# 8th MEETING OF THE SCIENTIFIC COMMITTEE

*New Zealand, 3 to 8 October 2020*

SC8-DW04

# Estimating Encounter Rates with Vulnerable Marine Ecosystem Indicator Species at Kopernik Seamount in the South Pacific Ocean from the Cook Islands Lobster Trap Fishery

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## Estimating encounter rates with vulnerable marine ecosystem indicator taxa at Kopernik Seamount in the South Pacific Ocean from the Cook Islands lobster trap fishery

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# Executive Summary

Under the auspices of CMM14b-2020 and its predecessors the Cook Islands has undertaken a three-year program of exploratory trap fishing targeting lobsters and crabs on seamounts along the Foundation Seamount Chain. This analysis attempted to assess encounters with Vulnerable Marine Ecosystems (VMEs) situated on Kopernik Seamount.

Generally, trap fisheries are assumed to cause little physical damage to the benthic environment, largely due to their small size and the immobile nature of the fishing operation when compared to trawl gear. Nevertheless, delicate organisms present in area where trap fisheries occur could be damaged when they come into contact with heavy traps.

The information presented here shows that potentially sensitive habitats are distributed across Kopernik Seamount, but also that they are distributed unevenly. More VME indicator taxa were encountered to the center and to the central east of the seamount, and in particular in the valley between the two Kopernik hills. This analysis provides a first glance at the potential impact of this fishery on the benthic environment on the Foundation Seamount Chain. Additional work is still required to gain a more complete picture of the total impact.

# 1 Introduction

South Pacific Regional Fisheries Management Organisation (SPRFMO) CMM14b-2020 allows for exploratory fishing to take place within the SPRFMO Convention Area. Under the auspices of CMM14b the Cook Islands has undertaken a three-year program of exploratory trap fishing targeting lobsters and crabs on seamounts along the Foundation Seamount Chain. As part of the data collection associated with the exploratory fishing the CMM requires that "*... all data necessary to assess encounters with [Vulnerable Marine Ecosystems (VMEs)] shall be collected to enable assessment and monitoring of the distribution of vulnerable marine ecosystems in the areas fished.*"

United Nations Food and Agriculture Organization (FAO) has developed criteria for defining VMEs, these include uniqueness or rarity; functional significance; fragility; probability of recovery; and structural complexity. In addition they have listed examples of taxa that are indicators of a VME that include: cold-water corals and hydroids; sponge-dominated communities; and seep and vent communities (Food and Agriculture Organisation [FAO], 2009). However, an ongoing challenge for RFMOs is how to determine suitable encounter thresholds to prevent significant adverse impacts on VMEs (Geange et al., 2020). Before determining suitable encounter threshold, one must first asses if, where and when organisms are encountered that would indicate the presence of VMEs.

Generally, trap fisheries are assumed to cause little physical damage to the benthic environment, largely due to their small size and the immobile nature of the fishing operation when compared to trawl gear. Nevertheless, delicate organisms present in area where trap fisheries occur could be damaged when they come into contact with heavy traps. The effects of traps on different types of seabed have not been widely documented (Schweitzer et al., 2018), although some useful experimental investigations have been undertaken (e.g. Eno et al., 2001). Clark et al. (2016) note that while static gears, such as traps are considered to have lower impacts than mobile gear types, during retrieval, static gear may move laterally across the seabed resulting in impacts to the habitat and biota. In addition, Kaiser et al. (2001) noted that biogenic reefs and areas that are relatively undisturbed by natural perturbations such as deep-water substrata are more likely to be affected by fishing than unconsolidated sediment habitats in shallow coastal waters.

The Cook Islands exploratory fishery which began in 2019 has provided new biological information on *Jasus caveorum* and *Chaceon* sp. as well as fishery data (Brouwer et al., 2019) and (Brouwer et al., 2020). Here we report on the fisheries interactions with the benthic environment, in particular we review the fishing gears contact with taxa that are likely to indicate the presence of VMEs.

