11th MEETING OF THE SCIENTIFIC COMMITTEE

11 to 16 September 2023, Panama City, Panama

SC11 – Obs02
Technical Response to AUS/NZL BFIA Public Consultation

High Seas Fisheries Group

TO: The SPRFMO Commission

11th August 2023

Summary Paper two:

HIGH SEAS FISHERIES GROUP SCIENCE COMMENT: PROCEDURAL AND SCIENTIFIC CONCERNS REGARDING DOCUMENT SC11-DW01: 'Cumulative Bottom Fishery Impact Assessment for Australian and New Zealand Bottom Fisheries in the SPRFMO Convention Area, 2023'

HSFG has registered its protest to Fisheries New Zealand, and in the interests of transparency is notifying the SPRFMO Scientific Committee, that in our view the science underpinning the 2023 re-presentation of the BFIA did not undergo the usual rigorous process of collaborative development and review which we have come to expect from New Zealand contributions to international forums.

We are concerned that the impact assessment has not been updated, noting that only the Relative Benthic Status (RBS) outputs meet the definition of an impact assessment under the Bottom Fisheries Impact Assessment Standard, and the RBS outputs presented this year originate from the 2020 BFIA (albeit provided this time in numerical rather than graphical form). It cannot be correctly asserted that the 'percent protected' analyses included in the BFIA document are an impact assessment. These figures do not represent impact; instead the 'percent protected' analysis is an assessment of a *policy response* intended to *manage* impact. This analysis does not meet the clear requirements of the BFIAS, or CMM03, or the FAO, or the UNGA resolution.

We identify that because they have not been updated, the impact and status estimates in the BFIA systematically over-estimate impact and under-estimate VME status, because every fishing effort scenario significantly over-estimates current fishing effort levels.

We note that even neglecting to consider these biases, VME status is high for every VME taxon in every SPRFMO bottom fishing FMA. In six of nine FMAs, the status of every VME taxon is higher than 95%. Only a single taxon in a single FMA (hydrocorals in the Lord Howe Rise) has an RBS value lower than 0.8. It appears that in every FMA and for every taxon, bottom fishing impacts are not high enough to constitute 'Significant Adverse Impact' under any existing international precedent.

We compare the outputs of the risk assessment at the FMA scale with the proposal for new spatial fishery restrictions to achieve '70% protection', and conclude that there is no discernible relationship between bottom fishing impacts and the proposed management response. In FMAs where the most dramatic (and costly) spatial fishery closures are proposed, fishery impacts are very low to negligible; in FMAs where impacts are higher (but still low compared to international precedent) the proposed spatial closures are much more modest.

We note that there is apparently no precedent from other international forums for the application of the '70% protected' threshold as a target to manage impacts on VMEs.

We raise technical concerns with the habitat suitability index (HSI) models currently used as inputs to the BFIA and to evaluate the performance of spatial management measures, noting that the accuracy of model predictions in the SPRFMO Area has never been tested, and new evidence from the New Zealand SPACWG suggests that the HSI models may not be useful as indices of VME abundance.

Finally we identify other potential indicators of analytical errors in the BFIA, which were not addressed prior to submission. We suggest to the SC that there are significant procedural and scientific errors that have given rise to the analyses and proposals presented by NZ and Australia to SC11. The HSFG strongly recommends that SC consider a 'reset' to rectify these errors and re-establish a sound scientific basis for decision making, before further changes are considered to CMM03.

Chair HSFG

Andy Smith

High Seas Fisheries Group Incorporated

TO: The SPRFMO Commission

11th August 2023

HIGH SEAS FISHERIES GROUP SCIENCE COMMENT: PROCEDURAL AND SCIENTIFIC CONCERNS REGARDING DOCUMENT SC11-DW01: 'Cumulative Bottom Fishery Impact Assessment for Australian and New Zealand Bottom Fisheries in the SPRFMO Convention Area, 2023'

Summary

In this paper we respond to the re-presentation of the Bottom Fishery Impact Assessment (BFIA) in paper SC11-DW01 and the proposal for new Bottom Trawl Management Areas (BTMAs) in SC11-DW-AA, registering our procedural concerns as well as providing detailed technical and editorial comment. We conclude that proper procedures have not been followed, and that the proposal for new spatial fishery restrictions cannot possibly be justified with reference to the need to 'prevent serious adverse impacts' on VMEs.

We also provide technical comment regarding the science underpinning much of the implementation and evaluation of bottom fishery management measures under CMM03. Citing new analyses arising from the New Zealand South Pacific Working Group (SPACWG) we raise concerns that VME spatial habitat models upon which CMM03 now relies have never been properly validated, and may not withstand critical scrutiny. We also present evidence reinforcing our previous contention that the 'encounter protocol' (move on rule) portion of CMM03 is likely to be having the perverse outcome of increasing rather than decreasing impacts on VME taxa.

Bottom Fisheries Impact Assessment

1. **We have procedural concerns regarding the lack of opportunity for scientific oversight and technical review of the BFIA, prior to submission by New Zealand**

HSFG has registered its protest to Fisheries New Zealand, and in the interests of transparency is notifying the SPRFMO Scientific Committee, that in our view the science underpinning the 2023 re-presentation of the BFIA did not undergo the usual rigorous process of collaborative development and review which we have come to expect from New Zealand contributions to international forums.

Normally, all of the science informing New Zealand's contributions to SPRFMO are developed and reviewed via the New Zealand South Pacific Working Group (SPACWG), a science working group where officials, government scientists, independent scientists, and stakeholder representatives including from NGOs and from industry work together to design, direct, and iteratively review every science output.

In the normal course, every project will be presented and discussed 3-5 times before it is finalised and submitted. It is this practice, whereby data, methods and assumptions are scrutinised and approved while the work is still in progress, that is responsible for the usual high quality of New Zealand's science submissions. HSFG is always proud to be a constructive member of the SPACWG regardless of the outcome of individual decisions, because the New Zealand science working group process is a good one.

Unfortunately the usual SPACWG process was not followed in the re-preparation of the BFIA. Despite initial assurances to the contrary, this year SPACWG members were only informed on 25 May 2023 that:

i) The impact assessment itself would not be updated; and
ii) The accompanying 'percent protected' analyses and other information in the re-submitted BFIA document would not be presented to the SPACWG. Instead, SPACWG members were provided with a 'complete' draft submission on 28 June and given nine days to provide written feedback, after which New Zealand officials had less than a week to finalise the document.

