

8th MEETING OF THE SCIENTIFIC COMMITTEE

New Zealand, 3 to 8 October 2020

SC8-DW13

New Zealand Summary of recent benthic bycatch data

New Zealand

South Pacific Regional Fisheries Management Organisation

8th Meeting of the Scientific Committee

Wellington, 3-8 October 2020

Summary of recent benthic bycatch data for New Zealand flagged vessels

Shane W. Geange¹, Martin Cryer², Tiffany D. Bock³, Marco Milardi³

3 September 2020

1. Department of Conservation, Wellington, New Zealand
2. Fisheries New Zealand, Ministry for Primary Industries, Nelson, New Zealand
3. Fisheries New Zealand, Ministry for Primary Industries, Wellington, New Zealand

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1. Purpose of paper

The purpose of this paper is to provide a summary of recent bycatch data from New Zealand trawl and line vessels bottom fishing in the SPRFMO Convention Area. Of particular relevance is the relationship between recent bottom trawl¹ bycatch and the Vulnerable Marine Ecosystem (VME) taxa identified in [SC7-DW13](#) and the VME indicator taxa weight and biodiversity thresholds contained in SPRFMO Conservation Management Measures CMM 03-2019 and CMM 03-2020.

2. Introduction

[CMM-2.03](#) for the Management of Bottom Fishing in the SPRFMO Convention Area, which became binding in 2014, required Member Nations and CNCPs to restrict bottom fishing within their historic bottom fishing footprint; to establish threshold levels for encounters with VMEs; and to require vessels flying their flags to cease bottom fishing within 5 nm of any site in the Convention Area where evidence of a VME was encountered above threshold levels. Those requirements were carried through [CMM 4.03](#), [CMM 03-2017](#) and [CMM 03-2018](#). New Zealand's implementation of conservation management measures under these CMMs included a three-tiered system of spatial management whereby 41% of New Zealand's historical fishing footprint was closed to fishing, 29% of the footprint was open to fishing with no move-on rule, and the remaining 30% was open to fishing subject to an move-on rule. The move-on rule identified 10 VME indicator taxa designated variously at the level of phylum, class, order and family, with bottom trawl vessels required to cease fishing if they: (1) caught any VME indicator taxa in quantities that exceed its taxon-specific weight threshold; or (2) three or more VME indicator taxa exceeding biodiversity thresholds.

CMM 03-2018 was superseded by [CMM 03-2019](#) on 28 April 2019. CMM 03-2019 specified encounter protocols for use by all member countries within the SPRFMO Convention Area to prevent significant adverse impacts of bottom fishing on VMEs. The encounter protocol in CMM 03-2019 used the same 10 VME indicator taxa as used by New Zealand under CMM 03-2018 and also included weight and biodiversity thresholds; however, because the encounter protocol included in CMM 03-2019 was considered as a "backstop" to spatial management, the weight thresholds were set higher, ranging between 5 kg and 250 kg.

Following the initial implementation of the measure in 2019, additional work was done to explore uncertainties in the modelling and the spatial management approaches that had been agreed. In reviewing that work SC7 agreed that lower encounter thresholds for VME indicator taxa would help to mitigate risks of significant adverse impacts on VMEs until key uncertainties with the performance of the spatial management measures could be resolved. Subsequently, the SPRFMO Commission reduced the threshold for Scleractinia (a stony coral) from 250 kg to 80 kg in [CMM 03-2020](#) (while retaining the weight and biodiversity thresholds for the other nine VME indicator taxa included in CMM 03-2019), which became binding on 20 May 2020. SC7 also recommended to the Commission

¹ In this paper, bottom trawl refers to both bottom trawl and midwater trawl targeting benthic-pelagic species.

that when it reviews CMM03-2020 in 2021, the list of VME indicator taxa used for the biodiversity component of the encounter protocol should be revised to include zoantharia, hydrozoa and bryozoa.

CMM 03-2020 (as well as its predecessor, CMM 03-2019) includes a mandatory annual review process for VME indicator encounters and benthic bycatch data. Here, we present a summary of benthic bycatch data from the New Zealand bottom trawl and bottom longline fisheries for the 2019 calendar year, and the part of the 2020 fishing year for which data is available. We report benthic bycatch relative to the thirteen VME taxa identified by Geange et al. (2019) in SC7-DW13. Of these thirteen taxa, ten were identified as suitable indicators for the potential presence of VMEs. Seven of those ten indicator taxa were previously been used by New Zealand as VME indicator taxa in its measures to prevent significant adverse impacts by bottom trawling on VMEs under CMM 03-2018 and are explicitly identified as indicator taxa in CMM 03-2019 (and its successor, CMM 03-2020).

