

6th Meeting of the Commission
Lima, Peru, 30 January 2018 to 3 February 2018

COMM 6 - INF 07

A New Exploratory Fishery Targeting deep-water species of Lobster and Crab:
Background
Cook Islands



Exploratory Fishing Application for Great Southern Fisheries Limited

“FV Great Southern”

**To fish in South Pacific Regional Fisheries Organisation Management Area
Targeting deep-water species of lobster and crab**

Dated 21st July 2017 _revised Oct 2017

Jasuscaveorum

Photo credit: Rick Webber Museum of New Zealand Te Papa Tongarewa

Table of Contents

	Page
1 Overview	1
2 Principal Point of Contact.....	2
2.1 Owners’ Representatives	2
2.2 Official Contact	2
2.3 Vessel Owners.....	2
3 Vessel details	3
4 Principals	3
5 Proposed Activities in the Management Area and the Target Species	4
5.1 Licensing	4
5.2 Area	4
5.3 Dr. David Sandwell	6
5.4 Methods	7
5.5 Phase Approach Methodology	7
5.6 Target Species.....	10
5.7 Transhipment.....	12
6 Research Zone Identified and Resource Calculation Methodology.....	12
7 Non-target, associated and dependent species.....	15
8 Planned Trips in Management Area	15
9 Datasets and Reporting of Vessel Movement and Activities	15
9.1 Datasets.....	15
9.2 Survey traps	17
9.3 Exploratory Research Fishing Data Collection	17
9.4 Vessel Movement in the Management Area.....	18
9.5 Control of Vessel	18
9.6 Reporting of Vessel Sightings	18
9.7 Vessel Monitoring System	18
9.8 Observers.....	18
10 Biological Sampling	18
10.1 Rick Webber.....	19
11 Assessment of the Potential for Significant Adverse Impacts on VMEs	20
11.1 Camera Study.....	20
11.2 Cumulative Impacts.....	20
11.3 Report Writing	20
11.4 Dr. Malcolm Clark and Dr. Ashley Rowden.....	21
12 Conservation & Management Measures	21
13 Conclusions.....	22

APPENDICES

Appendix 1 (John Chadderton& Mark Maring)

Appendix 2 (SPRFMO Research Zone Chart)

Appendix 3 (Exploratory Fishing Research Area)

Appendix 4 (Pictures of Traps)

Appendix 5 (Projasus Report)

Appendix 6 (Foundation Seamount Report)

Appendix 7 (Historical Fishing History on the Foundation Seamount Chain)

Appendix 8 (Foundation Resource Calculation)

Appendix 9 (VME Reports)

Appendix 10 (Picture of Projasus research trawl catch)

Appendix 11 (Vessel Diagram)

Appendix 12 (Camera Information)

Appendix 13 (NRC Scientific Sampling Plan)

Appendix 14 (NRC Catch Reporting & Information Summary Plan)

1 Overview

This document is in addition to an application to the Ministry of Marine Resources (MMR), Rarotonga, Cook Islands for an authorisation for Great Southern Fisheries Limited, of Avarua, Rarotonga (GS) to utilise their vessel, the FV Great Southern.

GS mission statement istoconduct an Exploratory Research Fishing plan in the South Pacific Regional Fisheries Management Area, outside of any previously established bottom fisheries footprint of the Cook Islands.

GS will implement the research planusing a Phased Approach which will most likely encompass the following years2018, 2019 & 2020 initially and then subsequently as determined by MMR and the Scientific Committee (SC) and Commission of the South Pacific Regional Fisheries Management Organisation (SPRFMO).

The GS research plan has several components.

- (1) GS intends to determine the geographical range of the targeted species which includes depth range contours and area.
- (2) GS desires to understand and determine the biology of the targeted species which includes, size composition, female to male composition, DNA sampling and other relevant biological information to better understand these species.
- (3) GS wants to fully understand the potential VMEs in the research zone. Plot their locations and have the compiled data mapped out in 3D projections for each seamount researched.
- (4) GS will utilize fixed underwater camera equipment to establish the composition and real time extent of the potential VMEs in real time. GS will have the data recorded andanalyzed to assist in the evaluation of potential VMEs and other bottom structures to better understand the type of bottom structures the targeted species concentrate.
- (5) GS will conduct a comprehensiveanalysis to build a robust reporting plan while collectingall research data and have it compiled in a model, in order to start the process to better understand the resourcespecies, population dynamics,densities and distributions across the research zone in support of the development ofa sound biomass assessment model.

