SPRFMO
South Pacific Regional Fisheries Management Organisation

7th MEETING OF THE SCIENTIFIC COMMITTEE

La Havana, Cuba, 7 to 12 October 2019

SC7-DW12

New data compilation for VME indicator taxa and implications for the review of VME habitat suitability models in the SPRFMO area

New Zealand

South Pacific Regional Fisheries Management Organisation

7th Meeting of the Scientific Committee

La Havana, Cuba, 7–12 October, 2019

New data compilation for VME indicator taxa and implications for the review of VME habitat suitability models in the SPRFMO area

Ashley Rowden and Owen Anderson

National Institute of Water & Atmospheric Research, New Zealand

7 September 2019

Table of Contents

Executive summary

The purpose of this work was to determine the availability of new data for VME indicator taxa and consider the associated implications for the review of VME habitat suitability models in the SPRFMO area. Data were compiled from various databases and datasets maintained or kept by NIWA. A total of 6106 new presence records were obtained. These data were plotted on maps to allow for a spatial comparison with the distribution of the previously compiled data used by Georgian et al. (2019) to make habitat suitability models for ten VME indicator taxa in the SPRFMO area.

Broadly, there were 10s of new records for *Madrepora oculata* and *Enallopsammia rostrata*, 100s for *Solenosmilia variabilis, Goniocorella dumosa*, Antipatharia Stylasteridae, Pennatulacea, and >1000 for Alyconacea, Demospongiae, and Hexactinellida. For taxa that had >1000 new records, most came from the *trawl* database, and for other taxa (in particular *Solenosmilia variabilis*) a notable proportion of the new data records came from the image datasets, a source of data not used for constructing the models of Georgian et al. (2019).

For most taxa, the new data records came from within the distribution envelope of the data used by Georgian et al. (2019) for their VME indicator habitat suitability models. However, there were some areas within this envelope where data were generally absent or scarce in the previous data compilation, and where a relatively large number of new records have now resulted from the updated data compilation.

In terms of whether the new data records represent sufficient data (numerical amount, distribution) to use for testing the robustness of the Georgian et al. (2019) models, both the proportion of new records and their distribution relative to the spatial predictions of habitat suitability was assessed. Using the proportion of data usually used for internal cross-validation of models (20-30%) as a guide, there are sufficient new data to test the models for the Pennatulacea, Hexactinellida, and *Solenosmilia variabilis.* Examination of the maps with the new data records overlain on the model predictions of suitable habitat indicates that new data exist in areas representing a range of habitat suitability predictions for all VME indicator taxa, which is ideal for testing models.

Overall, there are probably sufficient data, and reason, to consider the testing of the models of habitat suitability for VME indicator taxa used to develop the spatial management measures detailed in CMM-03-2019.

The results of this work lead us to recommend to the SPRFMO Scientific Committee that: (1) new records for VME indicator taxa should be obtained from Australian data sources, and that all new data should be groomed prior to being used to test the habitat suitability models of Georgian et al. (2019); and (2) should the testing of the models raise concerns about the accuracy of the habitat suitability predictions, then some or all of the models should be updated as part of 2020 Bottom Fishery Impact Assessment that is required to be submitted by New Zealand and Australia under CMM-03-2019.

1. Purpose

This paper reports on the availability of new data for VME indicator taxa, and the associated implications for the review of VME habitat suitability models in the SPRFMO area.

2. Requirements for a review of new benthic data

Relevant text from SPRFMO SC6-Report

Following discussion of SC6-DW09 (Methods of deriving thresholds for VME encounter protocols for SPRFMO bottom fisheries), the SC:

- **Recommended** a mandatory review process for VME Indicator encounters (annual), benthic data (annual), and models underpinning spatial management approaches (roughly every 5 years or when evidence suggests those models are misleading), and to include the development of the review process in suggested SC work plans for consideration by the Commission.

Following discussions of SC6-DW14 (Benthic Sampling and bycatch data, including VME taxa, in SPRFMO bottom Fisheries), the SC:

- **Agreed** that further work should be done to enable more sophisticated use of bycatch data in habitat suitability models and the development of VME indicator taxa thresholds that may inform encounter protocols, where these might be required.

Relevant text from the latest Deepwater Workplan

VME Encounter

- Collect and review VME catch and other benthic sampling data

Spatial Management

- Update and re-assess VME and habitat suitability modelling as appropriate

3. New data compilation

The spatial closures described in the new CMM for the management of bottom fisheries (CMM-03-2019) were in-part based on habitat suitability models for ten VME indicator taxa (Georgian et al. 2019). New data (presence records) for these VME indicator taxa, subsequent to the 2016 data compilation used by Georgian et al. (2019), were extracted from relevant data sources. Databases accessed were *trawl* (research trawl survey records), *cod* (fisheries observer records), *niwainvert* (mostly records from the NIWA Invertebrate Collection), and image datasets (specifically, coral images collected by fisheries observers, and camera surveys of Louisville Seamount Chain and Chatham Rise) managed or held by the National Institute of Water & Atmospheric Research (NIWA)[1]. New records

[1] *trawl* and *cod* are FNZ databases - https://www.mpi.govt.nz/dmsdocument/15613-database-documentation-trawl, https://www.mpi.govt.nz/dmsdocument/15532-database-documentation-cod; *niwainvert* is a NIWA

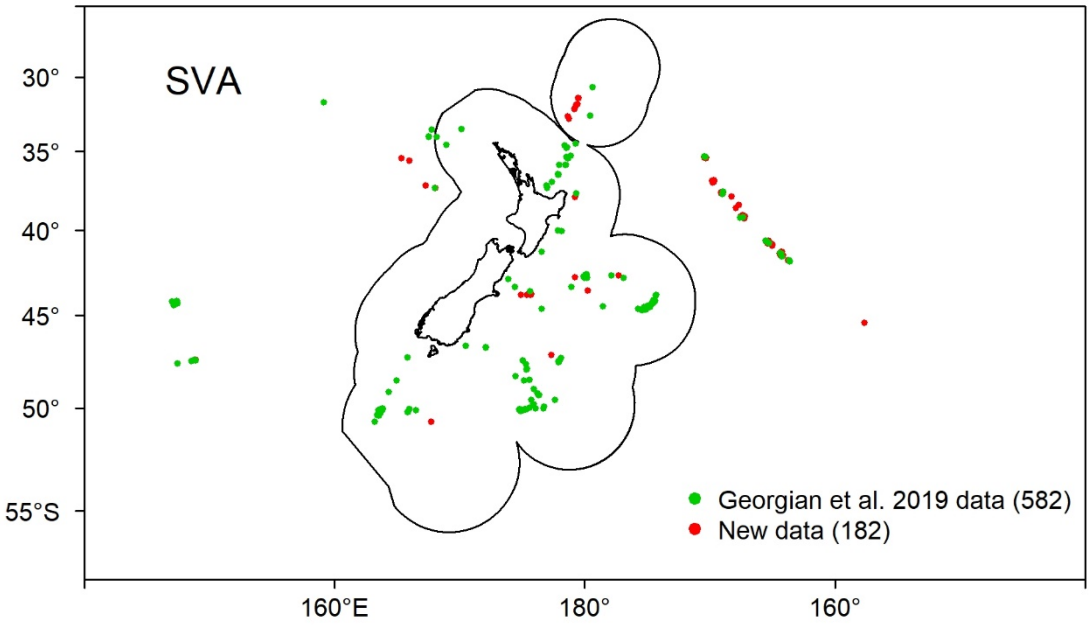
date from: 7/1/2013 (*trawl*), 20/7/2017 (*cod*), 5/2/2017 (*invert*), and 5/7/2015 (image datasets). Data from *trawl* older than 2016 are included because some bycatch specimens were only identified (or re-identified) since the data compilation used by Georgian et al. (2019). Data from image datasets were not used for the habitat suitability modelling. A total of 6106 new presence records were obtained for the ten VME indicator taxa (Table 1).

