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Progress toward a revised bottom fishing measure for the SPRFMO Area

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Contents

1. Purpose of paper

This paper updates the Scientific Committee on progress on the four elements suggested by New Zealand at SC2 (2014) that would be required for a new bottom fishing conservation and management measure (CMM).

2. Introduction

As indicated at SC2 (MPI 2014, SC-02-DW-02) and reinforced at SC3 (Roux et al. 2015, SC-03-DW-02 and Cryer 2015, SC-03-DW-04), New Zealand envisages that a new bottom fishing measure would take a more comprehensive approach to the management of bottom fishing than CMM 2.03 and CMM 4.03 and would be based on a spatial management approach. As foreshadowed at SC2, this approach will require:

1. the identification of an appropriate fishing footprint;
2. the setting of sustainable catch levels for key target species; and
3. the mapping of the distribution of vulnerable marine ecosystems (VME) within the footprint;
4. the design of management measures to avoid significant adverse impacts on VMEs, in particular, areas that will be open or closed to fishing within the footprint.

The intention, summarized in CMM 2.03, was to submit a draft bottom fishing CMM for consideration at the 2016 Commission meeting but it was not possible to complete all the necessary work in time for proposals to be considered by SC3 in late 2015 such that they might advise the Commission early in 2016 (SC3 report).

Australia and Chile agreed at SC3 to work with New Zealand in an ad hoc working party to develop a revised bottom fishing measure (see the 2016 Commission report and the updated Roadmap for SC).

3. Progress on components of a new bottom fishing measure

3.1. Footprints for bottom fishing methods

New Zealand and Australia have nominated bottom fishing footprints for the reference years 2002 to 2006 and included these in their bottom fishery impact assessments (these are shown on the SPRFMO website for Australia and New Zealand). As agreed, these footprints are specified as blocks of 20-arc-minutes on each side.

Both nations have established management approaches to constraining vessels flying their flag to fishing within the footprint and to catches no higher than the average of catches between 2002 and 2006 (unless otherwise agreed by the Commission, see 16 to 20 of CMM 4.03). Both nations have open and closed blocks within their respective footprints but apply different implementations of the move-on rule.

Use of midwater trawls to target bentho-pelagic species like alfonsino has been determined to fall within the definition of bottom fishing and such fishing has been constrained within New Zealand's bottom trawl footprint since 2013. The SC2 advised that the use of midwater trawls to target bentho-pelagic species like alfonsino had a much lower impact than fishing with bottom trawl and was unlikely to cause significant adverse impacts on VMEs (report from SC2).

New Zealand modified the status of a small number of blocks within its bottom trawl footprint in 2015 such that opportunities for midwater trawling for bentho-pelagic species like alfonsino could be maintained while decreasing the likelihood that significant adverse impacts on VMEs would occur (see SC-03-DW-03).

3.2. Estimating and setting sustainable catch limits for key bottom fishing target species

Orange roughy is the primary target of New Zealand's bottom trawl fisheries in the SPRFMO Area. Midwater trawling close to the seabed primarily targets alfonsino. Bottom longline fisheries initially targeted primarily bluenose but, since the reference years, the catch has gradually shifted toward wreckfish. Catches of major target fisheries are currently limited to the average of catches between 2002 and 2006 (see New Zealand's National Report to SC3).

Early estimates of sustainable yield for orange roughy in the SPRFMO Area were presented by Penney (2010). He used simple methods to predict MSY from biomass estimates from seamount meta-analyses (after Clark et al. 2001, Clark et al. 2010). He found catches at that time exceeded estimates of MSY but were lower than the average of catches between 2002 and 2006.

Complete catch per unit of effort information (CPUE) is available for New Zealand vessels (New Zealand's National Report to SC3) and should be available also from Australia (Australia's National Report to SC3). In many circumstances, CPUE is not very informative about biomass trends for species like orange roughy, often because of non-random changes in the spatial and temporal distribution of fishing (Walters 2003). To address at least some of the issues with CPUE, New Zealand has developed a spatially-disaggregated CPUE analysis that overcomes some of these issues. This approach was reviewed by SC3 (Roux et al 2015) and is undergoing simulation testing to assess its robustness.