HSFG provided detailed comments, and we are grateful that NZ officials took them seriously and even made considerable changes. Nonetheless, providing editorial comment on a science document cannot compare with providing technical input to, and oversight of, the application of scientific methods, (noting also that our comments went only to government officials, not the scientists delivering the analyses, which by that time were already finalised and could not be changed).

Regardless of how the analyses are described in the new document, it remains true that the actual BFIA analysis has not been updated (see below), and the update of the document describing it did not undergo the usual rigorous review process that we have come to expect in New Zealand science working groups. It is now incumbent then on the SPRFMO SC to provide that review, and/or to acknowledge the limitations of the BFIA as it presently stands.

We submit that in its current form the document is not suitable to inform the design of updated spatial management boundaries in SPRFMO. In section 2 below we present that the impact assessment has not been updated, and in section 10 below we identify evidence of likely coding or conceptual errors in the 'percent protected' analyses and accompanying sensitivities, which were then used to inform the evaluation of new BTMAs in paper SC11-DW-AA.

We suggest that these issues would have been detected and resolved prior to submission if this work had gone through the normal SPACWG review process in New Zealand.

The SC should recommend that the BFIA analysis be fully updated and re-presented to the SC next year before it is used to inform management.

2. The impact assessment in the BFIA has not been updated

As highlighted in our other SC11 submission (SC11-Obs-AA), we are concerned that the impact assessment has not been updated, noting that only the RBS outputs meet the definition of an impact assessment under the BFIAS (SC7-DW19), and the RBS outputs shown this year in SC11-DW01 tables 30-38 originate from the 2020 BFIA (albeit provided this time in numerical rather than graphical form; these outputs were formerly depicted in SC8-DW07-Rev1 Figures A6.1-A6.9).

It cannot be correctly asserted that the 'percent protected' analyses in SC11-DW01 Tables 42 and 43 are an impact assessment. These figures do not represent impact. The title of SC11-DW01 specifies that the impact assessment is 'cumulative' but there is nothing cumulative about the outputs in Tables 42 and 43: if historical fishing effort were 100x higher than it has been, the figures in these tables would not change; if future fishing effort were reduced to zero, the figures in these tables would not change.

The 'percent protected' analysis is an assessment of a <u>policy response</u> intended to <u>manage</u> impact; it is not an impact assessment. Some SC members may wish to argue that the two are interchangeable, because if the policy response is controlled then the actual impacts become irrelevant. Members are welcome to hold that view, but this position is not consistent with the clear requirements of the BFIAS, or CMM03, or the FAO, or the UNGA resolution (see SC11-Obs-AA).

The BFIAS states clearly (p 19): *"Participants are required to update bottom fishery impact assessments (including cumulative bottom fishery impact assessments) at least every five years, <u>and whenever a substantial change in the fishery occurs or is proposed, such that it is likely that the risk or impact of the fishery may change</u>."… and* continues (p 20): *The onus for updating bottom fishing impact assessments (including cumulative assessments) will be on the Member or Cooperating Non-Contracting Party whose fishing (or proposed fishing) has resulted or will result in a substantial change.* Noting that the orange roughy TAC reductions already constitute a 'substantial change' to the fishery, and that SC11-DW-AA ('Modification of Bottom Trawl Management Area Boundaries') proposes still further changes intended for consideration by Commission 12, it appears that New Zealand has not met its clear responsibility under the BFIAS and CMM03. CMM03 is clear that the impact assessment is an essential requirement of evaluating measures to manage bottom fishing impacts, and should be updated before new measures are proposed [emphasis added]

> *FURTHER NOTING UNGA Resolutions 71/123 and 72/72 which call upon RFMOs to use the full set of criteria in the FAO Deep-sea Fisheries Guidelines to identify where VMEs occur or are likely to occur as well as for assessing significant adverse impacts,* ***to ensure that impact assessments, including for cumulative impacts of activities covered by the assessment, are conducted consistent with the FAO Deep-sea Fisheries Guidelines, are reviewed periodically and are revised whenever a substantial change in the fishery has occurred or there is relevant new information****, and that, where such impact assessments have not been undertaken, they are carried*

out as a priority before authorising bottom fishing activities, and to ensure that CMMs are based on and updated on the basis of the best available scientific information…

And…

Each Member or CNCP proposing to participate in bottom fishing activities shall submit to the Scientific Committee a proposed assessment that meets the SPRFMO Bottom Fishery Impact Assessment Standard (SPRFMO BFIAS[1]) with the best available data ***including consideration of cumulative impacts****, not less than 60 days prior to the annual meeting of the Scientific Committee.*

On this procedural basis alone the SC should require that the RBS analysis is updated and reviewed by SC12 before any new changes to CMM03 are considered.

In the interim period, we are concerned that given the length and density of the BFIA document, a new or uninformed reader may not appreciate that the impact estimates it contains are both outdated and biased, such that RBS outputs could be quoted or used out of context if this is not identified clearly alongside the numerical outputs.

For clarity, we propose that a Rev1 of this document be submitted that includes the following text in the captions of Tables 30-38. *"Note that these RBS outputs are extracted from the 2020 BFIA (SC8-DW07_rev1). Estimates of 'current' fishing effort patterns do not include reduced effort in 2020-2022, and projections of 'future' effort assume increased TACs, instead of TAC reductions actually adopted in 2023".*

3. It is conceptually inappropriate, and potentially confusing, that the impact assessment also includes with it numerous references to a proposed risk management response that has not yet been adopted.

Impact assessment is distinct from risk management. Impact assessment describes the state of the world (*e.g.* the % intact status of a VME taxon, including likely future status) whereas risk management describes a policy response to affect the state of the world. *I.e.* impact assessment can be seen as strictly 'factual' whereas risk management responds to those facts but requires embedded value judgments *(e.g*. how high does the intact status of a VME taxon need to be, to be 'good enough'? What is our tolerance for uncertainty?). We may take guidance about the value judgments from international best practice, (e.g. the FAO definition of a 'serious adverse impact') but in SPRFMO this definition has not yet been operationalised by defining a quantitative maximum acceptable impact threshold.

