SPRFMO
South Pacific Regional Fisheries Management Organisation

7th MEETING OF THE SCIENTIFIC COMMITTEE

La Havana, Cuba, 7 to 12 October 2019

SC7-DW01_Rev2

Cook Islands revised Fisheries Operational Plan for an Exploratory Potting Fishery in the SPRFMO Area

Cook Islands

Ministry *of* Marine Resources
GOVERNMENT OF THE COOK ISLANDS

7th Meeting of the Scientific Committee
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SC7-DW01 rev2

Cook Islands Fisheries Operation Plan for an Exploratory Potting Fishery in the SPRFMO Area

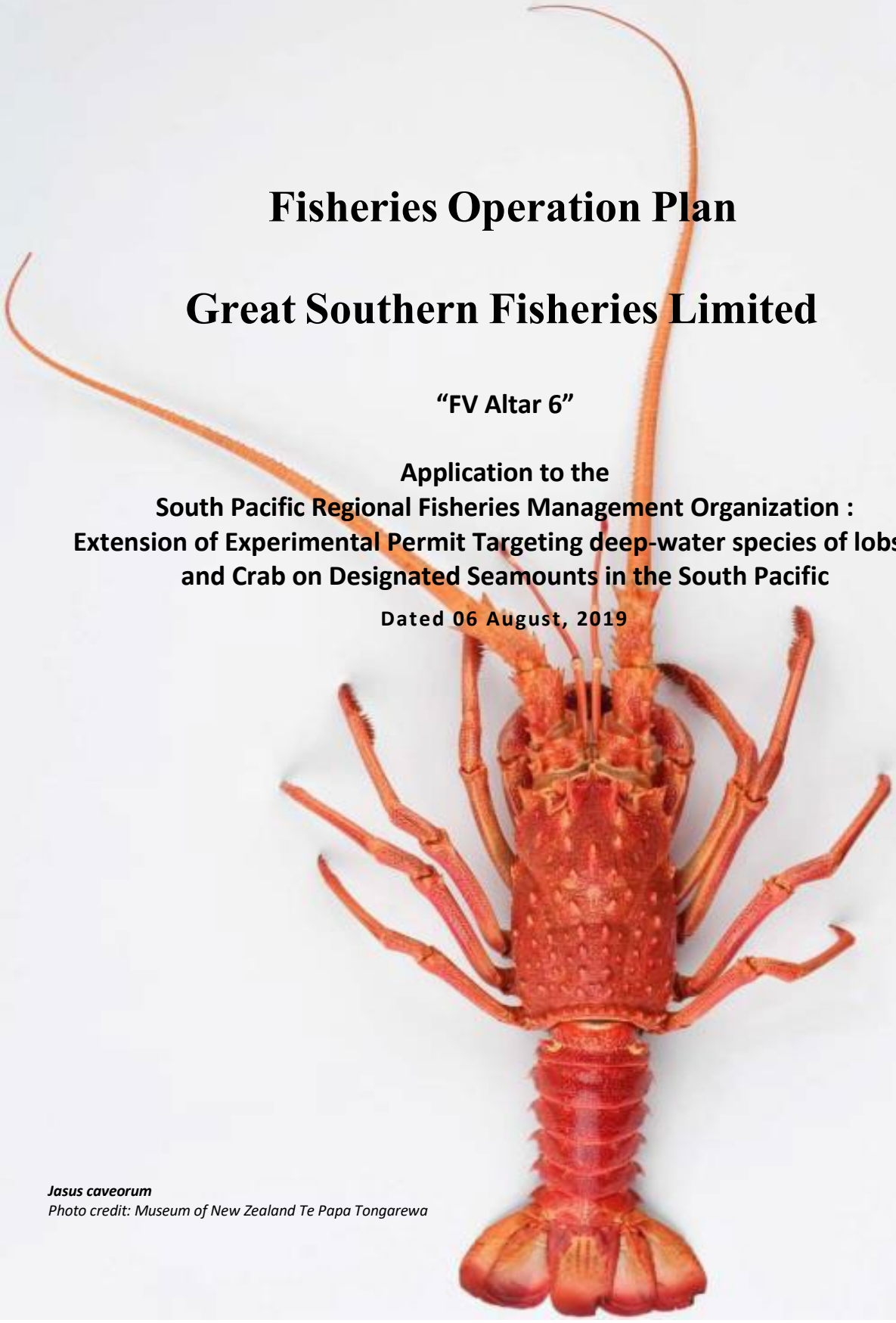
Fisheries Operation Plan

Great Southern Fisheries Limited

"FV Altar 6"

Application to the
South Pacific Regional Fisheries Management Organization :
Extension of Experimental Permit Targeting deep-water species of lobster and Crab on Designated Seamounts in the South Pacific

Dated 06 August, 2019



Jasus caveorum
Photo credit: Museum of New Zealand Te Papa Tongarewa

Executive Summary

The two –year exploratory fishing program provided by CMM 14b-2018, and subsequently superseded by CMM14b-2019, has successfully completed two trips in year 1 with new and important biological information collected for *Jasus* sp and *Chaceon* sp. These trips provided information on populations present as well as information on target stocks and marine ecosystems. Information collected during these first trips have guided the revision of the Cook Islands Fisheries Operations Plan, which has assessed the effectiveness of existing mitigation measures, to ensure that the bottom pot fishery is developed through a precautionary and gradual process, in accordance with the best available scientific information. To maximize the value of future data collection for the Cook Islands and Great Southern Fisheries Limited, the Cook Islands has screened the collected material and analysed all available data to ensure relevant adjustments are made to current exploratory methods, in accordance with CMM 14b-2019.

This revised FOP addresses the assessment made from the SPRFMO Scientific Committee 6th meeting in 2018 (SC-06), namely the revised FOP now provides a formal sampling program conforming to the Convention, CMM13-2019 and other relevant CMMs, proposes long term viability of the target species as well as mitigation measures to ensure the integrity of Vulnerable Marine Ecosystems (VME) is maintained within the fishing operation area.

It is also proposed that as a TAC cap has already been set on the catch that the fishing day limit be revised upwards from the current 30 days per trip and that testing of the 13 identified seamounts is permitted from year two. The rationale for this is not to be less precautionary, but rather to allow the operator more flexibility in operations to survey grounds for suitable fishing while still remaining within an appropriate potential catch limit. Following the advice of the SC7, this document has been updated and re-tabled as FOP rev2. This revision includes corrections, clarifications and the intent of the TAC and the proposal for further analysis.

In addition, the following recommendations are made to SC7:

1) Recommend that the SPRFMO Commission extend the expiry date to CMM 14b-2019 to 2022, aligning the CMM to the start of fisheries operations
2) Request that the SC7 endorse the following management actions:
    a. Set the total allowable catch (TAC) at 300t a year for fishing years 2 and 3.
    b. Set a trip specific total allowable effort (TAE) at 80 days per trip, setting and hauling no more than five lines of 100 traps a day, with a limit of 75% of the TAE on Kopernik Seamount (60 days).
    c. Allow for five additional fishing days for experimental fishing to accommodate the proposed experimental trapping as outlined in Appendix 7.
    d. Set CPUE limit of 4 kg per trap for Kopernik Seamount assessed weekly through a moving 30 day window starting on day 30 and being assessed every 7 days thereafter. Should this limit be reached, MMR will close Kopernik Seamount as allowed for in Section 52 of the MMR act of 2005, if this limit is triggered Kopernik Seamount will remain closed to fishing pending SCs review of the Cook Islands planned ongoing response.
    e. Lift the limit on fishable Seamounts as specified in paragraph 6c of CMM 14b-2019, which restricts effort to eight out of 13 identified seamounts, to allow for fishing on 15 seamounts within the region specified under paragraph 5 of CMM 14b-2019.

Table of Contents

This FOP should be read in conjunction with three other submissions, namely:

1. SPRFMO Scientific Observer Exploratory Potting Fishery Cruise Report : Observer report Trip 1 FV Altar 6 : 19/03/2019 To: 20/05/2019

2. SPRFMO Scientific Observer Exploratory Potting Fishery Cruise Report : Observer report Trip 2 FV Altar 6 : Altar 6 Trip 2 – 27 May -12 July 2019

3. Brouwer, S., Wichman, M., Maru, P., Epstein, A. and D. Japp. Cook Islands Exploratory Potting in the SPRFMO – Trips 1 & 2, (2019). (SC7-DW02)

Acronyms

CMM	Conservation Management Measure
EPF	Exploratory Potting Fishery
ETP	Endangered, Threatened and Protected species
FOP	Fisheries Operational Plan
FSC	Foundation Seamount Chain
GSF	Great Southern Fisheries
MMR	Ministry of Marine Resources (Cook Islands)
PA	Precautionary Approach
PSA	Productivity Susceptibility Assessment
SC	Scientific Committee (of SPRFMO)
SPRFMO	South Pacific Fishery Management Organization
TAC	Total Allowable Catch
VME	Vulnerable Marine Ecosystem

1.0 Operator Details, Proposed Activities in the Management Area and Target Species

Vessel Owner Operator

The operator of the vessel FV Altar 6 is *Great Southern Fisheries Ltd* (GSF), a company incorporated under the laws of the Cook Islands and based in Avarua, Rarotonga. Vessel details are provided in Appendix 1.

Principals

The principal, Alexander Epstein and the Scientific Team lead by Dr. David Japp have substantial experience in this type of exploratory research fishing operation proposed, including experience in other exploratory and research fishing in similar fisheries. They are cognizant of the requirements and objectives of SPRFMO, particularly in respect of the sensitive nature of the marine environment and benthos when conducting bottom fishing operations.

Owners' Representatives

The below named individual is the primary contacts for all operational, management and corporate matters.

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Official Flag-State Contact: Cook Islands Ministry of Marine Resources

The below named individual is the primary contact for all flag state matters and official SPRFMO correspondence.

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Licensing

GSF has an Access Agreement, Fishing License and High Seas Permit issued by the Ministry of Marine Resources (MMR), which will, *inter alia*, provides for the annual authorization of the vessel. These authorization documents require the company and the vessel to comply with all Cook Islands laws and the regulations, and all SPRFMO Conservation and Management Measures adopted by the Commission including standards for the collection, reporting, verification, and exchange of data on the management of the Bottom Fishing (CMM03-2019), minimizing By-catch of Seabirds (CMM 09-2017) and Exploratory Potting Fishery (EPF) (CMM-14b-2019) in the SPRFMO Convention area. Under the Marine Resources Act 2005, the Cook Islands have considerable powers of sanction against the company, master, crew and the vessel in the event that requirements of this EPF are not met.

Area of Interest

This document confirms the area to conduct the EPF as outlined in CMM 14b-2018, approved by the SPRFMO Commission. The geographic area for this EPF is identified in the boxed area of the SPRFMO Management area shown in Appendix 2a & 2b known as the Foundation Seamount Chain defined within the boundaries Longitude 100 – 134° W , Latitude 31-40° S with an area 2,400 x 880 km^2 .

2.0 SPRFMO Conservation Measures and Obligations

This document is submitted by MMR with GSF and is an updated Fisheries Operation Plan (FOP2) including updated data collection procedures for the Exploratory Potting Fishery (EPF) for lobster (*J. caveorum*, *Projasus sp*) and crab (*Chaceon sp)*. It is submitted cognizant of the SPRFMO CMM 13-2019 (Exploratory Fisheries) requiring submission of a revised FOP, 60 days prior to the annual meeting of the Scientific Committee (7th October 2019). Further, with regard to this meeting, supplementary information documents comprising observer trip reports undertaken to date and a consolidated scientific report of the information collected has also be submitted. MMR and GSF will be supported at the SC by a scientific team able to respond and engage on all matters related to the FOP and data collected.

The initial "Exploratory Fishing Application" for the Great Southern Fisheries, LTD (GSF), COMM6-INF 07, was approved at the 6thSouth Pacific Regional Fisheries Management Organization (SPRFMO) Commission meeting held in Lima, Peru on February 3rd 2018 with the adoption of Conservation and Management Measure, CMM 14b-2018 (superseded by CMM 14b-2019). FOP2 recognizes the Commission is mandated to adopt a Precautionary Approach (PA) and an ecosystem-based approach (EBA) to the management of the fisheries resource within the SPRFMO Convention Area. GSF recognizes this EPF must be conducted in a manner consistent with all relevant CMMs adopted by the SPRFMO Commission (https://www.sprfmo.int/assets/Fisheries/Conservation-and-Management-Measures/2019-CMMs/) and is not exempt from complying with any Convention obligations or any other CMMs adopted by the Commission.

The aim of the EPF, and as stated in SC6 report of 2018, is to proceed with a precautionary and gradual approach until sufficient information is acquired to enable the Commission to adopt appropriately detailed CMMs in the future. GSF initiated the EPF on 19 March 2019 (original starting date was anticipated as November, 2018). To date (2019), two trips have been completed with an anticipated 3rd trip in October-November 2019.

The objective of this updated FOP2 and EPF (responsive to CMM 14b-2019) to be implemented by the FV Altar 6, is to collect and provide the scientific data for evaluating the long-term fishery potential for *J. caveorum*, *Projasus sp.* and *Chaceon sp.* in the Foundation Seamount Chain (FSC) (Annexure 2a and 2b) within the SPRFMO Convention Area. To ensure the EPF continues to be developed on a precautionary and gradual basis according to the best available science, the data collected during FV Altar 6 operations in 2019 has been made available to assess the potential impacts on the target species, associated or dependent species, the marine ecosystem and to evaluate the effectiveness of the current Conservation and Management Measures (CMM). In this regard, GSF continues to collect the necessary data to fulfill its obligations to follow the exploratory protocols as laid out by SPRFMO below:

a. Determine the geographical range of the target species within the Foundation Seamount Chain, which includes depth range and relative stock density on eight seamounts;

b. Identify and survey through test fishing suitable seamounts for survey, including the 8 seamounts identified in the 2018 EPF (Appendix 2);

c. Evaluate the biology of the target species including review of size composition, sex ratios, variation in DNA signatures and other relevant biological information to better understand these species;

d. Document any potential Vulnerable Marine Ecosystems (VMEs) in the research zone, plot their locations of VME indicator species and produce a VME map in 3D projections for each seamount researched;

e. Identify the composition and extent of potential VMEs using video to assist in the evaluation of potential VMEs and other seafloor structures to better understand the type of habitat and the density of the target and by catch species;

f. Build a robust reporting plan while collecting all research data, and have it compiled for easy dissemination to the SPRFMO SC and MMR to better understand the biology of the target species, stock densities, population dynamics and species interactions across the research zone and the development of a sound biomass assessment in support of a management strategy for a future fishery.

Given the changes in the high seas management of the fishery resources in the Southern Pacific Ocean with the formation of the SPRFMO Commission, exploratory and commercial fishing voyages for target species are now mandated to account for interactions and footprints left on the physical environment. GSF is familiar with this and will have on board their vessel and familiarise themselves with the following documents:

1. FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas;
2. Current CMMs as adopted by SPRFMO;
3. (2006) Ecosystems and Biodiversity in Deep Waters and High Seas., UNEP Regional Seas Report and Studies no. 178, United Nations Environment Programme;
4. (2008) Evidence of a VME form, Ministry of Primary Industries, New Zealand;
5. Template for the compilation of information describing specific habitats in the Southern Pacific Ocean.

Further, CMM 14b-2018 (superseded by CMM14b-2019) called for effort limitation through designating fishing on eight (8) seamounts out of 62 documented in the FSC (Appendix 2a-h) during the course of two trips in 2019, each with a maximum of 30 fishing days. The maximum harvest level set by SPRFMO was 600 tonnes of whole weight for the combined species of *J. caveorum*, *Projasus sp.* and *Chaceon* sp. in Year 1.