3. Methods

We extracted bycatch data for the New Zealand bottom trawl and bottom longline vessels operating within the SPRFMO Convention Area in 2019 and 2020 from the New Zealand Centralised Observer Database (accessed 14 July 2020). Data were collected by scientific observers, with the New Zealand bottom trawl and bottom longline fleets having 100% and at least 10% observer coverage in the SPRFMO Convention Area, respectively.

These data consisted of tow-by-tow (for bottom trawl) or set-by-set (for bottom longline) observer data with one record per benthic taxon encountered on each tow or set, and included trip number, station number, event number, target species, benthic bycatch code, common name, bycatch weight, method of weight analysis and observer comments.

CMM 03-2020 defines a fishing year as the period 0001 hours UTC on 1 January and ending 2359 hours on 31 December in the same year. During the 2019 fishing year, CMM 03-2018 was in effect for the period 1 January to 27 April, and CMM 03-2019 was in effect for the period 28 April to 31 December. For the 2020 fishing year, CMM 03-2019 was in effect for the period 1 January to 19 May, and CMM 03-2020 became binding on 20 May. Consequently, for each of the 2019 and 2020 fishing years we disaggregate and report on bottom trawl bycatch data according to the CMM that was in force at the time, as per Table 1.

For the period 20 May 2020 to 14 July 2020, two New Zealand trawl fishing vessels reported bottom trawling in the SPRFMO Convention Area; however that data was unavailable at the time of the data extract due to a delay between when trips finish and having the data entered into the database (those trips ended in June and July). We are therefore unable to report on benthic bycatch for the period after 20 May 2020.

Because the encounter protocol only applies to bottom trawl fisheries, we report bycatch for longline fisheries across the entire fishing year, irrespective of which CMM was in place at the time. The bottom longline dataset included 109 sets conducted between 2 Jan 2019 and 31 December 2019, and 13 sets between 1 January 2020 and 14 July 2020.

Table 1 | Reporting periods used for each of the 2019 and 2020 fishing years, indicating the number of bottom trawls (including midwater trawls) conducted by New Zealand vessels within each period, the relevant bottom fishing CMM for the period, and references to the relevant encounter thresholds (as displayed in Tables 2–4).

Fishing Year	Period	No. bottom trawl tows by NZ vessels	Relevant CMM	Relevant encounter thresholds
2019	1 January 2019 to 28 April 2019	31	CMM 03-2018	Table 1 of Cryer and Nicol 2017
2019	28 April 2019 to 31 December 2019	238	CMM 03-2019	Annex 6A and 6B of CMM 03-2019
2020	1 January and 20 May 2020	33	CMM 03-2019	Annex 6A and 6B of CMM 03-2019
2020	20 May 2020 and 31 December 2020	Data not yet available	CMM 03-2020	Annex 6A and 6B of CMM 03-2020

4. Results

For the 2019 fishing year, a combined weight of 382.97 kg of benthic bycatch was reported by scientific observers from the 269 trawl tows conducted by New Zealand vessels. For the period between 1 January 2019 and 28 April 2019, a combined weight of 182.5 kg of benthic bycatch was reported by scientific observers from the 31 bottom trawl tows conducted by New Zealand vessels (Table 2). Of these 182.5 kg, 58.5 kg were of the 10 VME indicator taxa implemented in New Zealand’s encounter protocol under CMM 03-2018, 21 kg were from the additional three indicator taxa identified in SC7 DW13, and 103 kg included other benthic invertebrate taxa (Table 2). Bycatch from one tow exceeded the weight threshold for Antipatharia, although this tow occurred in an open area not subject to encounter protocol rules. There were no other instances of benthic invertebrate bycatch exceeding weight thresholds for VME indicator taxa (Table 2).

For the period between 28 April 2019 and 31 Dec 2019, a combined weight of 200.47 kg of benthic bycatch was reported by scientific observers from the 238 trawl tows conducted by New Zealand vessels (Table 3). Of this bycatch, 142.37 kg were from the 13 VME indicator taxa, as identified in SC7-DW13, 141.37 kg were from the 10 VME indicator taxa included in the encounter protocol in CMM 03-2019, and 58.1 kg included other benthic invertebrate taxa (Table 3). None of the reported benthic bycatch in any single tow exceeded the weight thresholds included in CMM 03-2019. No tows included three or more taxa above biodiversity thresholds (as required in CMM 03-2019 to trigger the move-on rule), although some tows did include one or two taxa above biodiversity thresholds (Table 3).