[1] As approved by the seventh session of the Scientific Committee 2019, available at: https://www.sprfmo.int/assets/Fisheries/Science/SPRFMO-Bottom-Fishery-Impact-Assessment-Standard-2019.pdf

Put differently, impact assessment is independent from, and must precede, risk management

Professional best practice is to keep impact assessment separate from subsequent risk management. The same impact assessment can be used to inform a multitude of risk management responses, because different resource users will make different value judgments, and there are different ways of achieving even the same risk reduction outcome. The BFIA should be a stand-alone description of the state of VME taxa in the SPRFMO area at the time of its publication, regardless of what future management measures are proposed or adopted.

By embedding a proposed policy response in the impact assessment document (references to the revised BTMA boundaries to achieve a '70% protected' threshold for each taxa, as proposed by New Zealand and Australia in SC11-DW-AA), the authors of this document conflate and confuse the distinction between impact assessment and risk management, and set the stage for further confusion. A statement that the SC 'endorses the impact assessment' (based on evaluation of its methods and execution) could later be interpreted as an endorsement of the particular risk management response. Yet in section 5 below we demonstrate that there is almost no correlation between the outputs of the BFIA and the proposed risk management response in SC11-DW-AA.

For these reasons we feel strongly that references to the proposed revised BTMAs (e.g. in Tables E.5 – E.8 and F, and Table 43) do not belong in the BFIA; in the rev1 of this document these references should be removed, and these analyses should instead be included in the supporting material accompanying the proposal in SC11-DW-AA.

4. Structural changes to the orange roughy fishery since 2019 mean that the impact assessment results in the re-presented BFIA are not only out of date, they are directionally biased

Outputs of the RBS method do not reflect current VME taxa status, they represent equilibrium status under a defined fishing effort regime carried out indefinitely; it is not possible to generate RBS outputs without specifying the intensity and spatial distribution of future fishing effort. The 2020 BFIA defined the following future effort scenarios:

- 'historical' fishing effort was based on the full history of the fishery,
- 'current' effort was based on effort in the ten year period 2010-2019;
- 'future' effort assumed increased effort relative to the period 2010-2019; in all FMAs except the South Tasman Rise, based on the extent to which catches in 2010-2019 had 'under-caught' the TAC or estimated sustainable yield. The effect was to increase projected fishing effort levels by roughly a factor of 2 for the 'slope' FMAs in the Tasman Sea, and by a factor of 3 in the Louisville Ridge FMAs (see Table 29 in SC8-DW7-01).

None of these three scenarios approximate the reality of current or likely future fishing effort levels and patterns.

Changes in actual catches (proxy for effort) over time are shown in Table 1 (reprinted from SC11-DW01). Since 2018, fishing effort levels have declined steadily. Using the 2010-2019 period to represent 'current' fishing effort is now grossly misleading (i.e. the outputs labelled 'current' in the re-presented BFIA will overestimate impact and underestimate equilibrium VME status).

Table 1: Total estimated catches (tonnes) of orange roughy from the main areas fished by New Zealand bottom trawl vessels fishing in the SPRFMO Convention Area by calendar year from 2009. Landings from the Westpac Bank area (part of the Challenger Plateau) are also reported against New Zealand's domestic ORH7A area catch limit. Catches from Westpac Bank between 2007 and 2010 were largely from research surveys. –, less than 1 tonne.

Year	Challenger Plateau	Westpac Bank	West Norfolk Ridge	Lord Howe Rise	Louisville Ridge	Other Areas	All Areas
2009	238	23	233	403	–	31	928
2010	415	5	79	385	584	6	1 474
2011	675	5	113	1	285	–	1 079
2012	247	8	49	121	288	8	721
2013	230	3	19	344	565	3	1 164
2014	57	54	0	79	754	54	998
2015	530	118	20	157	462	–	1 287
2016	486	234	0	208	27	–	954
2017	307	129	22	215	420	–	1 093
2018	399	569	5	180	81	–	1 232
2019	171	111	0	38	139	–	460
2020	76	88	3	2	133	–	301
2021	0	20	0	0	0	–	20
2022	0	0	0	0	0	–	0

Table 2: Orange roughy catch limits in tonnes (for both New Zealand and Australia combined)

	North Louisville	Central Louisville	South Louisville	North-West Challenger	Lord Howe Rise	West Norfolk Ridge	Westpac bank
2019*	1 140			346			200
2020	1 140			346			258
2021-2022**	1 140			396	261	54	258
2023***	116	305	160	160	174	44	258

*2006-2018 Total bottom fishing catch for each member/CNCP was limited to average annual bottom fishing catch of that member/CNCP in the convention area between 2002-2006
** Tasman Sea stock was split into North-West Challenger, Lord Howe Rise and West Norfolk Ridge in 2021
*** Louisville stock was split into North, Central and South Louisville in 2023

Further, and of more egregious concern, the outputs labelled 'future' in the re-presented BFIA assumed future effort levels 2-3x higher than the outputs labelled 'current', but in reality the orange roughy TACs were substantially reduced in 2023 (by roughly a factor two, but not spread evenly between FMAs; see Table 2). Under these restrictions future effort will likely be lower than in the previous period (to the extent that SPRFMO is now actively exploring options to accumulate TACs over multiple years because single-year TACs are so low as to make fishing uneconomical, even when caught by only one or two vessels.)

Thus, based on this rudimentary analysis (not broken down by FMAs, and neglecting fine-scale fishing effort patterns) it is clear that all of the RBS estimates from the 2020 BFIA (re-presented but not updated in the 2023 BFIA document) will consistently over-estimate impact and under-estimate VME status. Intuitively it appears that the outputs labelled 'current' will overestimate impact by a factor of roughly 2-3, and outputs labelled 'future' will overestimate impact by a factor of roughly 4-6.

It is of deep concern that we are forced to speculate now badly biased these outputs might be by piecing together clues scattered across four years of Scientific Committee documents and judging the effects intuitively. Evidence-based decision-making demands instead that all of these changing factors be combined empirically, by updating the impact assessment analysis using new approximations of current and future fishing effort. This is precisely what is required by the BFIAS (SC7-DW19 p. 19) and the requirements of CMM03-2023 (paragraphs 21-24).

We suggest that it is actively misleading to select only the most highly biased fishing effort projection ('future') for inclusion in the current BFIA document. The document should be revised, replacing all 'future' RBS projections with 'current' and then clearly flagging that even the 'current' projections will overestimate effort (hence impact) by a factor of roughly 2-3.

