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Setting Thresholds of Sessile Benthos Bycatch from Bentho-Pelagic Trawling

Relates to agenda item 7: Report of the Scientific Committee meeting

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Delegation of SIODFA

Abstract

A Review is encounter protocols for SPRFMO bottom fisheries. 6th Meeting of the Scientific undertaken of the SPRFMO Document Methods for deriving thresholds for VME Committee, Chile, 9 - 14 September 2018. SC6-DW09 33pp. Conclusions and Recommendations are made.

Setting Thresholds of Sessile Benthos Bycatch from Bentho-Pelagic Trawling

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1. INTRODUCTION

This document is an industry perspective as to the amount of bycatch of sessile benthos from bentho-pelagic trawling that 'constitute evidence of an encounter with a vulnerable marine ecosystem' (VME) (FAO 2009b) and thus provides the basis for setting the threshold value at which the respective fishing vessel must move to another location to continue fishing. The threshold value of bycatch and the distance of displacement required by a 'move-on' rule are directly linked by the, usually unknown, spatial ecology of the benthos in the area of fishing operation. Thus, an effective decision on a threshold should be informed by the appropriateness of the value of the 'move-on' distance applied – something that is, as yet, impossible, at least in the Southern Indian Ocean.

The note focuses on a review of Cryer, Geange & Nicol (2018) because it was cited by PAEWG (2021), para 21:

> "suggested that the PAEWG consider the South Pacific Regional Fisheries Management Organisation (SPRFMO) working paper SC5-DW09[1], which describes methods for deriving thresholds for VME encounter protocols …. Based on the options presented in that paper, Australia recommended setting VME indicator taxa weight thresholds using medians, percentiles, or other metrics based on historical SIOFA catch data."

A large literature exists on this topic. Much of it focuses on the effects of bentho-pelagic trawling on sessile benthos. Industry well know that when there is contact between fishing gear and the seafloor, if benthos are present, depending on their structure, the animals may be damaged or destroyed. Little of the literature addresses, or reports on the relative spatial impact on the ecosystem of concern. This may be in part because the ecosystem of concern is never explicitly defined, not least because of the difficulties of doing so. This critical issue is addressed by FAO (2008, p3) who note that it is the ecosystem that is rendered vulnerable in an ecological sense, i.e., in terms of its survival. We assume that the ecosystem of concern is bounded by the areal extent of the respective population, community or habitat of concern and not by the area of gear interaction.

The paper of Cryer *et al.*, titled "Methods for deriving thresholds for VME encounter protocols for SPRFMO bottom fisheries" addresses several aspects of this issue including:

i. The international origins of for measures to protect high seas VMEs
ii. Evidence to inform a VME encounter protocol
iii. Reference points for selecting threshold and biodiversity weigh
iv. A proposal for a VME encounter protocol and

[1] SPRFMO SC6-DW09 is the paper of Cryer, Geanager & Nicol 2018.

v. Weight thresholds for VME indicator taxa and a biodiversity component of a 'move-on' rule.

2. FACTORS DETERMINING THE BYCATCH OF SESSILE BENTHOS FROM BENTHO-PELAGIC TRAWLING

If 'VME' populations exist on the seafloor in areas where bentho-pelagic trawling occurs, their presence in the recorded benthic bycatch will depend on many factors. For a given overall areal density of benthic species, an important factor determining if a threshold amount of benthic bycatch occurs is the nature of the spatial distribution of the benthos. Characterizing the spatial ecology of benthos is difficult as it is a two-dimensional process (one might argue, three dimensional). The best sampling at present possible, using an appropriately equipped research vessel (swath mapping not withstanding) is by video linear transect sampling, a one-dimensional sample across a two-dimensional process. Inferences about the two-dimensional distribution might be drawn but any number solutions for parameter values are possible to whatever is observed. Clusters of benthos would be expected that in turn could comprise a spatial structure at a larger scale.

In reality, tows are point or very short transects observations repeated non-randomly as determined by the distribution and behaviour of the fish being pursued. The critical consequence, made evident by spatial modelling would be that, independent of the overall average density of benthos for the area, samples with no bycatch could occur next to tows with high bycatches, simply as a consequence of the spatial ecology of the benthos with little or nothing to do with inferences asserting the presence (or absence) of a vulnerable marine ecosystem from observations of the amount of bycatch from a tow.