For the period of the 2020 fishing year up to 14 July, a combined weight of 64 kg of benthic bycatch was reported by scientific observers from the 33 trawl tows conducted by New Zealand vessels, all of which was caught prior to CMM 03-2020 becoming binding on 20 May 2020 (1/1/2020 to 20/5/2020, Table 4). Of these, 48.9 kg were from the 13 VME indicator taxa, as identified in SC7-DW13, 40.6 kg were from the 10 VME indicator taxa implemented in CMM 03-2019, and 15.1 kg included other benthic invertebrate taxa (Table 4). None of the reported benthic bycatch in any single tow exceeded

the weight thresholds included in CMM 03-2020. No tows included three or more taxa above biodiversity thresholds (as required in CMM 03-2019 to trigger the move-on rule), although two tows did include a single taxon above biodiversity thresholds (Table 4).

Table 2 | Bottom trawl reporting period 1/1/2019 to 28/4/2019. Taxa-specific weight thresholds for New Zealand trawl vessels within designated move-on areas, and the number of bottom trawls tows between 1/1/2019 and 28/4/2019 (when [CMM 03-2019](#) becoming binding) reporting bycatch, the median, range and total bycatch weight (kg), and the number of times each taxa triggered weight thresholds for each VME indicator taxon. Row colors refer to VME indicator taxa included in the New Zealand encounter protocol at the time (purple), additional VME indicator taxa identified in SC7-DW13 (orange), additional VME taxa identified in SC7-DW13 (green) and other benthic invertebrate taxa (white).

VME groups	Weight threshold	No. tows	Median bycatch weight (kg)	Range of bycatch weight (kg)	Total bycatch weight (kg)	No. times weight threshold exceeded
Porifera (Sponges) ¹	50	4	1.5	1 – 5	9	0
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush) ²	1	23	1	1 – 1	23	0
Alcyonacea (Soft corals)	1	0	-	-	0	0
Stylasteridae (Hydrocorals)	6	0	-	-	0	0
Scleractinia (Stony corals) ³	30	0	-	-	0	0
Antipatharia (Black corals)	1	2	3.25	1 – 5.5	6.5	1*
Actiniaria (Anemones)	-	0	-	-	0	0
Pennatulacea (Sea pens)	-	0	-	-	0	-
Brsingida ('Armless' stars)	-	0	-	-	0	-
Crinoidea (Sea lillies)	-	20	1	1 – 1	20	-
Zoantharia (Hexacorals)	NA	0	-	-	0	NA
Hydrozoa (Hydroids)	NA	21	1	1 – 1	21	NA
Bryozoa (Bryozoans)	NA	0	-	-	0	NA
Xenophyophorea (Xenophyophores)	NA	0	-	-	0	NA
Serpulidae (Serpulid tube worms)	NA	0	-	-	0	NA
Echinodermata						
Asteroidea (Starfish)	NA	4	5.5	1 – 10	22	NA
Echinoidea (Sea urchins)	NA	3	20	10 – 1	80	NA
Ophiuroidea (Brittle stars)	NA	1	1	1 – 50	1	NA

VME Indicator Taxa implemented in New Zealand's encounter protocol under CMM 03-2018

Additional VME Indicator Taxa identified in SC8-DW13

Additional VME Taxa identified in SC8-DW13

Other benthic invertebrate taxa

* Event occurred outside a move-on area, so encounter not triggered

¹ Includes all Porifera within the classes Demospongiae and Hexactinellidae

² Includes all Gorgonacea within the sub-orders Halaxonia, Calcaxonia and Scleraxonia

³ Includes all taxa within the following genera: Solenosmilia; Goniocorella; Oculina; Enallopsammia; Madrepora; Lophelia

⁴ Includes taxa other than Gorgonian Alcyonacea, Alcyonacea, Scleractinia, Antipatharia, Pennatulacea, Zoantharia

⁵ Includes genera within the Scleractinia other than those designated as VME indicator taxa in CMM 03-2019 (see footnote 3).