In the first year of the EPF, the first trip was scheduled to start in February 2019 followed by a second

trip starting on the 15th April 2019. There were, however, delays in the commencement of the fishing period. Fishing trip operations and details are provided in the two observer reports where updated reflections of trip achievements are presented.

With the adoption of CMM 14b-2019 SPRFMO provided clear conditions on fishing periods and catch limits for Year 2. These included:

I. Year 1 from 1 July 2018 to 30 June 2019 (two trips 60 days total, 600 t catch limit)

II. Year 2 from 1 July 2019 to 30 June 2020 (300 t catch limit)

III. Exploratory fishing on the 8 selected seamounts

Under FOP1 (for Year 1), GSF has completed two 30 day fishing trips. GSF works closely with MMR and has contracted a support team to monitor the operation to provide an independent scientific service.

Collectively, the GSF and MMR's research and management team have submitted for consideration at SC7 documents in support of the fishing and research undertaken in Year 1 including:

1) Trip 1 and 2 observer reports;
2) A consolidated scientific report and analysis of the data collected, and;
3) Full access data base with all data collected on the trips in Year 1.

Further, noting the requirements of CMM 14-2019, GSF and MMR have prepared herewith a revised FOP for Years two & three (FOP2). If the SPRFMO 7th SC supports the FOP2 (herein) then the FOP2 be forwarded to the SPRFMO Commission for their consideration at their annual meeting scheduled to be held in February 2020. This new plan includes a revised research plan and an experimental fisheries plan to support the continued investigation on the crustacean species (*J. caveorum*, *Projasus sp.* and *Chaceon sp.*).

3.0 Introduction and Methodology

3.1 The Environment and Bathymetry of Foundation Seamount Chain

The Foundation Seamount Chain, due to its location, length and East/West orientation is subject to upwelling of nutrient-rich water from the Antarctic circumpolar current, driving the cold nutrient-rich waters north where a mixing of the Easterly sub-tropical current takes place (see Figure 1). This flow travels largely parallel to and across the ridges and seamounts in the Foundation Seamount Chain, mixing the sub-tropical waters with the cold sub-Antarctic waters. The mixing extends from the sea surface to depths of 2000-4000 m and can be as wide as 400 km.

The cold flow is intensified by upwelling of deep water caused by the combined effects of the drag of surface winds of the Southeast Trades and the Earth's rotation. The upwelling brings abundant nutrients close to the surface, where the eddies are believed to be sufficiently strong to reverse the direction of the surface currents in this area where shallow undercurrents exist, that flow in a direction counter to that at the surface. The East/West latitudinal trend mentioned earlier is expected to allow for a regional "hot spot" of biodiversity for crustaceans, molluscs, and microalgae across the FSC, whereby the same benthos is likely to occur throughout the chain.

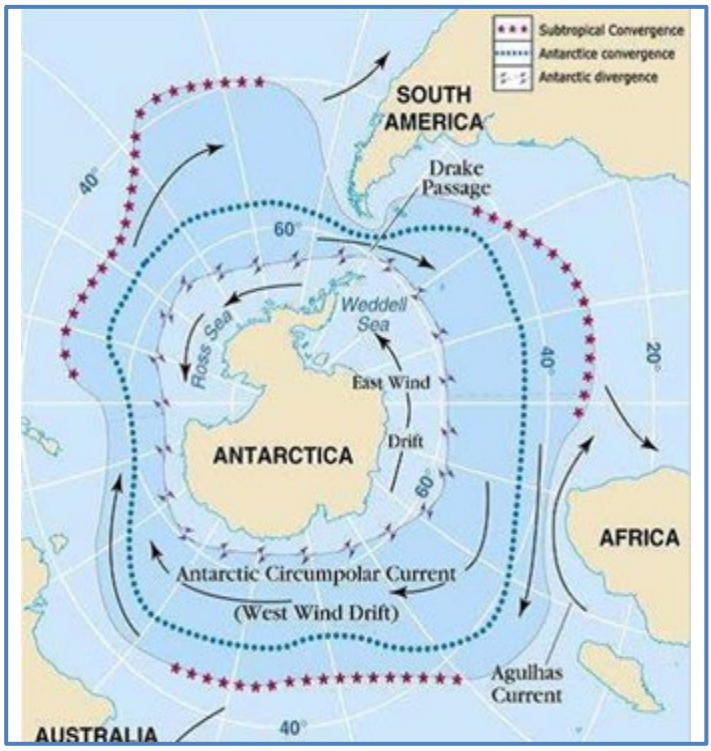


Figure 1. Schematic of Antarctic circumpolar current.

The oceanography of the Foundation Seamount Chain has not been extensively investigated on a fine scale, except by a high resolution bathymetrical multinational survey conducted in part by Dr. David Sandwell of Scripps Institute of Oceanography in California (Sandwell and Smith, 1997). GSF has communicated with Dr. Sandwell regarding his work on Marine Gravity Anomaly from Satellite Altimetry and Predictive Seafloor Topography. This fine scale bathymetric survey of the FSC provided him with soundings data to enhance and validate his predictive model to map seafloor topography from satellite altimetry data. He has shared with GSF his comprehensive bathometric charts of the Foundation Seamount Chain generated from his survey. This survey used satellite data, and then was followed up with an at-sea ship survey of the Foundation Seamount area using multi-beam echo-sounders (Maia, M, Dyment, J., Gente, P., Jouannetaud, D., 1999) RF Sonne survey of 1995 (Devey et al., 1997). In return GSF has agreed to forward all their soundings data to Dr. Sandwell collected during their research fishing on the Foundation Seamount Chain which he will use to improve his predictive model for the FSC. The development of this technology will be very important to future distant deep-water fisheries in the area. Dr. Sandwell's predictive modelling of seafloor topography will improve the ability of the scientific team to delineate the bottom structure in crustacean habitat and any potential VMEs seamount surveyed by GSF within the FSC.

3.2 Exploratory Fishing Gear Used

As described in the year 1 FOP, GSF deployed longline traps designed to catch deep-water crustaceans on seamounts. These traps were the only trap types used on the two trips undertaken so far. Under guidance from the scientific team modifications were made with cotton breaker lines in case traps were lost (to minimize ghost fishing effects), as well as trials with small mesh on selected traps to test selectivity (see Appendix 3). GSF intends to persist with this selective approach deploying EPF traps only in survey areas where there is a likelihood of a high density of the target lobster species. The approach has proven correct based on the two trips completed to date with low bycatch and a single lobster species caught (*J.*

caveorum) as well as crab (*Chaceon* sp.)

The traps used (see Appendix 3) are 150cm diameter at the base, 75cm high and 50cm diameter at the top. The entrance to the trap is 35cm in diameter and the trap is covered with netting of 5cm mesh. The backbone (ground line) and float line for each string of traps is made of 25mm polypropylene rope with each trap on each string spaced 25m apart. The traps have been constructed with "escape gaps" to allow for escapement of the small organism (Appendix 3). When targeting *Jasus* sp. or *Chaceon* sp. the escape gaps will remain open. When exploratory fishing is commenced for the smaller *Projasus* sp., the escape gaps will be closed with a flap of netting.

4.0 Operational Approach under CMM 14b-2018/19

The SPRFMO Commission's CMM 14b-2018/19 for an EPF in the SPRFMO Convention Area implemented by GSF is binding beginning on 5th May 2018 and expires in September 2021. In the first year GSF agreed to conduct two (2) 30 fishing day exploratory trips on eight (8) of the documented 62 seamounts in the FSC (see Table 1). The first of these trips commenced on the 19th March 2019 and ended on 20th May 2019 and the second trip commenced from the 27th May to 12th July 2019. These dates are inclusive of steaming time to and from the fishing grounds (Appendix 2b).

Table 1. The 13 seamounts with seafloor depths expected to be above 500 m of which eight (8) were listed to be surveyed in the 2018/2019 FOP.

Seamount No.	Seamount	Depth Range	2018/2019 fishing status	Km² 0-500M	Description	Comments
1. #8	Buffon	300-500	Yes	1.17	N-S Elongated Structure	Scatted Cones
2. #12a	Darwin A	300-500	Yes	90.41	Elongated Structure	Flat Summit Plateau
3. #18	Galilei	300-500	Alternate	12.40	Conical Structure	Circular Flat Summit
4. #22	Humboldt	300-500	Alternate	3.22	Circular Structure	Flat Summit
5. #23	Jenner	300-500	Yes	22.72	Elongated Structure	Flat Summit
6. #25	Kopernik	180-500	Yes	115.20	Circular Structure	Flat Summit
7. #27b	Linne b	200-500	Alternate	11.89	Circular Structure	Flat Summit
8. #28	Mendel	150-500	Yes	47.96	Elongated Structure	Flat Summit
9. #29	Mendeleiev	200-500	Alternate	9.18	Circular Structure	Flat Summit
10. #30	Mercator	300-500	Yes	46.77	Elongated Structure	Flat Summit
11. #37a	Platon	300-500	Alternate	3.11	Flank Structure	Rift Zone
12. #46	MM	150-500	Yes	318.87	Elongated Structure	Flat Summit with Cones
13. #48	GB	150-500	Yes	13.59	Elongated Structure	Flat Summit
Total Area km²				696		

Note: Five seamounts are identified as alternates to replace any of the 8 seamounts if they are unfishable with trap longline gear

In FOP1 the intended target species was spiny lobster (*Jasus* sp.) and based primarily on the known seafloor structures above the 500m depth (Table 1 and Appendix 2 a-h). From the 62 documented seamounts along the Foundation Seamount Chain, GSF believed 13 seamounts had seafloor that rose above 500m and these were identified for initial exploratory fishing. Given the nature and condition of

these eight (8) seamounts which were selected for the EPF, the remaining five (5) seamounts would be held in 'reserve' as alternates, to be surveyed in the event the approved eight (8) seamounts were unfishable with longline trap gear, deeper than 500m. GSF believed this approach would provide confidence that effort levels would be constrained to exploratory trials only and would be consistent with a precautionary approach to both the impact on the environment and on any crustacean stocks that may be found.

This approach of alternative seamounts is favorable for MMR and GSF as all 8 seamounts were surveyed in the first two fishing trips conducted in 2019. Significant quantities of *J. caveorum* were found on a single shallow seamount, "Kopernik". Two other seamounts, "Darwin A" and "Jenner" were found to be the next shallowest seamounts which produced small indicative yields, averaging 2kg per pot (Observer report of trip 2). From Year 2 and Year 3 it is proposed to maintain this targeted approach on *J. caveorum* with potential primary bycatch species being *Projasus sp.* and *Chaceon* sp., but to expand the trial area to include the alternate 5 seamounts, allowing all 13 selected seamounts for exploration.

As this is the first fishery experience for longline pot operations for rock lobster in the FSC, it is likely that some of the initial data collection procedures may need to be modified following the first round of analyses. To improve this minor sampling design changes will be necessary from time to time. The current setup of the EPF may require some refinements, particularly the operational deployment and retrieval of fishing gear and deck handling procedures of catch; GSF aims to modify current procedures to incorporate guidance from the scientific team, crew and observers who participated in trips 1 and 2. Any changes made will be done only from consultation with the scientific team, or if needed, direct consultation with the SPRFMO SC. As indicated in FOP1, consideration was given to unknown factors impacting the efficiency to the day to day operations. This extended to weather conditions, catch sizes per trap, bycatch interaction, marine mammals and seabirds interactions (CMM 09-2017). GSF anticipates that the selectivity of the fishing gear and fishing methods used has resulted in less than 5% of bycatch to the total landings. A minimum of 10% of pots hauled per fishing set is sampled by the on board observers.

The recording of lost gear and traps is a priority for GSF as it is an indicator of the vessel's imprint in this region. Lost traps have potential negative impacts in the environment and lead to ghost fishing. If any gear is lost; GSF will report the event in the daily logs during the survey. GSF has also cut parts of the traps nylon mesh and sewn them back together with cotton string, in the event that traps are lost and not found, the cotton string will eventually degrade, and the traps remained opened so ghost fishing doesn't occur. Although no fishing method is 100% benign to the environment, GSF believes that its choice of gear, methods and prior knowledge of the type of area to be researched will result in a negligible imprint on the seafloor. GSF sets and hauls sets of up to 500 traps per day in strings of 100 traps per string. Noting CMM14b-2019 allows for a maximum of 200 traps per day on five lines. With the target resource only found on Kopernik, the number of traps per day was reduced to an average of 80-100 traps.

It should be noted that the total anticipated footprint of all traps set in the first year was significantly lower than anticipated in FOP1. Lines set were closely tracked using on-board software (Annexure 5) – this was also used to track bycatch, including any samples that might reflect VME-related species (refer to the observer reports in this regard)[1].

[1] Refer also to the report by Brouwer et al. 2019

The soak time for the pots on the bottom varied but it became clear that shorter soak times produced higher catch rates (Brouwer et. al, 2019). Soak times therefore were maintained at about 24 hours with setting and retrieval of lines occurring within 24 hours, except for when weather and sea conditions did not permit.

The backbone line (ground line) used to attach the traps and float line used is buoyant polypropylene and, as such, the risk of entanglement and bottom damage is reduced. Floats for each longline string were appropriately marked to ensure easy identification. The methodology of setting was as follows:

I. The first float and float line were deployed behind the vessel from the stern and paid out in full, the length of the float line being 1.5 times the maximum bottom depth in the area.
II. The backbone line which the traps are attached is then similarly paid out, while the vessel steams slowly ahead.
III. The remaining float line and float are paid out from the opposite end of the longline string.
IV. No anchors are used; the traps themselves are sufficiently heavy to keep the gear in place on the bottom. This limits anchor damage to the seabed and benthos.
V. The entire gear is "stretched" gently to minimize the risk of self-entanglement on the way to the bottom. The sink rate of these trap strings is observed to be quite slow; less than 1 m/s, so a trap will take approximately 10 minutes to reach a depth of 500m.

Seabird's interactions were monitored by the observers. Deployment of the trap longline was done directly off the stern of the vessel, the traps weight resulted in rapid sinking of the gear and minimal potential impact with birds and mammals and other potential ETP species. Bait jars were filled with bait and tethered to the inside of the trap while the traps are being staggered and attached to the ground line just before they are deployed off the stern of the vessel. Typically, on pelagic and other longline type operations, bird mortality is expected – this is not the case for trap setting where no bait is exposed, and line sink rates are high. GSF was prepared for any interactions with seabirds, reptiles or mammals during operations; although as reported in the observer reports no significant interactions were noted. CMM 09-2017 does not mention specific protocols for bottom pot fishing, it was nevertheless one of the observers designated tasks to record any interactions, take pictures of the encountered species and decide whether or not pots may be hauled and/or set in that location. Protocol also required that if more than one marine mammal or turtle came into contact with the vessel or gear and suffered any potential injury or harassment during a fishing day, the fishing operation on any seamount would move to the next prescribed station outside a circle with a 5 nautical mile radius from the location of the encounter or move to the next scheduled seamount.

Traps were retrieved from the hauling station located mid-ship on the starboard side where the catch of the target species was weighed and observers undertook the required sampling. All bycatch from each set was accumulated in a small, stackable, plastic deck container (tote) and weighed and counted at the end of the set. The observer station was located near the hauling station; this was to allow the observer easy access to catches from selected traps for sampling collection before the catch was moved to the factory.

All offal obtained from the process of tailing on board was macerated before dumping. No dumping of offal is conducted while lines are being set or while lines are being hauled. Discharging of waste only took place at the end of a haul or while steaming and no biological material was discarded for at least 30

minutes before the start of any set or during any set. Discharging of waste was permitted from the opposite side of the vessel from the hauling position.