5. **Assembling the available information and applying the impact assessment framework fairly, there are almost no SPRFMO FMAs in which impact levels could ever be high enough to constitute 'SAI', regardless of what precedent is cited. The revised BTMAs proposed by New Zealand and Australia in SC11-DW11 cannot be justified with reference to the impact assessment.**

In Table 3 we assemble the following information:

- Best estimates of Relative Benthic Status (RBS) for each VME taxon (from SC11-DW01 tables 30-38). The numbers extracted are the 'median' impact estimates based on 'current' (i.e. 2010-2019) fishing effort levels within currently mandated BTMAs.
- Orange rough TAC changes, showing the TAC's adopted at Commission12 (2023) as a proportion of the TACs in the previous year
- Fishery cost estimates (from SC9_DW06-rev1), expressed in terms of foregone historical fishery value if the '70% protected' BTMA scenarios from SC11-DW-AA were adopted.

As above, even these estimates labelled 'current' will be negatively biased, i.e. they over-estimate impact and underestimate RBS. The magnitude of this effect will vary in each FMA roughly proportional to the percent reduction in TAC relative to recent fishing effort, shown in the top row of the table.

The colour scheme for this table is carried over from SC11-DW01, noting that even the orange and yellow highlighted cells are at intact status levels higher than any existing precedent for what may constitute a 'significant adverse impact'.

Even a cursory examination of Table 3 reveals that there is no discernible relationship between bottom fishing impacts and the proposed management response.

- The FMAs where the most dramatic (and costly) fishery closures are proposed, i.e. Louisville Ridge, have the lowest fishery impacts: every single RBS estimate is above 97%, and the vast majority of them are at 99-100%.
- In FMAs where there are VME taxa with the lowest status, the proposed spatial fisheries reduction is nonetheless much more modest.
- Only a single taxon in a single FMA (hydrocorals in the Lord Howe Rise) has an RBS value lower than 0.8 (the threshold chosen by the Marine Stewardship Council); and only for one of the two sensitivities. (note also that the RBS from the original base case HSI for this taxon was much higher, but these outputs have been omitted from the re-presented BFIA).

Clearly the proposed spatial fishery reductions in SC11-DW-AA are NOT motivated by a desire to manage bottom fishing impacts consistent with the BFIA or the requirements of the FAO or the UNGA resolution, i.e. to 'prevent significant adverse impact'. We are interested to consider whether there may be some other rationale that supports the proposed closures.

Furthermore, we respectfully submit that there can be no claim to urgency to avert damage to the benthic environment. The RBS estimates in Table 3 are of equilibrium status, i.e. the intact status of these VME taxa if fishing continues indefinitely. There can be no pretence that SPRFMO is somehow obligated to act quickly to resolve an urgent management problem; instead SPRFMO should slow down, take stock of where the previous advice went astray, and undertake the science necessary to update the BFIA based using model inputs that have been properly validated in the SPRFMO area (see below).

Table 3. *Relative Benthic Status (RBS) from the 2020 BFIA analysis (SC8-DW07_rev1; and extracted from SC11-DW01 Tables 30-38) for ten VME taxa. Note that estimates arising from the base case I models are missing. The extracted figures are the 'median' impact estimates from 'current' fishing effort scenario (i.e. 2010-2019 fishing effort levels within BTMAS mandated under CMM03-2020). Also shown (top row) are estimates of the extent to which these RBS figures will be biased low (i.e. over-estimating impact, under-estimating status) due to fishing effort reductions since the 2010-2019 period (TAC reductions in 2023 relative to previous year). Also shown are estimates of cost to fisheries (% value lost) associated with adoption of the '70% protected' scenario (extracted from COMM10-Info03).*

TAC change	**-29%**		**-33%**				**-60%**		**none**		**none**		**-49%**					
	West Norfolk		**North Lord Howe**		**Central Lord Howe**		**Northwest Challenger**		**Westpac Bank**		**South Tasman Rise**		**North Louisville**		**Central Louisville**		**South Louisvile**	
VME Indicator Taxa habitat	**ROC-linear**	**Power mean**	**ROC-linear**	**ROC-linear**	**ROC-linear**	**Power mean**	**ROC-linear**	**Power mean**	**ROC-linear**	**Power mean**	**ROC-linear**	**Power mean**	**ROC-linear**	**Power mean**	**ROC-linear**	**Power mean**	**ROC-linear**	**Power mean**
Sponges (*Porifera Demospongiae)*	**1.00**	**1.00**	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	1.00	1.00	1.00
Sponges (*Porifera Hexactinellida)*	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Stony corals (*Enallopsammia rostrata)*	0.99	0.99	1.00	1.00	0.99	0.99	**0.91**	**0.93**	0.99	1.00	1.00	1.00	NaN	1.00	1.00	0.99	NaN	0.99
Stony corals (*Goniocorella 10culat)*	0.97	1.00	0.95	1.00	0.99	0.99	0.99	0.97	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.98	0.99	1.00
Stony corals (*Madrepora 10culate)*	**1.00**	**1.00**	1.00	1.00	0.98	0.99	0.94	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Stony corals (*Solenosmilia variabilis)*	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.99	0.97	1.00	0.99
Black corals (*Antipatharia)*	1.00	1.00	1.00	1.00	0.99	0.99	0.95	0.96	0.99	0.99	1.00	1.00	1.00	1.00	0.99	0.99	1.00	1.00
Gorgonians *(Gorgonian Alcyonacea*)	1.00	0.99	1.00	1.00	0.99	0.98	0.98	0.98	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sea pens (*Pennatulacea)*	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hydrocorals *(Stylasteridae)*	1.00	1.00	0.89	0.99	0.62	0.82	1.00	1.00	0.97	0.99	1.00	1.00	1.00	1.00	0.99	0.99	1.00	1.00
Fishery cost: Loss of value (%) under 70% protection scenario	**21.12**		**19.8**		**21.39**		**32.18**		**1.28**		**1.74**		**41.7**		**88.36**		**83.38**	

6. **The papers cited as a precedent for the choice of 70% for a 'minimum protected threshold' in the 'percent protected' analysis is incorrectly applied; there is no such precedent.**

The first submission of revised spatial management boundaries to SPRFMO which abandoned the impact assessment in favour of the 'percent protected' approach was SC9-DW06_rev1, "Development of Spatial Management Scenarios for Bottom Trawling". This submission cites a Canadian Department of Fisheries and Oceans document (DFO 2017) as a potential precedent for the choice of a 70% protection target for each VME taxon.