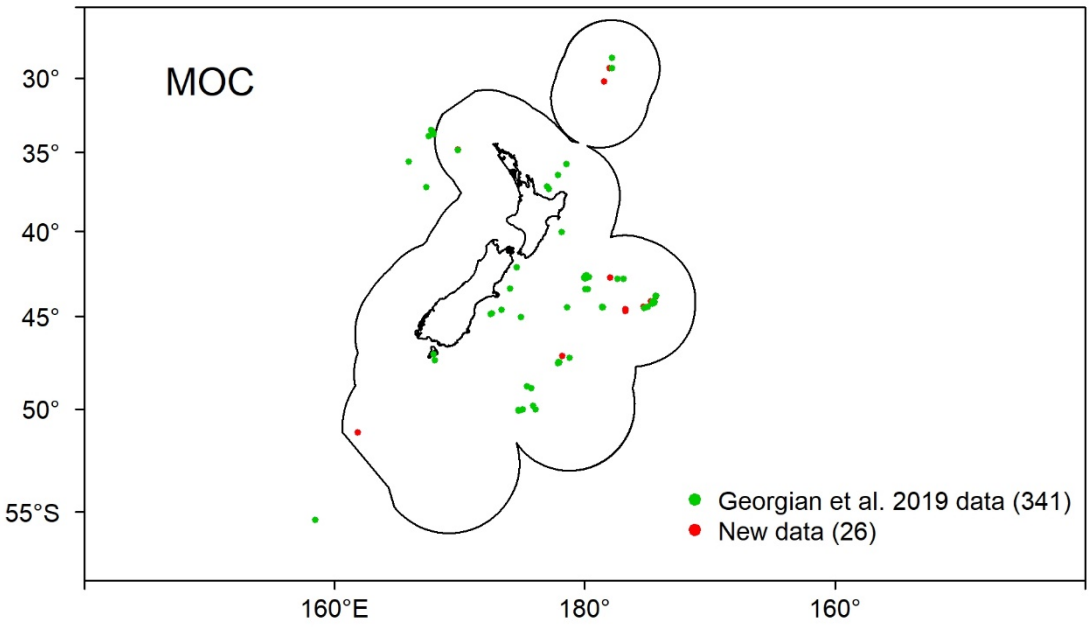
Table 1: Number of presence records for VME indicator taxa compiled from various data sources additional to those compiled by Georgian et al. (2019) for the habitat suitability modelling.

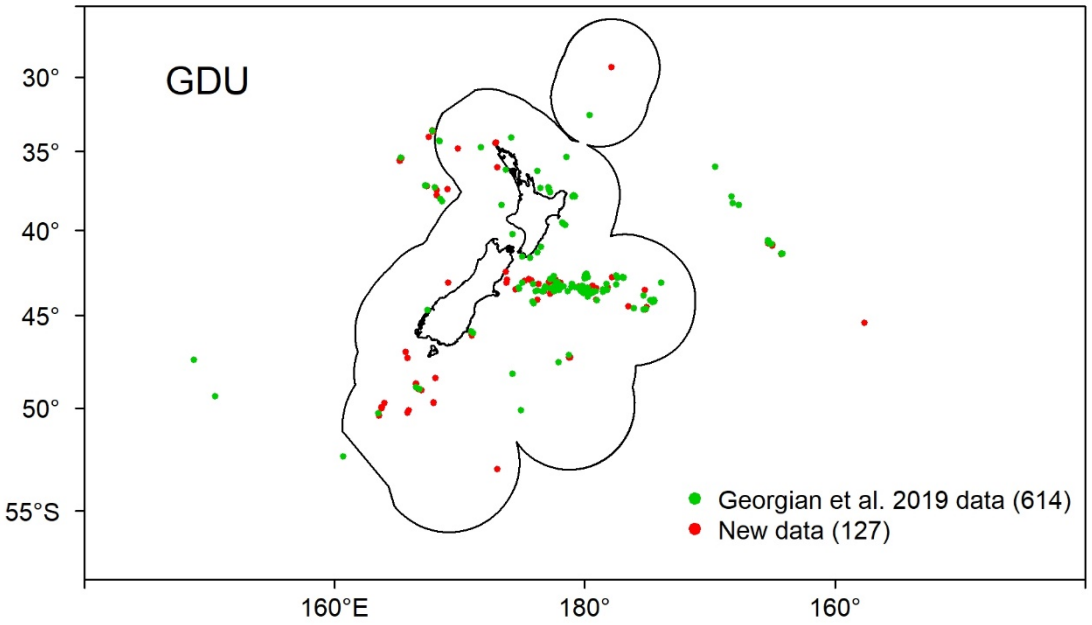
Taxon Name	Taxon Code	*trawl*	*cod*	*niwainvert*	image datasets	Total
Solenosmilia variabilis	SVA	-	23	36	123	182
Madrepora oculata	MOC	1	4	11	10	26
Goniocorella dumosa	GDU	-	93	15	19	127
Enallopsammia rostrata	ERO	1	20	19	21	61
Alcyonacea	SOC	108	614	311	247	1280
Antipatharia	COB	8	185	51	118	362
Stylasteridae	COR	11	37	39	160	247
Pennatulacea	PTU	204	206	51	208	669
Demospongiae	DEM	342	881	283	297	1803
Hexactinellida	HEX	292	743	139	175	1349

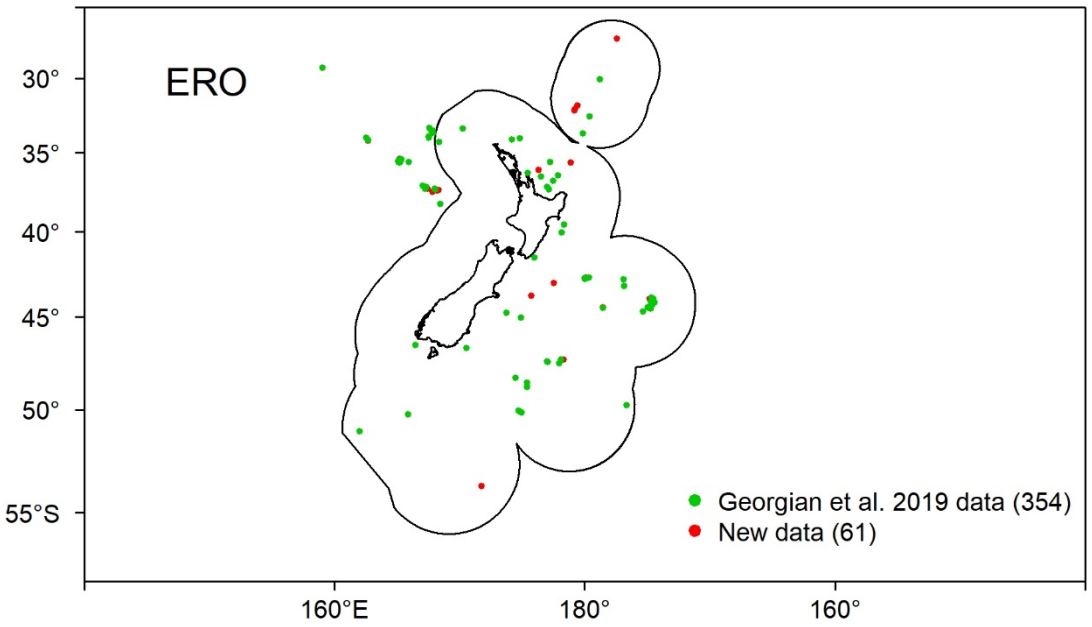
New data for the VME indicator taxa were plotted on maps to allow for a spatial comparison with the distribution of the previously compiled data used by Georgian et al. (2019) (Figure 1).