Biological sampling, undertaken by the two Observers, MMR Observer and Independent Observers provided by CapMarine. Both observers follow the specification of the Scientific Sampling Plan is detailed in Appendix 4. This included:

I. Catch of each trap was sorted into target species and bycatch.
II. The catch of the target species was weighed and summed over all traps in the longline set. A predetermined subset of traps (10%) were selected and sampled by the designated Independent Observers;
III. Retained catch was counted and sampled for individual weight, carapace length, sex, maturity and spawning stage.
IV. Depending on the amount landed bycatch or a subsample of bycatch was sorted to the nearest taxon to estimate the total amount of bycatch by taxon per longline set, following the sampling plan.
V. Data were recorded daily and summarized on a trip by trip basis. This data is captured in an access database format and forwarded to MMR, SPRFMO SC and used by the research team as needed.
VI. As the FSC research zone is different than isolated seamounts which are known to demonstrate degrees of endemism, individual seamounts and structures throughout the FSC are unlikely to hold only endemic species due to the prevailing conditions which would appear to reflect similar diversity throughout the chain. Five samples of variant age classes and sizes for each target species from each seamount will be packaged and preserved to be distributed at the end of the trip to collaborating scientist Rick Webber, marine biologist and invertebrate curator at the Museum of New Zealand Te Papa Tongarewa, for further biological laboratory studies such as DNA research to confirm species identity and to assess the potential for genetic separation of stocks between seamounts[2].
VII. With regard to bycatch, if the total bycatch for a fishing day location exceeded 5% of the weight of lobsters/crab, those stations would be deleted from future fishing station plans.

Regarding berried females it is common practice for *Jasus* sp. and other lobster commercial fisheries to avoid areas and seasons with the likelihood of high proportions of berried fish[3] . The proportions of berried lobster were therefore closely monitored. GSF shall continue to monitor the number of berried females and avoid seasons when females are carrying eggs, which is thought to go from June to October (Dupré, 1999). In cases where berried females are landed, GSF will retain them onboard in a tank wit flowing water and then returned them to the sea at the end of the set by lowering down a pot filled with these individuals, with an open mechanism that assure they reach their habitat. But a sample from for each seamount will be retained which will be added to the subset group of lobsters selected for sampling in order to analyze its condition, berry cycle and general characteristics. Further, the distribution and seasonality of the *Jasus* sp., *Projasus* sp. or *Chaceon* sp. abundance in the designated seamounts will become clearer as the fishery progresses.

[2] Samples have been sent to both Rick Webber and Dr Groeneveld for identification and genetic work
[3] Oceanographic Research Institute, Durban, South Africa.

4.1 Target Species

The primary target research species will be *J. caveorum*. While *J. caveorum* are the primary target group, *Projasus sp.* remains a target species on only deeper seamounts. Similarly, crab *Chaceon sp.* are and will be targeted in deeper waters.

4.2 Non-target, associated and dependent species

Based on the seamounts fished on the first two trips, bycatch and non-target species catch was low (< 5%). While it is apparent that deeper sets will encounter crabs, it cannot be said conclusively that this pattern will be typical of the entire FSC. As suggested in FOP1, small amounts of fish bycatch were caught in the traps comprising of trumpeter, rock cod, and terakihi. Because of low occurrence and the highly selective nature of the gear, impact projections and risk assessment are not possible for these species at this time.

With regard to other bycatch, in particular mammals and turtles, the strategy followed is and will be consistent with the requirements of CMM 09-2017.

4.2 Landing and/or Transshipment

GSF will discharged all catch from the EPF outlined in CMM 14b-2018 /19 to an approved facility at an approved port and does not intend to engage in any transshipment operations either at sea or in port. GSF will follow all requirements as discussed in the "Conservation and Management on Minimum Standards of Inspection in Port" (CMM 07-2017). GSF anticipates all production from the EPF outlined in CMM 14b- 2018/19 will be discharged at Lima, Peru and will follow all aspects of CMM 07-2017 including Annex I-Port Call Request, Annex II-Port State Inspection Standards and Annex III-Format for Port Inspection Reports (these templates are available for review in CMM 07-2017).

5.0 Resource Biomass Calculations and Potential Management Reference Points

The maximum allowable catch approved by SPFRMO in CMM 14b-2018 for GSF EPF was initially set at 1,000 t total weight for the first year, reduced to 600 t in CMM 14b-2019 to included 60 days effort (two trips). GSF strategy for year two remains as per FOP1 with a TAC2 of 300 t. *J. caveorum* will remain the primary target species above 500 m depths, but if catch rates are significantly below expectations then the fishery will likely switch to fishing deeper depths to target *Projasus* sp. and *Chaceon* sp.

Based on fisheries in other seamount areas outside the FSC, GSF has an expectation that each of the target species exists within the proposed area, although preliminary results from the two trips undertaken in Year 1 suggests that C*haceon* sp. predominantly occur in water deeper than 500m. This nevertheless remains an area of uncertainty and the likelihood of there been other crustacean species in depths and locations different to what has already been tested still exists.

Based on the surface area alone of the 62 documented seamounts for the three depth zones; 0-500 m, 501-1,000 m, 1,001-2,000 m (see Appendix 2e) the total area across all the 62 seamounts above 2,000 m contour is 11,207 km^2. Based on depth and historical catches from fishing by Chadderton, Cave and Peterson in 1988, 1992 and 1995 respectively, crude estimates of biomass supported the SPRMO precautionary catch limit on the 13 FSC seamounts of 1000 mt (FOP1 and SC6 report refers – adjusted in

CMM 14b -2019 to 600 t in Yr1 and 300 t in Yr2). This approach also assumes that the lobster distribution and benthos at these three historical fishing sites on which the calculations were based, maybe similar across the FSC and, specifically, for the eight (8) seamounts targeted in FOP1. GSF is not aware of any other exploratory fishing trips to the area that could assist in this assessment of the productivity of the general area. The dominant crustacean in the 0-500 m zone was a *Jasus caveorum* with the deeper two zones likely to have *Projasus* sp. and *Chaceon* sp. for which no past catch data exist for the FSC.

These crude estimates in FOP1 remain pertinent although some preliminary estimates based on the catch rates on Kopernik from the two trips conducted in 2019 have been made and presented in Brouwer et al., 2019. In the analysis CPUE was used to both measure the change in abundance during Trip 1 and 2.

Catches of lobster in the two trips undertaken were well below the precautionary level set by SPRFMO, although not all seamounts were fully tested. On Kopernik alone on Trip 1 some 7,515 traps were hauled resulting in a total catch of *J. caveorum* of 76,148 Kg at an average overall catch rate of 9.8 Kg/trap haul. On Trip 2, the comparative numbers were 60 hauls of trap lines were undertaken which resulted in a catch of 39,109 Kg of lobster (*J. caveorum*) being taken from a total of 4959 trap lifted and an average catch rate of 8.65Kg/trap lift for 1-day soak times and 7.07 Kg/trap lift for 2-day soak times. The total area of Kopernik influenced by trapping was calculated to be 4.42% of the area fished. Based on this, it was estimated that the total exploitable biomass of *J. caveorum* on the area fished was approximately 1,720t, at a density of around 2.60 Kg of lobsters per 100 m^2.

Brouwer et al., 2019 have done a thorough assessment (including length analysis, sex ratios etc.). However, the data remains limited and a longer time series is needed for any robust assessment. Until that is possible, a simple harvest control rule and reference points that are precautionary will be applied. This approach uses CPUE as the default reference point to track relative biomass over time and assumes the efficiency of a unit of fishing effort remains constant and does not fluctuate or improve over time. A key point is also that since the EPF will occur on multiple seamounts of different sizes, each seamount will need to be monitored separately.

A 40% CPUE limit reference point (ie $CPUE_{max}$ *0.4) as suggested on Kopernik would equate to a CPUE of about 3.9Kg/trap lift. This is thought to be a reasonable precautionary approach to avoid overexploitation in the absence of other information if the CPUE is reflective of abundance. In the context of the trips conducted to date, the CPUE threshold reference point would apply only to Kopernik. As further suggested in FOP1, the value of 40% CPUE can be used as a control rule to lower annual harvest level in the upcoming year for a specific seamount if its CPUE for the current year is closing in on 40% CPUE. In addition, a TAC and TAE will be applied to further regulate fishing activity in year two and three.

For FOP1, it was suggested that a depletion experiment might be a useful approach to inform the stock assessment. We would reserve judgment on this approach and SC7 has provided a way forward (see the section 10 and Appendix 7). .

6.0 Planned Trips in Management Area and Vessel Monitoring

The area of interest, the FSC, consists of distant-water, high seas seamounts and adjacent fishing grounds that cover an expansive area of approximately 2.1 million km^2 (~612,000 square nautical miles). The grounds are near 35° South latitude approximately 2,500 nautical miles from GSF home port of Lima, Peru. The remote nature of the target research grounds in the central-south Pacific Ocean has been a

conservation buffer and a barrier to sustainable fisheries development. This schedule of fishing operations takes into consideration the balance between capital costs to get to these grounds and the important opportunity to collect scientific information without jeopardizing the goal of successful fishing operations.
The FOP for Year 2 (2019/20) for which a precautionary catch limit has been set by SPRFMO at 300 t is as follows:

1. Between October 2019 and 30 June 2020 three exploratory trips will be undertaken, with a 80 fishing day effort limit per trip.
2. While the recommendation of CMM 14b-2019 is for 8 seamounts in Year 1, these have largely been covered. It is proposed that for Year 2, in total all 13 of the designated seamounts are open to be tested and surveyed. While the original 8 selected seamounts in Year 1 (2020) were tested, the availability of lobster was limited to <500m depth at least.
3. With a 300 t, this could be separated into three units i.e. 100 t combined catch per trip for lobster and crab in year two.
4. This TAC would apply to the 13 selected seamounts for 2019 / 2020.
5. Further, for the now established lobster resource base on Kopernik, the following reference points apply :
    - A Baseline Catch Rate as measured by CPUE in Kg/trap hauled = 10kg/trap hauled, and
    - A limit reference point (B_{LIM}) of 3.9 kg/trap hauled.

    The rate at which B_{LIM} may be reached should be agreed on. Ordinarily, B_{LIM} would be much lower, or about 20% of biomass, being the point at which recruitment impairment might occur.

    For all other seamounts on which a resource base may be found a similar approach can be applied on a trip by trip basis – that is 1) establish average CPUE (Kg/Trap hauled); 2) B_{LIM} of 40% of baseline CPUE from Trip 1 (2019/20).

Table 2. References for voyages per year and trip, and target landings for *Jasus* sp., *Projasus* sp., and *Chaceon* sp.. combined;

Year	Seamounts	Trip 1	Trip 2	Trip 3	Target Landings of ***Jasus*** **sp.,** ***Projasus*** **sp., Chaceon sp.. (t whole weight)**
2 (2019)	8	-		Y2T1	300t
2 (2020)	13	Y2T2	Y2T3	Y3/T1BD	
3 (2020/2021)	TBD	TBD	TBD	TBD	300t

Fishing for Trip 1, year two and into 2020 would follow a similar pattern to that of the first two trips in 2019, except that on one of the trips an experiment will be undertaken to assist with biomass estimation

(see Appendix 7). The vessel will steam from home port to FSC towards the Kopernik seamount, undertake a staged planned experiment for a week, then sail to the north-western-most seamounts of the FSC and target for survey the first seamount and thereafter on each trip systematically survey selected seamounts (of the 13) and trial fish if suitable ground is identified. Should the depth profile not prove suitable, the vessel would move eastwards systematically surveying seamounts each trip. Trial pot setting would only be attempted if the ground was deemed suitable. Once on Kopernik, normal fishing operations would apply. Using this approach, a balance is obtained between surveying and testing suitable ground and fishing on Kopernik where there is a known resource and commercial return increasing the viability of the EPF. The observers on board the vessel will be involved in this decision-making process and will notify MMR of any proposed change.

Table 3. *FV Altar 6* FSC exploratory fishing operations proposed for Trip 3 (2019) and 2020 (x 3 trips).

Seamount	Seamount Name	Seamount Area Depths <500 m (km^2)	Estimated Days Fished	Footprint of Gear (m^2)
8	Buffon	1.2	Survey (4)	3540
46	MM	318.9	Survey (4)	12390
12A	Darwin a	90.4	Survey (4)	7080
18	Galilei	12.4	Survey (4)	Unknown
23	Jenner	22.7	Survey (4)	5310
22	Humboldt	3.2	Survey (4)	Unknown
25	Kopernik	115.2	25, 25, 25, 25	10620
27B	Linne b	11.9	Survey (4)	Unknown
28	Mendel	48.0	Survey (4)	5310
30	Mercator	46.8	Survey (4)	5310
29	Mendeleiev	9.2	Survey (4)	Unknown
48	GB	13.6	Survey (4)	3540
37A	Platon	3.1	Survey (4)	unknown
Total		696	150	53100

If the catch rates at any of the seamounts sampled on the Y2T1 were unproductive, then that seamount will be replaced with one of the remaining alternates (Kopernik excluded). If any area within a seamount was found not to be populated with *Jasus* sp., effort would not be applied to that portion of the seamount during the remaining year two fishing year. If time is available, additional sets can be made in the more productive portions of the more productive seamounts. One of the main objectives of the year two is to determine if the CPUE values and length compositions change from one trip to another. Upon completion of year two, the MMR will develop a new fisheries operation plan for year three for consideration at the SC based on an assessment of the years data.

7.0 Monitoring of Vessel Operations

7.1 Vessel Movement in the Management Area and Control of Vessel

The vessel and its operators will report to MMR all the vessel's activities in the Management Area to MMR's legal specifications and requirements. This will include, but is not limited to:

- Notification of: Entry and Exit from SPRFMO waters;
- Adequate prior notice when planning a trip into SPRFMO Convention waters;
- Adequate prior notice of date and port of arrival after a trip in SPRFMO Convention waters;
- While at sea the vessel will report its location and current activity to MMR through VMS and through mandated email reporting.
- While at sea, the Master will be responsible for the day-to-day operations of the vessel and ensuring compliance in accordance with Cook Islands law and SPRFMO CMMs.
- The Master will be responsible for recording details of any other fishing vessels sighted in the SPRFMO Management Area. Details of identifying features, names and numbers will be recorded and photographs taken where possible. At the end of each trip all information on vessel sightings will be reported to MMR.
- Vessel Monitoring System: GSF will have a VMS system of an approved type on board the Altar 6 and will report simultaneously to both the Cook Islands and SPRFMO as contemplated in CMM 06-2017 for the option described in Paragraph 9.b, once the SPRFMO system is advised as operational.

7.2 Observers

GSF will ensure and comply with all of the directives from MMR in relation to 100% Cook Islands Observer coverage during all fishing operations described in this Fisheries Operation Plan. GSF will also have its own marine biologist / observer on board collecting the data as described in the Scientific Sampling Plan**.** The Cook Islands Fisheries Observer will be provided by the Cook Islands National Observer Programme (CINOP).

The main duties of the observer are outlined in detail in Appendix 4 and are in accordance to CMM 14b-2018. The independent observer shall also be responsible for the data collection and capture on an already establishes scientific observer data base (MS Access).

8.0 Data Collection Methods and Scientific Sampling Plan

GSF has an established and tested data collection procedure. Use of a comprehensive data capture system and sampling methodology has been implemented under the guidance of an experienced scientific support team.

This data collection is consistent with a robust exploratory pot fishing operation including tracking and observations of bycatch on traps to confirm the existence of VMEs, biological data collection of the target species and a data collection reporting system to compile data sets necessary to evaluate biomass assessments and geographical distribution of the target species using traps.