There remains some uncertainty about whether CPUE is a reliable index of abundance for orange roughy, and it would be preferable to use fishery-independent data, but CPUE is currently the only index of abundance available to support a model-based stock assessment. New Zealand has applied the spatially-disaggregated CPUE indices in preliminary Bayesian biomass dynamic (surplus production) models fitted using a state-space approach. Reasonable fits to the available data were found for four of the six areas within the western SPRFMO Area. Fits were not attempted for two other areas because there were insufficient data. This work is the subject of a separate paper by New Zealand to SC4 (Roux et al. 2016).

These Bayesian biomass dynamic models have been simulation tested on data from similar fisheries with much more data (Edwards and McAllister 2014) and have been found to provide similar estimates of stock depletion to more complex models fitted to a range of data.

Some development of the biomass dynamic models is still required, and it is important that each model includes the full catch history from each area. In particular, the Australian catch of orange roughy from the Tasman Sea fisheries (especially) is required. Australian catch and effort information at a fine spatial scale would also be useful, but not as critical as knowing the catch from each area. These preliminary models cannot be finalised in time for SC4 in late 2016 but will be worked on as and when Australian catch and effort becomes available.

It is not considered feasible to develop stock assessment models at this stage for alfonsinos, bluenose, or wreckfish given the highly variable effort and CPUE for these fisheries.

3.3. Mapping of VMEs within the footprints

Records of the location or density of VMEs or VME indicator taxa such as reef-forming corals within the SPRFMO Area are sparse and inadequate to accurately map the distribution of VMEs directly. It also seems extremely unlikely that sufficient funding will become available to survey the vast areas outside nations' EEZs with the intensity necessary to map VMEs directly. This means that model-based predictive methods will always be required to map the distribution of VMEs. Models will need to be based on physical and chemical information that can be acquired or predicted with sufficient accuracy across the SPRFMO Area at all relevant depths (200 to 1600 m).

New Zealand has made steady progress developing such predictive models using a variety of approaches and spatial scales. SPRFMO-scale models and models using presence-only data to predict the likelihood of VMEs occurring within a given cell have been superseded by regional-scale models and, increasingly, models that use absence and well as presence of given VME indicators (e.g., Cryer 2015 and New Zealand's National Report to SC4). It is rare for such models to be independently tested using independent data but New Zealand conducted such a test in 2014 (Anderson et al. 2016). This test highlighted substantial inaccuracies with some global bathymetry information layers. This was a serious problem because many of the variable that are important for the prediction of VME indicator taxa are highly correlated with depth.

Models would ideally focus directly on VME habitat (e.g. coral reef) rather than individual species or combined taxa (e.g. coral species or taxonomic group). The identification of such habitat, and the use of abundance data rather than presence-absence, relies heavily on photographic surveys and currently there are insufficient records at the regional scale in New Zealand waters and at the broad scale across the SPRFMO Area.

The latest model development (briefly summarised in New Zealand's National Report to SC4) is feature-scale models using both presence and absence records as well as abundance as well as abundance data. It will not be possible to develop such models for all features (seamounts) until much more information on the distribution of VMEs has been collected.

3.4. Establishing spatial management measures to avoid significant adverse impacts on VMEs

There are several methods of designing spatial management areas ranging from entirely political or stakeholder-driven proposals to sophisticated decision-support software approaches drawing on explicit objectives and large amounts of data.

New Zealand used decision-support software in the design of MPAs in the Ross Sea (Sharp & Watters 2011), and has been focussing on the application of Zonation software to considering potential spatial management approaches within the SPRFMO Area (Cryer 2015 and New Zealand's National Report to SC4). Both approaches require information or predictions on the distribution of biodiversity attributes to be protected, on the potential cost of achieving protection through spatial closure, and on the objectives to be met.