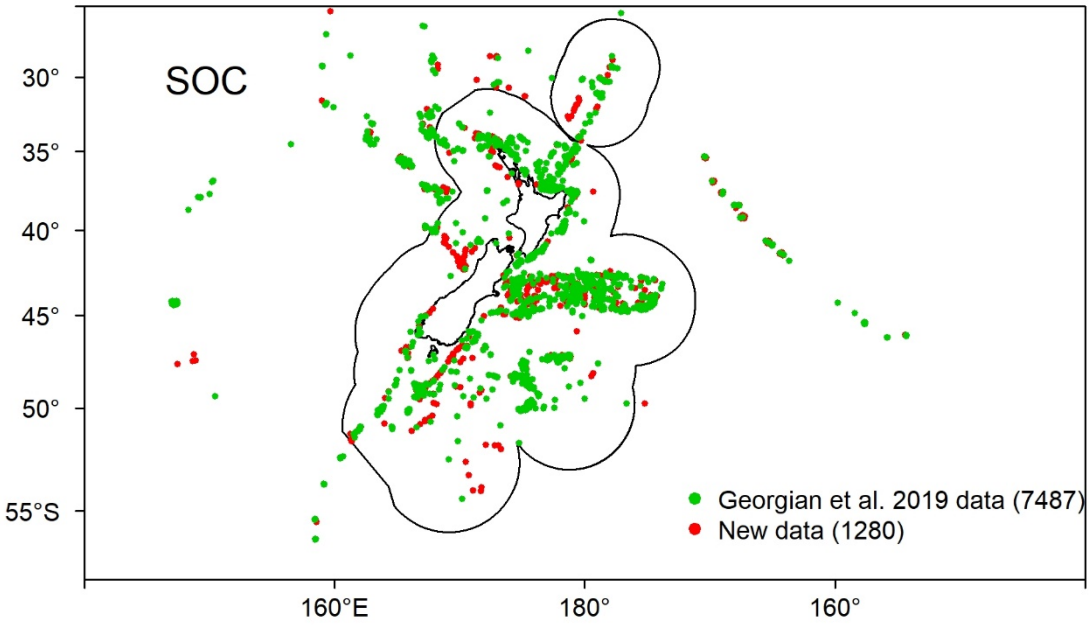
database that contains biodiversity records, mainly those associated with the NIWA Invertebrate Collection; NIWA maintains various image datasets, some of which have been loaded into its *ATLAS* image database.

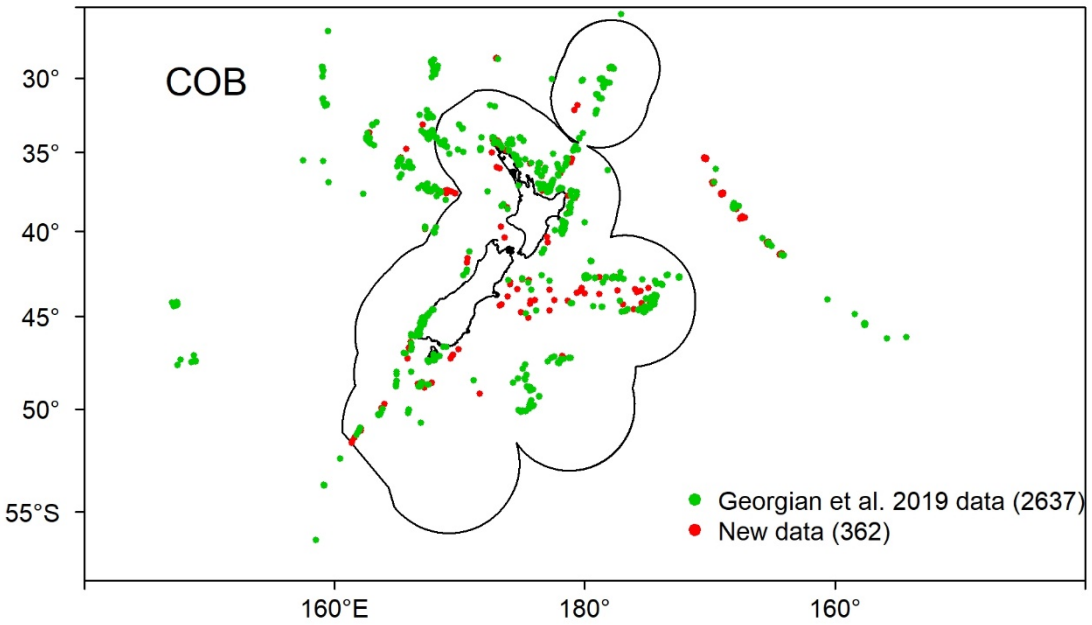

SVA
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (582)
New data (182)

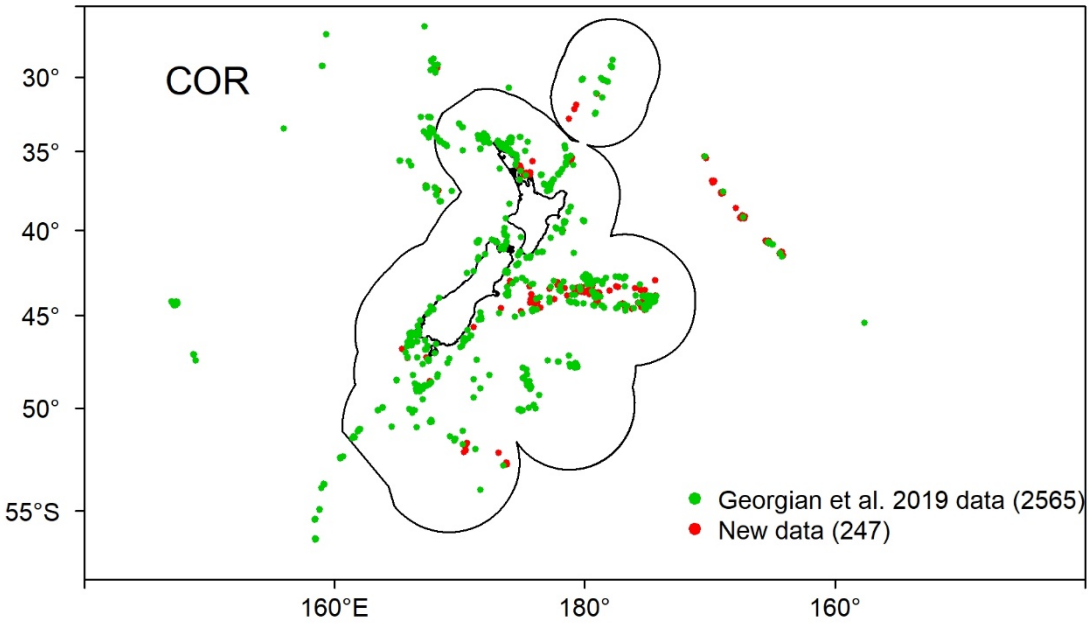

MOC
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (341)
New data (26)