During the EPF, data will be collected daily in accordance with CMM 02-2017 using two daily logs:

I. A Daily Effort regarding Catch data and Production Log will be collected to better understand

and research the target species. The Daily Effort, Catch and Production (SPRFMO Fishing Activity Report) will capture operational information on a set-by-set basis and will be described on this form. Lost gear is also recorded on a set-by-set basis or trap by trap basis.

II. Daily Environmental Log to record discards and waste management, wildlife abundance and interactions and mitigation measures. Prior to each exploratory pot fishing trip, an assessment will be made to determine whether the area might be a Vulnerable Marine Ecosystem (VME).

GSF have appointed Capricorn Marine Environmental (Pty) Ltd to manage the independent scientific observer deployments who have and will continue to appoint Observers of the highest level and specifically with experience in scientific sampling of crustacean fisheries

9.0 Vulnerable Marine Ecosystems Sampling

GSF is extremely conscious of its obligation with regard to responding to any potential VMEs that might be encountered. While bottom trap fishing is relatively benign, encounters with VME indicator species is be expected and Observers have been trained to report any indications of VME indicator species, volumes, weights and frequency of occurrence (refer to both observer reports in this regard from Trips 1 & 2) in accordance with the SPRFMO protocols[4].

Observers carry and are familiar with the numerous guides available and the stringent reporting of the observers is testament to their rigor and familiarity in this regard and, as has been done on the already-completed trips, photograph all potential VME species fouled on traps, submit these for identification as needed, and, retain samples as needed for identification.

By using the analysis of seamounts included in Appendix 2, for the first year (Trips 1 and 2), GSF will be considering seamounts only shallower than 500m. GSF recognizes that it is also where the majority of potential VMEs might be expected to occur. According to CMM 03-2018 and BFIAS, the observers on board the *FV Altar 6* will register and map out the interactions with VMEs and example of which is provided in Appendix 11 from Trips 1 and 2 relating to Kopernik. It is imperative that the observers work closely with the vessel skipper to track line setting using the on-board sea-bottom tracking technology, and importantly, to relate this to location of pots on the lines as they are set and hauled.

GSF considers that the impact of this bottom potting will have minimal impact on the sea floor, as the likely total bottom contact on these areas will be sight, <1% of the total assessed target areas. However, GSF will take a precautionary approach where:

- Sets shall not occur on known seamount slopes;
- Restricting the lines to 100 pots on small seamounts and as far as possible keep line sets on low profile ground where the likelihood of encountering a VME e.g. coral outcrop, is reduced; and
- Where potential VME indicator species are encountered, GSF will follow the Cook Islands VME protocol including collecting images, as well as requiring the vessel to leave the area and "move-

[4] VME indicators, thresholds and encounter responses adopted by R(F)MOs in force during 2019. http://www.fao.org/in-action/vulnerable-marine-ecosystems/vme-indicators/en/

on"[5] in accordance with the relevant CMMs.

The approach GSF will undertake will aid developing and collecting data to allow comprehensive VME assessments to be undertaken by MMR. With the use of the camera mounted on a meshless trap frame to enable data collection on the benthic environment and will build a thorough and comprehensive report based on the BFIAS on a trip-by-trip basis to MMR or more frequently is so directed by MMR.

If significant quantities of coral or sponge are found in or attached to traps or by the camera study (more than 1% of the total lobster/crab weight), then the vessel will move on in accordance with CMM 03-2018. Knowing GSF will have the capability to deploy cameras to film bottom structure and benthos, GSF will deploy these cameras per the camera study on a regular basis, especially where new areas are being fished and the data will be provided to MMR in the reports at the end of each trip.

The majority, if not all of the seamounts GSF has identified for this EPF, have not been commercially fished in the modern era and, as such, very little is known about the potential for VMEs to occur on these seamounts. Nevertheless, and as required by the BFIAS, if GSF encounters VME indicator species volume of more than 1% of the total weight of the target species landed by string, they will move-on to the next fishing site, and will flag the location as a potential VME area, where pots with cameras will be dropped in order to assess the amount and type of VMEs that could be potentially found in that area.
Further underwater video cameras will be dropped periodically when evidence of very high CPUE, gear damage, anomalous substrate, or sensitive bycatch areas are observed. Cameras will be attached to netless trap frames for observation of the substrate near the footprint of the gear. GSF has investigated the correct camera system to use during the camera survey/study.

[5] The trigger for "moving on" is likely to occur if GSF encounters a VME interaction of more than 10% of the total pots landed per line. They will move-on to the next fishing site, and will record the location as a potential VME area. In VME areas pots with cameras will be dropped in order to assess the abundance and type of VMEs that could be potentially found in that area.

10.0 Proposals for year two and three

The revised FOP has presented a number of management options for the lobster and crab fisheries including the Total Allowable Catch (TAC), size limits, pot mesh size rules and close seasons. Corals and rhodoliths are indicators of VME their occurrence was noted by the vessel and the positions recorded on charts. Additional work is still needed to assess the camera footage of sets to assess the benthos. In the interim, areas with indicator species for VMEs will be avoided in the future fishing operations. Initial indications are that the corals appear to be more abundant on the seamount slope and if this trend persists, fishing operations could be restricted flat surface of the seamounts in the future.

To ensure precautionary and appropriate management measures are in place, the Cook Islands have adjusted and expanded future fishing operations to include;

- Collection of morphometric information from *Jasus* sp. Including:
    - Carapace length;
    - Tail width;
    - Whole weight; and
    - Tail weight.
- Continue the collection of morphometric information from *Chaceon* sp. Including:
    - Carapace width;
    - Tail width;
    - Whole weight;
    - Processed weight; and
    - Half crab weight.
- Tag lobsters in pre-malt condition to assess the growth rate and population size estimates should trips go beyond Year 3.
- Collect still camera footage of the benthos from each set to assess the benthic environment;
- Use small mesh nets on a sub-sample (4-10) of the sample traps to collect biological information on smaller subset of the lobster and crab.
- In areas where catch rates are very low the observer should get biological samples from each trap.
- A 40% CPUE limit reference point[6] on Kopernik would equate to a CPUE of about 3.9Kg/trap lift.
- Place a 75% total effort limit on Kopernik seamount per trip.

In addition, the following recommendations are made to SC7:

1) Recommend that the SPRFMO Commission extend the expiry date to CMM 14b-2019 to 2022, aligning the CMM to the start of fisheries operations
2) Request that the SC7 endorse the following management actions:
    a. Set the total allowable catch (TAC) at 300t a year for fishing years 2 and 3.

[6] Typically a limit reference point such as B(lim) would aim for 20% of unexploited biomass. A more precautionary approach would raise that level to, for example 20-50%.

b. Set a trip specific total allowable effort (TAE) at 80 days per trip, setting and hauling no more than five lines of 100 traps a day, with a limit of 75% of the TAE on Kopernik Seamount (60 days).
c. Allow for five additional fishing days for experimental fishing to accommodate the proposed experimental trapping as outlined in Appendix 7.
d. Set CPUE limit of 4 kg per trap for Kopernik Seamount assessed weekly through a moving 30 day window starting on day 30 and being assessed every 7 days thereafter. Should this limit be reached, MMR will close Kopernik Seamount as allowed for in Section 52 of the MMR act of 2005, if this limit is triggered Kopernik Seamount will remain closed to fishing pending SCs review of the Cook Islands planned ongoing response.
e. Lift the limit on fishable Seamounts as specified in paragraph 6c of CMM 14b-2019, which restricts effort to eight out of 13 identified seamounts, to allow for fishing on 15 seamounts within the region specified under paragraph 5 of CMM 14b-2019.

In order to estimate lobster fishable biomass at Kopernik Seamount a fishing experiment will be undertaken. This fishing experiment is to determine the effective fishing area of a trap. Following this an analysis of the catch and effort to estimate biomass across the seamount will be undertaken. In the interim, a desktop analysis will be run using a range of effective fishing areas and depth strata (for details on the proposal see Appendix 7). These analyses will be presented to SC8 in 2020.

11.0 References

Ministry of Fisheries [1](2005) A guide to common deep-sea invertebrates in New Zealand waters. New Zealand Aquatic Environment and Biodiversity Report No 1.

Ministry of Fisheries (2005) A guide to common offshore crabs in New Zealand waters. New Zealand Aquatic Environment and Biodiversity Report No 2.

Tracey, D.M., Anderson, O.F., Naylor, J.R. (comps) (2011). A guide to common deep-sea invertebrates in New Zealand waters (3rd edition). New Zealand Aquatic Environment and Biodiversity Report No. 86. 317 p.

Other relevant publications as may be recommended or available.

[1] The New Zealand former Ministry of Fisheries is now called the Ministry of Primary Industries

Appendix 1. Vessel Details

The vessel will be converted for dedicated use to deploy and retrieve longline strings of traps for setting in deep water.

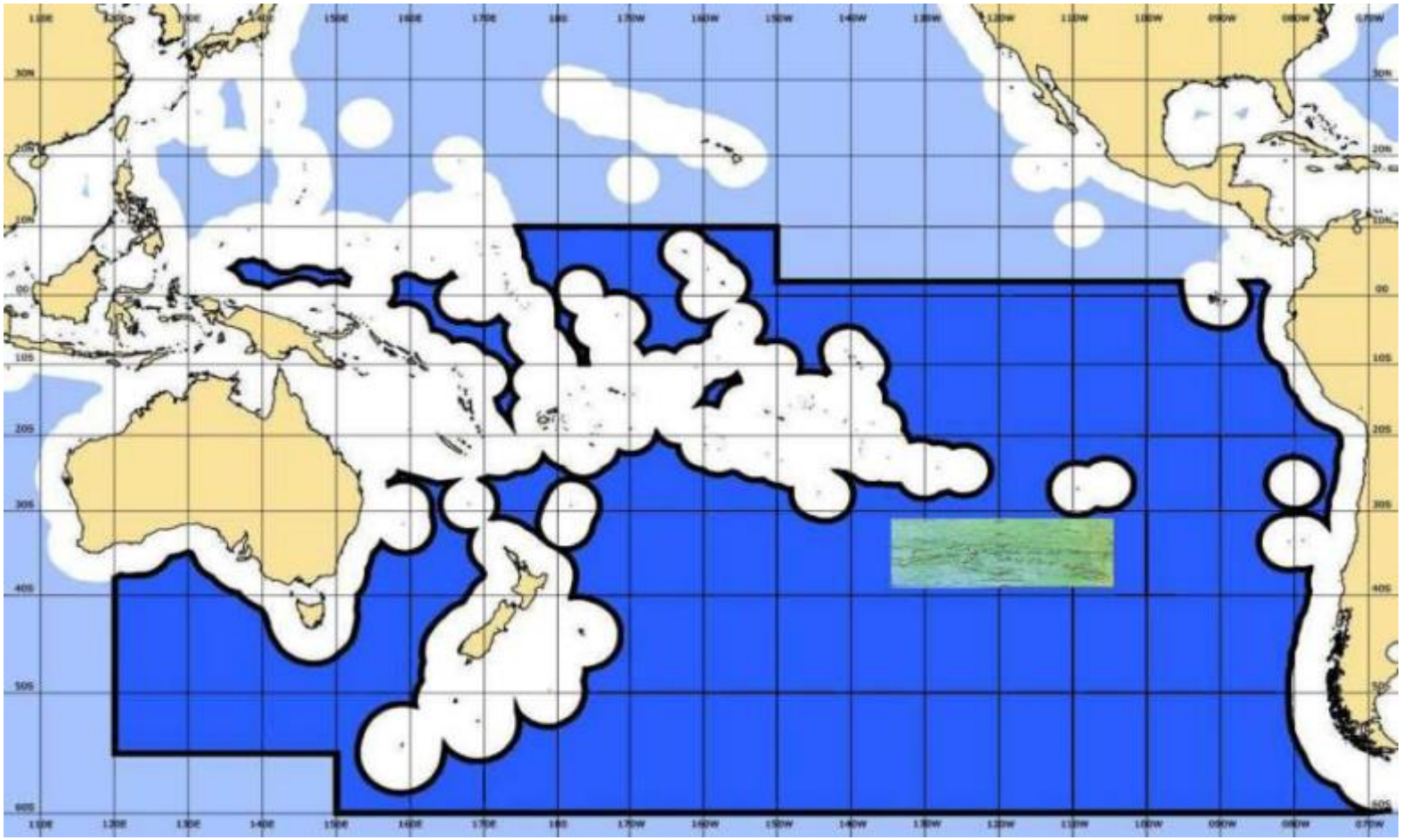
Vessel Name:	Altar 6
International Call Sign	E5U3515
Flag State	Cook Islands
Port of Registry	Avatiu
Hull	Steel
Length overall	53.51m
Registered length	49.7m
Breadth	8.7m
Depth	3.75m
Gross tonnage	576
Hold capacity	539.6cbm
Freezing capacity	20 tons/day
Freezer plant	108cbm
Fresh water capacity	22.8cbm
Crew accommodation	Up to 25
Main engine	Akasaka DM28AKFD

Figure 2. FV Altar 6 – Designated Exploratory Pot Trapping vessel (SPRFMO)

Auxiliary Engines and Generators
YANMAR S165LUN
YANMAR S165LUN
Fuel Capacity Fuel Oil 292.71 cbm

Vessel Markings: Once the conversion is complete, GSF will be marked in accordance with FAO 415 Annex J: Fishing vessel identification and marking. Photos will be provided to MMR and the Secretariat once available along with the vessel's International Tonnage Certificate.