# 2 Methods

The analysis required accurate depth information across the seamount. The depth data were obtained from the fishing operation over all trips and then depth and slope surfaces were calculated (Figure 1). This database consisted of 559 data points. A raster interpolation tool set was applied in ArcGIS to attempt to predict the continuous surface representation of the seabed. Inverse distance weighting (IWD) was then used to provide a deterministic interpolation where values to locations are assigned based on the surrounding measured values to determine the smoothness of the resulting surface (Johnston, 2004). Raster values were then reclassified to provide slope intervals and depth strata with five class rages. The reclassified raster was then converted to a polygon to allow the generation of contour lines and calculation of geometry attributes. Further reclassification of the polygons allowed for slope including, 0-5, 5-10, 10-18, 18-35, 35-67 degrees classes. The resulting points were then converted in into a grid in R (R Core Team, 2018) with mean slope and depth being assigned to each cell, and then the final grid was pooled into four broad depth groups for ease of analysis (Figure 2).

The vessel sets traps on a longline and records the start, mid and end points of each line. Traps are spaced 25m apart. Trap positions were interpolated assuming even space along the line and a latitude and longitude assigned to each trap. Traps were then aggregated spatially into the grid to get estimates of VME indicator taxa caught and trap effort for each grid square. Data are then presented spatially as absolute catch and as Catch per Unit Effort (CPUE) in numbers per trap.

# 3 Results

While all bycatch is reported here, spatial analyses were only undertaken at Kopernik Seamount. Kopernik has the highest effort and therefore the most data. The remaining seamounts did not have enough data for in-depth spatial analyses at this stage. Kopernik Seamount consists of two flat topped hills next to one-another separated by a deep valley (Figure 1). The slope sides are relatively steep, and the western hill has a deep hole roughly in the middle.

Overall 19 bycatch species were reported across the four trips undertaken to date (Table 1), and bycatch species were reported at nine seamounts (Table 2). Seven taxa that are considered to be possible indicators of VMEs were landed (Table 3), although this could be an under estimate as the observes noted that some material that was attached to the traps fell off if the trap hit the side of the vessel in rough seas and identification was not possible in these cases.

Fishing effort covered both hills of Kopernik and was largely centred on the relatively flat hill tops, although a few sets placed traps along the slope edge (Figure 2). VME indicator taxa were caught in low numbers but over a relatively wide area, however, higher numbers occurred in the valley between the two hills (Figure 2).

Assessing the VME indicator taxa CPUE, despite the low catch rates, there is a strong evidence of high encounter rates in the valley separating the two Kopernik hills (Figure 3).

# 4 Discussion

Complex habitats enhance community structure and species richness, and biogenic habitats consisting of sponges, corals, and bryozoans increase structural complexity providing critical habitat for fish and invertebrates (Schweitzer et al., 2018). Lobster traps can interact with the benthos in two ways, firstly when the trap lands on the seabed, and secondly at the hauling stage when the trap can be dragged across the sea floor. Upon landing on the seabed the traps potential for damaging the benthos is relatively low as flexible organisms like sea pens will bend out of the way of the trap, being pushed aside by the wake of the incoming trap (Eno et al., 2001), and hard structures could withstand the net placement over them, but may break if the trap frame lands on them. However, on retrieval observations have noted that larger areas are impacted and the damage can be more destructive, but that also depends on trap placement along the line (Schweitzer et al., 2018). At this stage we are uncertain as to the impact this may have or the distance traps in this fishery could be dragged on retrieval.

The information presented here shows that potentially sensitive habitats are distributed across Kopernik Seamount, but also that they are distributed unevenly. More VME indicator taxa were encountered to the center and to the central east of the seamount. The catch rate data showed that they are encountered at disproportionately high rates in the Kopernik valley. While the encounter rates here are disproportionately high, relative to other areas, numerically overall the total encounter rate is low. With a total of 88 individuals encountered on 66 traps from over 18,000 traps set in the area over the four trips. This encounter rate (0.0049 individuals per trap) even if an underestimate is still very low.

This analysis provides a first glance at the potential impact of this fishery on the benthic environment on the Foundation Seamount Chain. Additional work is still required to gain a more complete picture of the total impact. Namely video analysis to get a more complete picture of the trap settlement damage and potential haul drag damage, as well as an indication of weather individual VME indicator taxa are lost from the trap and not recorded.

Follow up work will include the analysis of video footage to classify the benthos across the various seamounts, as well as attempt to estimate the distance dragged of trap being retrieved. Once a more complete view of the area is obtained targeted video/camera deployment could also be considered to improve our understanding of the overall impact of this fishery.

