17 March, 2009

Mr Andrew Penney
Chair, Science Working Group
Wellington

Via email: Andrew.Penney@fish.govt.nz

Dear Andrew,

Re: Comments on New Zealand Bottom Fishery Impact Assessment: Bottom Fishing Activities by New Zealand Vessels Fishing in the High Seas in the SPRFMO Area during 2008 and 2009

These are the comments by the Deesp Sea Conservation Coalition (DSCC) on the New Zealand assessment at http://www.southpacificrfmo.org/assets/Science/Benthic-Impact-Assessments/New-Zealand/New-Zealand-Bottom-Fishery-Impact-Assessment-low-res.pdf.

Absence of comment on any section does not imply agreement.

OVERALL COMMENTS

It is disturbing that New Zealand is the only Participant to have submitted an assessment framework to date. While New Zealand is acting responsibly by doing so, other partipants engaged in bottom trawling are urged to submit assessments as a matter of priority. In addition, New Zealand's assessment does need modifications to comply with the Interim Measures agreed for the South Pacific RFMO and UN General Assembly resolution 61/105 with respect to on high seas bottom fisheries. We do note that the New Zealand Government is proposing a multi-stage implementation process, but it is important that full implementation is performed expeditiously. Damage is still continuing while implementation is delayed. As was noted at the recent COFI meeting,[1] additional efforts were required to respond fully to Resolution 61/105 and countries and RFMO/As should continue their efforts in this regard. DSCC is advocating that all countries in the SPRFMO faithfully implement these interim measures.

The background to this assessment is threefold:

1. 2006 UN GA resolution 61/105, which in paragraphs 83-86 provides that States and RFMOs must adopt and implement measures by 31 December 2008 or not authorize bottom fishing on the high seas to proceed.

2. The SPRFMO Interim Measures, adopted in Reñaca, Chile in May 2007. Paragraph 6 of those Measures requires participants to close areas where vulnerable marine ecosystems are known to occur or are likely to occur based on the best available scientific information to bottom fishing unless, based on an assessment undertaken in accordance with paragraphs 11 and 12, conservation and management measures have been established to prevent significant adverse impacts (SAIs) on vulnerable marine ecosystems (VMEs) and the long-term sustainability of deep sea fish stocks or it has been determined that such bottom fishing will not have SAIs on VMEs or the long term sustainability of deep sea fish stocks.

[1] Draft Report, Committee on Fisheries, 28th Session, Rome, Italy 2-6 March 2009, Draft Report, COFI/2009, page 11.

3. The FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas, adopted in August 29th 2008. These guidelines show States how to apply 61/105 and provide strong guidance on implementation of the Interim Measures, but do not supercede them: the first two instruments have priority. Some Members at the recent COFI meeting expressed the view that the International Guidelines should be considered as minimum requirements for the management of deep-sea fisheries and the protection of vulnerable marine ecosystems.[2]

The UN Fish Stocks Agreement 1995 and the FAO Code of Conduct are also relevant considerations, and the IUCN General Assembly also adopted recommendations which are relevant, including consolidated motion CGR4.MOT043: Achieving conservation of marine biodiversity in areas beyond national jurisdictions and CGR4.MOT040-Rev 1: Fisheries management by Regional Fisheries Management Organisations (RFMOs).

Missing Elements

There are a number of elements missing in the proposal put forward. These include that:

1. There are no measures in place or proposed to manage the significant adverse impacts of longlining. The current observer coverage is low (only 10 percent) so that the level of temporal and geographic spread of the fishery will not be covered.

   Information from the New Zealand waters (eg around the sub-Antarctic Islands) and in the Ross Sea (and elsewhere in CCAMLR Antarctic waters) shows that longlines do catch a wide range of sensitive species which can make up a VME.
2. The environmental assessment approach is qualitative and hard to replicate. The assessment makes assumptions about the effects of different fishing techniques which are not precautionary or based on the best available information.
3. Bottom longlining: There are no measures in place or proposed to manage the significant adverse impacts of longlining. The current observer coverage is low (only 10 percent) so that the level of temporal and geographic spread will not be covered. The Ministry proposes not to change observer coverage or apply measures to protect VME from impacts of longlining.
4. Bottom trawling and high impact areas: There is no proposal to manage the significant adverse effect of trawling in high impact areas. This year's result indicated that VMEs could be present in these high impact areas but no measures are proposed to protect these VMEs.

Assessments

The proposal notes that analyses of methods, other than bottom trawling, are provisional which is unfortunate given the time that has elapsed since the interim measures were adopted.

