management planning and use of decision-support tools (led by Ashley Rowden and Carolyn Lundquist);
6. Example use of the ZONATION decision-support tool for Vulnerable Marine Ecosystems (VME) in the NZ region as previously presented to SPRFMO's SC (e.g., National Report 2016);
7. Agree on the objectives for the analysis using written statements of what all stakeholders want to achieve from spatial management planning (**this is a very important step**);
8. Determine data input types (e.g., VME indicator taxa or VME thresholds, fishing "cost" – i.e., what constitutes "value" for commercial fishers, impact, naturalness etc) and identify suitable input data and data layers;
9. Agree any stratification and bio-regionalisation, treatment of connectivity (including with adjacent EEZs), and the nature and spatial scales of candidate management approaches (grids, individual seamounts, etc);
10. Identify appropriate modifiers to guide the analysis (e.g., weightings, boundary length etc). This may include presentation and discussion of some examples showing the impact of different ZONATION settings;
11. Identify next steps and list model runs and analyses for inter-sessional work (Chair).

NOTES AND AGREEMENTS ON ZONATION ANALYSES AND FUTURE WORK FROM A STAKEHOLDER WORKSHOP HELD ON FRIDAY 14 JULY 2017

The following were agreed as a basis for conducting initial exploratory runs using the Zonation spatial decision-support tool. Further workshops will use the results of these initial runs to develop final options for consideration by decision-makers.

Objectives for the analysis to design spatial management options using the Zonation decision-support tool (acknowledging that some of these are competing objectives)

- Access to as much economically productive fishing ground as possible;
- Industry acknowledged as being responsible;
- UNGA resolutions and conventions to be implemented, including closing area where VMEs occur or are likely to occur to bottom fishing unless fishing can be managed to avoid significant adverse impacts on VMEs;
- Impacts on vulnerable marine ecosystems to be minimised ;
- Measures that are easily-understood, practical, enforceable, and without un-necessary complexity and cost.

Area and fisheries to be included

- All New Zealand and Australian trawl fisheries to be included (all bottom trawl plus all midwater trawl targeting bentho-pelagic species);

- Other fisheries (e.g., longline) will not be included in the Zonation analyses and are likely to have to be dealt with differently within the management measures;
- The area of coverage to be expanded beyond a previous example analysis (centred on the New Zealand region), noting that this will mean that new habitat suitability maps for VME indicator taxa will need to be made for this area, and a new data compilation made that includes both New Zealand and Australian bottom trawl fishing effort;
- Analyses will be done at a 1 km scale so the results can be used to design spatial management areas at that or any larger scale.

Taxa to be included

- The following VME indicator taxa will be included:
    - Porifera (sponges), demosponges and hexactinellids separately (if data allow);
    - Alcyonacea (soft corals);
    - Gorgonacea (sea fans);
    - Pennatulacea (sea pens);
    - Scleractinia (stony corals), each matrix-forming genus separately and collectively. Solitary taxa excluded;
    - Antipatheria (black corals);
    - Stylasterida (hydro corals);
- Crinoidea (sea lilies) and Brisingida (armless stars) and Actiniaria (anemones) to be excluded because recent analysis suggests they are not always reliable VME indicators;
- Additional taxa identified independently as rare or to be "unique" will be notified by Barry Weeber a.s.a.p..

Other guidance for designing spatial management options using the Zonation decision-support tool

- Initial runs to be conducted using the existing New Zealand Region model for VME indicator taxa while the new models are being developed;
- Naturalness index: Sharp et al. method was agreed as ideal but consideration was required of whether/how to allow for periods of fallow or recovery;
- Value to the fishing industry (for the "cost" layer): Patrick Cordue will work with fishing industry members to define a layer (maybe two) that describes their values and interest (for both New Zealand and Australian trawl fisheries);
    - Key focus probably availability of orange roughy;
    - Distance from port may be useful to consider;
    - Value of alfonsino or other species could be considered as well as orange roughy;
- All EEZs to be masked out for the Zonation analysis;
- The depth cut-off for the Zonation analysis to be 2000 m
- Edge removal to be applied;
- Preference was for a simple stratification or bio-regionalisation scheme with ~ three categories (NIWA analysts to make a call);
- Layers for EBSAs will be considered for inclusion or as a stratifying tool;
- Genetic connectivity would not be included formally but would be considered as part of the bio-regionalisation;
- At least two types of habitat suitability models for VME indicator taxa (BRT and RF?) and an ensemble model to be developed for the agreed area of coverage;
- Sensitivity analyses:
    - Area covered by best habitat suitability models for VME indicator taxa vs area covered by poorer models for entire SPRFMO convention area (lowest priority);
    - With or without any in-Zone protection (e.g., BPAs and seamount closures)

  - Depth limit of 1600 m vs 2000 m
  - With or without edge removal
  - With or without inclusion of EBSAs With (using two bio-regionalisation schemes – simple and more complicated) or without bio-regionalisation
  - Different weights on different taxa, on naturalness, on uncertainty, and on bio-regionalisation
  - Sensitivity on the relative weights of cost layer and biodiversity
- Each sensitivity would include analysis and tabulation/figures of the outcomes of the solutions for biodiversity protection and use