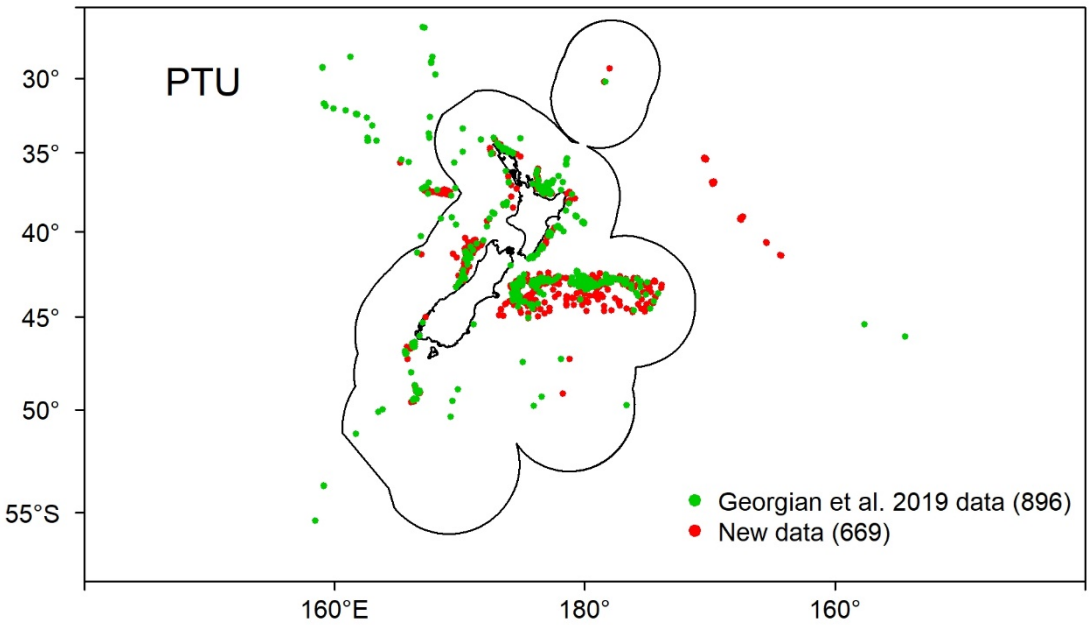

GDU
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (614)
New data (127)


ERO
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (354)
New data (61)


SOC
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (7487)
New data (1280)


COB
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (2637)
New data (362)


COR
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (2565)
New data (247)


PTU
30°
35°
40°
45°
50°
55°S
160°E
180°
160°
Georgian et al. 2019 data (896)
New data (669)

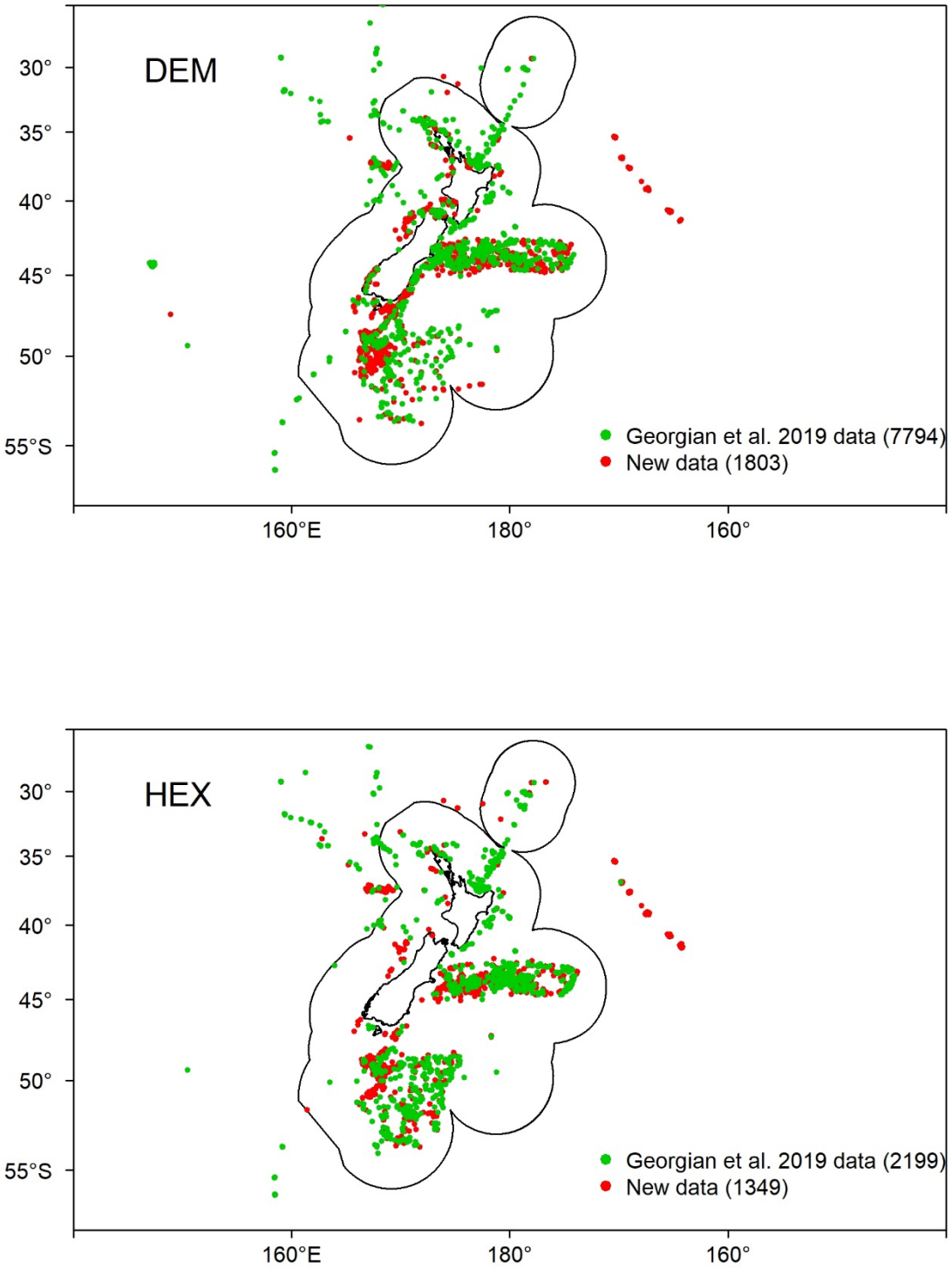


Figure 1: Maps showing the distribution of new data records for VME indicator taxa compared to data used by Georgian et al. (2019) to make habitat suitability models. See Table 1 for key to taxon codes; black line = EEZ; note that records from Georgian et al. 2019 are plotted over new records to highlight previously unknown presence locations.