Para. 47 of the FAO Guidelines requires States to carry out assessments to establish if deep-sea fishing activities are likely to produce significant adverse impacts in a given area. The requirements for the assessments are further provided in para. 47. These requirements are detailed, and include baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes are to be compared.

> *47. Flag States and RFMO/As should conduct assessments to establish if deep-sea fishing activities are likely to produce significant adverse impacts in a given area. Such an impact assessment should address, inter alia:*

[2] COFI Draft Report, para. 57.

i. *type(s) of fishing conducted or contemplated, including vessels and gear-types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing (harvesting plan);*

ii. *best available scientific and technical information on the current state of fishery resources and baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes are to be compared;*

iii. *identification, description and mapping of VMEs known or likely to occur in the fishing area;*

iv. *data and methods used to identify, describe and assess the impacts of the activity, the identification of gaps in knowledge, and an evaluation of uncertainties* ***in*** *the information presented in the assessment;*

v. *identification, description and evaluation of the occurrence, scale and duration of likely impacts, including cumulative impacts of activities covered by the assessment on VMEs and low-productivity fishery resources in the fishing area;*

vi. *risk assessment of likely impacts by the fishing operations to determine which impacts are likely to be significant adverse impacts, particularly impacts on VMEs and low productivity fishery resources; and*

vii. *the proposed mitigation and management measures to be used to prevent significant adverse impacts on VMEs and ensure long-term conservation and sustainable utilization of low-productivity fishery resources, and the measures to be used to monitor effects of the fishing operations.*

It is important that the aim of the assessments is to determine if the fishing is likely to produce SAIs in a given area. Paras. 17 and 18 of the FAO Guidelines provide that:

> *"17. Significant adverse impacts are those that compromise ecosystem integrity (i.e. ecosystem structure or function) in a manner that: (i) impairs the ability of affected populations to replace themselves; (ii) degrades the long-term natural productivity of habitats; or (iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types. Impacts should be evaluated individually, in combination and cumulatively.*
>
> *18. When determining the scale and significance of an impact, the following six factors should be considered:*
>
> i. *the intensity or severity of the impact at the specific site being affected;*
> ii. *the spatial extent of the impact relative to the availability of the habitat type affected;*
> iii. *the sensitivity/vulnerability of the ecosystem to the impact;*
> iv. *the ability of an ecosystem to recover from harm, and the rate of such recovery;*
> v. *the extent to which ecosystem functions may be altered by the impact; and*
> vi. *the timing and duration of the impact relative to the period in which a species needs the habitat during one or more life-history stages."*

It is clear from these guidelines that the impacts on the specific sites are to be considered. This has implications for the heavily fished areas: the impacts on each site must be considered, and measures adopted to prevent SAIs on VMEs – or fishing not authorised.

CONSERVATION AND MANAGEMENT MEASURES TO PREVENT SIGNIFICANT ADVERSE IMPACTS ON VMES (7.1.1, 7.1.2)

The Assessment needs to incorporate the FAO Guidelines.

Para 73 states that: "*States and RFMO/As should assess, on the basis of the best available scientific information, whether DSFs[3] activities would have significant adverse impacts on VMEs, and to ensure that, if it is assessed, in accordance with Section 5.B of these Guidelines, that these activities would have significant adverse impacts, they are managed to prevent such impacts or not authorized to proceed."*

Para 74 states that *"'7 If after assessing all available scientific and technical information, the presence of VMEs or the likelihood that individual DSFs activities would cause significant adverse impacts on VMEs can not be adequately determined, States should only authorize individual DSFs activities to proceed in accordance with:*

i. precautionary conservation and management measures to prevent significant adverse impacts as described in paragraph 65;

ii . a protocol for encounters with VMEs consistent with paragraphs 67-69; and

iii measures, including ongoing scientific research, monitoring and data collection, to reduce the uncertainty.

Note the reference to 'individual' DSF activities. Each individual deep sea fishery must be assessed. Where activities would have SAIs on VMEs, they must be managed to prevent such impacts or not authorized to proceed. This means that VMEs cannot be 'sacrificed' in exchange for closures elsewhere. The fishing must be managed to prevent such impacts. If they are not, or cannot be, they must not be authorised to proceed.

Where there is doubt about SAIs on VMEs, then there must be precautionary measures to prevent SAIs, as well as a protocol for encounters (the 'move-on rule') and measures to reduce uncertainty.