This document seeks to comply with the application requirements of SPRFMO Conservation and Management Measure (CMM) 13-2016 and includes, in full, all information material to such application for consideration by the SPRFMO SCat the nextintercessionalmeeting scheduled for the end of November 2017and thereafter by the Commission, when it meets in January 2018.

This application contains in full the Exploratory Research Fishing Operation Plan as required by CMM 13-2016 under a phasedmethodological approach which most likely will take place during the yearsof 2018, 1019 & 2020 which will be determined by the completion of the exploratory research operating plan contemplated.

Given the changes in the high seas management of the fishery resources in the South Pacific in particular with the formation of SPRFMO, the applicant, GS, acknowledges that exploratory and commercial fishing voyages for target species are now mandated to account for interactions and footprints left on the environment. GS is familiar with and will have on board their vessel the following documents:

1. FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas.
2. The Conservation and Management measures as adopted, amended and added to, from time to time, by the South Pacific Regional Fisheries Management Organisation (SPRFMO).
3. Ecosystems and Biodiversity in Deep Waters and High Seas. (2006) UNEP Regional Seas Report and Studies no. 178. United Nations Environment Programme.
4. Evidence of a Vulnerable Marine Ecosystem (VME) form. (2008). Ministry of Fisheries, New Zealand.
5. Template for the compilation of information describing specific habitats in the Southern Pacific Ocean.

2 Principal Point of Contact

2.1 Owners' Representatives

The below name individuals will be the primary points of contact for all operational, management and corporate matters.

Name: John Chadderton
Address: 3 Henry Street, Fremantle, WA 6160, Australia
antartic@iinet.net.au

Name: Mark Maring
Address: 4430 SE Flavel Street, Portland, Oregon 97206, USA
mfm@markfmaring.com

2.2 Official Contact

Name: Tim Costelloe, Director, Offshore Fisheries
Address: Ministry of Marine Resources
Avarua, Rarotonga, Cook Islands t.costelloe@mmr.gov.ck

2.3 Vessel Owners

The owner of the vessel is Great Southern Fisheries Limited, a company incorporated under the laws of the Cook Islands and based in Avarua, Rarotonga, Cook Islands.

3 Vessel details

The vessel is a typical “squid jig” vessel, converted for dedicated use to deploy and retrieve strings of traps for setting in deep water. Great Southern – Schematic post-conversion at Appendix 10.

Vessel Name:	Great Southern
International Call Sign	TBC
Flag State	Cook Islands
Port of Registry	Avatiu
Hull	Steel
Length overall	69.35m
Registered length	63m
Breadth	10.7m
Depth	6.8m
Gross tonnage	1094
Hold capacity	1,908cbm
Freezing capacity	80 tons/day
Freezer plant	157cbm
Fresh water capacity	22cbm
Crew accommodation	Up to 35
Main engine	Akasaka K31FD of 1800Bhp

Auxiliary Engines and Generators

1. NIIGATA 6L18CX of 620 hp at 900 rpm
2. NIIGATA 6L18CX of 620 hp at 900 rpm
3. SHINKO of 520 Kva
4. SHINKO of 520 Kva
5. Fuel Capacity Fuel Oil 577 cbm
6. Vessel Markings: Once the conversion is complete, GS 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.

4 Principals

The principals' named above, John Chadderton and Mark Maring, both have substantial experience in the type of exploratory research fishing operation proposed, including experience in other exploratory and research fishing in similar fisheries. They are cognisant 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. Biographies of the fisheries and scientific experience of both individuals is attached see Appendix (1)