Finally, potential management actions could be considered should the need arise in the future. One obvious mechanism could be limiting sets to one hill per line (i.e. not allowing the longline to straddle the Kopernik valley), developing a buffer zone either side of the valley or instructing the vessel to avoid the Kopernik valley when setting. However, at this stage given the very low encounter rate and pending video analysis, this may seem premature.

## Acknowledgements

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# Tables

**Table 1: Bycatch recorded on all trips from all seamounts fished during the Cook Islands exploratory trap fishery on the Foundation Seamount Chain.**

| English name | Trip 1 | Trip 2 | Trip3 | Trip 4 |
|---|---|---|---|---|
| Anthozoa | 9 | 0 | 0 | 0 |
| Black coral | 0 | 1 | 0 | 0 |
| Blue shark | 1 | 0 | 0 | 0 |
| Chaceon geryons nei | 17 | 0 | 46 | 0 |
| Cnidarians nei | 9 | 0 | 3 | 19 |
| Cusk-eels nei | 0 | 0 | 0 | 2 |
| Echinoderms | 0 | 0 | 0 | 12 |
| Hydrozoans | 1 | 1 | 0 | 3 |
| King crabs, stone crabs nei | 0 | 0 | 1 | 3 |
| Marine shells nei | 0 | 0 | 1 | 0 |
| Moras nei | 0 | 0 | 0 | 1 |
| Nylon shrimps nei | 0 | 0 | 14 | 237 |
| Porae | 1 | 0 | 0 | 1 |
| Scorpionfishes, redfishes nei | 1 | 0 | 2 | 4 |
| Siliceous sponges | 1 | 0 | 0 | 0 |
| Tarakihi | 11 | 0 | 0 | 0 |
| Trumpeters nei | 1 | 0 | 0 | 0 |
| Rhodolith | 0 | 0 | 2 | 0 |
| Ball coral | 0 | 25 | 0 | 0 |

**Table 2: Bycatch recorded on all seamounts fished during the Cook Islands exploratory trap fishery on the Foundation Seamount Chain.**

| English name | Buffon | Galilei | Humboldt | Kopernik | Linne B | Mendel | Mendeleiev | Mercator | MM |
|---|---|---|---|---|---|---|---|---|---|
| Anthozoa | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 |
| Black coral | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Blue shark | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Chaceon geryons nei | 46 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 3 |
| Cnidarians nei | 2 | 0 | 0 | 8 | 0 | 0 | 0 | 1 | 20 |
| Cusk-eels nei | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Echinoderms | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 |
| Hydrozoans | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 3 |
| King crabs, stone crabs nei | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Marine shells nei | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Moras nei | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Nylon shrimps nei | 14 | 111 | 86 | 0 | 6 | 33 | 0 | 0 | 1 |
| Porae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Scorpionfishes, redfishes nei | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 4 |
| Siliceous sponges | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Tarakihi | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 |
| Trumpeters nei | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Rhodolith | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Ball coral | 0 | 0 | 0 | 25 | 0 | 0 | 0 | 0 | 0 |

**Table 3: Observed Vulnerable Marine Ecosystem Indicator Species from all seamounts fished during the Cook Islands exploratory trap fishery on the Foundation Seamount Chain..**

| English name | Trip 1 | Trip 2 | Trip3 | Trip 4 |
|---|---|---|---|---|
| Anthozoa | 9 | 0 | 0 | 0 |
| Black coral | 0 | 1 | 0 | 0 |
| Cnidarians nei | 9 | 0 | 3 | 19 |
| Hydrozoans | 1 | 1 | 0 | 3 |
| Siliceous sponges | 1 | 0 | 0 | 0 |
| Rhodolith | 0 | 0 | 2 | 0 |
| Ball coral | 0 | 25 | 0 | 0 |