The DFO (2017) describes 'Sensitive Benthic Areas' (SBAs) as equivalent to VMEs, and defines a policy goal that *"100% of SBAs should be protected"*, but *"as an interim precautionary measure, where 100% of the area cannot be protected, protection of 70% of each SBA total extent in the NS bioregion would be expected to maintain ecosystem functionality".* However, elsewhere the document states *"SBAs do not correspond to the entire distribution of the defining taxa, they represent regional habitats that contain SBA taxa as a dominant and defining feature. The individual delineated habitats (or "polygons") in an SBA will be referred to SBA units herein" (p 5).*

It is not clear in the DFO publication what abundance threshold is required to determine that a particular location has SBA taxa *"as a dominant and defining feature",* but the method description and a visual examination of the mapped SBA units (Figure 1 below), of which the Canadian government then seeks to protect 70%, reveals that SBAs constitute a minority portion of the seascape (perhaps 5%), concentrated on identifiable bathymetric features where it is ecologically foreseeable that VME taxa would be concentrated (e.g. on continental shelf breaks or the edges of submarine canyons).

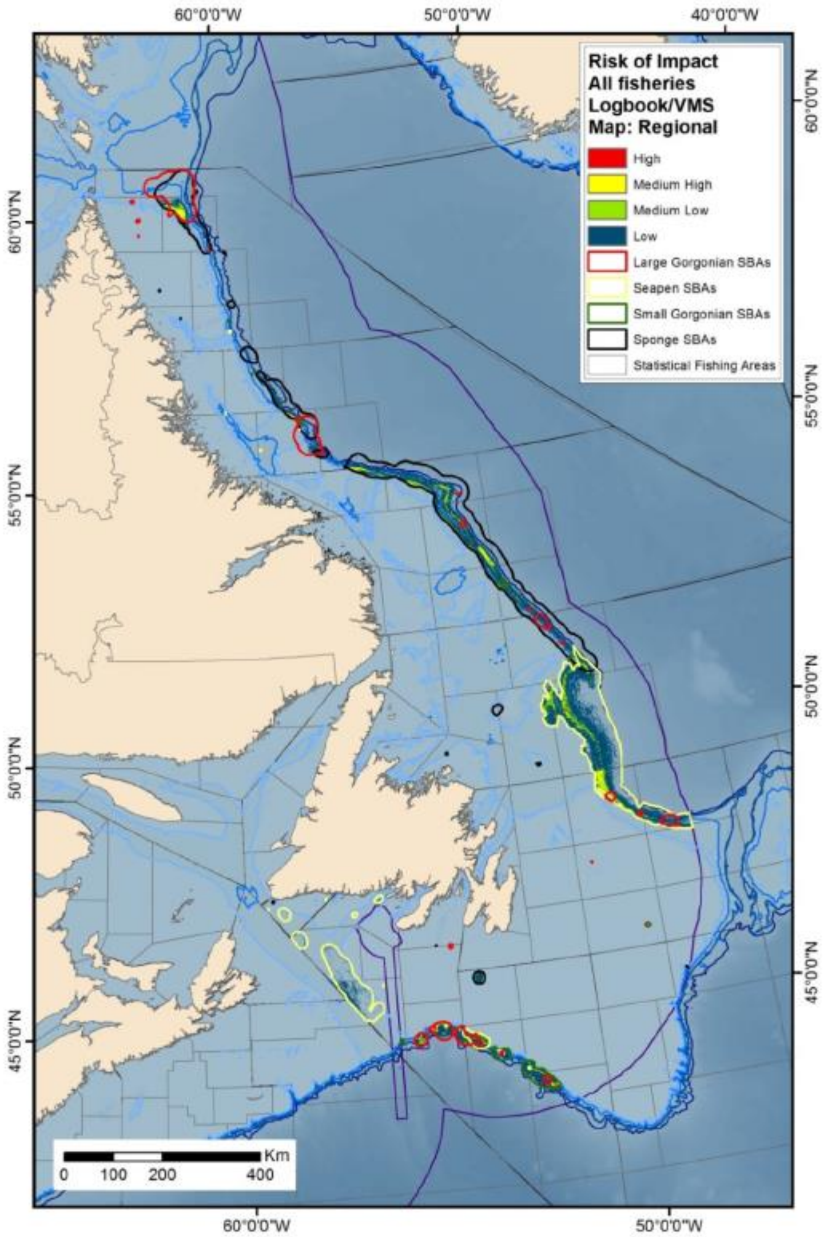

Figure 1. Map of SBA (Sensitive Benthic Areas, comparable to VMEs) used in protected area design by the Canadian Department of Fisheries and Oceans (DFO) off the coast of Newfoundland (DFO 2017). Designated SBAs are delineated by colour-coded polygons, and subsequently used to guide fisheries closed areas, to achieve a 70% protection target.

It is clear that the authors of SC9-DW06_rev1 misinterpreted the use of 70% threshold in DFO (2017) because applying the 70% threshold '*to the entire distribution of the defining taxa'* is precisely what that they did do in that analysis (and in every subsequent application of the 'percent protection' approach in SPRFMO, now including the proposed revised BTMAS in SC11-DW-AA). Compare Figure 1 above with any of the maps in Figures 37-54 of SC11-DW01: the former provides clear guidance for spatial management design, the latter merely reminds us that most benthic taxa can occur in most marine locations. Unless SPRFMO decides on a functional and operational definition of a VME (e.g. the 95th percentile of abundance for vulnerable taxa), there is no useful precedent to be cited from DFO (2017), and reference to that document to justify the choice of a 70% threshold is not legitimate.

Elsewhere, the authors of SC9-DW06_rev1 refer to the MSC (2014) precedent for an 80% protection threshold, but the MSC guidelines very clearly refer to 80% as a threshold for intact status (i.e. arising from the impact assessment), not as a threshold for 'enclosure within areas closed to fishing'. Interestingly, the MSC guidance also includes a temporal component: status is expected to be capable of recovering to 80% within 20 years of the cessation of fisheries disturbance. Effectively this creates a minimum RBS threshold that approaches 80% for very slow growing benthic taxa, and a lower threshold for faster growing taxa, as we suggest in section 6.3 of the other HSFG submission to this meeting (SC11-Obs-AA).

Neither the DFO (2017) nor the MSC approach can provide precedent for the '70% protected threshold' used by the proponents of the new BTMA's in SPRFMO, because those approaches apply different methods. Examination of the actual DFO and MSC documents reveals that those approaches give rise to protected area networks where the proportion of the ocean closed to fishing is much smaller than 70%, despite being applied in locations with higher effort levels and much higher historical impacts.