5 Proposed Activities in the Management Area and the Target Species

5.1 Licensing

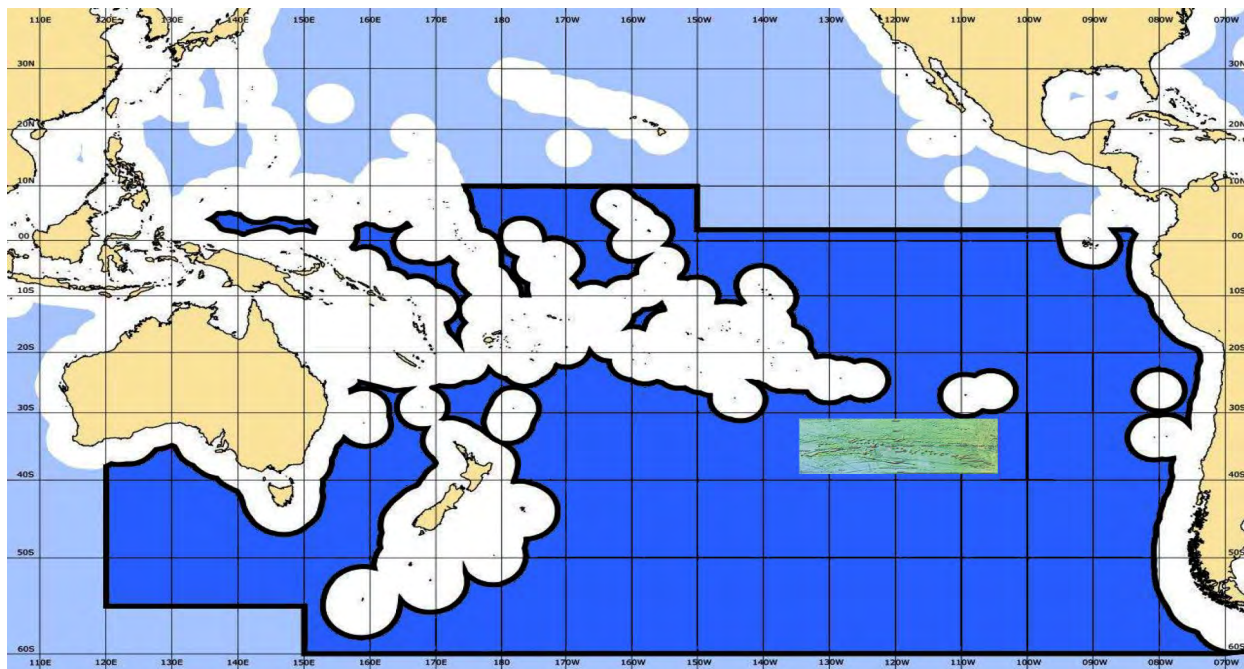
An Access Agreement will be negotiated with the Government of the Cook Islands through MMR, which will, *inter alia*, provide for the annual authorization of the vessel. This Access Agreement will require the company and the vessel to comply with all relevant Cook Islands laws and the rules, CMMs and other requirements of SPRFMO. The Cook Islands has considerable powers of sanction against the company, individuals concerned, including the Master, and the vessel, in the event, that requirements are not adequately met.