# Figures

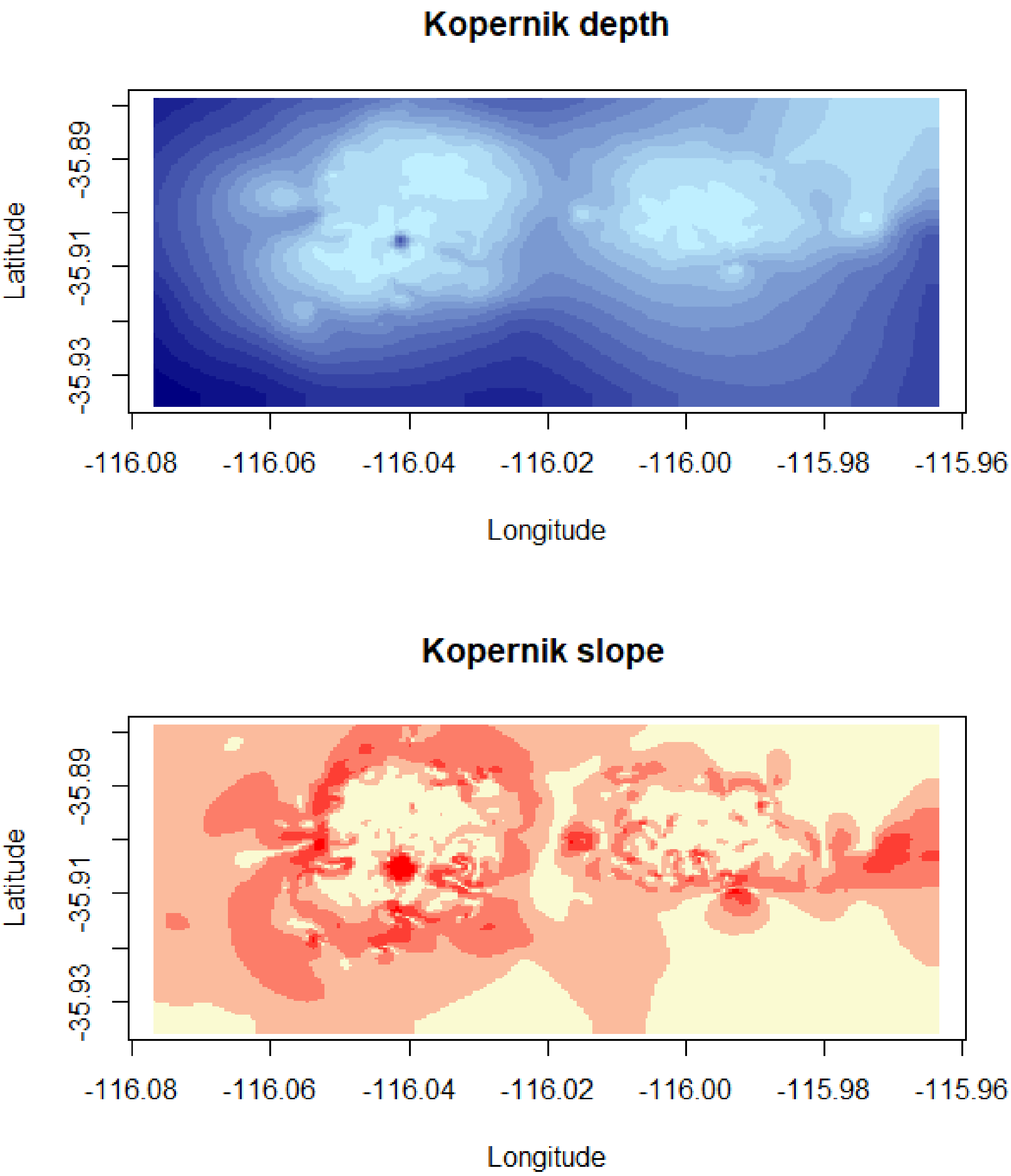


**Figure 1: Kopernik Seamount showing the interpolated depth (top) and slope (bottom). Deeper blue - deeper depths, deeper red = steeper slope.**