Appendix 2a : Area of proposed exploratory operations



Appendix 2b. Relative location of fishing grounds relative to operational home port (Lima, Peru)

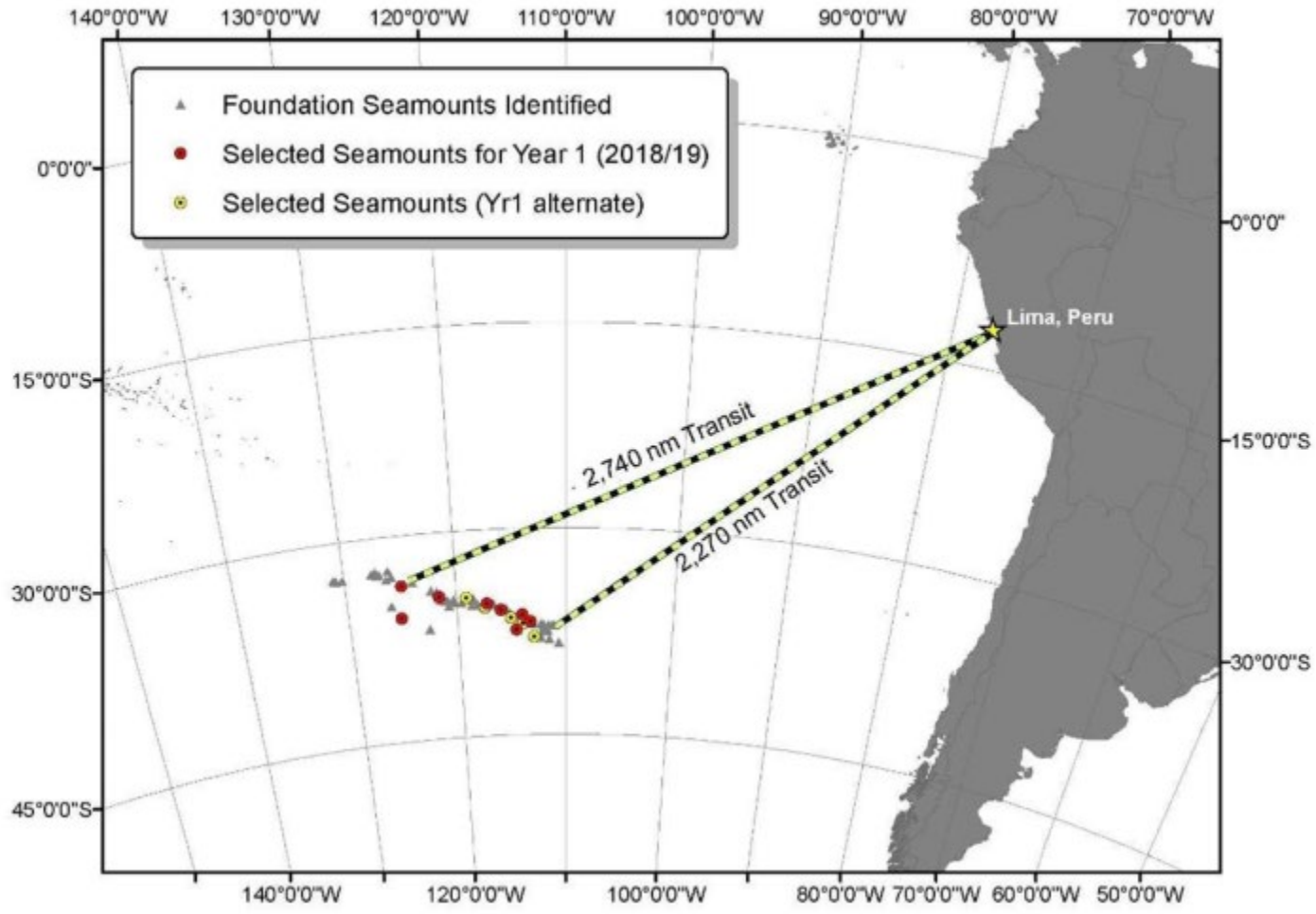


Figure 3. Relative location of fishing grounds relative to operational home port (Lima, Peru)

Appendix 2c: Historical Fishing Effort on the Foundation Seamount Chain

Operator Name	Description	John Chadderton	Joe Cave	Jim Petersen	Total
Year Fished on Foundation Seamounts	**Year Fished**	**1988**	**1992**	**1995**	
1. Total number of pots fished		15	50	120	185
2. Total number of days fished		5	16	22	43
3. Total number of pots hauled		75	400	1,320	1,795
4. Total number of pots hauled per day		15	25	60	100
5. Total lobster catch (tails)	Tonnes	4.50	6.60	19.80	30.90
6. Total live lobster production	kg	13,636	20,000	60,000	93,636
7. Average lbs per pot haul	lbs	401	110	100	115
8. Average kg per pot haul	kg	182	50	45	52
9. Average size of lobsters	Grams per lobster	1,500	1,667	1,500	1,536
10. Number of lobsters per pot haul	Average	121.21	30.00	30.30	34.03
11. Total number of lobsters		9,091	12,000	40,000	61,091
12. Percentage of catch per voyage		14.56%	21.36%	64.08%	100.00%
13. Bottom contact per voyage	sqm	150	500	1,650	2,300
14. Pot size	sqm per pot	2.00	1.25	1.25	1.28
15. Lobsters per sqm & kg per sqm	1	121.21	30.00	30.30	34.03
	kg per sqm	181.82	50.00	45.45	52.26
Note:	10	12.12	3.00	3.03	**3.40**
	kg per sqm	18.18	5.00	4.55	5.23
1. Blue is the area of bait attraction per pot	25	4.85	1.20	1.21	**1.36**
	kg per sqm	7.27	2.00	1.82	2.09
2. **Red** is the kg per sqm	50	2.42	0.60	0.61	**0.68**
	kg per sqm	3.64	1.00	0.91	1.05
3. **Black** is the # of lobsters per sqm	75	1.62	0.40	0.40	**0.45**
	kg per sqm	2.42	0.67	0.61	0.70
	100	1.21	0.30	0.30	**0.34**
	kg per sqm	1.82	0.50	0.45	0.52

Appendix 2d: Foundation Seamount Characteristics

Seamount number	Seamount name	Depth range	sqkm	sqkm	sqkm	Description	Comments
			A	B	C		
			0-500 m	500-1000 m	1000-2000 m		
1. #1a	Ampere a	1,500-2,000			47	2 Circular Structures	Scattered Cones
2. #1b	Ampere b	1,400-2,000			104	Linear Structure	Scattered Cones
3. #2	Archiminds	1,260-2,000			78	Linear Structure	Flat Uneven Summit
4. #3	Aristotelis	1,340-2,000			47	Linear Structure	Flat Summit
5. #4a	Avogadro a	1,460-2,000			62	Linear Structure	Flat Summit
6. #4b	Avogadro b	1,780-2,000			26	Linear Structure	Flat Summit
7. #4c	Avogadro c	1,060-2,000			73	Linear Structure	Steps on Flank
8. #5	Becquerel	600-1,000		70		Circular Structure	Flat Summit
		1,000-2,000			171	Circular Structure	Sharp Basement Line
9. #6	Bohr	1,060-2,000			124	Circular Structure	Smooth Flanks
10. #7	Bouguer	1,860-2,000			3	Elongated Volcanic Cones	Southern Flank
11. #8	**Buffon**	**400-500**	**1.17**			**N-S Elongated Structure**	**Scattered Cones**
		500-1,000		207		N-S Elongated Structure	Sharp Basement Line
		1,000-2,000			466	N-S Elongated Structure	
12. #9	Celsius	500-600		65		Star-like Structure	Flat Summit
		600-1,000		210		Star-like Structure	Gentle Slopes
		1,000-2,000			78	Star-like Structure	
13. #10	Curie	500-600		5		Seamount Structure	Flat Summit
		600-1,000		31		Seamount Structure	Smooth Basement Line
		1,000-2,000			21	Seamount Structure	
14. #11	Da Vinci	1,000-2,000			218	Conical Elongated Structure	Summit Cones, Gentle Slope
15. #12a	**Darwin a**	**300-500**	**90.41**			**Elongated Structure**	**Flat Summit Plateau**
		500-600		104		Elongated Structure	No Basement Line
		600-1,000		57		Elongated Structure	No Basement Line
		1,000-2,000			129	Elongated Structure	
16. #12b	Darwin b	1,000-2,000			65	Conical Structure	Summit Cones
17. #13a	Einstein a	500-1,000			10	Elongated Conical Structure	Summit Cones, Gentle Slopes
		1,000-2,000			93	Elongated Conical Structure	
18. #13b	Einstein b	1,340-2,000			93	Elongated Conical Structure	Summit Cones, Gentle Slopes
19. #14	Fahrenheit	940-2,000			52	Conical Structure	Sharp Borders
20. #15	Faraday	860-2,000			93	Conical Structure	Summit Cones
21. #16	Fermi	840-2,000			10	Conical Structure	Elongated Summit
22. #17	Fleming	500-1,000		41		Conical Structure	Circular Flat Summit
		1,000-2,000			155	Conical Structure	Smooth Basement Line
23. #18	**Galilei**	**400-500**	**12.40**			**Conical Structure**	**Circular Flat Summit**
		500-1,000		52		Conical Structure	Smooth Borders
		1,000-2,000			104	Conical Structure	
24. #19a	Herschel a	1,040-2,000			41	Conical Structure	With Rift Zones
25. #19b	Herschel b	1,000-2,000			166	Conical Structure	With Rift Zones

Seamount number	Seamount name	Depth range	sqkm	sqkm	sqkm	Description	Comments
26. #19c	Herschel c	920-2,000			93	Conical Structure	With Rift Zones
27. #20	Hippocrate	500-1,000		41		Conical Structure	Gentle Slopes
		1,000-2,000			166	Conical Structure	
28. #21a	Hubble a	500-1,000		21		Elongated Structure	3 Summits, Gentle Slopes
		1,000-2,000			114	Elongated Structure	
29. #21b	Hubble b	840-2,000			62	Elongated Structure	3 Summits, Gentle Slopes
30. #22	**Humboldt**	**400-500**	**3.22**			**Circular Structure**	**Flat Summit**
		500-1,000		73		Circular Structure	Smooth Borders
		1,000-2,000			135	Circular Structure	
31. #23	**Jenner**	**300-500**	**22.72**			**Elongated Structure**	**Flat Summit**
		500-600		16		Elongated Structure	Gentle Slopes
		600-1,000		52		Elongated Structure	Smooth Basement Line
		1,000-2,000			73	Elongated Structure	
32. #24a	Kelvin	500-1,000		3		Conical Structure	Elongated Summit
		1,000-2,000			23	Conical Structure	
33. #24b	Kepler	1,400-2,000			10	Conical Structure	Elongated Summit
34. #25	**Kopernik**	**180-500**	**115.20**			**Circular Structure**	**Flat Summit**
		500-600		347		Circular Structure	Gentle Slopes
		1,000-2,000			321	Circular Structure	Smooth Basement, Lateral Cones
35. #27a	Linne a	500-1,000		93		Flat Summit Structure	Gentle Slopes
		1,000-2,000			290	Flat Summit Structure	Gentle Slopes
36. #27b	**Linne b**	**200-500**	**11.89**			**Circular Structure**	**Flat Summit**
		500-600		73			
		600-1,000		73		Circular Structure	Uneven Slopes, Rifts Zones
		1,000-2,000			186	Circular Structure	
37. #28	**Mendel**	**150-500**	**47.96**			**Elongated Structure**	**Flat Summit**
		500-600		49			
		600-1,000		78		Elongated Structure	Broad Volcanic Area
		1,000-2,000			311	Elongated Structure	
38. #29	**Mendeleiev**	**200-500**	**9.18**			**Circular Structure**	**Flat Summit**
		500-600		36			
		600-1,000		62		Circular Structure	Gentle Slopes
		1,000-2,000			129	Circular Structure	
39. #30	**Mercator**	**500-600**	**46.77**			**Elongated Structure**	**Flat Summit**
		600-1,000		52		Elongated Structure	Lateral Cones, Smooth Basement Line
		1,000-2,000			233	Elongated Structure	
40. #31	Newton	500-600		13		Elongated Structure	Flat Summit
		600-1,000		26		Elongated Structure	Broad Volcanic Area
		1,000-2,000			155	Elongated Structure	
41. #32	Ohm	600-1,000		10		Circular Structure	Flat Summit, Broad Volcanic Area
		1,000-2,000			104	Circular Structure	
42. #33	Pascal	1,160-2,000			23	Polygonal Structure	Gentle Slopes

Seamount number	Seamount name	Depth range	sqkm	sqkm	sqkm	Description	Comments
43. #34	Pasture	1,300-2,000			41	Circular Structure	Polygonal Shape
44. #35	Pauling	1,600-2,000			98	Three Structures	Flat Summit, Two Craters
45. N. Ridge	N. Ridge	1,500-2,000			93	Elongated Structure	Volcanic Ridge, Flat Summit, 6+ Cones
46. #36	Planck	1,440-2,000			104	Elongated Structure	Flat Summit, Gentle Slopes
47. #37a	**Platon**	**300-500**	**3.11**			**Flank Structure**	**Rift Zone**
		500-600		21		Flank Structure	Rift Zone
		600-1,000		166		Flank Structure	Rift Zone
		1,000-2,000			373	Flank Structure	Rift Zone
48. #37b	Richter	980-1,000			124	Elongated Structure	Flat Summit, Gentle Slopes
49. #38	Rutherford	1,180-2,000			78	Circular Structure	
50. #39	Schrodinger	1,420-2,000			26	Polygonal Structure	Flat Plateau, Gentle Slopes
51. #40	Volta	2,340/up			23	Circular Structure	Elongated Summit, Conical Shape
52. #41	Watt	1,580-2,000			73	Polygonal Structure	Flat Summit, two higher areas
53. #42		1,400-2,000			23	Polygonal Structure	Flat Summit, Gentle Slopes
54. S. Ridge	S. Ridge	1,500-2,000			388	Elongated Structure	Flat Summit W/Crater & Gentle Slopes
55. #43		1,460-2,000			47	Polygonal Structure	Flat Summit W/Crater
56. #44		2,160/up			10	Elongated Structure	Flat Summit, Polygonal Shape
57. #45	JC	500-600		93		Elongated Structure	
		600-1,000		140		Elongated Structure	
		1,000-2,000			256	Elongated Structure	
58. #46	**MM**	**150-500**	**318.87**			**Elongated Structure**	**Flat Summit with Cones**
		500-600		62		Elongated Structure	
		600-1,000		62		Elongated Structure	
		1,000-2,000			186	Elongated Structure	
59. #47	Viola	600-1,000		60		Elongated Structure	Flat Summit
		1,000-2,000			409	Elongated Structure	
60. #48	**GB**	**150-500**	**13.59**			**Elongated Structure**	**Flat Summit**
		500-1,000		181		Elongated Structure	
		1,000-2,000			129	Elongated Structure	
61. #49	AJ	500-600		41		Elongated Structure	Flat Summit
		600-1,000		52		Elongated Structure	
		1,000-2,000			78	Elongated Structure	
62. #50	IT	500-600		10		Circular Structure	Flat Summit
		600-1,000		31		Circular Structure	
		1,000-2,000			62	Circular Structure	
Total sqkm			**696.49**	**2,877**	**7,581**	**11,155**	
Total sqmiles			**268.92**	**7,453**	**19,634**		

1. % of Area in sqkm **0-2,000 m** **6.24%** **25.80%** **67.96%** **100.00%**

2. Yellow area shows the eight (8) seamounts for the first year

3. Blue area shows the five (5) alternate seamounts for the first year

Appendix 2e. Preliminary resource biomass potential as calculated for FOP (1)

1. Foundation seamounts	Seamount numbers	Species	Gram per species	Biomass %	sqkm	Habitat area	sqm	10	25	50	75	100
							Jasus spp. per sqm	3.40	1.36	0.68	0.45	0.34
							Projasus spp. per sqm	0.10	0.04	0.02	0.01	0.01
							Chaceon spp. per sqm	0.10	0.04	0.02	0.01	0.01
								Tonnes	Tonnes	Tonnes	Tonnes	Tonnes
a. Seamounts A 0-500 m	8, 12A, 18, 22, 23, 25 27b, 28, 29, 30, 37a 46, 48	*Jasus spp*.	1,500	100%	696	25%	696,490,000	888,025	355,210	177,605	117,533	88,802
b. Seamounts B 500-1,000 meters	5, 8, 9, 10, 12a,17, 18, 20 21a, 22, 23, 24a, 25,27a 27b, 28, 29, 30, 31, 37a 45, 46, 47, 48, 49,50	*Projasus spp*.	150	50%		25%		5,394	2,158	1,079	719	539
		Chaceon spp.	500	50%	2,877	25%	2,877,000,000	17,981	7,193	3,596	2,398	1,798
d. Seamounts C 1,000-2,000 meters	62 Seamounts below 1,000 M	*Projasus spp*.	150	50%		25%		14,214	5,686	2,843	1,895	1,421
		Chaceon spp.	500	50%	7,581	25%	7,581,000,000	47,381	18,953	9,476	6,318	4,738
Total					**11,154**		**11,154,490,000**	**972,996**	**389,198**	**194,599**	**128,862**	**97,300**
2. Total Biomass												
a. *Jasus spp.*								888,025	355,210	177,605	117,533	88,802
b. *Projasus spp.*								19,609	7,844	3,922	2,615	1,961
c. *Chaceon spp*.								65,363	26,145	13,073	8,715	6,536
Total								**972,996**	**389,198**	**194,599**	**128,862**	**97,300**
3. Bottom Contact	Pot pulls per day	Fishing days per year	Pot Size sqm				sqm Bottom Contact	% of Bottom Contact				
a. Seamount A	1,000	90	1.77				159,300	0.023%				
b. Seamount B	1,000	0	1.77				0	0.000%				
c. Seamount C	1,000	0	1.77				0	0.000%				
Total	**1,000**	**90**	**1.77**				**159,300**	**0.023%**				