Table 3 | Bottom trawl reporting period 28/4/2019 to 31/12/2019. Taxa-specific weight and biodiversity thresholds from [CMM 03-2019](#), and the number of bottom trawls, median, range and total bycatch weights (kg) by New Zealand trawl vessels between 28/4/2019 (when CMM 03-2019 becoming binding) and 31/12/2019. Also shown is the number of times bycatch of each VME indicator taxon triggered weight or biodiversity thresholds. Row colors refer to VME indicator taxa included in CMM 03-2019 (purple), additional VME indicator taxa identified in SC7-DW13 (orange), additional VME taxa identified in SC7-DW13 (green) and other benthic invertebrate taxa (white). *Note that the number of times biodiversity weights are exceeded by a single taxon doesn't correspond to the number of move-on events if fewer than three taxa in a single tow exceed biodiversity thresholds.*

VME groups	CMM03-2019 Weight threshold	CMM03-2019 Biodiversity threshold	No. tows	Median bycatch weight (kg)	Range of bycatch weight (kg)	Total bycatch weight (kg)	No. times weight threshold exceeded	No. times biodiversity threshold exceeded
Porifera (Sponges) ¹	50	5	12	0.35	0.1 – 2.7	6.4	0	0
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush) ²	15	1	7	1.2	0.1 – 5.7	10.5	0	2
Alcyonacea (Soft corals)	60	1	0	-	-	0	0	0
Stylasteridae (Hydrocorals)	-	1	0	-	-	0	0	0
Scleractinia (Stony corals) ³	250	5	5	0.3	0.2 – 3.7	7.4	0	0
Antipatharia (Black corals)	5	1	29	0.1	0.1 – 0.8	7.17	0	1
Actiniaria (Anemones)	40	5	29	3.9	0.1 – 9.6	107.8	0	2
Pennatulacea (Sea pens)	-	1	10	0.15	0.1 – 0.5	2.1	0	0
Brisingida ('Armless' stars)	-	1	0	-	-	0	0	0
Crinoidea (Sea lillies)	-	1	0	-	-	0	0	0
Zoantharia (Hexacorals)	NA	NA	1	1.0	0.1 – 1.0	1.0	NA	NA
Hydrozoa (Hydroids)	NA	NA	0	-	-	0	NA	NA
Bryozoa (Bryozoans)	NA	NA	0	-	-	0	NA	NA
Xenophyophorea (Xenophyophores)	NA	NA	0	-	-	0	NA	NA
Serpulidae (Serpulid tube worms)	NA	NA	0	-	-	0	NA	NA
Arthropoda								
Hexanauplia (Barnacles)	NA	NA	3	0.9	0.1 – 0.9	1.9	NA	NA
Malacostraca (Crabs, prawns and Lobsters)	NA	NA	3	1	1 – 6	8.0	NA	NA
Pycnogonida (Sea spiders)	NA	NA	1	1	1 – 1	1.0	NA	NA
Cnidaria								
Anthozoa (Sea anemones and soft corals) ⁴	NA	NA	5	1.9	0.5 – 3.9	9.6	NA	NA
Scleractinia (Stony corals) ⁵	NA	NA	19	0.4	0.1 – 9	27.6	NA	NA
Echinodermata								
Asteroidea (Starfish)	NA	NA	8	1	1 – 1	8.0	NA	NA
Ophiuroidea (Brittle stars)	NA	NA	2	1	1 – 1	2.0	NA	NA

VME Indicator Taxa implemented in CMM 03-2019

Additional VME Indicator Taxa identified in SC8-DW13

Additional VME Taxa identified in SC8-DW13

Other benthic invertebrate taxa

¹ Includes all Porifera within the classes Demospongiae and Hexactinellidae

² Includes all Gorgonacea within the sub-orders Halaxonia, Calcaxonia and Scleraxonia

³ Includes all taxa within the following genera: *Solenosmilia*; *Goniocorella*; *Oculina*; *Enallopsammia*; *Madrepora*; *Lophelia*

⁴ Includes taxa other than Gorgonian Alcyonacea, Alcyonacea, Scleractinia, Antipatharia, Pennatulacea, Zoanatharia

⁵ Includes genera within the Scleractinia other than those designated as VME indicator taxa in CMM 03-2019 (see footnote 3).