The well-known aspect of spatial ecology was addressed in the 2008 FAO publication in the Section on Deep-sea habitats (p6). FAO explicitly note (2009a, p52 and 2009b, p4, para 18):

> *18. When determining the scale and significance of an impact, the following six factors should be considered:*
>
> *…*
>
> *ii. the spatial extent of the impact relative to the availability of the habitat type affected.*

This is explicitly discussed in MMR (2017).

To be measured, benthos in the path of a trawl must be retained in the net. Their entry into the net will depend in part on the nature of the seafloor. When demersal trawls fish smooth seafloors, to be sampled the benthos height must be above the footrope which threads the ground bobbins. When tickler chains are used (as in fishing orange roughy), presumably the tickler chains will hit benthos, ejecting some up and into the net. In either case it is reasonable to expect some benthos will pass under the foot rope and bobbins and not be retained.

On rough bottoms, the gear will follow a saltatory trajectory. Where the footrope contacts the seafloor, benthos, if present, may be retained: when the foot rope is off-bottom between 'jumps', the net will pass over the benthos without contact. In this case, repeating a tow along exactly the same path may result in a very different bycatch. Benthos passing into the trawl may, either whole or following disintegration, pass through the 110 mm mesh net. The retention of such benthos will be, in part, dependent on chance, i.e., an unknown stochastic process.

A further factor determining the amount of bycatch taken by a tow will be the length of time the net is in contact with the sea floor. Tows that cover a short distance would be expected to have less bycatch than tows covering a greater distance, though no relation (R^2 = 0.014) was found by Parker, Penny & Clark (2009). This may be because there is no relation between the measured tow duration and the time the trawl is in contact with the sea floor. The length of time a tow is in contact with the bottom may depend on how successful the bridge officer is in corralling the aggregation of fish that is being pursued. The start time of gear contact with the sea floor has only a general relation with the time that is recorded as the time of the tow start. This is usually the time when the trawl has reached a pre-determined depth as it is being set. These potential variables depend on the bridge officers practice, the seafloor feature, oceanographic variables and the characteristics of the individual tows as they develop. Successful bridge officers may have different average/median times of net bottom time contact than those who are less skilled. It is conceivable that if there was a problematic threshold value, the bridge officer could simply adjust the length of the tow to reduce possible bycatch and compensate by making more tows. Consequence? No gain and only cost.

Thus, the benthic bycatch that is recorded will depend on several unknown stochastic processes:

i. The spatial ecology of the respective benthic species, the functional nature and parameters, which should be expected to vary depending on the characteristics of the feature being fished
ii. The probability of the various benthic species being retained in the cod-end of the trawl as it is towed along the sea floor, itself a function of the nature of the bottom (i.e., the sea floor feature), tide, the particular rigging of the gear and bridge officers' fishing tactics.
iii. The distance the tow is on the bottom, loosely related to, but less than, the period of time recorded for the duration of the tow.

These stochastic processes, in total, will form a composite density function describing the probability distribution of bycatch by species for a given (average) density of benthic organisms. Clearly, an area of any average density of benthic organisms, simply as the inevitable results of the spatial scale of sampling, the arbitrary scale being used to determine the distribution of the species of interest and standard sampling theory, could produce high, low or zero bycatches and all for the same ecosystem under consideration.

An introduction to these issues is given by FAO (2008, p6) that would benefit from development.

3. THE INTERNATIONAL ORIGINS OF MEASURES TO PROTECT HIGH SEAS VMES

Cryer *et al.* refer to resolutions of the UNGA, starting with UNGA 61/105": calling "upon regional fisheries management organizations (RFMOs) to adopt conservation measures to protect vulnerable marine ecosystems (VMEs) from significant adverse impacts of bottom fishing activities, or to cease bottom fishing activities in areas where VMEs are likely to occur unless conservation and management measures have been established to prevent significant adverse impacts on VMEs". The Resolution did not define a VME but included seamounts, hydrothermal vents and cold-water corals. Nor, did it elaborate on the term ' likely' in relation to the occurrence of VMEs.

It is unfair to criticize UNGA Res 61/105, now 16 years old, for its lack of scientific rigor. The resolution has 26 preambular paragraphs covering all fisheries management concerns. One hundred and eight paragraphs follow addressing twelve areas of fisheries governance. Of these, Section X, "Responsible fisheries in the marine ecosystem", deals with environmental issues in 19 articles, six of which refer to VMEs and two sections from one paragraph in detail. These texts were debated on the Assembly floor, and as with all negotiated compromises, reflect wording pursued by different members according to their interests and acceptable compromises.