<u>VME Spatial distribution modelling</u>

7. **We can find no scientific justification to discard the base case HSI estimates and only present the ROC-linear and 'power' sensitivity outputs.**

The VME spatial distribution models used to evaluate interactions between fishing effort and VME taxa were built using 'presence-only' data and then applied using different post-hoc assumptions about the relationship between 'habitat suitability index (HSI) and VME abundance. The base case distributions assumed a linear relationship; sensitivities applied non-linear transforms to the HSI.

Having carefully reviewed the submitted materials of the past three years, we see that the authors of the BFIA and the later spatial protection scenarios (COMM10-Inf03) argue that the 'ROC 0-linear' and 'Power Mean' sensitivity outputs are superior, and the IWG chose to only show the sensitivities in their submission to Commission 11 (COMM11-Doc05), but the only Scientific Committee comment on the matter is as follows (SC9 paragraph 78):

> *78. [The SC]… a. . Noted the metrics used to assess the protection levels for VME indicator taxa, ROC 0-linear and Power Mean, are representative of the metrics spectrum presented in the BFIA.*

This text suggests that the choice of spatial abundance metric was discussed in SC9 but no conclusions were reached; contrary to the way this paragraph has been subsequently cited, nothing was 'supported', 'accepted', or 'endorsed'. Looking back through subsequent SC reports, we can find no decision by the SC to replace the former base case or endorse either sensitivity as a superior metric of VME abundance. Because these metrics affect the application of binding decisions at Commission level (i.e. setting protection thresholds or setting a quantitative SAI threshold) this is not a decision that should be made without supporting analysis and transparent discussion at the SC level.

Until that happens, and because the RBS analysis itself is unchanged since 2020, we don't feel it is appropriate to exclude the base case HSI outputs from the 2023 document, in favour of presenting only the ROC-linear and 'power' sensitivity outputs. The numerical base case HSI outputs should be added alongside the sensitivity outputs.

If the answer to this query is that the HSI predicts presence not abundance, but abundance is more relevant to the management goals of SPRFMO, then this begs the question why the ROC and 'power' curves have not been used to transform the distribution maps into abundance maps based on relationships derived empirically from the data, rather than applied as post-hoc adjustments to maps that are not fit for purpose.

In any event, it appears that all of the model validation that we have seen, including all of the AUC outputs referred in SC11-DW01 section 4.4.2.2 and the spatial distribution models of Georgian et al. (2019) through to Stephenson et al. (2021) and the maps in Figures 37-54, depict HSI, not the post-hoc adjustments to HSI presented initially as sensitivities. It cannot be considered scientifically rigorous to continue to test and validate and assert the utility of the spatial models with reference only to the former base case (HSI) but then discard the base case in favour of the former sensitivities when it comes time to implement binding Commission advice. We discuss concerns with spatial habitat model validation (or the lack thereof) in the next section.

8. The predictive power of the HSI models has never been demonstrated for the SPRFMO area or at the scale of the FMAs.

We reiterate our previously expressed concern (SC10-Obs1 and SC10-WG02) that the model validation analyses previously submitted to SPRFMO are not sufficient to demonstrate the utility of the HSI models in the SPRFMO Area. These validation exercises have only ever been carried out at the scale of the full model spatial domain, which includes the entirety of the New Zealand EEZ.

- It is not sufficient to only validate model predictive power at the largest scale. For a model to be proven accurate it needs to be accurate in the location where it will be applied and at the scale at which it will be applied.
- The vast majority of the data used to inform the HSI models is from temperate latitudes (in New Zealand coastal areas or on the Chatham Rise and Subantarctic Plateau); the modelled environment-biology relationships

are then effectively extrapolated to make predictions in dissimilar subtropical environments, where the species composition may be completely different.

- Effective model validation requires that geographically contiguous subsets of the data are iteratively withheld from the model building / tuning phase and then compared with predictions in the same locations from the full model from which data was not withheld (as in Pinkerton et al. 2010)
    - It is not sufficient to withhold data randomly, especially when most of the data are not from the area of interest. Consider: it is relatively 'easy' for a model to interpolate between adjacent sampling locations in data-rich areas (e.g. the New Zealand Chatham Rise), but in SPRFMO we are relying on the ability of these models to extrapolate between widely spaced locations and extend outward into virtually unsampled and environmentally dissimilar areas.
- This means that to be fit for purpose in SPRFMO, model validation should withhold data from the SPRFMO area, at the scale of whole FMAs.

To date no such model validation has been presented to the SPRFMO SC. SC has previously noted that the appropriateness of the management of VMEs under CMM03 "depends strongly on the ability of the available habitat suitability models to infer abundance" (SC9 paragraph 71b); it seems clear that demonstrating that ability for the models being used to inform management should be a high priority.

HSFG have expressed our frustration that under the umbrella of SPRFMO, New Zealand will fund new modelling approaches (e.g. VAST, or VME abundance modelling) that may be used in future or in other locations, but have to date resisted straightforward requests to validate the utility of the models that are being used now.

9. New Zealand research completed in the intersessional period and submitted to SC11 strongly suggests that, if proper validation were done, we may learn that the HSI models are not fit for purpose within SPRFMO

Through our participation in the SPACWG, HSFG has seen preliminary outputs of new research that may be useful to evaluate HSI model performance, and are only now being submitted for consideration by the SC. We feel that it is inappropriate to push ahead with additional changes to CMM03 while failing to acknowledge clear warning signals arising from the new available science, suggesting that the science on which we currently rely to evaluate those measures may not withstand further scrutiny.

In particular, consistent with the SC work plan (COMM11-WG17_rev1), new research is underway to build VME abundance models, using two different methods (VAST models and hurdle models). Preliminary results of this work are presented to SC11 in New Zealand paper SC11-DW-BB: 'Modelling vulnerable marine ecosystem (VME) indicator taxa'. We highlight the following:

9.1 Preliminary but incomplete validation analyses strongly suggest that these models are over-fitting the data, and may not have adequate predictive power, especially in the SPRFMO Area

Table 3 of paper SC11-DW-BB (reproduced below) shows the extent to which model the predictive power of the density models is diminished when it tested using withheld data (i.e. latter columns labelled 'evaluation data'. Such a substantial drop in model power is strong evidence of over-fitting.