Appendix 2f : Foundation Seamount Chain Characteristics

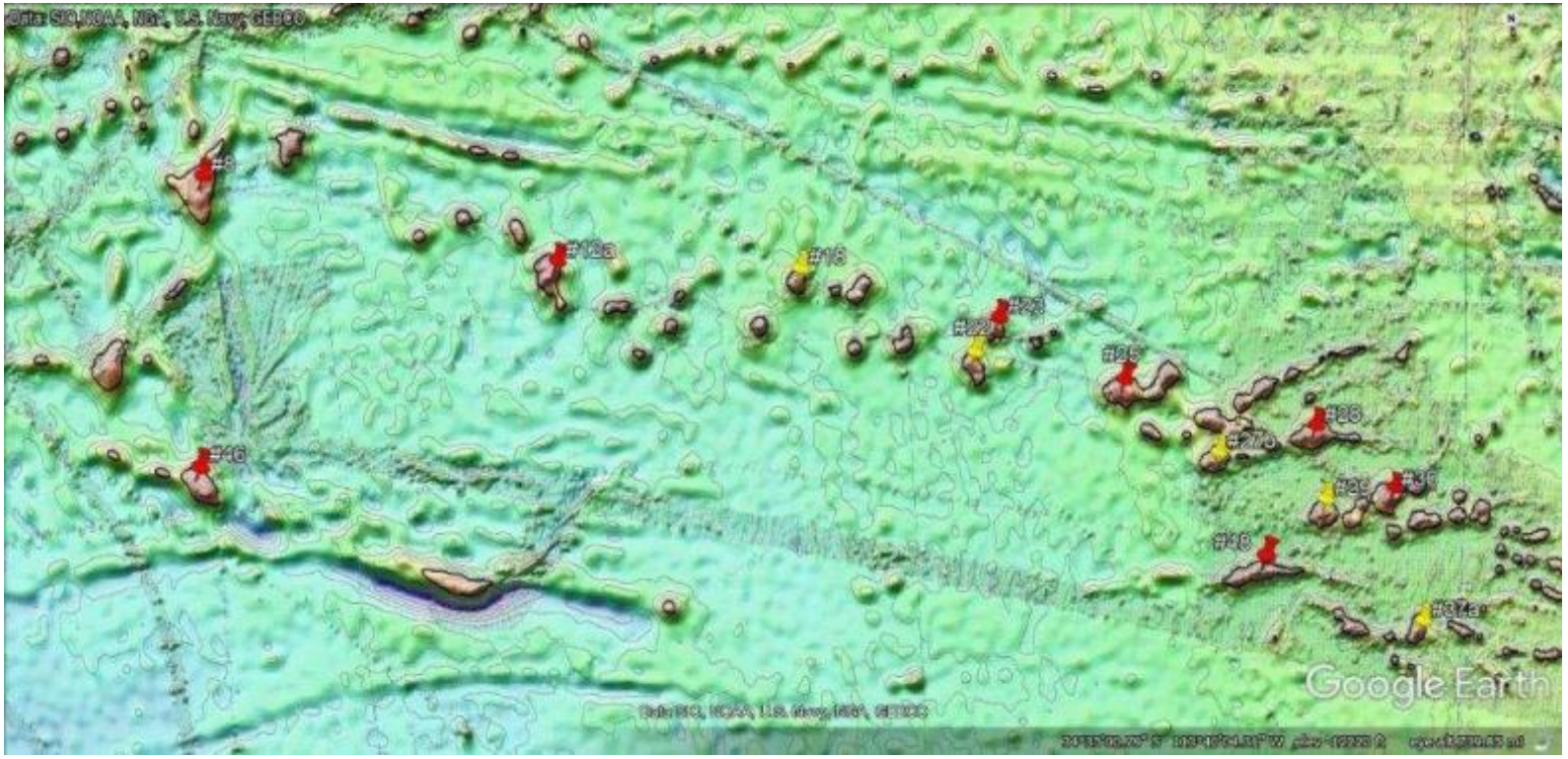


Figure 4. Expanded graphics of the seafloor of the proposed Exploratory Fishing Operations (FOP (1)

Defined seamounts for 2019 shown as follows : (Red = chosen eight (8) seamounts to be surveyed; Yellow = alternate five (5) seamounts).

Appendix 2g. Foundation Seamount Chain Characteristics

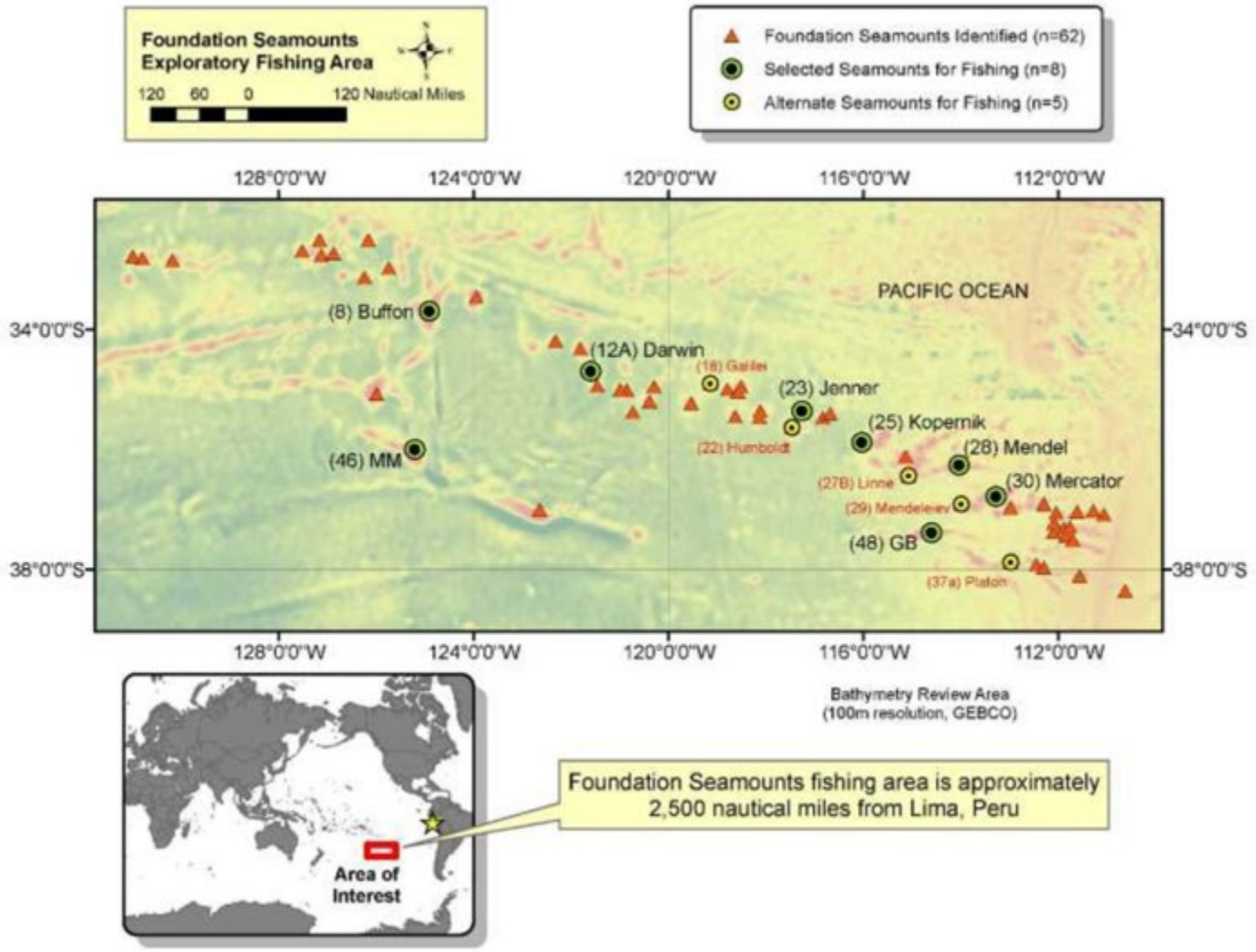


Figure 5. Relative position of Foundation Seamount Chain: Selected Seamounts for Exploratory Pot Fisheries (FOP 1)

Appendix 2h. Foundation Seamount Chain Characteristics

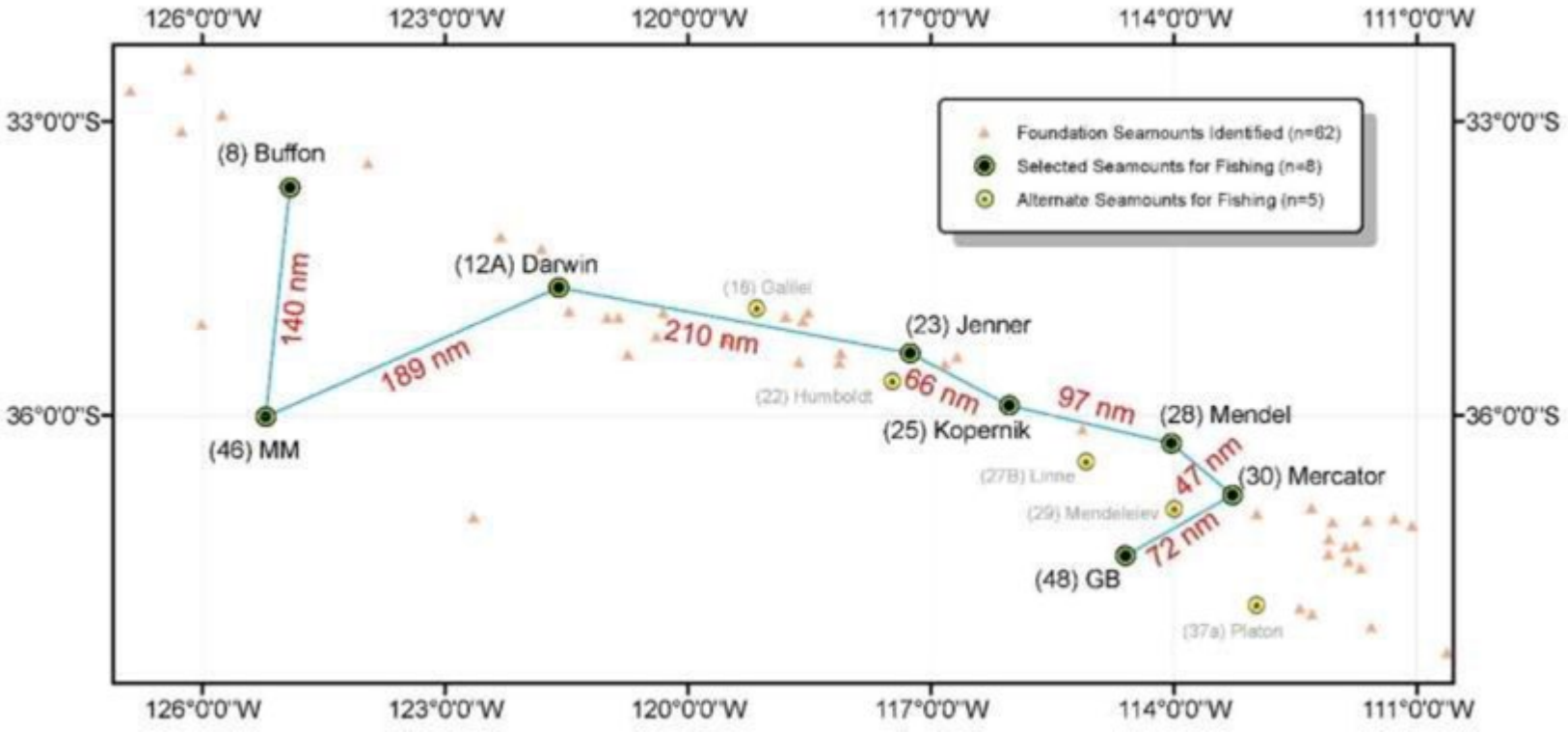


Figure 6. Relative Position of Foundation Seamount Chain: Transit Distance between selected seamounts

Appendix 3 : Type & Configuration of Traps to be used in the Exploratory Fishing Operations

Figure 7: Stackable top loading traps with bridles and bones

Figure 8: Escape gaps on trap

Figure 8b: Anti Ghost-fishing line

Figure 7. Actual traps deployed on trips one and 2 (extracts from Observer reports)

Appendix 4. Observer Tasks and Sampling Instructions

Research in SPRFMO

The sampling protocols below must be clear and understood in conjunction with the requirements for capturing data in the database titled ***SPFRMO_Lobster_V8_blank*** (Access file). If you are unsure what to capture under the field names, refer to the **bottom left corner** (of the database page) for the field description.

NOTE NO DATA THAT IS NOT RECORDED BY THE OBSERVERS MAY BE ENTERED INTO SPRFMO DATABASE.

For reference, Observers must also read the ***SC6-DW01 Cook Islands Fisheries Operational Plan v2 (clean)***

The tables below should provide a view of the sampling requirements that must be undertaken by the Observers. Note, yellow highlights indicate the additional sampling for trip 2.

FEW POINTS TO NOTE

1) The Observer must fully understand the difference between random and non-random samples.
2) All biological data recorded in the database must be taken from a random selection of crustaceans.
3) Please ask if anything is unclear. We are going to request copies of your database on a weekly basis and will revert if we pick up any issues.
4) Please also read the following CMMs, which can be found on the SPFRMO
    a. CMM-02-2018-Data-Standards-8March2018
    b. CMM-03-2018-Bottom-Fishing-8March2018
    c. CMM-09-2017-Seabirds-8March2018
    d. CMM-13-2016-Exploratory-Fisheries-8March2018
    e. CMM-16-2018-Observer-Programme-8March2018

Cruise Report
The tables also provide some reference to the cruise report where additional information can be recorded and comments made. Please keep this information relevant to the work being done or to assist in understanding specific information that has been recorded.

Photographs are very important.

Please do not make personal comments or suggestions that are not relevant to the work. These should be recorded in your Internal Report that can also include comment on vessel cooperation, safety etc.

Details for the vessel Altar 6 has been provided in ***SC6-DW01 Cook Islands Fisheries Operational Plan v2 (clean)***

Appendix 4. Observer Tasks and Sampling Instructions

Research in SPRFMO

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For reference, Observers must also read the ***SC6-DW01 Cook Islands Fisheries Operational Plan v2 (clean)***

The tables below should provide a view of the sampling requirements that must be undertaken by the Observers. Note, yellow highlights indicate the additional sampling for trip 2.

FEW POINTS TO NOTE

5) The Observer must fully understand the difference between random and non-random samples.
6) All biological data recorded in the database must be taken from a random selection of crustaceans.
7) Please ask if anything is unclear. We are going to request copies of your database on a weekly basis and will revert if we pick up any issues.
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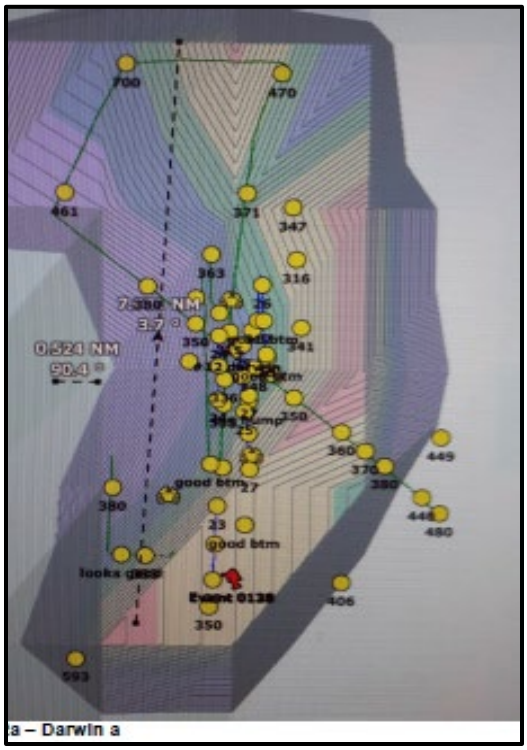
Observer Sampling Procedure contd.