Two important sub-sections are:

> 83 (*c*) In respect of areas where vulnerable marine ecosystems, including seamounts, hydrothermal vents and cold-water corals, are known to occur or are likely to occur based on the best available scientific information, to close such areas to bottom fishing and ensure that such activities do not proceed unless conservation and management measures have been established to prevent significant adverse impacts on vulnerable marine ecosystems;
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> 83 (*d*) To require members of the regional fisheries management organizations or arrangements to require vessels flying their flag to cease bottom fishing activties in areas where, in the course of fishing operations, vulnerable marine ecosystems[2] are encountered, and to report the encounter so that appropriate measures can be adopted in respect of the relevant site.

UNGA 61/105 does not provide a useable definition of a *vulnerable marine ecosystem.* Cryer *et al*. conclude "This leaves RFMOs to develop their own interim definitions of VMEs and their own criteria for detecting encounters with VMEs". Cryer *et al.* note "actions were needed to strengthen the implementation of UNGA Resolution 61/105 and called upon RFMOs to establish and implement **science-based** [our emphasis] protocols, including "*threshold levels and indicator species*", **that would define** evidence of an encounter with a VME.

FAO (2009a), i.e., the Technical Consultation that addressed International Guidelines for the Management of Deep-sea Fisheries in the High Seas, in section 3.2 titled "Vulnerable marine ecosystems", defined 'vulnerability' but in the context of "population, community, or habitat", i.e. not the ecosystem – in paragraphs 14 and 15, but then returns to the term ecosystem – an unwelcome source of potential confusion. This diversification of descriptors is extended in Section 5 to 'areas' and 'species groups'.

4. EVIDENCE TO INFORM A VME ENCOUNTER PROTOCOL

Cry *et al.* note that "the FAO has not, as yet, provided any advice or technical guidance on what constitutes evidence on an encounter with a VME during bottom fishing operations. Participants in deep-sea fisheries in the high seas are therefore currently still in the position of having to determine for themselves, based on best available scientific information, what constitutes evidence of an encounter with a VME,…". As the original FAO guidelines can be ascribed to the FAO Committee of Fisheries

[2] At this point, undefined.

(COFI), presumably it is this FAO body who would update the present advice but this may require another Technical Consultation.

The SPRFMO (2013) Scientific Committee "endorsed" a number of characteristics of move on rules. In this list was the point: "Encounter thresholds indicating evidence of a VME should be based on analyses of historical bycatch data, taking account of the different retention rates of species by each gear type. Multiple species can be used to indicate higher biodiversity" No elaboration was given as to the understanding of ' biodiversity'. No further explanation is provided for this view. What is left unasked is *do threshold values of bycatch of species concluded to, or asserted to, provide evidence of vulnerable marine ecosystems, actually identify vulnerable marine ecosystems* though this is not the purpose of the paper.

Cryer *et al.* (p7) note that a SPRFMO threshold value specified in 2018 was derived from the 2012 – 2017 catch records of New Zealand ' bottom' trawlers fishing in the SPRFMO zone. The top 2% of vessel catches were pooled across all areas. It is unclear if the pooled catch referred to sessile bycatch or retained catch. Cryer *et al.* further note that there was agreement that "*should a move-on rule be implemented as part of the revised CMM for bottom fisheries, the threshold for triggering such a rule should be high. Ideally a move-on response should follow* ***more than one encounter*** [our emphasis] *involving weights of bycatch of benthic fauna that would indicate the models used to predict the distribution of VME taxa are misleading.*

More complex methods were tabled, but there was little chance these methods could be parameterized and were not considered feasible. Thus, a method that was necessarily arbitrary and used descriptive statistics of catch results was used to indicate evidence of the existence of vulnerable marine ecosystems.

Cryer *et al.* (p8) also note that subsequent to a 2018 workshop of the North Pacific Fisheries Commission, a meeting of Australians and New Zealanders concluded that of threshold options considered the most feasible option would be:

"*2. Arbitrary but based on actual historical catch records*
   a. [VME?] *catch records could come from the fisheries for which a threshold is required, or from similar fisheries, and*
   b. *thresholds could be based on medians, percentiles, or other metrics*".

Cryer *et al.* describe a "more pragmatic "data-informed" method based on historical catch records from the fishery" to trigger the bottom trawl 'move-on' rule after concluding that it was not possible to use methods based on VME abundance and trawl catchability. Cryer *et al.* note that the choice of threshold weights should be high and triggered by rare and large catches of VME taxa. "To inform the choice of potential threshold weights," Cryer *et al.* (p14) calculate percentiles ranging from the 80th to the 99.5th taxon-specific percentiles of the VME bycatch indicator taxa and plotted cumulative distributions.