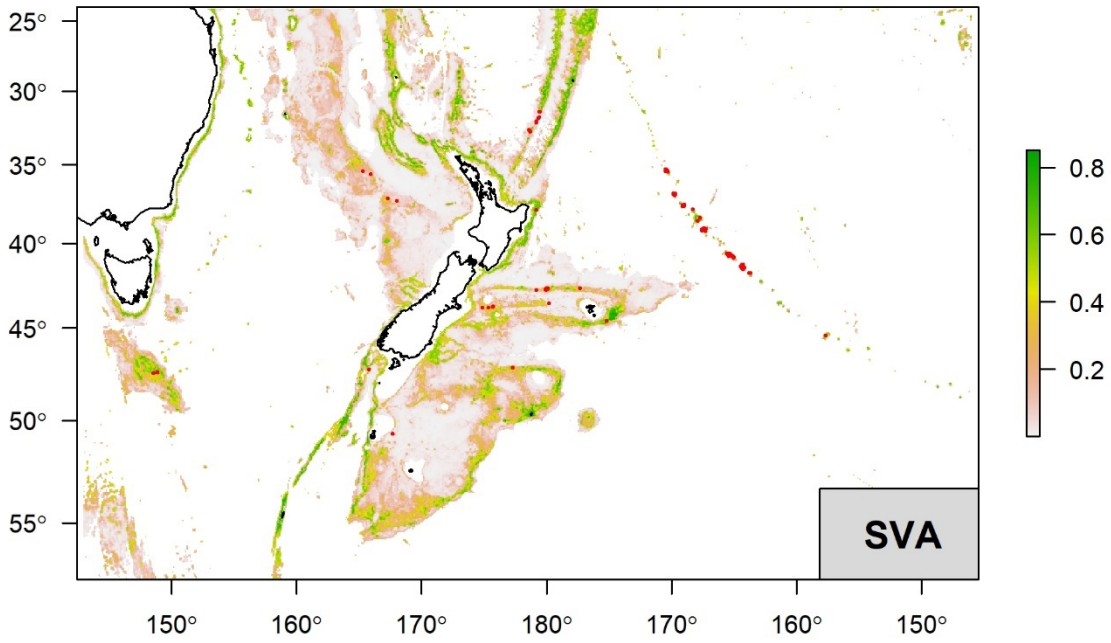
4. Implications for review of VME habitat suitability models

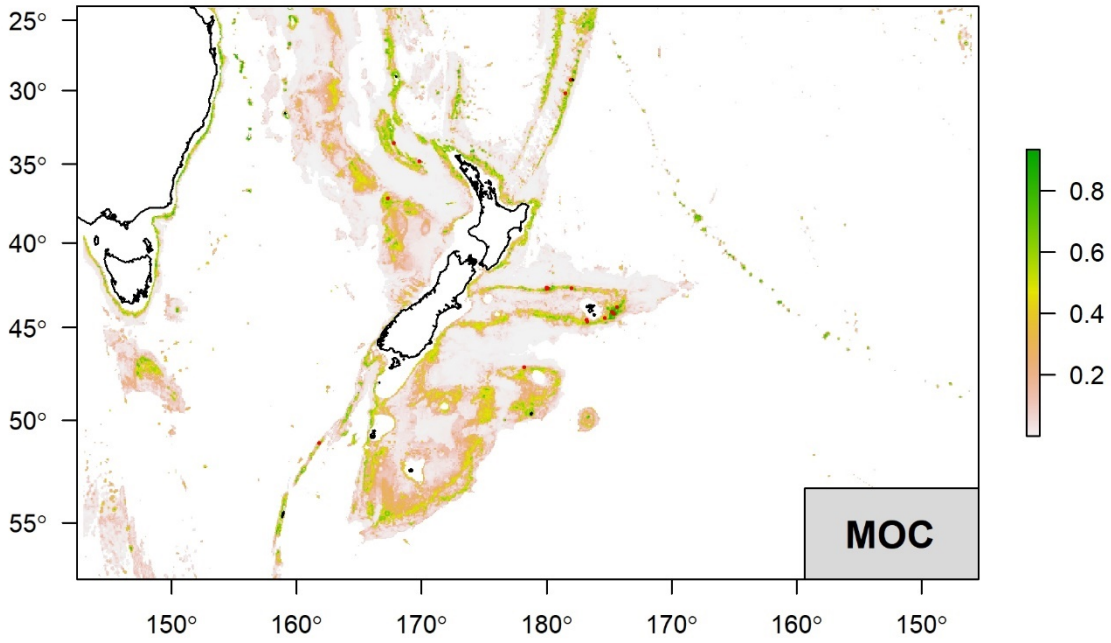
To assess whether the new data records are likely to be numerically sufficient to allow a review of the habitat suitability models for VME indicator taxa, the percent new data of the total available data was calculated (Table 2).

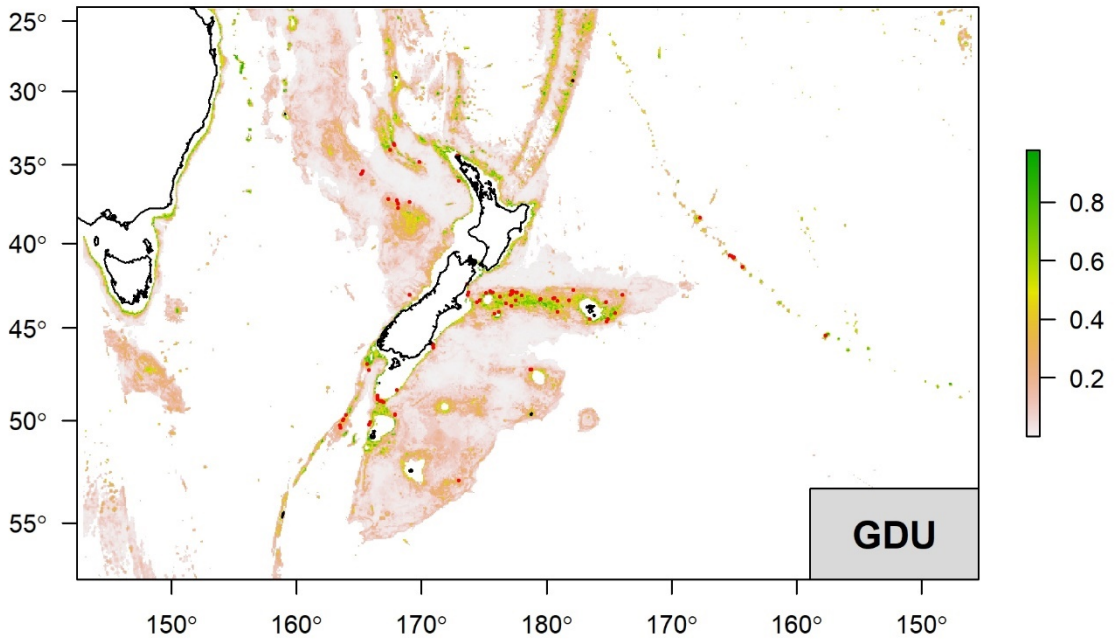
Table 2: Comparison of number of presence records for VME indicator taxa used by Georgian et al. (2019) and those from the new data compilation, and the latter as a percent of the total available data.