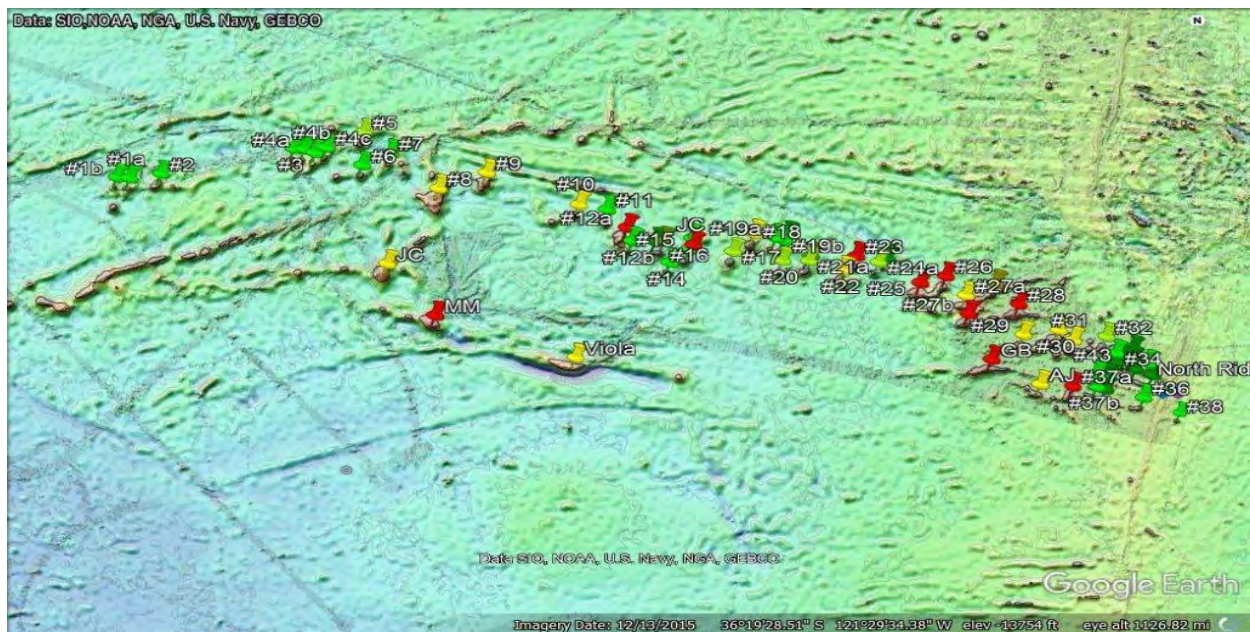
5.2 Area

This document is for an Exploratory Fishing Application to engage in a New Exploratory Research Fishery on the seabed in the following boxed area of the SPRFMO Management Area, see Appendix(2)

Foundation Seamount Chain

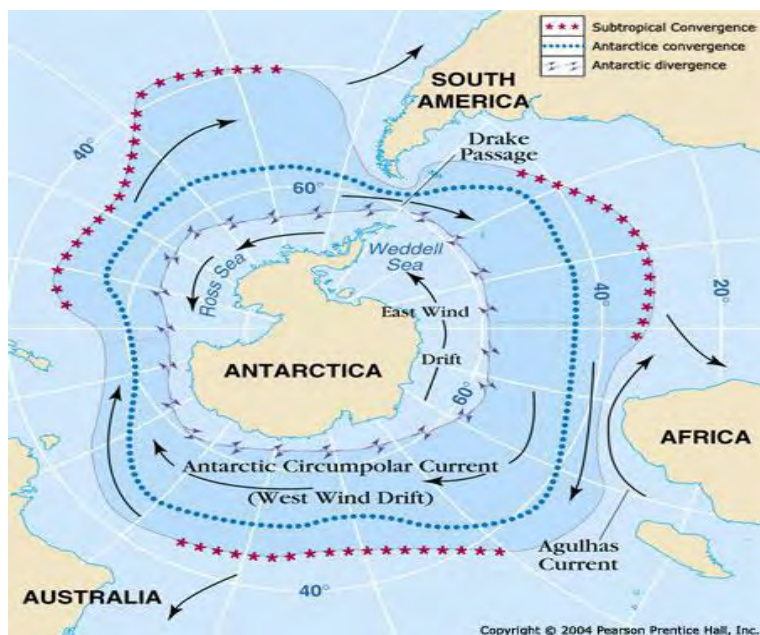
- a. 100 degrees west to 134 degrees West
- b. 31 degrees South to 40 degrees South
- c. 2,400 kilometres by 880 kilometres: 2,100,000 square kilometres





Expanded graphics of the seabed of this area, showing the features to be examined and a map of the SPRFMO Management Area showing the above area is attached see Appendix (3)

The Foundation Seamount chain, due to its location, length and East/West orientation is subject to dramatic upwelling of nutrient rich water from the Antarctic circumpolar current, which is forced by the earth's rotation, and the presence of the Pacific-Antarctic Ridge including the South American continent into a hump effect, or Gyre driving the cold nutrient-rich waters North where a mixing of the Easterly sub-tropical current takes place.



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

enough 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 Foundation Seamount Chain, whereby the same benthos is likely to occur throughout the chain.

The seamount chain in the research zone is different than isolated seamounts which are known to demonstrate degrees of endemism. Individual seamounts and structures throughout the Foundation Seamount Chain are unlikely to hold only endemic species due to the prevailing conditions which would appear to reflect similar diversity throughout the chain.

5.3 Dr. David Sandwell

The area has not been recently or extensively researched and the oceanographic data including high resolution bathymetry may be shared with Dr. David Sandwell of Scripps Institute of Oceanography in California. Review of information and data analyses from Dr. Sandwell may help with further understanding of the unique seamount oceanography in the area of interest.