Table 4 | Bottom trawl reporting period 1/1/2020 to 20/5/2020. Taxa-specific weight and biodiversity thresholds from [CMM 03-2020](#), and the number of bottom trawls, median, range and total bycatch weights (kg) by New Zealand trawl vessels between 1/1/2020 and 20/5/20 (when CMM 03-2020 becoming binding). Also shown is the number of times bycatch of each VME indicator taxon triggered weight or biodiversity thresholds. Row colors refer to VME indicator taxa included in CMM 03-2020 (purple), additional VME indicator taxa identified in SC7-DW13 (orange), additional VME taxa identified in SC7-DW13 (green) and other benthic invertebrate taxa (white). *Note that the number of times biodiversity weights are exceeded by a single taxon doesn't necessarily correspond to the number of move-on events if fewer than three taxa in a single tow exceeded biodiversity thresholds.*

VME groups	CMM03-2020 Weight threshold	CMM03-2020 Biodiversity threshold	No. tows	Median bycatch weight (kg)	Range of bycatch weight (kg)	Total bycatch weight (kg)	No. times weight threshold exceeded	No. times biodiversity threshold exceeded
Porifera (Sponges) ¹	50	5	9	1.4	0.1 – 2.7	11.0	0	0
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush) ²	15	1	1	0.3	-	0.3	0	0
Alcyonacea (Soft corals)	60	1	0	-	-	0	0	0
Stylasteridae (Hydrocorals)	-	1	1	0.3	-	0.3	0	0
Scleractinia (Stony corals) ³	80	5	10	0.8	0.1 – 5.8	12.4	0	1
Antipatharia (Black corals)	5	1	4	0.15	0.1 – 0.3	0.7	0	0
Actiniaria (Anemones)	40	5	10	0.75	0.2 – 8.4	15.5	0	1
Pennatulacea (Sea pens)	-	1	3	0.1	0.1 – 0.2	0.4	-	0
Brisingida ('Armless' stars)	-	1	0	-	-	0	-	0
Crinoidea (Sea lillies)	-	1	0	-	-	0	-	0
Zoantharia (Hexacorals)	NA	NA	4	1.55	1 – 4.2	8.3	NA	NA
Hydrozoa (Hydroids)	NA	NA	0	-	-	0	NA	NA
Bryozoa (Bryozoans)	NA	NA	0	-	-	0	NA	NA
Xenophyophorea (Xenophyophores)	NA	NA	0	-	-	0	NA	NA
Serpulidae (Serpulid tube worms)	NA	NA	0	-	-	0	NA	NA
Arthropoda								
Hexanauplia (Barnacles)	NA	NA	0	-	-	0	NA	NA
Malacostraca (Crabs, prawns and Lobsters)	NA	NA	1	2	-	2.0	NA	NA
Pycnogonida (Sea spiders)	NA	NA	0	-	-	0	NA	NA
Cnidaria								
Anthozoa (Sea anemones and soft corals) ⁴	NA	NA	1	0.1	-	0.1	NA	NA
Echinodermata								
Echinoidea (Sea urchins)	NA	NA	4	1	1 – 3.4	6.4	NA	NA
Holothuroidea	NA	NA	2	3.3	1.7 – 4.9	6.6	NA	NA

VME Indicator Taxa implemented in CMM 03-2019

Additional VME Indicator Taxa identified in SC8-DW13

Additional VME Taxa identified in SC8-DW13

Other benthic invertebrate taxa

¹ Includes all Porifera within the classes Demospongiae and Hexactinellidae

² Includes all Gorgonacea within the sub-orders Halaxonia, Calcaxonina and Scleraxonia

³ Includes all taxa within the following genera: Solenosmilia; Goniocorella; Oculina; Enallopsammia; Madrepora; Lophelia

⁴ Includes taxa other than Gorgonian Alcyonacea, Alcyonacea, Scleractinia, Antipatharia, Pennatulacea, Zoanatharia

⁵ Includes genera within the Scleractinia other than those designated as VME indicator taxa in CMM 03-2019 (see footnote 3).

For the 2019 fishing year, less than 4 kg of benthic bycatch from four VME indicator taxa was reported by scientific observers from the 109 sets (183k hooks) conducted by New Zealand bottom line vessels within the SPRFMO Convention Area (Table 5). For the 2020 fishing year, less than 1 kg of benthic bycatch from two VME indicator taxa was reported by scientific observers from the 13 sets conducted by New Zealand bottom line vessels within the SPRFMO Convention Area (Table 5).

Table 5 | Bottom longline reporting for 2019 and 2020. Weight (kg) of benthic bycatch from New Zealand bottom longline vessels within the SPRFMO Convention Area for the 2019 and 2020 fishing years. Row colors refer to VME indicator taxa included in CMM 03-2019 (purple), additional VME indicator taxa identified in SC7-DW13 (orange), and additional VME taxa identified in SC7-DW13 (green)).