NZ para. 7.1.2 reads that *"New Zealand's interpretation of paragraph 6 [of the SPRFMO Interim Measures] is that once adequate conservation and management measures have been established to prevent significant adverse impacts on VMEs and the long-term sustainability of deep sea fish stocks, it was not intended that any encounter with evidence of a VME would require a halt to fishing."* That is indeed the case, but the crucial *sine qua non* is adequate measures being established. Para 7.1.3 goes on to state, with reference to the heavily fished areas, that *"These blocks are considered, in principle, to be 'open' fishing areas, in which seamounts and VMEs are 'known' to occur. The 'move on' rule is not [sic] be applied, as these areas are treated in accordance with interim measure paragraph 6, with substantial block closures being implemented to protect a substantial proportion of the footprint area."*

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[3] Note that DSF are defined in para. 8 and 9 as follows:

8. These Guidelines have been developed for fisheries that occur in areas beyond national jurisdiction and have the following characteristics:

i. the total catch (everything brought up by the gear) includes species that can only sustain low exploitation rates; and

ii. the fishing gear is likely to contact the seafloor during the normal course of fishing operations.

States and RFMO/As should consider, as appropriate, the application of elements of these Guidelines to similar fisheries in areas beyond national jurisdiction, including those targeting medium productivity species.

9. For the purpose of these Guidelines, the fisheries described in paragraph 8 shall be referred to as "deep-sea fisheries" (DSFs).

It is clear that such areas are not subject to conservation and management measures adopted in accordance with interim measure paragraph 6. Such areas where VMEs are known to occur must be managed to avoid SAIs on VMEs. Partial closures and sacrificing VMEs will not achieve this and is incompatible with the Interim Measures and the FAO guidelines.

Instead, paras 70 and 71 of the FAO Guidelines state what is required:

> *"70. States and RFMO/As should, based on the results of assessments carried out pursuant to Section 5.B, adopt conservation and management measures to achieve long-term conservation and sustainable use of deep-sea fish stocks, ensure adequate protection and prevent significant adverse impacts on VMEs; these measures should be developed on a case-by-case basis and take into account the distribution ranges of the ecosystems concerned.*
>
> *71. Conservation and management measures pursuant to paragraph 70, may include:*
>
> *i. effort controls and/or catch controls;*
> *ii. temporal and spatial restrictions or closures;*
> *iii. changes in gear design and/or deployment or operational measures (as discussed in the 2006 Bangkok Expert Consultation), including,*
> *• reduction of contact between the fishing gear and the seabed,*
> *• use of effective bycatch reduction devices, and*
> *• use of technical measures to eliminate or minimize ghost fishing; or*
> *iv. other relevant measures necessary to achieve the objective of paragraph 70."*

The performance of each measure depends on many factors related to the particular fishery, ecosystem, and how these measures are implemented. Management measures for DSFs, where applicable, should take account of appropriate biological reference points. Such measures should be accompanied by an effective set of MCS [monitoring, control and surveillance] measures sufficient to ensure compliance with agreed measures."

These are only some measures, to which the measures detailed in paragraph 7.5 ("Operational Measures to Minimise Benthic Effects of Bottom Trawling") are relevant. However the test is that cited in para. 70.

As the CCAMLR Commission noted:

> "… although fishing gears are likely to be poor sampling devices of VME taxa, and the presence of VME taxa or indicators of VMEs in catches from any of these methods would be evidence that VMEs could be present. Conversely, the absence of VME taxa or indicators of VMEs in the catches did not necessarily represent an absence of VMEs. The degree to which this could be concluded would be dependent on the selectivity and sampling efficiencies of the gears;"

There is clearly a difference in the species sampled by different fishing gear and that needs to be considered when applying rules consistent with the interim measures. Para 7.4.7 of the New Zealand paper notes that the design raises more issues which could result in VMEs being under-estimated than over-estimated.

THRESHOLD WEIGHT DETERMINATION (7.4)

This section does not adequately incorporate the FAO Guidelines.

We do not agree that *"The choice of what weight percentile to use as a threshold for determining evidence of a VME is essentially a management choice, amounting to choosing what percent of tows should qualify as encountering evidence of VMEs, based on the data analysed."*

To recall, Paragraph 83(D) of UNGA resolution 61/105 mandates "[t]o require members of the regional fisheries management organizations or arrangements to require vessels flying their flag to cease bottom fishing activities in areas where, in the course of fishing operations, vulnerable marine ecosystems are encountered, and to report the encounter so that appropriate measures can be adopted in respect of the relevant site". Paragraph 7 of the Interim Measures likewise mandates that participants "[r]equire that vessels flying their flag cease bottom fishing activities within five (5) nautical miles of any site in the Area where, in the course of fishing operations, evidence of vulnerable marine ecosystems is encountered, and report the encounter, including the location, and the type of ecosystem in question, to the interim Secretariat so that appropriate measures can be adopted in respect of the relevant site. Such sites will then be treated in accordance with paragraph 6 above.