GS has worked with Dr. Sandwell regarding his work on Marine Gravity Anomaly from Satellite Altimetry and Predictive Seafloor Topography. Dr. Sandwell has shared his research with GS which assist to better understand the Seafloor Topography in the Foundation seamount chain. Dr. Sandwell also shared his comprehensive bathymetric mapping of the Foundation seamount chain which he used to compare his predictive models in order to enhance the development of his predictive model.

GS has agreed to share their bathymetric data when collected during their research fishing on the Foundation seamount chain which will give further data points that Dr. Sandwell can use to improve his predictive model. The development of this technology may be very important as distant deepwater fisheries are considered. Dr. Sandwell will share his findings with GS which will assist NRC to better understand the bottom structure in the Foundation seamount chain to determine the available bottom structure for the target species. Dr. Sandwell's contact information is:

Dr. David Sandwell
Scripps Inst. of Oceanography
La Jolla, California
dsandwell@ucsd.edu

It is in this area that very productive sea mounts were discovered in 1988 by John Chadderton Antarctic Fishing & Oceanographic Research Co (AFORCO) with the research vessel “Mata-Whao-Rua” after completing a survey of the Pitcairn Island EEZ



The “Mata-Whao-Rua”

5.4 Methods

GS will deploy gear carefully designed and dedicated to capturing particular species of crustaceans. GS intends to be very selective about the exploratory research fishing methods and only research areas where there is a high likelihood of the target species with potential strong biomass. The approach should have minimal adverse impact on the environment. It is anticipated that at least 95% of the marine creatures harvested will be the target crustacean species, Pro-Jasus Parkeri, Jasus Caveorum and Chaceon crab. Very little non-crustacean bycatch is expected. Based on prior knowledge and design of the survey trap, GS is able to conduct their exploratory research fishing selectively.

5.5 Phase Approach Methodology

GS will conduct their exploratory research fishing operation using what is commonly described as the “Phased Approach” which details the research activity based on the completion of the desired research results step by step of the research area identified.

Phase One (1): Is designed to complete a “Wide Area Survey” of the entire set of seamount structures with depth ranges less than 600 meters. From definitive analysis twenty (20) seamounts in the research zone have been identified which fit this category. The research design for these structures will take into account the species distribution on these seamounts to determine if the target species are widely distributed and try to determine the geographical boundaries for the targeted species.

This Phase will also take into consideration the depth range where the different species live to try and confirm the depth contours in the different areas to confirm if these depth ranges are consistent. This Phase is expected to provide an overview of the habitat these targeted species live in as well as conducting a robust biological sampling of these species to determine, weight, length frequency, sex, spawning stage, egg clutch strength, seasonality of the different resources and some DNA testing to confirm the species identification if possible. This first Phase is very important as all data will be collected on a voyage by voyage basis. This data will be forwarded to Natural Resource Consultants (NRC) who will analyse these data to reach conclusions about the survey findings which will be supplied to the MMR and SPRFMO SC for evaluation.

Phase Two (2): Once Phase One (1) is completed then Phase Two (2) would be implemented. The second phase would start by focusing on a few identified highly productive seamounts to enable the commencement of what is commonly known as a “Depletion Study”.

This will allow for the recorded catch data to be formulated and start the process of determining the biomass densities and estimates. The plan is to identify a number of the most productive seamounts, possibly four (4) or five (5) depending on the results of Phase One (1) on which to conduct the “Depletion Study”.

NRC has developed a research plan whereby a significant amount of catch would be taken over a period of time from each selected set of seamounts to determine where catch rates decline with increase fishing effort. The application of the DeLury depletion study method to these observed catch and effort data should provide estimates of the initial population size on each seamount. These results then would provide a means to extrapolate at large area encompassing all known seamounts in the proposed fishing grounds within the depth range of the experiment.

During Phase Two (2) research will also start in the areas below the 600 meter depth range. The research program would start in the depth range between 600M to 1,000M this will allow for the determination of the species as expected and should provide similar results as in Phase One (1). From this research it will be possible to determine the depth contours each targeted species inhabits, determine the type of terrain and conditions of the habitat to better understand the environment where these different targeted species reside.

Phase Three (3): Once Phase Two (2) has been completed Phase Three (3) would start. The objective of this Phase is to take into consideration all of the relative scientific data collected in Phase One (1) & Phase Two (2) to start the process working on stock differentiation for the targeted species to establish the process of making some acceptable stock assessments.