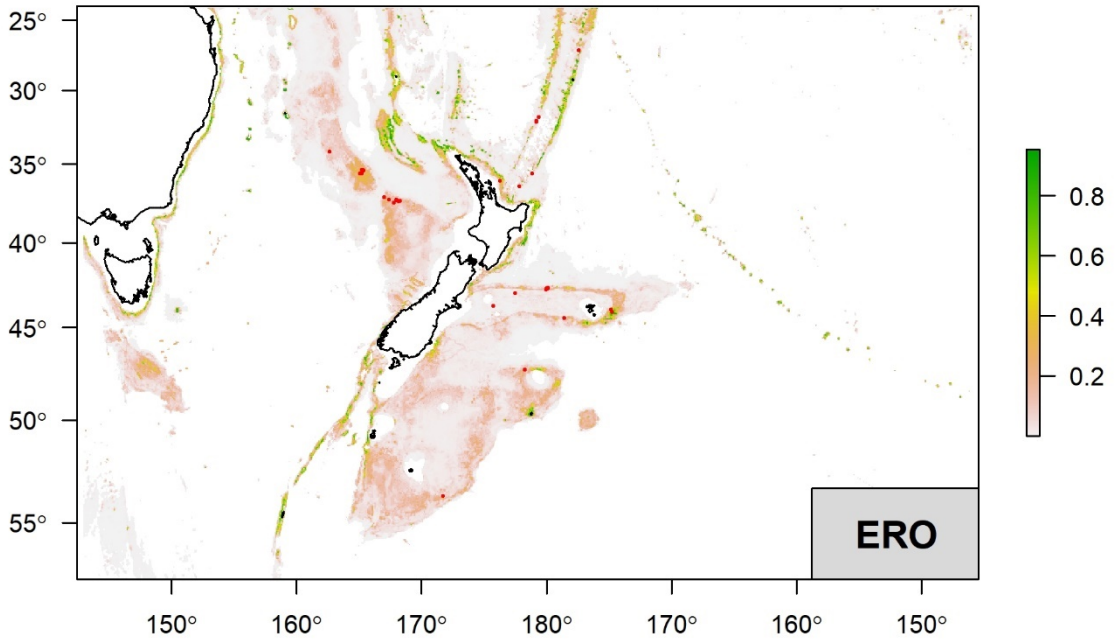
Taxon name	Taxon code	Georgian et al. (2019) data	New data	Total available data	% new data
Solenosmilia variabilis	SVA	582	182	764	24
Madrepora oculata	MOC	341	26	367	7
Goniocorella dumosa	GDU	614	127	741	17
Enallopsammia rostrata	ERO	354	61	415	15
Alcyonacea	SOC	7487	1280	8767	15
Antipatharia	COB	2637	362	2999	12
Stylasteridae	COR	2565	247	2812	9
Pennatulacea	PTU	896	669	1565	43
Demospongiae	DEM	7794	1803	9597	19
Hexactinellida	HEX	2199	1349	3548	38

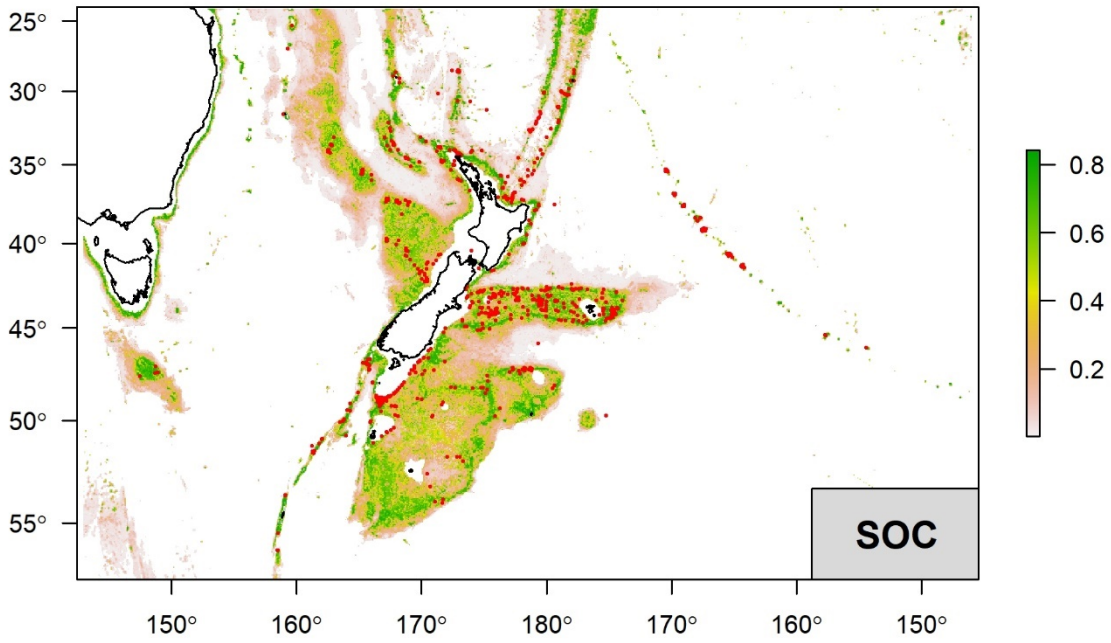
New data records for the VME indicator taxa were also plotted on maps of the habitat suitability predictions made by Georgian et al. (2019) to provide a spatial context for the new records (Figure 2).