Work in the last two years has focussed on assessing the sensitivity of outputs to choices among habitat modelling approaches and design choices implemented in Zonation (see Cryer 2015 and New Zealand's National Report to SC4). Decision-support software can be used to generate candidate spatial management areas for discussion with stakeholders and decision-makers. The software can be used to identify and quantify trade-offs among specified objectives and the extent to which such objectives are met by different candidate measures (e.g., Kukkala & Moilanen 2012; Ardron et al. 2014). The utility of the approach depends on the quality of the input layers and the ability of stakeholders to identify and express their objectives.

3.5. Other emerging issues relevant to a new bottom fishing measure

Another emerging issue that may be worth including in the development of a comprehensive bottom fishing measure is the impact of bottom fishing on fish and other bycatch species affected by bottom fishing activities. Impacts on seabirds, marine mammals, reptiles, and other species of concern are managed under other existing CMMs, but a fifth component of a revised bottom fishing measures may be the development of appropriate risk assessments for fish bycatch.

4. Next steps to assemble a new bottom fishing measure

4.1. Choice of a single measure or national measures

New Zealand suggests that assembling the four or more components into a coherent and comprehensive bottom fishing measure could take one of two approaches, although it is acknowledged that approaches intermediate between these two extremes are also possible:

- Development of a prescriptive SPRFMO bottom fishing measure with a single (bottom trawl[1]) footprint for all bottom fishing members, a consistent approach to move-on rules that applies to all bottom fishing members, and move-on triggers that apply to all bottom fishing members; or
- Development of a high-level SPRFMO bottom fishing measure that defines just the performance objectives, standards and evaluation criteria for management; each bottom fishing member could choose how to give effect to the CMM's requirements (as in CMM 2.03 and the current CMM 4.03). Such an approach would recognise there are a number of possible management approaches and would provide some flexibility to the members in how the scientific and regulatory objectives were to be achieved.

Within either of these two approaches, or an intermediate or different approach, it may be appropriate to develop separate measures for bottom-impacting trawl and bottom line methods, and to treat bottom trawling and midwater trawling for bentho-pelagic species differently, given their different levels of impact.

4.2. Steps required to progress new conservation and management measure(s)

Whatever overall approach is selected (see section 4.1), a number of steps will be required to develop new conservation and management measures for bottom fisheries:

1. Finalise current simulation testing of spatially-disaggregated CPUE method, revise and update New Zealand CPUE time series for each stock of orange roughy as appropriate;
2. Enhance, as possible, spatially-disaggregated CPUE time series using Australian catch and effort data for each stock of orange roughy;
3. Develop and finalise Bayesian state-space biomass dynamic models for each stock of orange roughy including catches from all bottom fishing nations in the assessed areas;
4. Use stock assessment models to estimate stock depletion and sustainable catch limits for each stock of orange roughy;
5. Finalise and assess the reliability of best possible regional-scale models and maps of the distribution (and, as possible, density) of VMEs within the western part of the SPRFMO Area;
6. Finalise current work on genetic connectivity between seamount features within the western part of the SPRFMO Area as an input to spatial management area decision-support software;
7. Convene one or more face-to-face or virtual working parties of stakeholders (in the broadest sense) to:
   - 7.1. Specify their respective objectives for spatial management areas;
   - 7.2. Develop understanding of decision support software approaches;
   - 7.3. Iteratively consider candidate spatial management areas and, as necessary, revise their objectives and criteria for scoring candidate areas;

[1] Midwater trawling for bentho-pelagic species has been determined to be included within the SPRFMO definition of bottom fishing but is considered unlikely to cause significant adverse impacts on VMEs