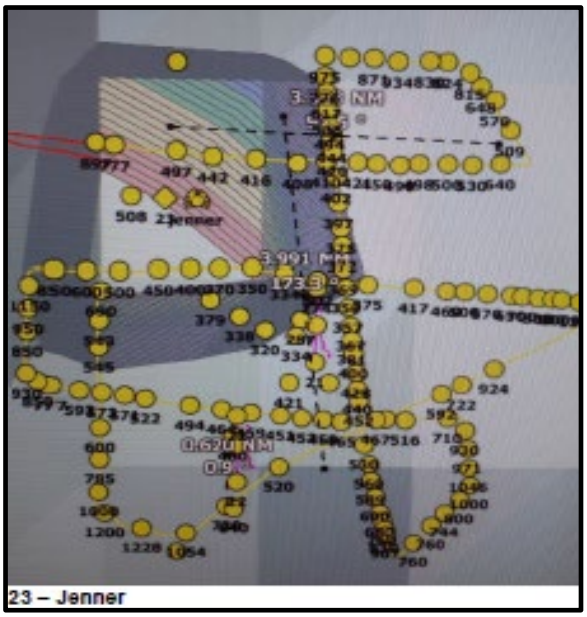
Database page Trip Details	**Cruise Report Section** 1) TRIP SUMMARY and 2) CRUISE DETAILS and 4) CATCH DETAILS
• Vessel details • Trip summary • Retained or landed catch (number and weight) per target species Note, please use the Line form to record this information on hard copies	Provide a brief outline of the work carried out, including any specific and/or additional tasks in the Trip Summary. Also include observer details (name and company). Cruise Details must include; sail/dock dates and ports etc. Insert a table of the landed catch (total number and weights summed for the trip) under the Catch Details heading
Database page Set and Haul	**Cruise Report Section** 3) FISHING OPERATIONS
• Positional data including depth • Trap details (type, spacing, number, sampled) • Total catch per target species per trap • Bycatch species of concern (Y/N) • Environmental observations • Gear information (inclu. Lost traps) • Problems	Under Fishing Operation***s***, write a description of the fishing method, lost fishing gear, environmental observations and comment on any information that the database does not cover. Please cross check your positions with those recorded by the vessel. It is probable that you will record these from the vessels log, that's ok however if you detect any discrepancy in your personal observation please keep a record in your notebook and record detail in your cruise report. You can add paragraphs to your Cruise Report as you need. Relationship between catch composition (and catch rate) and depth at which a trap is set: We need the approximate depth of at least some of the traps that you sample. There are 3 depth soundings made per line (start, mid and end). Would it be possible to sample traps at these points, so that we will have the numbers / size / species comp. per trap as well as the depth for that trap? If you work it into your normal sampling schedule, you may be able to do this without increasing the total number of traps that you sample per line?
Database page Trap Tally	**Cruise Report Section** 4) CATCH DETAILS
Please receive this information from the vessel. The Cook Island observer should collect and capture these data; • Record weight per target/non target species in kilograms per trap • Bycatch weight is recorded for all "other" bycatch species summed together per trap • Record whether the trap was Missing, Damaged or Not damaged	Approx. 1000 traps will be set per day on five lines of 200 traps per line, or only 100 traps per line when fishing smaller seamounts. Catch of each trap will be sorted (**by the crew and Cook Island observer**) into target species (*Jasus*, *Projasus* and *Chaceon*) and bycatch. Each of the target species will be weighed per species. All bycatch will be "lumped" together and weighed.
Database Sheet Sampling	**Cruise Report Section** 9) BIOLOGICAL DATA SUMMARY
• For each 10th trap (starting at number 1) measure the first 40 lobsters/crabs but if there are less than 40 in the pot, measure all of them. • **Weigh** the 40 lobsters/crabs (i.e. sample weight per species). *You will have the total weight of all lobsters/crabs caught by the trap from the Trap Tally data; and also the weight of the subsample of 40 lobsters. Therefore, individual lobsters are NOT weighed during the size composition sampling.* • Once you reach a minimum of 200 lobsters on a line (i.e. 5 pots of 40; or 20 pots of 10	The international observer (i.e. CapMarine Observer) is required to sample 10% of the traps per line i.e. sample every 10th trap that comes up, which equates to 20 traps per line of 200 traps. Please measure length to the nearest mm and total sample weights kg using a motion compensated scale. All traps hauled will also be recorded by the deck camera for by-catch and other potential issues to be assessed

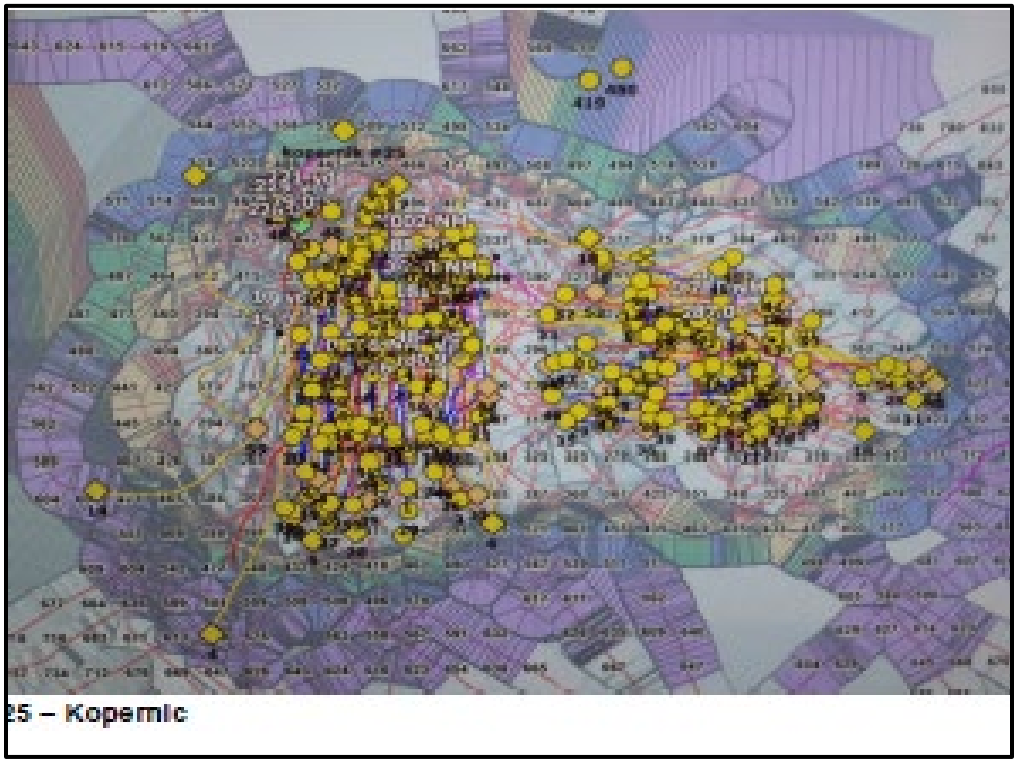
lobsters, if this is all that was caught) then you can stop measuring on that line.
• For lobsters (*Jasus* and *Projasus*) and crab (*Chaceon*)record;
  ○ Trap number
  ○ Species , Sample weight (per sp. per trap)
  ○ Measure type, Lobster length = CL (mm); crab length = CW (mm)
  ○ sex & berry stage = F1 – F4, BF - Female with berry, FM – female mature, I – female immature, M – Male, NF – no female maturity defined
  ○ shell condition = 1-3
  ○ sex – automatically updated
  ○ berry – automatically updated
  ○ Retained Sample No = If samples are retained i.e. bagged and tagged, please record the serial number for the species on the database as well as on the label in the bag. This also includes blood or tissue samples taken.
  ○ Please take **photos** of unknown species and label them with the Retained Sample No
Note, orange highlight on the database means that you must re-check that you have captured the data correctly.
 	
Please also collect five samples of each lobster Jasus sp.., Projasus sp.. *and Chaceon* sp.. *crab per seamount, which will be bagged on a species by species basis and landed at the end of each voyage. The sample bags containing the crustaceans will be identified by the vessel name, common name and scientific name (if known) of the crustaceans, approximate weight of the total samples and details of a contact person. Additionally, any interesting species caught as bycatch and unable to be identified at sea by the observers will be bagged and preserved along with details mentioned above.*
 	
Collect genetic samples: 5 Jasus, 5 Projasus, 5 Chaceon please. Best is to break of a leg with some muscle tissue inside, and then cut it in half to make sure the ethanol gets through the shell to the tissue. Fill the tube to the top with the ethanol and store it in the freezer. Please fill the ethanol up from time to time – it gets sucked into the tissue and can also evaporate.
Introducing small-mesh traps:
• For now, the standard mesh size is retained and sampled in the same way as on trip 1, but it would be useful to introduce some small-mesh traps as well, to assess the relative abundance of smaller lobsters and crabs.
• Sample a total of 5 small-mesh traps, which are fitted to the line, exactly in the same way as the normal traps.
• Each time the line is hauled, the observer should sample these 5 traps, along with the standard mesh-traps.
• For example, if the line consists of 100 traps, then the catches would be measured for 5 small-mesh traps and 5 standard mesh traps (10% sampling). If 200 traps, then measure the 5 small-mesh traps and 15 standard mesh traps. etc. In this way our normal sampling regime is maintained, while we add the test with small-mesh traps.
	Provide a brief description of any sub-sampling tasks undertaken during the cruise
	
	List all the types of samples collected and the location where they are to be stored.
	
	Describe the design, sampling strategy and outcomes when using traps with smaller mesh size.

Database Sheet Bycatch	**Cruise Report Section** 5) BIOLOGICAL DATA SUMMARY
For every trap sampled i.e. every 10th trap record; • Species code for all the invertebrate (particularly VMEs) and vertebrate bycatch species in the trap. • LiveDead = alive, dead or unknown • Location = inside the trap, outside the trap or on the line • Retained (Y/N) • Condition = broken or whole , Number, Weight (kg) • Comment • BioSampleNumber = bycatch serial number Please retain unknown species for ashore identification. The serial number must correspond to the label in the sample bag.	Provide information about the bycatch sampling and include a summary of the state, location on the trap/line and condition of the species caught. Please report on any interactions with seabirds, turtles and marine mammals. Describe any bycatch mitigation devices used by the vessel and comment of their effectiveness. Insert table of all retained samples with reference to the Biological Sample number.
Database Sheet Length – weight (conversion factors)	**Cruise Report Section** 5) BIOLOGICAL DATA SUMMARY
Length-weight data for Jasus caveorum. You need to measure CL, Total length (TL), whole weight (WW) and tail weight (TW). Maybe just do a few per line. Tail weight should be tails removed by the factory in the normal way, not cut off. In the end (after the trip) it would be good to have a nice broad size range covered (50 – 170 mm CL) and equal numbers of males and females (50 – 100 of each sex), if possible. • Measure a max of 200 individuals per retained species across the size distribution for the entire trip. • For each size class (<40mm, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, 100-109, 110-119, 120-130, >130 mm) measure a minimum of 5 males and 5 females and record; o Sex (M/F) o Measurement type (CL or CW) o Length (mm) after processing, Total Length (mm) o Whole weight (kg),Processed weight (kg) There may not be many species in the smaller and larger length categories but even 1 individual will be useful.	Provide a summary of conversion factors used by the vessel and your calculated values for the appropriate areas. Provide a description of how the conversion factors were calculated in the comments section A length-weight regression equation can also be derived from these data.

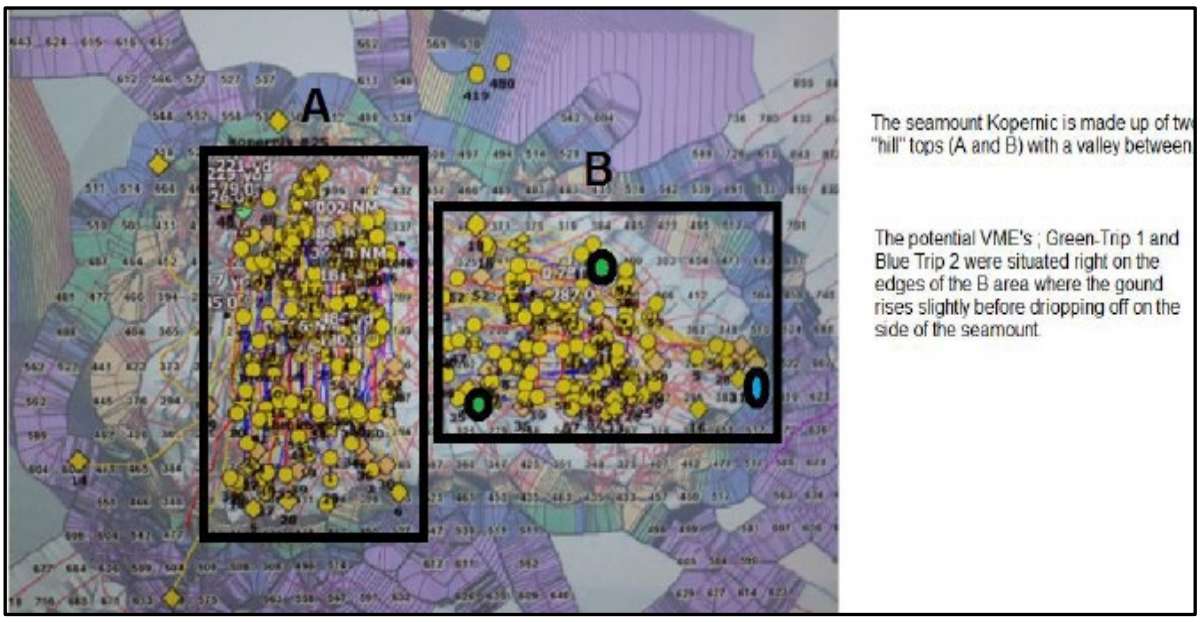
Appendix 5 : Figure showing vessel tracking of lines set on Kopernik, Jenner and Darwin-A Seamounts



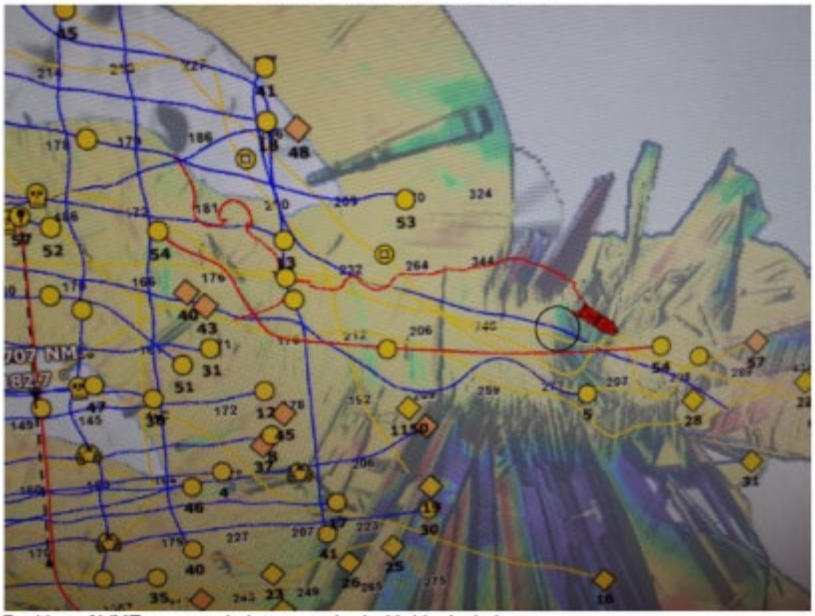




Appendix 6. Sample tracking of VMEs from FV Altar 6 on Trips 1 & 2 (2019)



VME on seamount Kopernic



Position of VME on vessel plotter, marked with black circle.