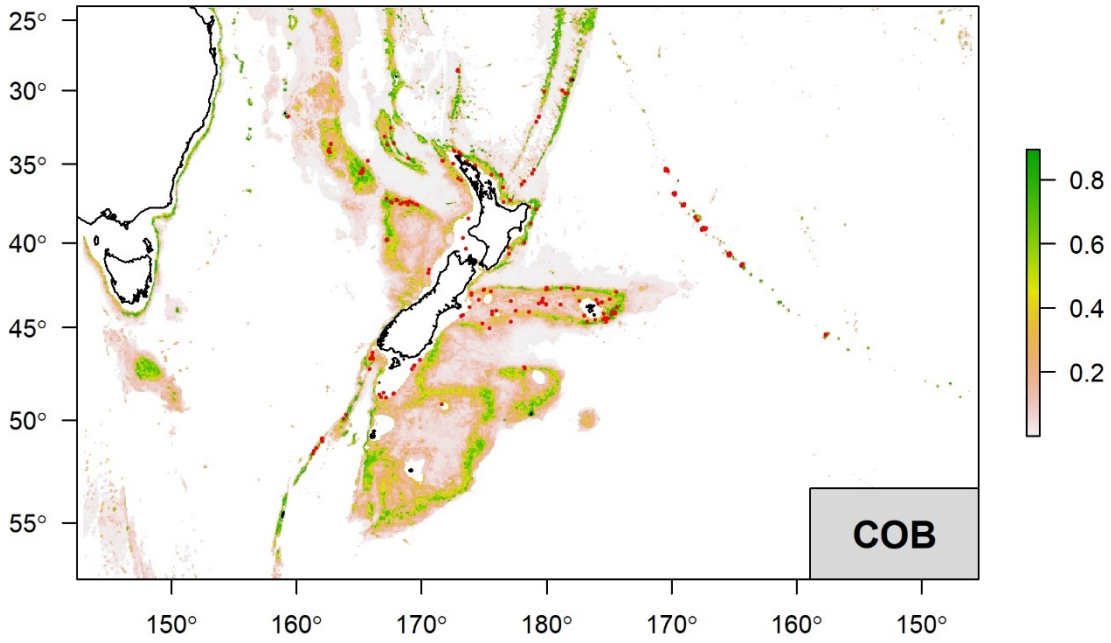

25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
SVA
0.8
0.6
0.4
0.2

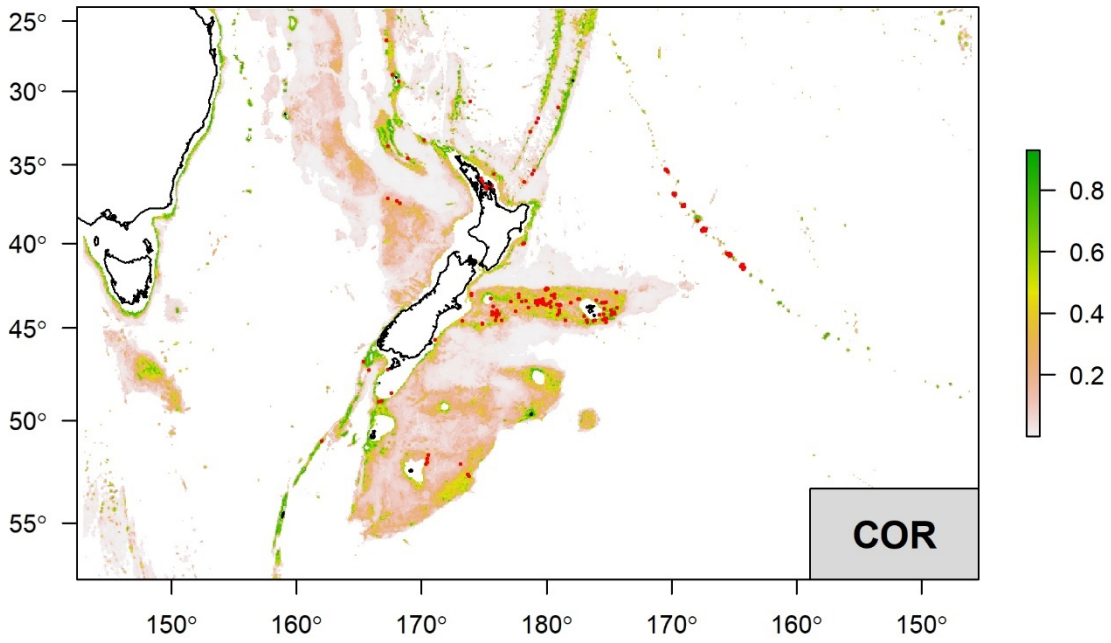

25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
MOC
0.8
0.6
0.4
0.2

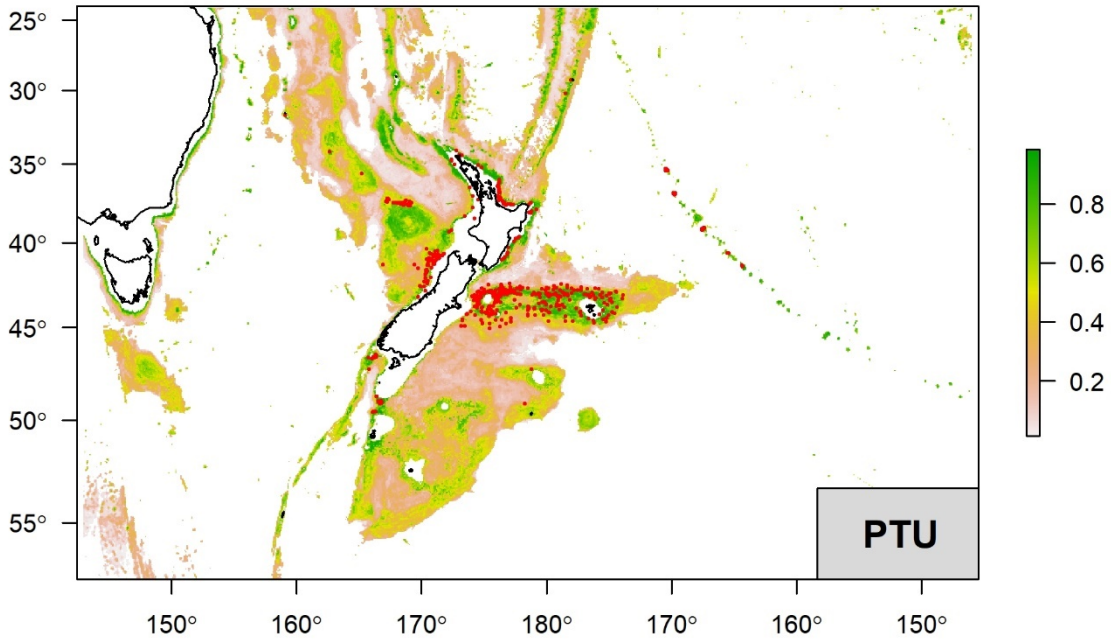

25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
GDU
0.8
0.6
0.4
0.2


25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
ERO
0.8
0.6
0.4
0.2


25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
SOC
0.8
0.6
0.4
0.2


25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
COB
0.8
0.6
0.4
0.2


25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
COR
0.8
0.6
0.4
0.2


25°
30°
35°
40°
45°
50°
55°
150°
160°
170°
180°
170°
160°
150°
PTU
0.8
0.6
0.4
0.2

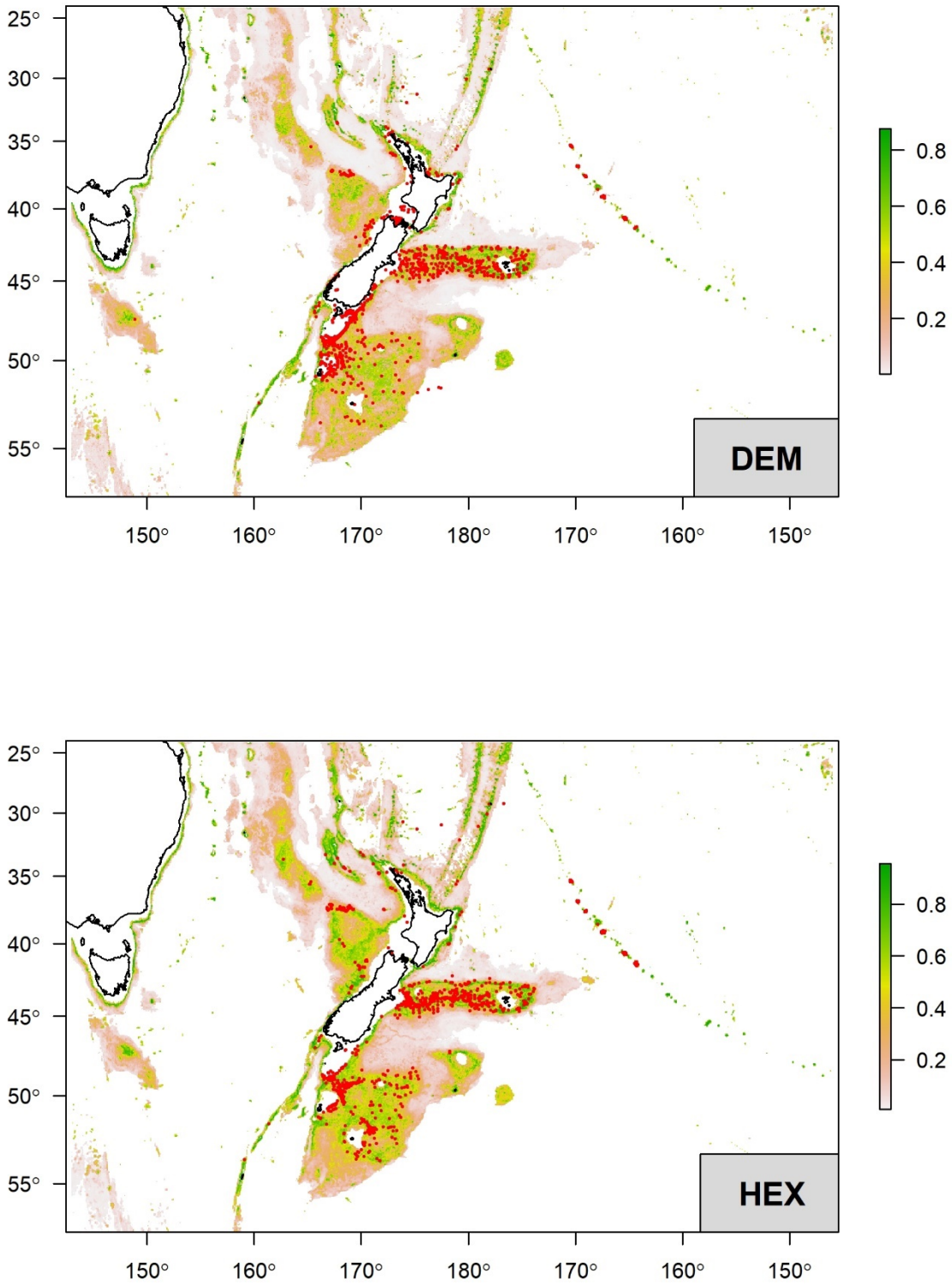


Figure 2: Maps showing new presence records for VME indicator taxa (red circles) overlain on the habitat suitability prediction of Georgian et al. (2019) (scale on right shows habitat suitability 1.0 to 0.0; see Table 2 for key to taxa codes).

5. Discussion

The purpose of this work was to determine the availability of new data for VME indicator taxa and consider the associated implications for the review of VME habitat suitability models in the SPRFMO area.

The number of new data records, subsequent to those used by Georgian et al. (2019) for the VME indicator taxa habitat suitability models, ranged from 26 (*Madrepora oculata*) to 1803 (Demospongiae). Broadly, there were 10s of records for *Madrepora oculata* and *Enallopsammia rostrata*, 100s for *Solenosmilia variabilis, Goniocorella dumosa*, Antipatharia Stylasteridae, Pennatulacea, and >1000 for Alyconacea, Demospongiae, and Hexactinellida. The various data sources contributed generally unequally to the total amount of new records across the ten VME indicator taxa. However, for taxa that had >1000 new records, most came from the *trawl* database. For some taxa, a notable proportion of the new data records came from the image datasets, a source of data not used for constructing the models of Georgian et al. (2019). These taxa were *Solenosmilia variabilis* (68%), Pennatulacea (65%), *Madrepora oculata* (38%), *Enallopsammia rostrata* (34%), Antipatharia (33%).

For most taxa, the new data records came from within the distribution envelope of the data used by Georgian et al. (2019) for their VME indicator habitat suitability models. However, there were some areas within this envelope where data were generally absent or scarce in the previous data compilation, and where a relatively large number of new records have now resulted from the updated data compilation. For example, new records for Pennatulacea and Antipatharia from the southern and central portions of Chatham Rise, respectively. There are also a few instances where new records now obviously extend the previous data distribution envelope. For example, new records for Demospongiae and Hexactinellida from the Louisville Seamount Chain. These notable spatial additions to data for the aforementioned VME indicator taxa are mostly from photographic surveys; data from which was not used by Georgian et al. (2019).

In terms of whether the new data records represent sufficient data (numerical amount, distribution) to use for testing the robustness of the Georgian et al. (2019) models, both the proportion of new records and their distribution relative to the spatial predictions of habitat suitability was assessed. The new records represent from 9% (Stylasteridae) to 43% (Pennatulacea) of the total amount of data now compiled for VME indicator taxa. Typically, 20-30% of the total available data is used when validating models using internal cross-validation (see procedure used by Georgian et al. 2019). Using this proportional range as a guide for whether sufficient new records now exist to test the individual models using independent data, there are sufficient data to test the models for the Pennatulacea, Hexactinellida, and *Solenosmilia variabilis.* New data for these taxa represent 43%, 38% and 24% of the total available data, respectively.