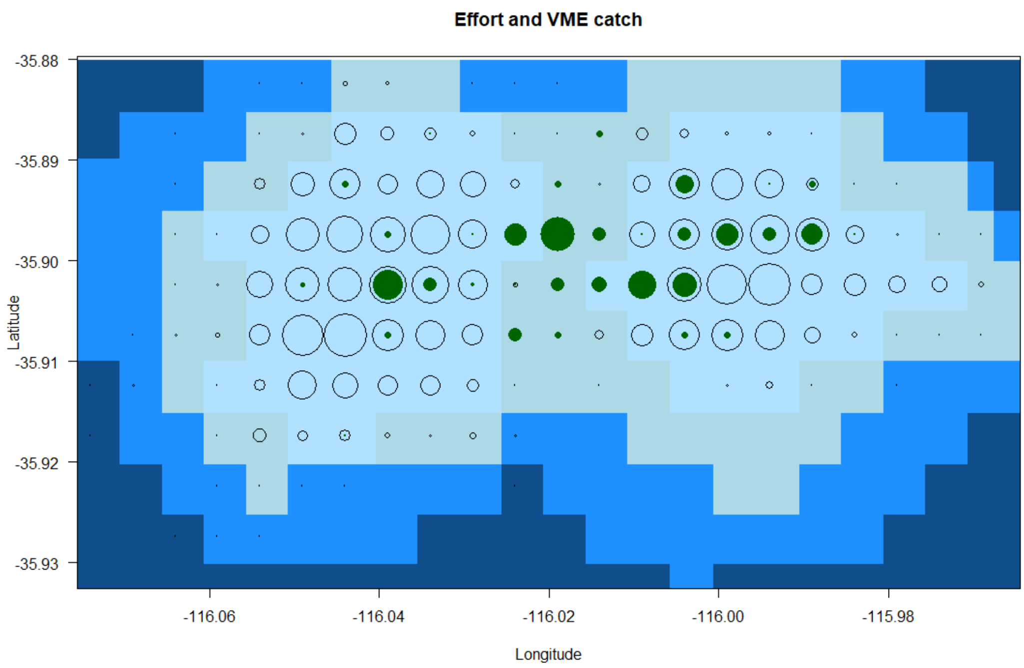


**Figure 2: Kopernik Seamount showing the depth group, effort by cell and VME indicator taxa catch per cell. Deeper blue - deeper depths, deeper red = steeper slope.**

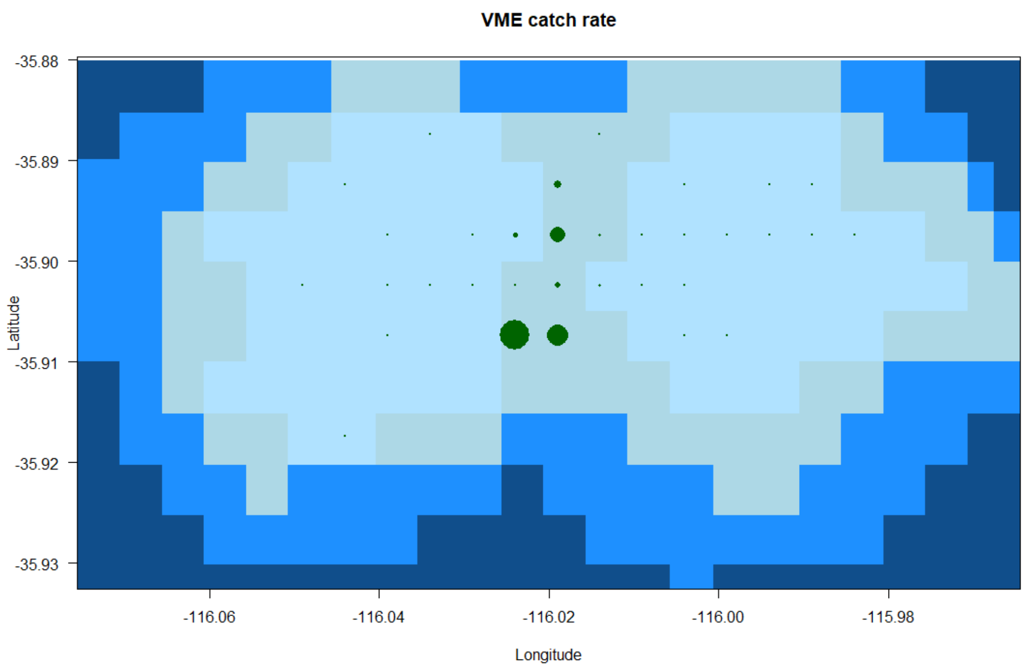


**Figure 3: Kopernik Seamount showing the depth group, and Catch per Unit Effort (number per trap) of VME indicator taxa per cell. Deeper blue - deeper depths.**