Elsewhere in the paper the authors write "*using Pearson's correlation measure, 0.4 is considered good (based on a subjectively defined threshold)*". <u>Table 3 of that paper shows that many of the taxa fail to achieve that subjective 0.4 threshold, and models for some taxa have almost no predictive power at all.</u>

Furthermore, this analysis used randomly withheld data from across the spatial domain; if data were withheld from geographically contiguous areas (see section 8 above), and from the SPRFMO Area in particular (which is outside the 'environmental space' envelope of most of the data used in these models) then it is almost certain that the drop in model power would be more dramatic than shown below.

These analyses underscore the inherent difficulty of building complex multi-variate statistical models without over-fitting to the data. The HSI models need to be critically examined before they are used to justify major and binding management decisions. However it is not necessary to wait for new independent data to be collected; rigorous validation is possible using existing data, as described in section 8 above.

Table 1 (from SC11-DW-BB 'Modelling VME indicator taxa') | Mean model fits based on 100 bootstraps for Boosted Regression Trees (BRTs) and Random Forest (RF) density models for the entire study area for the 15 VME indicator taxa used in the data-driven approach.

	Mean correlation (100 bootstraps) (Pearson's r)			
	Training data		**Evaluation data**	
VME indicator taxon	**RF**	**BRT**	**RF**	**BRT**
Actiniaria	0.90	0.85	0.54	0.50
Alcyonacea	0.88	0.79	0.25	0.21
Antipatharia	0.83	0.69	0.29	0.30
Brisingida	0.93	0.87	0.38	0.33
Bryozoa	0.85	0.86	0.25	0.15
Crinoidea	0.77	0.82	0.30	0.33
Demospongiae	0.87	0.89	0.32	0.24
Enallopsammia rostrata	-	-	-	-
Goniocorella dumosa	0.95	0.89	0.62	0.57
Gorgonacea Alcyonacea	0.87	0.92	0.25	0.16
Hexactinellida	0.82	0.79	0.31	0.29
Hydrozoa	0.86	0.87	0.27	0.25
Madrepora oculata	-	-	-	-
Pennatulacea	0.88	0.90	0.39	0.32
Solenosmilia variabilis	0.73	0.32	0.21	0.23
Stylasteridae	0.88	0.94	0.54	0.57
Zoantharia	0.87	0.70	0.11	0.09

9.2 *There is almost no statistical relationship between modelled VME abundance and HSI. This conclusion was equally true for the base case HSI, the 'Roc-0 linear' sensitivity and the 'Power Mean' sensitivity.*

Paper SC11-DW-BB describes new VME abundance models (using VME density estimates from camera transect data). The intended use of the HSI models, and the justification for the non-linear transformations of HSI ('ROC-linear' and 'power') was to serve as a proxy for VME abundance. SC11-DW-BB Figure 4-4 (reproduced here) shows that there is no relationship between modelled VME abundance and any of the three HSI metrics: if both models were accurately indexing the same property (i.e. abundance) we would expect to see a linear correlation, but instead we see only a disorganised clouds of points.

That model diagnostics appear favourable for both the abundance models and the HSI when evaluated in isolation, but there is no meaningful corelation between them in panels A, B, and C, is problematic. It could be that one or both models is /are overfitting the data, and may not be as accurate as the AUC diagnostics viewed in isolation would suggest. Alternately, in the SPACWG, the scientists who produced these models explained these results by claiming that HSI is not (and was not meant to be) an index of abundance.

The only way to resolve these questions is to perform more rigorous location-specific validation, using geographically withheld data, as described in section 8 above.

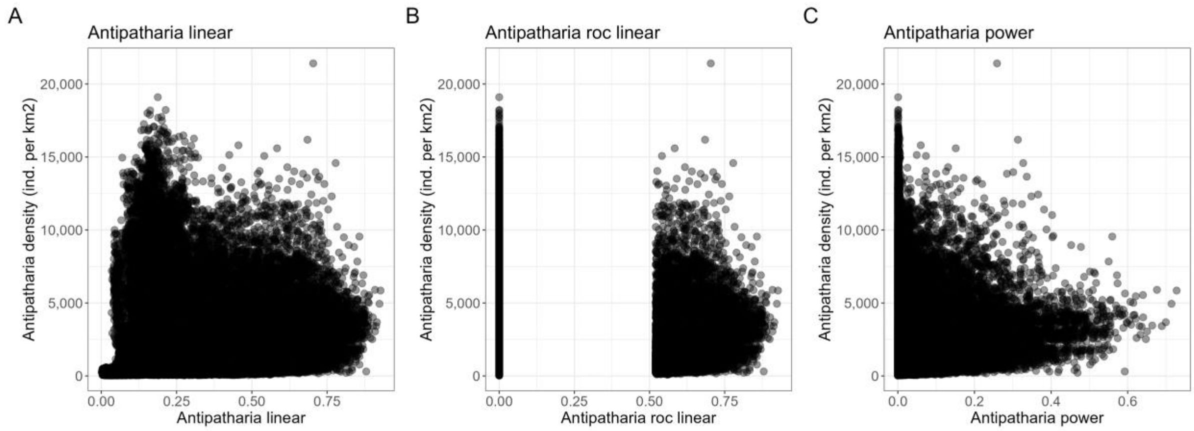

Figure Error! No text of specified style in document.**-2 (from SC11-DW-BB 'Modelling VME indicator taxa')** Predicted estimates of density (*data-driven* approach) of Antipatharia compared to predictions from different methods previously used to estimate (or proxy for) abundance: (a) linear habitat suitability model; (b) thresholded habitat suitability model based on the ROC AUC; (c) power transformed habitat suitability model. Samples represent a randomly selected subset of 10% of the modelled area due to the high number of points.

9.3 *There is almost no statistical relationship between modelled VME abundance and VME bycatch, or between HSI and VME bycatch, including the transformed HSI sensitivities.*

Corelation values between VME bycatch and predictions arising from three spatial distribution models (HSI, the ROC-linear transform of HSI, and the new hurdle abundance models) are shown in Table 11 of SC11-DW-BB (reproduced below). That the hurdle abundance estimates do not correlate to bycatch is perhaps not concerning, because these are still in development and not being used to inform management. That the HSI and HSI ROC-linear estimates do not correlate to bycatch suggest that either:

i) HSI and HSI ROC-linear estimates are not an accurate reflection of actual VME taxon abundance or biomass on the sea floor; or

ii) VME bycatch (even on a taxon-specific basis) is not an accurate reflection of actual VME taxon abundance or biomass on the sea floor; or

iii) … a combination of the two

If i) is true then HSI distributions are not useful to inform the design of spatial management under CMM03.