Ideally, new records for testing and improving models using independent data should come from areas where model data are absent or scarce, and/or where models predict a range of values from low to high habitat suitability (Anderson et al. 2016). Where many new records are found in areas where models predict low habitat suitability, then this raises concern about the accuracy of the model. As

already noted above, new data for Pennatulacea, Antipatharia, Demospongiae, and Hexactinellida are from areas where previous data compilations resulted in no or few records. Examination of the maps with the new data records overlain on the model predictions of suitable habitat indicates that new data do exist in areas representing a range of habitat suitability predictions for all VME indicator taxa. New records for *Enallopsammia rostrata* are mostly from areas of low habitat suitability, and suggest that the model for this taxon could be improved.

Overall, there are probably sufficient data, and reason, to consider the testing of the models of habitat suitability for VME indicator taxa used to develop the spatial management measures detailed in CMM-03-2019. However, first the newly compiled data, whose accuracy was taken on 'face-value' for this report, requires additional grooming to remove likely misidentifications (e.g., made by observers; Tracey et al. 2011). In addition, there are other data sources that could be used to access further new data. The most important data source in this regard are bycatch records from Australian fishing vessels.

There are a number of methods available for assessing the accuracy of habitat suitability models. Anderson et al. (2018) describe some of these, and should testing of the Georgian et al. (2019) models proceed, they or modifications thereof could be considered for use. Should such an examination of the models suggest that they could be improved by inclusion of the new data, then new models could be made to satisfy the SC6 Workplan to update models when deemed appropriate. Ultimately, a follow-up assessment of if/how the new models influence the VME conservation values that were used to devise the spatial management measures would satisfy the SC6 Workplan to re-assess said measures.

6. Recommendations

It is recommended that the Scientific Committee:

- **Agrees** that new records for VME indicator taxa should be obtained from Australian data sources, and that all new data should be groomed prior to being used to test the habitat suitability models of Georgian et al. (2019).

- **Agrees** that, should the testing of the models raise concerns about the accuracy of the habitat suitability predictions, then some or all of the models should be updated in 2020 to be used in the revised BFIA (refer paragraph 25 of CMM-03-2019).

7. Acknowledgements

Thanks are owed to Di Tracey, Sadie Mills, Diana Macpherson, Brent Wood, and David Fisher (all NIWA) for extracting and compiling new records for VME indicator taxa from various data sources. This work was funded by Fisheries New Zealand (SPR2018/01). We are also grateful for comments, suggestions and inputs from the Fisheries New Zealand's South Pacific Fishery Assessment Working Group.

8. References

Anderson, O.F., Guinotte, J.M., Rowden, A.A., Clark, M.R., Mormede, S., Davies, A.J., and Bowden, D.A. 2016. Field validation of habitat suitability models for vulnerable marine ecosystems in the South Pacific Ocean: Implications for the use of broad-scale models in fisheries management. *Ocean and Coastal Management*, 120, 110–126.

Anderson, O.A.; Bowden, D.A.; Rowden, A.A.; Clark, M.R. (2018). Quantifying benthic diversity: assessing the utility of existing models of benthic fauna distributions on Chatham Rise. MPI Final Research Report for project ZBD2016/11. 46 p.

Georgian, S.E., Anderson, O.F., Rowden, A.A. (2019) Ensemble habitat suitability modeling of vulnerable marine ecosystem indicator taxa to inform deep-sea fisheries management in the South Pacific Ocean. *Fisheries Research*, 211, 256-274.

Tracey, D., Baird, S. J., Sanders, B., Smith, M. H. (2011) Distribution of protected corals in relation to fishing effort and assessment of accuracy of observer identification. NIWA Client Report prepared for Marine Conservation Services (MSC), Department of Conservation, Wellington, New Zealand. 70 p.