It is important to emphasize that the move-on rule as laid out in the UN GA resolution is intended as a measure of last resort to protect VMEs, as a complement to, not a substitute for, impact assessments, identifying and closing areas where VMEs are known or likely to occur, and establishing regulations to prevent significant adverse impacts to VMEs in areas where high seas bottom fishing is permitted to take place. Even where stringently applied, the move-on rule is not likely to be effective in preventing significant adverse impacts to VMEs other than in exceptional cases. As was noted on page 69 of the Assessment, commercial bottom trawls do not retain taxa efficiently, and thus likely to be of limited value in assessing whether significant adverse impacts have occurred to VMEs.

So the simple question is: is a VME encountered?

Rather than choosing the percentage of tows which 'should qualify' as encountering evidence of VMEs, the measures put in place must instead identify the amounts of taxa which will themselves provide evidence of VMEs – bearing in mind that commercial bottom tows (or bottom longline sets for that matter) are unreliable methods of providing such evidence, since, for instance, material will fall out of the nets or be crushed and pass through the net. The test is one of identifying 'evidence of an encounter." The FAO Guidelines make this clear, in paras. 67-69 and elsewhere. We may never be able to tell from observer data what damage has been done. This is why bottom fishing should not occur until individual assessments have been done - most likely a benthic survey - and measures put in place.

Penney *et al*[4] *stated that "[s]uch evidence would not necessarily constitute proof of actual existence of VMEs, and would also not provide adequate evidence of significant adverse impacts on such VMEs. Additional review and comprehensive scientific analysis of all available data, including data from frequent repeated encounters with VMEs, together with additional information indicating likelihood of existence of VMEs in specific areas, would be required to properly identify and map VMEs."*

Previously we have heard the views of industry that 50 or 30 kg is too low a threshold (presumably in the case of porifera sponges and scleractinia, or stony corals, respectively) and that 10 or 20 kg

[4] A. Penney, S. Parker, J. Brown, M. Cryer M. Clark & B, Sims, New Zealand Implementation of the SPRFMO Interim Measures for High Seas Bottom Trawl Fisheries in the SPRFMO Area

of coral is 'not an issue'. The IUCN paper[5] on FAO guidelines for deep-sea fisheries considered that a single haul constituting more than 5 kg of stony coral or coral rubble or 5 kg of sponge constitutes as significant by-catch indicating the presence of a VME.

In the CCAMLR interim measures for bottom longlines and pots there was agreement that 10 litre or 10 kg basket of all significant species caught in 1200m or 1000 hooks would identify a potential VME which should be closed and subject to further investigation.

Lastly, we note that in terms of the Interim Measures, VMEs include cold water corals and sponge fields according to footnote 3, which then trigger a report and appropriate measures. This indicates in fact that the 50 kg and 30 kg thresholds (Table 18) are far too high. There are other criteria listed in the IUCN report which do not feature in Annex 3. We also refer to the IUCN report (page 25), a lack of by-catch of species that comprise VMEs is not definitive evidence that they are not present in an area that is fished. It is therefore clear that while the proposed conditions are a worthwhile start, more work needs to be done fully to implement the Interim Measures.

In summary, we recommend thresholds based on what are likely to indicate a VME, and suggest that repeated encounters need to be addressed.

Applying the test 'is a VME encountered?' we recommend that the move-on rule is triggered upon any evidence of an encounter with coral, sponges or other vulnerable species. The area should then be subject to an impact assessment to determine whether one or more types of bottom fishing would have significant adverse impacts. Depending on the results of the impact assessments, the area could be reopened to one or more types of bottom fishing activity.

7.5 Operational Measures to Minimise Benthic Effects

The use of gear such as rockhopper disks, short sweeps and bridles, very short groundrope, high aspect semi pelagic doors, PC based winch system, sonar, and full gear monitoring system, if it is as effective as industry claims, could all be assessed by the Science Working Group and considered for inclusion in conservation and management measures.

The assessment of options to minimize the benthic impact of fishing should be undertaken through a workshop with relevant people.