   7.4. Work together with governments of bottom fishing members to develop agreed, consensus or arbitrated spatial management areas and the need for, nature of, and response to move-on rules that will collectively avoid significant adverse impacts on VMEs
   7.5. Consider how bottom fishing methods with different potential for impact on VMEs should be managed within bottom fishing footprints (bottom line methods have less potential for impact on VMEs that midwater trawls for bentho-pelagic species which, in turn have less potential for impact than bottom trawls)
8. Develop proposals on new conservation and management measures for bottom fisheries for the consideration of SC5 in late 2017 and the Commission meeting in early 2018;
9. Update each member's bottom fishery impact assessment, and any other risk assessments, in the light of the current arrangements and any proposed new conservation and management measure(s)
10. If the updated bottom fishery impact assessment does not conclude that significant adverse impacts on VMEs will be avoided, iterate steps 7–9.

New Zealand's two suggested approaches to developing a new, comprehensive CMM for bottom fisheries each has advantages and disadvantages (summarized below). On balance, and based on this analysis, New Zealand believes that a single prescriptive CMM is to be preferred, even though the work this entails will be substantially greater.

	Advantages	Disadvantages
Single, prescriptive CMM	• Little or no chance of different members' measures counteracting one another (e.g., one member permitting bottom fishing in a block that another member had closed to bottom fishing to protect VMEs) • Very little, if any, work would be required to harmonize measures proposed to SC5 by different bottom fishing members (because such harmonization conducted prior to the development of proposals) • Very clear to all members and fishers where bottom fishing was allowed or prohibited • Detection of IUU fishing simplified • All research work, including response to accumulated evidence of VMEs, can be focused on key areas of importance	• Substantially more work required in stages 7 and 8 of the above development process for a new CMM; discussions would need to bring together the governments, industries, and other stakeholders from at least Australia and New Zealand • Bottom fishing nations may not be able to agree on aspects of the revised CMM (e.g., allocation of catch, permissions to bottom fish in particular footprint blocks, application and triggers for move-on rules) • The additional work and discussion brings a risk that proposals will not be ready for discussion by SC5 and the 2018 Commission meeting
High-level CMM to be implemented by members as they see fit	• Substantially less work required in stages 7 and 8 of the above development process for each member's CMM; discussions would need only the government, industry, and other stakeholders from one member • Bottom fishing nations need not have to agree on all aspects of their revised measures • Little risk that proposals will not be ready for discussion by SC5 and the 2018 Commission meeting	• Some chance that different members' measures could counteract one another (e.g., one member permitting bottom fishing in a block that another member had closed to bottom fishing to protect VMEs) • Substantial work may be required to harmonize measures proposed to SC5 by different bottom fishing members • Potential for some confusion for members and fishers where bottom fishing was allowed or prohibited • Detection of IUU fishing may be more complex • Research work, including response to accumulated evidence of VMEs, may become fragmented

5. Recommendations

It is recommended that the Scientific Committee:

- **notes** the establishment by New Zealand and Australia (and fine-tuning by New Zealand) of 20-minute block footprints for its bottom fisheries in the western part of the SPRFMO Area
- **notes** steady progress on low information stock assessment methods for estimating stock depletion and sustainable yield for orange roughy, the key target species of bottom trawl fisheries
- **notes** steady progress on the development and testing of methods to model and map VMEs in the western part of the SPRFMO Area

- **notes** steady progress on the development of software-based methods to design candidate spatial management areas to provide for sustainable use while avoiding significant adverse impacts on VMEs
- **affirms** its agreement at SC2 and SC3 that this work should be integrated into a revised comprehensive CMM for bottom fisheries in the SPRFMO Area
- **determines** whether a more prescriptive bottom fishing CMM for all members is preferable to a high-level CMM under which members can choose how to give effect to the CMM's requirements
- **notes** that developing a more prescriptive bottom fishing CMM entails much more work and entails a risk that this work may not be completed in time for proposals to SC5 and the 2018 Commission meeting
- **advises** the Commission of its preferred approach to developing a revised bottom fishing measure and the anticipated timetable for delivery

6. References

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