If ii) is true then the move-on rule should be discontinued.

In the SPACWG the authors of this work suggest hypothesis ii), but with the level of detail provided in paper SC11-DW-BB, and in the absence of validation analyses, the SC cannot be expected to make any such decision.

It is clear however that at least one part of CMM03 (i.e. pertaining to spatial management or to the move on rule) is unsupported by the available evidence. The SC should ask that further validation analyses described in sections 8 and 9.1 above, are presented to the SC12 for full evaluation before rushing ahead to adopt further changes based on assumptions that are clearly wrong for one of the two major components of CMM03.

Table 2 (from SC11-DW-BB, 'Modelling VME indicator taxa') *Pearson's correlation measuring the linear relationship between benthic bycatch (using data compiled for SC8-DW11) and estimates of abundance, using density models, HSI and HSI ROC-linear habitat suitability models from Stephenson et al (2021) and SC10-DW05.*

VME indicator taxon	Density models	HSI	HSI ROC-linear
Actiniaria	0.01	0.29	0.289
Alcyonacea	0.023	0.058	0.063
Antipatharia	0.079	0.262	0.286
Brisingida	0.028	0.099	0.111
Bryozoa	-0.004	0.066	0.066
Crinoidea	0.002	0.026	0.029
Demospongiae	0.003	0.022	0.021
Goniocorella dumosa	0.03	0.034	0.035
Gorgonacea Alcyonacea	0.014	0.046	0.047
Hexactinellida	0.234	0.159	0.165
Hydrozoa	-0.014	0.047	0.041
Pennatulacea	0.17	0.087	0.086
Solenosmilia variabilis	0.178	0.165	0.185
Stylasteridae	0.386	0.134	0.141
Zoantharia	0.012	0.082	0.091

10. Other technical feedback on document SC11-DW01

We offer the following specific technical and editorial comments and/or queries regarding the re-submitted BFIA. We note that feedback of this nature would normally have been addressed and resolved prior to submission of the document to the SPRFMO SC, had this document undergone the usual internal review process in the SPACWG.

10.1 We note the bullet point on p. 6 beginning 'habitat suitability models…' is factually in error; it refers to an 'updated RBS to meet the 70% protection threshold', but the RBS and the protection analysis are separate analyses with separate outputs. The protection analysis has been updated but the RBS has not; and even if/ when it is updated, RBS does not relate to the 70% protection threshold; RBS would relate to an operational definition of SAI.

10.2 Unless the new proposed 70% protection BTMAs are opening areas previously closed to fishing, it seems there may be errors in the right-hand column of tables 30-38. There should be no taxa for which the RBS estimates are lower in column 4 than in column 3, but this is the case (e.g. see column 3 vs column 4 for stony corals and Hydrocorals in Table 30). This is likely indicative of a coding error and should be investigated before the document is finalised.

10.3 We note that the first sensitivity (Appendix G) clipping the spatial domain to areas where environmental coverage > 0.05 does not illustrate the actual effects of extending model predictions into areas where coverage is low. The effect of this test is to say in effect "where we are most unsure about our predictions of VME taxa abundance, we will assume VME taxa abundance is zero". A truer illustration of the effect of extending predictions into marginal environmental coverage would be to withhold all data from locations where environmental coverage < 0.05, (and 0.1, and 0.2) and then test model power to predict into the withheld marginal areas using data from retained core areas.

Note also that Pinkerton et al. (2010) used < 0.1 (not < 0.05) to define locations where they considered that predictions are not valid, and used data withheld from spatially contiguous blocks to test model extrapolative power.

10.4 The second sensitivity described in section 4.6.7 and Annex H is difficult to interpret. It is alternately described as if it either

a) assumes no fishing in locations deeper than 1400 m (i.e. taxa in unfishable areas are counted as 'protected'); or
b) assumes there are no VME taxa in location deeper than 1400 m (i.e. analysis was clipped to the 1400 m contour).

The fact that the results are directionally mixed (i.e. protection for some taxa goes up and for other taxa it goes down, see Table H.1) suggests the latter sensitivity in b) was done, but the bullet point in section 1.1 summarising this sensitivity, and the introductory text in Appendix H, suggest the former sensitivity in a). Only the sensitivity in a) can be logically supported; if what was actually done was to deliver sensitivity b) then this analysis should be re-run and the outputs corrected.

Conclusion

Given our analysis above, it should be clear to the SC that there are significant errors, both procedurally and technically, in the current scientific analysis presented by NZ and Australia to SC, and in the use (or lack thereof) of previous analyses to support their proposal to further modify the BTMAs.

It is disingenuous for members to selectively quote from Commission advice to argue that the SC is obligated to endorse the adoption of new fishery restrictions on a short timeframe (i.e. for adoption at Commission 2024) while at the same time resisting or ignoring advice, from both SC and Commission, to update essential analyses and to test the validity of the science upon which our advice relies. The impact assessment outputs in Table 3 of this paper demonstrate clearly that there is no urgency. There can be no defensible rationale for imposing still more stringent restrictions without first delivering the science that SPRFMO requires.

SC is charged with balancing competing risks. We all recognise that we are charged with managing risks to the marine environment. Perhaps less often we are forced to acknowledge that we are also charged with managing risks to the credibility of this body, and the integrity of SPRFMO. We submit that that under the current fishing regime the former risks are demonstrably negligible. We are concerned that if SPRFMO rushes to adopt new measures without taking stock of the procural and technical mistakes that got us to this place, the latter risks may be considerable.

On this basis the HSFG strongly recommends that SC consider a 'reset' in order to give SPRFMO the time required to:

1. Review spatial model inputs and conduct rigorous model validation specific to the SPRFMO area,
2. Update all aspects of the BFIA, adhering to the formerly approved and scientifically rigorous process;
3. Consider the true effect and utility of the encounter protocol;
4. Agree an operational definition of SAI, and clarify other undefined aspects of the bottom fishing impact management framework, consistent with the draft template provided in section 6 of our other HSFG submission to this meeting

We ask that SC recommend to Commission that the current measures remain in place (unaltered) until these steps have been completed.

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