VME groups	2019	2020
Porifera (Sponges) ¹	1.2	0
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush) ²	0	0.7
Alcyonacea (Soft corals)	2.0	0
Stylasteridae (Hydrocorals)	0	0
Scleractinia (Stony corals) ³	0.1	0
Antipatharia (Black corals)	0	0.2
Actiniaria (Anemones)	0	0
Pennatulacea (Sea pens)	0	0
Brsingida ('Armless' stars)	0	0
Crinoidea (Sea lillies)	0	0
Zoanatharia (Hexacorals)	0	0
Hydrozoa (Hydroids)	0.1	0
Bryozoa (Bryozoans)	0	0
Xenophyophorea (Xenophyophores)	0	0
Serpulidae (Serpulid tube worms)	0	0

VME Indicator Taxa implemented in New Zealand's encounter protocol under CMM 03-2018

Additional VME Indicator Taxa identified in SC8-DW13

Additional VME Taxa identified in SC8-DW13

Other benthic invertebrate taxa

¹ Includes all Porifera within the classes Demospongiae and Hexactinellidae

² Includes all Gorgonacea within the sub-orders Halaxonia, Calcaxonia and Scleraxonia

³ Includes all taxa within the following genera: Solenosmilia; Goniocorella; Oculina; Enallopsammia; Madrepora; Lophelia

⁴ Includes taxa other than Gorgonian Alcyonacea, Alcyonacea, Scleractinia, Antipatharia, Pennatulacea, Zoanatharia

⁵ Includes genera within the Scleractinia other than those designated as VME indicator taxa in CMM 03-2019 (see footnote 3).

5. Discussion

The absence of move-on events triggered by New Zealand vessels in 2019 prior to the 28th April (under New Zealand's implementation of CMM 03-2018) and between 28th April 2019 and 19 May 2020

(under the encounter protocols included in CMM 03-2019) is consistent with the intention that the threshold for triggering move-on events should be high and triggered only when bycatch indicates the models used to predict the distribution of VME taxa are misleading². It is also consistent with Cryer et al. (2018, [SC6-DW09](#)), who estimated that fewer than 0.6% of bottom trawl tows would trigger the encounter protocol under CMM 03-2019 if New Zealand flagged-vessels maintained the 2008–18 average fishing effort and distribution.

The observer coverage of the bottom longline fishery is low (but still above 10%), and this report covers only the observed portion of the fishery. Even accounting for the unobserved portion of the longline fishery, bycatch is still orders of magnitude smaller than that of bottom trawling.

The total amount of benthic invertebrate bycatch in 2019 appears to be lower than in the previous four years in absolute terms (see also Table 22 in SC8-Doc14 New Zealand Annual Report). Similarly, the aggregate catch for VME indicator taxa, and the mean catch of VME indicator taxa per tow was lower in 2019 than the previous 4 years (Appendix 1). However, there were taxon-specific differences in the five-year trends in the proportion of tows in which VME indicator taxa were reported and mean catch per positive tow: Porifera (sponges) were caught in proportionately fewer tows and at a lower weights in 2019 than in the previous four years; Actiniaria (anemones), Alcyonacea (soft corals), Scleractinia (stony corals), Stylasteridae (hydrocorals) and Brisingida ('Armless' stars) were caught in a similar proportion of tows, and at comparable weights in 2019 as in the previous 4-year period; Antipatharia (black corals), Gorgonian Alcyonacea and Pennatulacea (sea pens) were all caught in a higher proportion of tows in 2019 but at weights comparable to or lower than the previous four years; and Crinoidea (sea lilies) were caught in a higher proportion of tows and at higher weights in 2019 than the previous 4-year period (Appendix 1). We interpret these early trends as a potential indication that the new spatial management measures may have increased the separation of fishing and VME indicator taxa compared with previous measures or otherwise incentivized changes in fishing behavior (e.g., via the broader scope of the VME encounter protocol compared with previous New Zealand measures).

Requirements of CMM 03-2020

CMM 03-2020 requires that where VME indicator taxa are encountered in any one tow at or above the threshold limits in Annex 6A of CMM 03-2019, or three of more different VME indicator taxa at or above the weight limits in Annex 6B, Members and CNCPs shall submit to the Scientific Committee a detailed description of each encounter by vessels flying their flag. This should allow the Scientific Committee to determine whether the encounter was unexpected or not, based on the relevant VME habitat suitability models and the ongoing effectiveness of the spatial management measures.