5. COMPLICATIONS FROM CONFOUNDING GEAR TYPES

SIOFA defines "Bottom Fishing"[3] as any type of fishing in which the gear may contact the sea floor. With bentho-pelagic trawling this confounds two different fishing methods. Fishing targeting alfonsino has constituted about 71% of all tows undertaken by Cook Island-flagged vessels. They may use a trawl designed for midwater trawling though they accord with the SIOFA definition of bottom fishing. They usually have little or no benthic bycatch. Trawls targeting orange roughy are designed for sustained bottom contact, but will not be deployed where gear damage or fastenings is expected. This type of fishing results in much greater benthic bycatch.

This complicates the use of a single threshold value for 'bottom fishing'. If the threshold value is based on a percentile chosen for all "bottom tows" – SIOFA definition, inclusion of the large number of zero-bycatch tows when targeting alfonsino will markedly lower the size of any percentile threshold based on all bottom tows combined. A single threshold based on a percentile for all "bottom fishing" will disproportionately affect bentho-pelagic trawling for orange roughy as including the low-benthic bycatches from alfonsino "bottom fishing", i.e. mid-water trawling, will lower thresholds for given percentiles.

FAO (2008b p39), in considering *Scope and Principles* notes that the guidelines are intended to apply to fisheries where "the fishing gear is likely to contact the seafloor during the normal course of fishing operations." "Likely" is not defined but logic indicates that it means a probability greater than 0.5, or 50% of tows. This may not be the case for mid-water trawling targeting alfonsino. FAO (2008b, para 15)) recognize the potential for gear effects and note "the vulnerability of some populations, communities and habitats may vary greatly depending on the type of fishing gear used.

A complication arises depending on the period over which bycatch values are chosen to determine the percentile values. Bycatch will decline as fishing removes benthos. Values from the early phase of the fishery will be high, but this usually when data are scarce or of doubtful reliability. Later, threshold values will be lower and data more reliable. For a stable ecosystem situation and fishing footprint, operators could face a dynamic and downward threshold value.

These considerations emphasize the complications and implicit terminological condundrums that characterize the unavoidable subjective process of choosing a threshold value.

6. A BIODIVERSITY COMPONENT OF AN ENCOUNTER PROTOCOL

Cryer *et al.* believe that "the presence of several VME indicator taxa in a single tow may indicate that the fishing event has encountered an area with a diverse seabed fauna, *potentially constituting evidence* [our emphasis] of a VME" citing Parker (2008) and Penny (2014 so introducing the concept of protection of biodiversity[4] through reference to Parker (2008) and Penny (2012). But, these citations simply note

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[3] 'bottom fishing' means fishing using any gear type ***likely*** to come in contact with the seafloor or benthic organisms during the normal course of operations. General provisions and definitions, p2 - CMM 2020/011 Conservation and Management Measure for the Interim Management of Bottom Fishing in the Agreement Area (Interim Management of Bottom Fishing). *An argument exists that bottom contact by mid-water bentho-pelagic trawls targeting alfonsino is **not likely.***

[4] No elaboration of given on what is understood by biodiversity and it use implies a non-technical sense. The interested reader is referred, as a start, to Cochrane *et al.* 2016.

what Cryer *et al.* repeats, but this does not validate them. No empirical grounds to justify the claim are given.

Parker's (2008) rationale (in Penny 2014) for the incorporation a measure of biodiversity, was: "... the assessment of "Evidence of a VME" should ideally also incorporate other information available from the catch, such as the diversity of taxa encountered ... ". The "Evidence of a VME" form developed uses an additional presence / absence score to capture diversity among broad taxonomic groups by assigning a single point to any listed taxon present in the catch, but below the threshold level. Summing those points provides a weighting factor that slowly increases the total VME score, even where threshold weights are not exceeded." Parker *et al*. (2009) do not provide a clear explanation for the choice of three species to trigger a 'move-on' as a result of an indication of biodiversity.