8. Environmental Impact Assessment

The CCAMLR Fish Stock Assessment Working Group noted that a risk assessment framework needs to consider a range of matters and these are relevant to any assessment undertaken by New Zealand particularly for longlining (para 10.30):

[5] Alex D Rogers, Malcolm R Clark, Jason M Hall-Spencer, Kristina M Gjerde, "The Science behind the Guidelines: A Scientific Guide to the FAO Draft International Guidelines for the Management of Deep-Sea Fisheries in the High Seas and Examples of How the Guidelines may be Practically Implemented," (December 2007).

(i) Not all areas are equal with regard to probability of encounters with or impacts to a VME but information needed to assess such probabilities is very limited.

(ii) Models of likely habitat can be developed based on geomorphological, oceanographic and other environmental data and relating these to observations of where different VME taxa might be found. Observations can include direct observations (using videos, benthic sampling equipment) or indirect observations such as by-catch from fisheries.

(iii) An appropriate scale for characterising risk would be 0.5° latitude and 1.0° longitude, consistent with CCAMLR fine-scale areas.

(iv) Different areas will have different risks, e.g. higher risk areas might be seamounts, heads of canyons and depths shallower than 550 m.

(v) There will be different requirements for data collection, research and mitigation for different levels of risk and different gear types.

(vi) The assignment of risk would need to be reviewed as new information becomes available.

Criteria for assessment:

We have a number of concerns about the criteria used in the assessment:

Extent criteria: this criteria has been applied to the whole of the SPRFMO area rather than to the vulnerable marine areas or the depth ranges where the target species exists.

The "Extent" consideration should focus on the area at risk as this is the area which is vulnerable rather than comparing with areas of greater or shallower depth which contains different benthic or other species and ecosystems. This criteria should be modified so that it indicates the impact on the depth range of the target species: that is *site specific* (limited to one site), *local* (limited to one seamount or VMEs within 10nm of a site) or *regional* (limited to one identified fishing area).

Intensity: The intensity criteria should focus on the impact on "ecological" function and processes rather than general "environment" focus.

Overall significance: The focus should be on impact on the ecological processes and functions.

8.1 Identification of Potential Adverse Impacts: *8.1.1 Adverse Impacts on Benthic VMEs*

Impact of bottom trawling on VMEs

Given the changes suggested for "extent" then the impact of bottom fishing would be high. Intensity would also be high given the impacts of trawling and the long recovery times of species eg corals.

NW Challenger is clearly an area which has been heavily fished where there must be questions about whether "ecosystem processes" have been "substantially altered across the spatial scale of the ecosystem concerned".

Impact of bottom linefishing on VMEs

The analysis assumes that the impact of bottom longlining is small but there is no analysis of the spatial scale. The assessment also assumes that the gear does not move and thus compound the impact of a longline. CCAMLR Fish Stock Assessment Working Group this year assessed a range of movement for bottom longlines based on empirical data from "1 m (CCAMLR-XXVII/19) and 25 m (consistent with WG-FSA-08/56)" (para 10.18). If a figure of 25 metres is used then the

impacts area would be 25 times that assessed or 0.3 km2 and only an order of magnitude smaller than bottom trawling.

Any assessment needed to note that:

(i) such analyses will need to take account of the potential for lines to be overlapping, such as would be the case in repeat sets, and that, in these cases, consideration will need to be given as to whether the full impact of fishing occurs during the first interaction, with repeat sets having subsequent negligible effects (but see the conclusions in CCAMLR-XXVII/19);

(ii) the degree of impact within the footprint is difficult to ascertain because of the absence of empirical data on the effects of the different types of longlines on benthic habitats and VME-taxa. The Working Group agreed that future work to obtain empirical data was needed to reduce this uncertainty on the degree of impact of an individual line. Also, refinement is needed of the methodologies and calculations for determining the footprint (area) affected by the different types of longlines (WG-FSA-08/58) and for estimating the possible impacts on VME-taxa within the footprint as described in WG-FSA-08/53. These would be useful topics for discussion in the workshop noted in paragraph 10.54.

(iii) observed by-catch from longlines may not be a good indicator of interactions of longlines with VMEs because taxa affected by the longlines may not be observed as by-catch when landed (paragraph 10.11). As a result, no by-catch may not mean that there has been no interaction with a VME. However, presence of VME taxa in by-catch may be indicative of the presence of a VME. Although catch rates of VME taxa cannot be used at present, it may be possible to use such rates to estimate the scale of impacts on VMEs in the future if the catchability of individual VME taxa can be determined.