APPENDIX 7

Preliminary sample design for determining the effective fishing area for traps used in the Cook Islands Foundation Seamount exploratory fishery.

When using traps to estimate the abundance of benthic resources, it is important to estimate the relationship between captures and population density as a first step in assessing the sustainability of catches. Due to the depth of the habitat and the cryptic behaviour of lobsters, other survey methods are cost-prohibitive so this work intends to use a method of distance between traps to estimate effective fishing area, assuming an exponential decrease in capture probability with distance from a trap, as used in other similar fisheries that use trap gears.

Aim

Estimate the effective fishing area of traps for lobsters on Kopernik seamount.

Methods

The study area will be Kopernik seamount, as this seamount has sufficient biomass and is more likely to generate enough data to provide meaningful results.

The fishing vessel *Altar 6* will fish using longline sets and traps for five fishing days. Prior to departure, the captain, fishing master and both observers will be briefed on the protocol in detail. The vessel will undertake the experimental work at the start of the trip and the catch will be retained and counted against the total allowable catch (TAC). The fishing days used for the experiment will not be deducted from the total allowable effort (TAE).

Each day, five fishing lines will be set with 30 traps divided into six groups, each set at varying distances apart. The smallest inter-trap distance will be 20m as lobster telemetry studies on *Jasus lalandii* have shown that the normal foraging range (in the absence of a baited trap) of these lobsters is 10-45 m per day (Adkinson et al. 2005). Studies on other crustaceans indicate that a 20m trap separation (equivalent to a 10m radius) is likely to be within easy reach of an adult lobster. For each consecutive group, trap spacing will increase (20, 40, 60, 90, 140 and 200 m between traps). The trap spacing will be as follows (Figure A7-1):

Group 1 - inter-trap distance 20m, followed by a 40m space.
Group 2 - inter-trap distance 40m, followed by a 60m space.
Group 3 - inter-trap distance 60m, followed by a 90m space.
Group 4 - inter-trap distance 90m, followed by a 140m space.
Group 5 - inter-trap distance 140m, followed by a 190m space.
Group 6 - inter-trap distance 200m.

Five fishing events (i.e. five lines set on each of five days) with an average soak time of 20-30 h will be undertaken during the experiment, resulting in 25 replicates of each trap group. Each line will be set at 300m or more from the previous line set, and lines will be set parallel to one another. This may seem like a relatively high level of replication but the variable nature of the CPUE data from Kopernik suggests that the CPUE is likely to be fairly variable within each group and increased sampling may be more likely to produce useable data. In addition, the increasing inter-trap distance (Figure A7-2) and the large difference between group 1 and 6 should provide enough contrast in the data for meaningful analysis. The Vessel may require the first day to set fewer lines so that the vessel crew and observers can familiarise themselves with the experiment and sampling protocols.

Experimental traps will be set in groups of five with the inter-trap distances being 20, 40, 60, 90, 140 and 200 m, with five replicates per inter-trap distance daily. To the extent possible, traps will be set from group 1-6. The reason for this is that group 1 cluster is likely to sink fastest, hereby keeping the line taught on the set. However, noting that the traps in group 1 are close to together and if catch rates are high, the

observer work load may result in sampling difficulties for group 1. The observers will have the flexibility to change the setting and hauling order e.g. setting from group 1-6 but then hauling from group 6-1 thereby allowing them to stack traps from groups 1 and 2 to allow time for sampling.

Between each group a space equivalent to the next biggest group will be used between the last group of the prior group and the first trap of the next group, for example the distance between the last trap of Group 1 (20m) and the first group of group 2 (40m) will be 40m. It is hoped that this will reduce traps from the lower groups competing for lobsters from the higher group.

The catch from each trap will be weighed, counted and a sub sample will be sexed and measured. Lobsters will be measured and sexed from each trap. From traps with less than 30 lobsters, all individuals will be measured, traps with more than 30 lobsters will be subsampled where 30 lobsters from the trap will be randomly collected and measured.

The data will be housed in an access database and retained for analysis post trip. Upon return, the data will be provided to MMR Cook Islands for analysis.

Analysis

CPUE and the estimation of the effective fishing area of traps

The probability of capture relative to the trap will be assumed to have an exponential decay with increasing distance from the trap, with lobsters immediately adjacent to the trap having a probability of 1. The potential capture area will be assumed to be circular[7] and the actual catchability will be knife edged within the capture area.

The CPUE will be analysed by trap group. Given that smaller lobsters may have limited ability for movement analysis by lobster size is considered relevant. CPUE therefore, will be analysed in both weight and numbers. In addition, length frequency analysis will undertaken.

Desktop estimation of lobster population size on Kopernik seamount

A desktop analysis will be carried out to estimate lobster biomass at Kopernik Seamount. This analysis will use a range of estimates of effective fishing area by depth to estimate fishable biomass (via estimation of catch per unit area and expansion to total habitat area). It is likely that the analysis will assume even density from the surface of the seamount (130m depth) to 300m depth but then the assumption will be that lobster density declines from 300m – 500m below which density will be assumed to be zero (see Figure 7 in Brouwer et al. 2019). The analysis will require accurate depth information, without which the depth surface will be inferred from the set depth data obtained from the fishing operation e.g. Figure A7-3.

Broadly speaking the analysis will likely select effective fishing areas from 1-200m under a reasonable likelihood profile based on known foraging ranges from other *Jasus* species, as well as, published effective fishing distances and areas from other crustaceans. These will be used to estimate the effective sampling area of the fishing gear. Then the sets from Trip 1 will be assessed to find "pristine lines". These will be defined as a subset of lines set where another fishing line has not previously been placed, and for which the set time is 20-30 hours (see Figure 14 in Brouwer et al. 2019). These lines will then be treated as transect lines to sample the population which will then be extrapolated across the area by depth stratum to estimate a potential range of population sizes for each depth stratum.

[7] While the shape is assumed to be circular, this is unlikely to be the case as shape of the attraction plume and thus the effective fishing area are influenced by the speed and direction of the current. Knowing this the assumption is that all traps in a treatment are subject to the same local physical conditions.

The results will be presented at SPRFMO SC8, including the estimated effective fishing area from the experimental fishing being applied to the data set to get an estimate of initial biomass. The analysis, if accepted by SC8, could then be repeated for the data collected during fishing year 2 or by trip to estimate the population change following each trip.

References

Atkinson, L.J. Mayfield, S. and Cockcroft, A.C. 2005. The potential for using acoustic tracking to monitor the movement of the West Coast rock lobster *Jasus lalandii*. *African Journal of Marine Science*. Volume 27(2), Pages 401-408.

Brouwer, S., Wichman, M., Maru, P., Groeneveld J., Epstein, A. and Japp, D. 2019. Cook Islands exploratory lobster trap fishing in the SPRFMO - Trips 1 and 2. *SPRFMO SC7-DW02*, pp42.

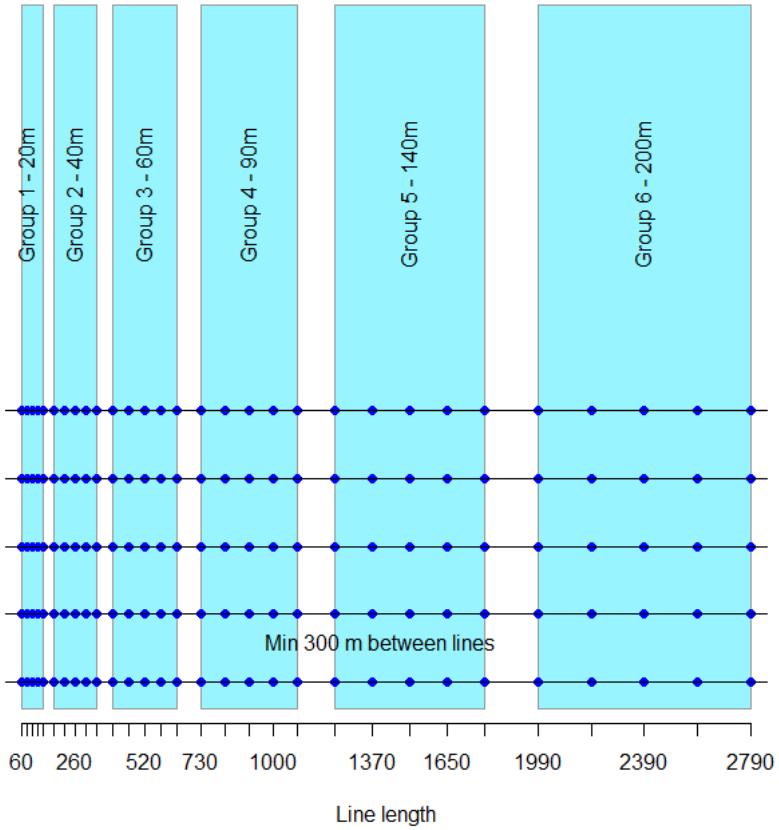


Figure A7-8: Trap spacing for the Cook Islands experimental fishing to assess trap competition and effective fishing distance for Jasus cavorum on the Kopernik Seamount. The five lines are separated by a minimum of 300m and set in parallel across the flat surface of the seamount.

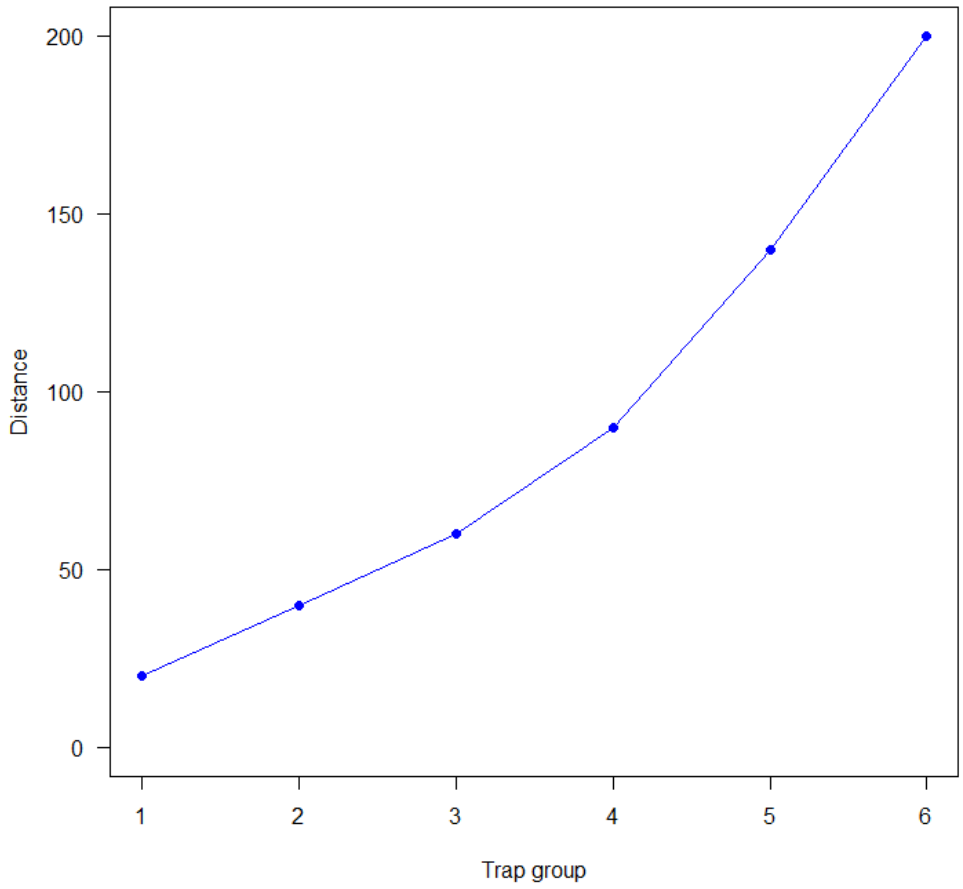


Figure A7-9: Inter-trap distance between experimental trap groups.

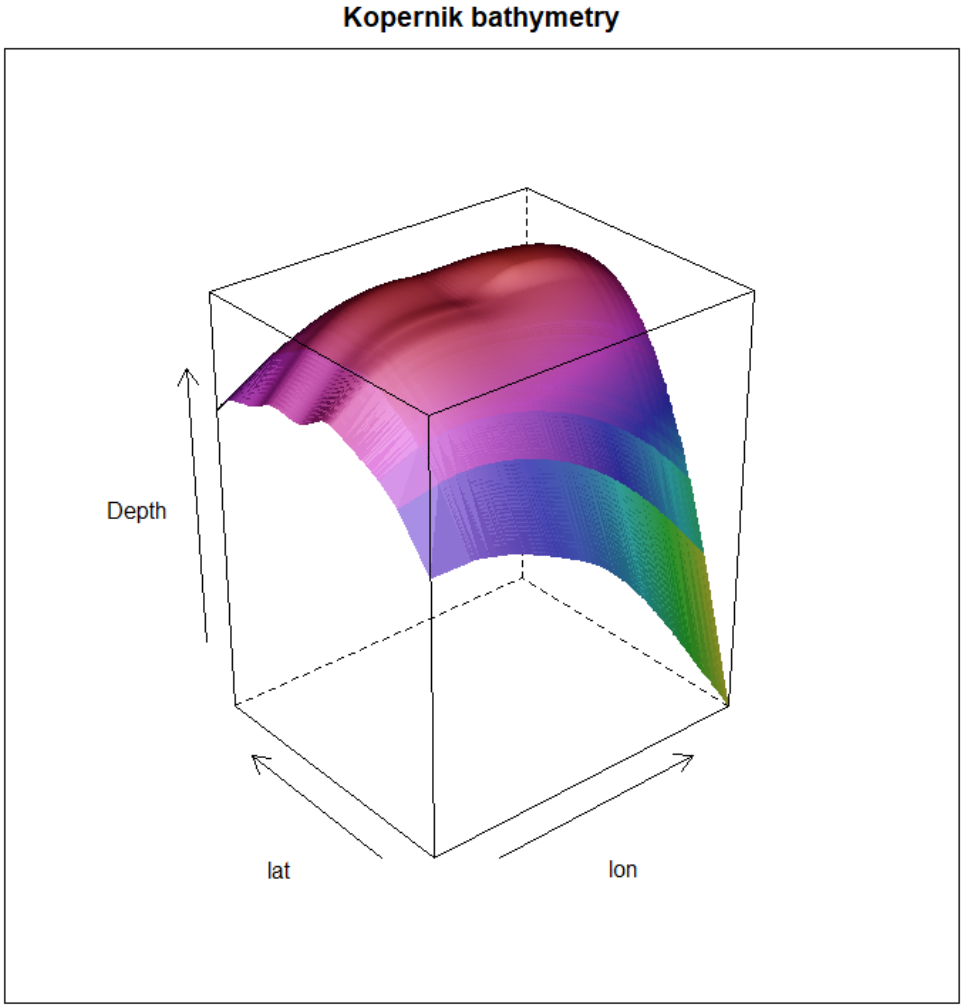


Figure A7-10: Kopernik seamount bathymetry estimated from trap depths recorded by the vessel Altar 6 during trips 1 and 2 in fishing year 1.