GS may be required to adjust the different time lines under the Phase Approach as it is understood there are several unknown factors regarding the targeted species, such as the size and seasonality of first maturity, seasonal availability and seasonality of reproduction cycles. Therefore once these biological

factors are better known, the timing and duration of the depletions studies can be set which will dictate when the research can be conducted and completed for the depth strata and targeted species.

For *Jasus Caveorum* lobsters GS will not conduct research survey activity in the geographical area where this species live when they are egg bearing. GS will follow the fishery design implemented in New Zealand and the Australian Rock Lobster fisheries as a guideline for our research project until the biological factors are known.

This means there will be several months per/year when GS will, (unless otherwise specifically authorised) by eg: MMR & SPRFMO, conduct scientific research in the depth range above 400 meters. During this time frame GS will conduct the research below the 400 meter depth range as investigation on the *Projasus* and *Chaceon* crab species is undertaken.

Currently there is no clear data on the seasonality of the *Chaceon* crab and *Projasus* species in the designated area and so determinations and adjustments will be made as the data is gathered and formulated during the survey plan.

The SPRFMO SC discussed the idea that all three Phases could occur simultaneously and GS does not disagree and will determine the process once the exploratory research fishing begins and GS will advise the SPRFMO SC of these changes in the monthly or annual report submitted to the SPRFMO SC.

GS will use stationary gear, that is, traps which are relatively selective for the target species and their impact on the seafloor is already acknowledged to be very low. One of the potential negative impacts of trapping can be ghost fishing by poor ecological design, which happens when traps are lost and the trap effectively could continue fishing over time. However, the design of these particular traps, with a large direct entrance is intended to only hold the catch when there is bait present, as lobsters, crabs and fish are able to exit the trap with relative ease, there being no barrier within the entrance to prevent this. This will sharply minimize the potential for ghost fishing in the event of lost gear.

Additionally, “escape gaps” will be designed into the construction of the traps. The measurements of these will be in line with the positions and measurements required under Australian and New Zealand fisheries management regulations for the Rock Lobster fisheries. When targeting the *Jasus Caveorum* species the Escape Gaps will remain open, but when targeting the far smaller *Projasus* in the deeper waters these will be closed with a quick flap closure of netting.

Nonetheless, the importance of recording lost gear and traps is noted by GS as it will be an indicator of the vessel’s imprint in this region. As traps are expensive, the GS will make every effort to find lost traps so that minimal, if any, loss of gear is expected. Although no fishing method is 100% benign to the environment, GS believes that its choice of gear, methods and prior knowledge of the type of areas to be researched will mean a negligible imprint will be left, even on sensitive areas. GS will carry approximately 3,000 traps, setting 800-1,000 traps, in strings of 200 traps, in a 24 hour period, with a 3 day set, soak, retrieve cycle. There are a number of other fisheries, including the Hawaiian lobster fishery; Argentine king crab fishery, Russian far-east crab fisheries and Canadian snow crab fishery, which have used a similar strategy with similar volumes per vessel of the same type of traps over many years, in what remain well-managed and sustainable fisheries.

The traps to be used see pictures at Appendix (4), are 150cm diameter at the base, 75 cm high and 50cm diameter at the top. The entrance to the trap is 35cm in diameter and the trap is covered with a mesh

size of 5cm. The backbone and float line for each string of traps is made of 25mm polypropylene with each trap on each string spaced 25m apart.

It should be noted that the total footprint of all traps set each year of the research program is approximately 1.3sq km or just 0.0108% (108 one-hundredths of 1 percent) out of the assessed total seafloor of the targeted area.

The line used to string the traps is positively buoyant and as such the risk of entanglement and therefore damage to bottom structure is very low. Floats will be appropriately marked to ensure easy identification. The methodology of setting is as follows: The first float and float line are deployed behind the vessel and paid out in full, the length of the float line being 1.5 times the maximum bottom depth in the area. The backbone line of traps is then similarly paid out, while the vessel steams slowly ahead and finally the remaining float line and float are paid out. It is important to note that no “anchors” as such are used, the traps themselves being sufficient to keep the gear in place on the bottom. This eliminates the impact of any “anchor damage” to the bottom features.