² SC-05 **agreed** 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... involving weights of bycatch of benthic fauna that would indicate the models used to predict the distribution of VME taxa are misleading.

In addition to the review of encounters, CMM 03-2020 also requires the effectiveness of the spatial management measures to be informed by the annual review of benthic bycatch data:

35. *Members and CNCPs shall submit to the Secretariat annual reports of all benthic bycatch data from vessels flying their flag, consistent with CMM 02-2020 (Data Standards), to enable an ongoing review of the effectiveness of the spatial management arrangements. By no later than its annual meeting in 2019, the Scientific Committee shall develop a review process to provide for ongoing monitoring and feedback.*

There is currently no defined process outlining how annual reports of benthic bycatch data should be incorporated alongside encounters into an ongoing review of the effectiveness of the spatial management measures. However, annual reviews of benthic bycatch data present an opportunity to maximize the use of available data to evaluate the effectiveness of spatial management measures as well.

A review of bycatch of VME indicator taxa could recognise that:

1. The selection of encounter threshold values was somewhat arbitrary in the context of reviewing the spatial management measures, and that bycatch that doesn't trigger either the weight or biodiversity of the encounter protocol may still provide meaningful information that can be used to evaluate the effectiveness of the spatial management measures;
2. Although bycatch of a VME indicator taxon within a single tow may not exceed encounter thresholds, the bycatch of that VME indicator taxon within multiple tows at the same location may collectively indicate the presence of a VME; and
3. Similarly, clusters of tows with bycatch of different VME indicator taxa within the same location that have not triggered the biodiversity component of the encounter protocol may still indicate the presence of a diverse seabed fauna, potentially constituting evidence of a VME.

We suggest that the SC develop a process for reviewing annual summaries of all benthic bycatch data to determine if there are meaningful within or between year trends, clusters or triggers in benthic bycatch that suggest bycatch is unexpected based on the relevant VME habitat suitability models. Such a review could then be used alongside the review of encounters to evaluate the effectiveness of the spatial management measures.

The encounter review process, as described in CMM 03-2020 requires that:

33. *The Scientific Committee, at its next annual meeting, shall review all encounters reported pursuant to paragraph 28(b) and determine whether any encounters were unexpected based on the relevant VME habitat suitability models, and provide advice on management actions proposed by the relevant Member or CNCP under paragraph 32 and any other management actions the Scientific Committee considers appropriate. This review should include consideration of:*
 - a) *the detailed analyses provided by a Member or CNCP pursuant to paragraph 32;*
 - b) *historical fishing events within 5nm of the encounter tow, in particular, any previous encounters, and all information on benthic bycatch;*
 - c) *model predictions for all VME indicator taxa;*
 - d) *details of the relevant fishing activity, including the bioregion; and*

e) *any other information the Scientific Committee considers relevant.*

We propose incorporating the annual summary of bycatch data alongside encounters in the evaluation of the effectiveness of spatial management measures by undertaking a comparison of all historic bycatch data against the existing habitat suitability models to determine if bycatch is unexpected, and then updating that analysis annually. However, we seek input from the scientific committee in developing guidance to identifying patterns in bycatch of VME indicator taxa (relative to the habitat suitability models) would suggest the habitat suitability models should be updated, or the spatial management measures or encounter threshold refined.

6. Recommendations

We recommend that the Scientific Committee:

- **Note** that, for the period 1 January 2019 to 28 April 2019, no catches of benthic invertebrates reported by scientific observers on New Zealand bottom trawl vessels triggered New Zealand's encounter protocol under CMM 03-2018.
- **Note** that, for the period 28 April 2019 to 31 December 2019, no catches of benthic invertebrates reported by scientific observers on New Zealand bottom trawl vessels triggered the encounter protocol under CMM 03-2019.
- **Note** that, for the period 1 January 2020 to 19 May 2020, no catches of benthic invertebrates reported by scientific observers on New Zealand bottom trawl vessels triggered the encounter protocol under either CMM 03-2019 or CMM 03-2020.
- **Note** that benthic bycatch data for bottom trawls conducted between 20 May 2020 and 14 July 2020 is currently unavailable for analysis.
- **Note** that, for the 2019 fishing year and the 2020 fishing year to date, only a small amount of benthic bycatch was reported by scientific observers on New Zealand bottom line vessels operating in the SPRFMO Convention Area in 2019, which is consistent with the assumption that the impacts of bottom line are likely orders of magnitude smaller than those for bottom trawling.
- **Include** in their workplan to develop a process to review of all historic benthic bycatch data to determine if bycatch is unexpected based on the relevant VME habitat suitability models, and an annual update of that analysis using the most recent bycatch data.