Extent: This needs to consider that targeting of effort in a certain depth range that the extent could be high in this range.

Intensity: As there is not assessment of spatial scales of effort it is not possible to say intensity of low for VMEs. The assessment should be precautionary with consideration of a medium level of impact.

Management and Mitigation: As noted here the low level of observer coverage means it is not possible to assess benthic bycatch.

The only appropriate level of coverage to assess this fishery is 100 percent.

8.1.2 Overexploitation of low productivity deepwater species

The extent of the impact is high given the targeting of orange roughy depths.

The assessment also needs to recognize that New Zealand is main fisher in this fishery and thus New Zealand can take effective unilateral action and reduce catches to an ecologically sustainable level. Given the history of over-expoitation in orange roughy fisheries in New Zealand and around the world, this may require closing areas.

Over-exploitation of bottom lined species

The intensity may not be low medium for some species (e.g. hapuku bass) given the localized nature of some of these stocks and the possibility of serial depletion.

Management and Mitigation – There should be no question that active management is needed: New Zealand has obligations under the Interim Measures and the UN Fish Stocks Agreement.

As noted in the latest New Zealand stock assessment report for bluenose:

> *"The updated estimate of maximum age of 60 years determined by Horn et al. (2008) results in an estimate of natural mortality M = 0.08 for a lightly exploited population (p = 0.01), and an estimate of M = 0.06 for a moderately exploited population (p = 0.03), using the method of Hoenig (1983). This range is substantially lower than previous estimates of M for bluenose reported in Plenary reports, such as the 2004 estimate of 0.18 based on a maximum age of 25 years (Paul et al. 2004), or the earlier estimate of 0.3 based on a maximum age of 15 years (Horn & Massey 1989)."*

There is no information on the stock structure of bluenose. It is possible that these fisheries are related to the New Zealand stocks and quota areas and could be a straddling stock. As noted in the stock assessment report:

> *"Stock boundaries are unknown, but similarity in trends in catch and CPUE across fisheries occurring in each of the five New Zealand BNS QMAs quota management areas] suggests the possibility that there may be a single BNS stock across all these areas, or of some close relationship between stocks in these QMAs. There is a possibility that the long period of relatively stable CPUE observations in the face of increasing catches before the period of decline may be evidence of hyper-stability caused by the replenishment of adult stocks on specific areas or features."*

Given the state of the New Zealand bluenose stocks it is essential that a high level of observer coverage is adopted to obtain improved information to manage this stock or stocks and the impacts of fishing.

8.1.3 Incidental Mortality of deepwater elasmobranchs:

Given that these species are longlived and slow growing and are part of the bycatch of the roughy fishery and the longline fishery it is essential that a precautionary approach is taken in assessing the impacts.

LONG TERM SUSTAINABILITY

We note that consultation on catch limits to achieve long-term sustainability of fish stocks, also necessary for the implementation of the Interim Measures, is occurring separately from this process.

Yours sincerely

Barry Weeber

APPENDIX: KEY BIOLOGICAL INDICATORS OF TARGET AND MAIN BYCATCH FISH SPECIES

Common name	Scientific name	Age when mature	Maxi-mum age	Age when first fished	M - natural mortal-ity	Von B growth *k*	Risk rating
Alfonsino	*Beryx splendens* and *B. decadactylus*	4-5 ?	17 ?	4-5 ?	0.23 ?	0.11 ?	C?
Black cardinal fish	*Epigonus telescopus*	35-45	100+	35	0.034	0.034	E
Bluenose	*Hyperoglyphe antarctica*	10	60+	8	0.06-0.08	0.00963	C
Orange roughy	*Hoplostethus atlanticus*	23-29	120-130	23-29	0.045	0.061-0.070	E
Oreos – black, smooth, Spiky	*Allocyttus niger,* *Pseudocyttus maculatus* *Neocyttus rhomboidalis*	27 31 ?	153 86 100+	27? 21 ?	0.044 0.063 ?	0.05 0.047-0.067	E E D?
Ribaldo	*Mora moro*	?	60+?	?	?	?	D?

REFERENCES: SULLIVAN *ET AL* (COMP) 2005, ANNALA J H, SULLIVAN K J, AND O'BRIEN C J (COMP) 2002 AND 2003, PAUL 1992, NEIL *ET AL* 2004.

Risk rating see table 5. e = endemic; s= sharks, rays and relatives; ? = unknown