Other issues

- Once the Sharp et al. footprint/impact assessment had been done, this would be combined with models of the distribution of selected taxa to estimate the intersection (overlap) of the distribution of each taxon and each fishery;

Timing and content of subsequent workshops

- The second stakeholder workshop would be convened in the first week of August, noting the desirability of avoiding clashes with the Seafood NZ conference and technical workshops;
- The current suggested timeline is as follows:
  - Monday 31 July: SPACWG for orange roughy CPUE and stock assessments;
  - Tuesday 1 August: Second stakeholder workshop for Zonation analyses and other aspects of the SPRFMO bottom fishing measure
  - Wednesday 2 August: New Zealand and Australia officials meetings;
  - Tuesday or Wednesday 15 or 16 August: Third stakeholder workshop for Zonation outputs and other aspects of the SPRFMO bottom fishing measure;
  - Thursday 17 August: SPACWG for orange roughy CPUE and stock assessments and other papers for Scientific Committee;
  - Thursday 24 August: Papers due for Scientific Committee (30 days prior);
  - Wednesday 20 September: Scientific Committee pre-workshop convenes;
  - Thursday 21 September: Scientific Committee proper convenes;
- The second workshop will view initial Zonation runs and provide feedback to develop further runs. Stakeholder views on other aspects of the management measures will also be canvassed to inform subsequent processes to develop a new Conservation and Management Measure.
- More detailed agendas for subsequent stakeholder workshops will be circulated closer to the time.

Second Stakeholder Workshop to Discuss Potential Changes to the SPRFMO Bottom Fishing Measure

Timing: Tuesday 1 August, 09:30 to 17:00 (if needed)

Location: Allen Boardroom, NIWA, Greta Point, Wellington

Present (* = via video): Martin Cryer (Chair), William Emerson, Ben Sharp, Tiffany Bock (MPI), Jonathan Maliaga (MFAT), Shane Geange, Kirstie Knowles (DOC), Simon Nicol, Kerrie Robertson (DAWR, Australia), Ashely Rowden, Carolyn Lundquist, Fabrice Stephenson (NIWA), Ozvaldo Urrutia, Craig Loveridge, Johanne Fischer (SPRFMO), Geoff Tingley (SFP), Barry Weeber (ECO & DSCC), Amelia Connell (Pew), Duncan Currie (DSCC), Jack Fenaughty (Sanford), Andy Smith (Talley's), Patrick Cordue (HSG),

Apologies: Malcolm Clark, Bronwen Golder, Ryan Keightley, Brodie Macdonald

Agenda as circulated:

1. Brief introduction from the Chair (Martin Cryer);
2. Brief reminder/update of tasks from last workshop (Ashley Rowden);
3. Present work on value layer for industry (cost layer for ZONATION runs) (Patrick Cordue);
4. Present results of ZONATION runs (Carolyn Lundquist & Fabrice Stephenson);
5. Discuss results of ZONATION runs and other analyses to ensure understanding (Chair);

   Lunch will be provided (approximately 13:00 to 13:45)

6. Identify any new data/modifications/analyses required for next ZONATION runs;
7. Discuss other questions related to the development of a revised bottom fishing measure and document stakeholder perspectives, these could include:
    a. Move-on rules;
    b. Treatment of different fishing methods;
    c. Treatment of new and exploratory fisheries;
    d. Spatial treatment of catch limits;
    e. Other
8. Identify next steps and list model runs and analyses for inter-sessional work (Chair);
9. Confirm date of next meeting;
10. Any other business.

NB: Notes and agreements from the second workshop were circulated as an early draft of this report, no separate document was generated.

Third Stakeholder Workshop to Discuss Potential Changes to the SPRFMO Bottom Fishing Measure

Timing: Tuesday 15 August, 11:00 to 17:00 (if needed)

Location: Allen Boardroom, NIWA, Greta Point, Wellington

Present (* = via video): Martin Cryer (Chair), William Emerson, Tiffany Bock (MPI), Jonathan Maliaga, Allice Revell (MFAT), Shane Geange, (DOC), *Simon Nicol, (ABARES, Australia), Ashely Rowden, Carolyn Lundquist, Fabrice Stephenson (NIWA), Craig Loveridge (SPRFMO), Barry Weeber (ECO & DSCC), Amelia Connell (Pew), Jack Fenaughty (Sanford), Patrick Cordue (HSG),

Apologies: Andy Smith, Geoff Tingley, Ben Sharp, Duncan Currie, Kirstie Knowles Malcolm Clark, Ryan Keightley, Brodie Macdonald, Kerrie Robertson

Agenda as circulated:

1. Brief introduction from the Chair (Martin Cryer);
2. Brief reminder/update of tasks from last workshop (Ashley Rowden);
3. Present revised work on value layer for industry (cost layer for ZONATION runs) (Patrick Cordue);
4. Present results of ZONATION runs (Carolyn Lundquist & Fabrice Stephenson);
5. Discuss results of ZONATION runs and other analyses to ensure understanding (Chair);
6. Discuss and agree report from the workshops or process for finalising (Chair)
7. Identify next steps and timelines (Chair);
8. Any other business.

NB: Notes and agreements from the third workshop were included directly into drafts of this report, no separate document was generated.