7. References

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Appendix 1 | Aggregate catch by year, mean catch per tow, proportion of tows catching a given taxon, and mean catch per positive tow for VME indicator taxa in New Zealand bottom trawl tows in the SPRFMO Area since 2015.

	2015	2016	2017	2018	2019
Bottom trawl tows	959	943	1423	858	251
Aggregate catch by year:					
Actiniaria (Anemones)	1002.9	906.3	902.5	989.1	107.8
Alcyonacea (Soft corals)	0	0	0	0	0
Antipatharia (Black corals)	61.3	48.7	37.9	46.9	13.7
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush)	178.2	33.6	78.9	45	33.5
Pennatulacea (Sea pens)	1.7	3.3	18.3	8.1	2.1
Scleractinia (Stony corals)	8806.2	32	633	41.5	7.4
Stylasteridae (Hydrocorals)	2.2	0	3.7	2.3	0
Brsingida ('Armless' stars)	10.1	2.1	0	2.3	0
Crinoidea (Sea lillies)	0	3.8	1.7	3.5	20
Porifera (Sponges)	358.4	191.9	428.5	168.5	15.4
All VME indicator taxa	10421	1221.7	2104.5	1307.2	199.9
Mean catch per tow (kg):					
Actiniaria (Anemones)	1.05	0.96	0.63	1.15	0.43
Alcyonacea (Soft corals)	0.00	0.00	0.00	0.00	0.00
Antipatharia (Black corals)	0.06	0.05	0.03	0.05	0.05
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush)	0.19	0.04	0.06	0.05	0.13
Pennatulacea (Sea pens)	0.00	0.00	0.01	0.01	0.01
Scleractinia (Stony corals)	9.18	0.03	0.44	0.05	0.03
Stylasteridae (Hydrocorals)	0.00	0.00	0.00	0.00	0.00
Brsingida ('Armless' stars)	0.01	0.00	0.00	0.00	0.00
Crinoidea (Sea lillies)	0.00	0.00	0.00	0.00	0.08
Porifera (Sponges)	0.37	0.20	0.30	0.20	0.06
All VME indicator taxa	10.87	1.30	1.48	1.52	0.80

Proportion of positive tows:

Actiniaria (Anemones)	23.0%	21.0%	11.2%	9.3%	11.6%
Alcyonacea (Soft corals)	0.0%	0.0%	0.0%	0.0%	0.0%
Antipatharia (Black corals)	8.1%	7.1%	4.1%	8.0%	12.4%
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush)	5.1%	5.7%	5.6%	7.2%	12.0%
Pennatulacea (Sea pens)	0.7%	1.6%	2.0%	1.3%	4.0%
Scleractinia (Stony corals)	5.0%	1.9%	4.2%	1.7%	2.0%
Stylasteridae (Hydrocorals)	0.2%	0.0%	0.3%	0.3%	0.0%
Brsingida ('Armless' stars)	0.5%	0.5%	0.0%	0.2%	0.0%
Crinoidea (Sea lillies)	0.0%	0.7%	0.9%	0.7%	8.0%
Porifera (Sponges)	18.9%	13.3%	6.8%	8.5%	6.4%

Mean catch per positive tow (kg):

Actiniaria (Anemones)	4.54	4.58	5.68	12.36	3.72
Alcyonacea (Soft corals)	0.00	0.00	0.00	0.00	0.00
Antipatharia (Black corals)	0.79	0.73	0.65	0.68	0.44
Gorgonian Alcyonacea (Tree-like forms, sea fans, sea whips, bottlebrush)2	3.64	0.62	1.00	0.73	1.12
Pennatulacea (Sea pens)	0.24	0.22	0.65	0.74	0.21
Scleractinia (Stony corals)	183.46	1.78	10.55	2.77	1.48
Stylasteridae (Hydrocorals)	1.10	0.00	0.93	0.77	0.00
Brsingida ('Armless' stars)	2.02	0.42	0.00	1.15	0.00
Crinoidea (Sea lillies)	0.00	0.54	0.13	0.58	1.00
Porifera (Sponges)	1.98	1.54	4.42	2.31	0.96