What is now referred to as the 'biodiversity component' then evolved. It was considered that no taxon could be confidently ranked a 2 as this level of resolution could not be justified using the FAO (2009b) criteria for VME taxa. This reduced the taxonomic importance options to either High=3 for the already designated taxa and Low=1 for all other taxa chosen as indicator taxa. The 50% cumulative weight frequency values for the secondary taxa were typically less than 1 kg and weight thresholds at such low values could not be rapidly and reliably determined at sea, thus the presence of these lower importance species be used rather than attempting to determine weights of less than 1 kg on board. The total score constituting evidence of a VME and triggering a move on was retained at three (based on the initial decision to trigger a 'move on' if the weight of the primary species exceeds the score of three). Thus, three taxa would trigger a 'move-on'.

7. CRYER *ET AL.*'S RECOMMENDATIONS

Cry *et al*. conclude with a number of recommendations. These provide a point-form distillation of the many interrelated factors involved, which are reviewed on that basis.

	Recommendation	Comment
1	that a pragmatic, data-informed approach has been used to develop thresholds to support a proposed move-on rule for bottom trawls that can work as a "back stop" together with spatial management areas to prevent SAIs on VMEs;	Threshold values '*based on medians, percentiles, or other metrics'* are pragmatic if a decision is required for administrative purposes. It does not guarantee the protection of benthic communities, populations or habitats. Indeed, the most sensitive, and thus vulnerable, benthic ecosystems could well be those with relatively low densities of animals that generate low bycatch values . Being "data-informed" does not validate the decision.
2	insufficient data on VME distribution and density and on trawl catchability exist to apply more sophisticated methods	The SPRFMO situation relies on possibly the most comprehensive set of existing benthic trawl bycatch data, in terms of the number of observations, temporal extent and taxonomic resolution. This is in complete contrast to the SIO bentho-pelagic fishery.
3	insufficient data from bottom longline fisheries exists to develop a data-informed move-on rule for that method	This would appear to also be the case for the bentho-pelagic fishery in the SIO.

4	that it is proposed that a move-on rule for bottom trawl would include two thresholds, exceeding either of which would require the vessel to move away from the location: ○ a catch of any one of the six most commonly-caught VME taxa over a taxon-specific threshold weight (based on the 99th percentile of the distribution of historical positive catch weights); OR ○ a catch of three or more VME taxa over a taxon-specific qualifying weight (based on the 80th percentile of the distribution of historical positive catch weights);	The taxonomic detail in the SIOFA benthic bycatch record for the bentho-pelagic trawl fishery is insufficient to inform decisions on an appropriate two-level threshold decision process. While specification of 99th and 80th percentiles may be pragmatic/data informed, Parker *et al*. (2009) and Penny (2014) note that making such decisions is not for scientific workers, **but for management** because measures based on catch metrics **do not provide a scientific basis for decisions on what threshold levels will protect benthic populations, communities and habitats.** These decision involve consideration of precaution, which in turn requires the decision makers specify their attitude to risk and that a risk function is exists. Such a risk function would be informed by knowledge of the relative amount of habitat that is affected by bentho-pelagic trawling.
5	Agree that the scientific methods used to develop thresholds for the proposed move-on rule for bottom trawl to work as a “back stop” together with spatial management areas to prevent SAIs on VMEs are appropriate;	Cryer *et al.* agree as to their treatment of this topic but the methods are only ‘scientific’ in the sense that they are systematic and methodical. No scientific inference is involved. SIODFA strongly endorses the recommendation to develop spatial management and have been proactive in this view since 2006.
6	benthic bycatch data and all move-on events should be reviewed annually by SC	This happens in the SIOFA SC (see Table 4, *Weight of benthic bycatch reported, 2019*, Section 5.1. Benthos organisms bycatch summary.
7	models underpinning spatial management approaches should be reviewed periodically (perhaps every 5 years) or when evidence suggests those models are misleading, and to include these in suggested SC workplans for consideration by the Commission.	No such models have been proposed as applicable for the SIO. If proposed they should be subject to appropriate prior peer review.

8. SUMMARY — DISCUSSION

SIODFA members strongly endorse the need to protect sessile benthos in the SIOFA area. Indeed, this was recognized through their proposal to implement 10 Benthic Protected Areas raised in discussions at the start of their business in February 2006. As further information became available, two additional sea floor features – Banana and MOW - were proposed for a total of 12 areas. These remain closed to fishing as a requirement of membership in SIODFA and their protection is required by the fishing permits of two of the SIODFA members’ vessels and are voluntarily recognized by the other member. From SIODFA’s start our view was that the most effective method of protecting sessile benthos, was a spatial management principle cognizant of the objectives/requirements of UNGA resolution A61/105.