The entire gear is then “stretched” gently to minimise 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 1m/s, so approximately 20 minutes to settle at a depth of 1000m. The methodology of the set and slow sink rate of the gear, combined with variations in wind and current conditions, mean that it is practically impossible to set the gear in the exact same place twice, with variations in bottom placement of up to several thousand meters from the same surface release point. This has the benefit of limiting damage to sensitive benthos by avoiding repeated contact in the exact same areas.

5.6 Target Species

The primary target research species will be *jasus spp* and *pro-jasus spp* of lobster with an expectation of secondary target research species of *chaceon spp* of crab. A document in Appendix (5) describing the fishery in respect of the primary *pro-jasus spp*. Because various *jasus spp*. and *chaceon spp*. are the subject of well-developed fisheries in a number of areas around the globe, this application will not dwell on them as information is so widely available. Various reports and studies on *jasus spp*. fisheries and *chaceon spp*. fisheries can be found here;

“*Jasus spp.*”

Tristan de Cunha fishery

<https://www.rspb.org.uk/Images/Tristan%20da%20Cunha%20fisheries%20detailed%20report%202017tcm9-440551.pdf>

South Australia

<https://www.environment.gov.au/system/files/pages/0706d910-18b1-4344-940f-1f639a662f90/files/reassessment-report.pdf>

New Zealand:

<https://www.mpi.govt.nz/document-vault/14566>

Chaceon spp.

South East Atlantic

<http://www.seafo.org/Science/Species-Summary/Deep-sea-Red-Crab> (download status report)

North-eastern USA

<https://www.nefsc.noaa.gov/sos/spsyn/iv/redcrab/>

IUCN notes the following in respect of the *pro-jasusparkeri* species of lobster that is expected to be encountered:

“Pro-jasusparkeri” has been assessed as Least Concern. This is due to its wide distribution; having now been found around the globe in all oceans, Atlantic, Indian & Pacific from South Africa, Australia, New Zealand, Kermadec Ridge, Chile. Furthermore, it occurs down to great depths of 3200mtrs and locations (such as seamounts) where harvesting is unlikely and/or restricted, it is established to be the dominant carnivore and to be abundant in suitable habitat.

This species is known and documented from Cape Province, South Africa (Stebbing 1902); Valdivia Bank, Namibia; Ile Saint-Paul, French Southern and Antarctic Lands; and New Zealand (Holthuis 1991), but has been taken as a by-catch in most locations where pots or trawl gear has touched bottom in deep waters. Recently it has been taken in pots fishing Crystal Crab (Chaceon) in Western Australia if the pots are placed in 700mtrs depth. A larval specimen has also been taken from New South Wales, Australia (Holthuis 1991). This species has also been found on seamounts along the Kermadec Ridge (A. MacDiarmid pers. comm. 2009)."

It is possible, but unlikely (see comments under "Area") that other *pro-jasus spp.* may also be encountered and they are expected to have similar stock characteristics as have been observed for *parkeri*. It is assumed, but not known absolutely, that this species has a similar age to other *jasus spp.* of 3-5 years to maturity.

IUCN notes the following in respect of the *jasuscaveorum* species of lobster that is expected to be encountered:

“Jasuscaveorum” has been assessed as Data Deficient. The range and biology of this species is not currently known, it is possible that this species was heavily fished during the 1960s though this cannot be confirmed. It is known to have been fished several times by Chadderton and two New Zealand fishers 20 to 25 years ago 1988 to 1995. This species occurs in international waters and in the past was not subject to any management restrictions. It is well understood that further research is needed on the fishing effort and abundance of this species before a more accurate assessment of conservation status can be made. This species is currently only known from several seamount that were the only ones known of and fished on the Foundation Seamount Chain (35°S 120°W), in the southeast Pacific Ocean, in 1988/93 & 95 to the west of Chile and identified by (Webber and Booth 1995)."

It is possible, but unlikely (see comments under "Area") that other *jasus spp.* may also be encountered and they are expected to have similar stock characteristics as have been observed for *caveorum*. The discovery of *jasuscaveorum* was in the course of short experimental voyages by Chadderton, Cave & Petersen (see commentary in "Catch and Fishery Products Produced" below).