The SIODFA bentho-pelagic trawl fishery has now a 23-year history. Three of the four existing vessels in the current fishery have prosecuted this fishery from before 2000. All skippers who have been asked expressed the view that the exploration of potential sites in the SIO for bentho-pelagic trawling was complete: none believed that new fishing grounds would be found. Trawlers typically fish up to 50 features in a year and possibly 75 over a five-year period. SIODFA data records list over 350 named features that have been explored for possible viable commercial fishing operations.

Current fishing operations, almost without exception, are undertaken on carefully mapped tow lanes. In some cases a sea floor feature has only one tow lane, where fishing is possible. To deviate from these is to risk gear damage and possible trawl loss. The exact locations of the tow lanes are proprietary information. This method of fishing has direct implications to the concept of what is a *significant adverse impact*. This concept has received much attention at various management levels. FAO (2009b, para. 19) notes that to avoid significant adverse impacts the benthos should recover within 5 – 10 years. As many benthic animals grow slowly over a period of hundreds of years, such a concept is evidently misconceived. Our view is that the most desirable trawl fishery from the perspective of protecting sessile benthos is one that has a stable footprint in terms of potential bottom impact and which is relatively small compared with the area over which benthic communities, populations and habitats, etc. are expected to occur[5].

SIODFA already restricts the area of its fishing operations: they are more restricted than those required by SIOFA CMMs (nine of the benthic protected areas observed by SIODFA vessels were rejected by the SC as appropriate for conservation; one then became the area of a new fishery. However, SIODFA agrees that fishing should must cease in an area if bycatch indicates that substantial sessile benthos exists. . However, a single record of bycatch will not inform scientists as to whether this was the result of the unusual, though fully possible, result of the stochastic processes resulting in the observed bycatch (a coin that returns one head in 10 tosses may still be fair) or whether benthos density is in fact greater than was expected. From a scientific perspective, the requirement is clear – seize the opportunity to collect more information – it is unlikely there will be a follow up by a scientific research vessel! This principle was recognized in the earlier Cook Islands benthic bycatch move-on protocol where following a threshold catch of benthos, fishing could continue but with 50% reduction in bycatch 'move-on' threshold value. scientifically important is the acquisition of a second sample in terms of validating the benthic catch observation that SIODA believes a compelling case can be made for insisting that there is a second tow following an threshold event, even if the skipper prefers to go elsewhere. And, the reduction in the threshold for a move-one requirement for the repeat tow could be yet more severe than 50%.

9. CONCLUSIONS AND RECOMMENDATIONS

- Trawl bottom-rope contact will impact sessile benthos if it is present.
- Current bentho-pelagic fishing is along well-defined tow lanes: on rare occasions currents may displace the trawl from the intended tow path.
- A sustainable fishery can have a fixed benthic fishing footprint. There would be little or no recovery of benthos on such well-defined tow lanes.
- The areal distribution of benthos is expected to follow a multi- cluster process, i.e., clusters of clusters of species specific conditioned by the bottom features and currents.

[5] The interested reader is referred to p25, Section 4.2, Fished Area 4.2.1 Spatial Extent Processing (MMR 2017). — http://apsoi.org/sites/default/files/documents/meetings/SC-03-06.2%2804%29%20BFIA%20-%20Cook%20Islands.pdf

- The sessile bycatch would follow a stochastic process depending on the nature of the specific sea floor feature, the distribution of benthos, the trajectory of the foot rope's contact with the sea floor and the skipper's skill and fishing tactics.
- Thus, for a given benthos density, the benthic bycatch would vary along a cumulative distribution process
- Benthic thresholds at which a move-on is required can be based on descriptive distribution statistics but these values have no scientific relation to the nature of the feature, population, community, habitat, skipper's skill and fishing practices: it is a 'management', not a 'scientific' decision depending on attitudes to precaution and thus risk.
- Repeated towing in an area may result in many sub-threshold values until finally a threshold value is encountered — in the manner of Russian roulette.
- Confounding gear types with different benthic impacts when specifying a threshold (assuming the data exist) will penalize one gear sector relative to another. To avoid this the results from the higher impact gear should cover the lower impact gear.
- SIODFA strongly endorses that spatial management be used to affect conservation of benthic populations, communities and habitats and that they be urgently undertaken through an appropriate working group(s).
- SIODFA notes earlier, partially successful, efforts to close areas to fishing. This issue should be revisited.
- Because setting thresholds values is necessarily subjective, it should be done in a manner consistent with the various objectives of the UNGA resolution 61/105.

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