As a result of these voyages, it is believed that the species is present in considerable density and that it occurs at times to depths beyond 450m, but that after this depth *pro-jasus spp.* become dominant.

The proposed exploratory fishery will provide an opportunity to conduct extensive scientific investigation of this species to enhance knowledge of it and provide a basis for management in this and other areas where it or similar deep sea *jasus spp.* are discovered. Age to maturity is unknown, but for the purposes of this application is assumed to be 3-5 years as per other *jasus spp.* until such time as better information becomes available as a result of this exploratory fishery.

Various reports of interest and upon which key assumptions regarding the *jasuscaveorum* fishery have been developed are referenced above. As per the referenced reports, *chaceon spp.* is known to occur at depth in many areas around the world's ocean where suitable habitat exists. From the experimental fishing voyages carried out on the Foundation Seamount Chain by Chadderton, Cave & Petersen it is known that *chaceon spp.* are prevalent in the area below 500m. Following his 1995 voyage, Petersen sent samples of the crab caught to NIWA in Wellington, New Zealand, although it is unknown what analysis resulted from this. It is expected that the crab species encountered will have similar age to maturity to other *chaceon spp.* of 5-7 years. Scientific data and analysis can only be conducted on these resources following fishing effort by GS.

5.7 Transshipment

GS will discharge catch to an approved facility in an approved port and does not intend to engage in any transshipment operations either at sea or in port.

6 Research Zone Identified and Resource Calculation Methodology

Appendix (6) is an examination of a sample of 63 bottom features in the proposed Foundation Seamount Chain exploratory fishing area. It should be noted here that these 63 features are those for which GS has detailed bathymetric and other information and the accessibility of this information is the reason these features were chosen to conduct an Exploratory Research examination here and used as the basis for the resource calculations herein.

There are known to be at least an additional 180 features in the chain with similar characteristics and thought to be an additional unknown number of similar features also in the proposed research area. The detailed information on features, the estimate of the number of other known features and the advice that there are additional unknown features has been obtained by GS from The Scripps Inst. of Oceanography La Jolla, California, USA.

Appendix (7) contains the results of the 3 known short research trips to the Foundation Seamount Chain carried out by Chadderton, Cave and Peterson in 1988, 1992 and 1995 respectively. GS is not aware of any other exploratory research fishing trips to the area and as such can base its assessments on the productivity of the general area (noting above the expectation and benthos across the chain is expected to be similar) only on the results of these trips.

Setting aside the fact that absolute spatial distribution of crustaceans can only be determined by continuous fishing across a gridded area over time and that the effect of "bait attraction" must be set

aside due to the high number of variables, then the weighted average of crustaceans per 10 square meter of bottom contact was 266 lobsters, which is an extremely high density. These lobsters were caught in the depth band of (0-600m) which we have identified 20+ features of the 63 features in total and encompass an area of 1,550 square kilometres.

Appendix (8) contains analysis of expected biomass at various depth bands (0-400m, 400-600m, 600-1000m & 1000-2000m) on the 63 features identified in Appendix (6) referred to above. The depth bands represent significant changes in expected catch composition for each.

The total area across these features above 2000m in depth is 11,278 square kilometres. Given the extremely high density of crustaceans observed during the known, brief, exploratory fisheries conducted on the area and noting the need for a precautionary approach, biomass estimates have been based on densities which are thought to be conservative, but are unknown, at this time.

A range of densities of 1 crustacean per 10 square meters, 1 per 25, 1 per 50, 1 per 75 and 1 per 100 of bottom structure can be expanded to abundance for this exploratory fishing area by depth strata. Total estimated biomass is for the examined features only (Appendix 8) and for depths of above 2000m only. Total biomass across the proposed research area is therefore likely to considerably exceed the estimates included herein due to additional researchable features in the area and the known historical research catches in Appendix (7).

GS has endeavoured to obtain possible relevant FIMS data from South Africa, Australia and New Zealand via the assistance of renowned Marine biologists on Lobster to refine if necessary the bio-mass estimates but at this point in time and over the past 20 or more years, all bio-mass data is established through constant monitoring of puerulus settlement catch size and male/ female ratios. Therefore it is only possible to work from the known catches and effort previously established in this area.

The maximum production capacity of the vessel over the course of 12 months is expected to be no more than 3,500 ton of green product. It is intended to harvest approximately either 3,000 tons of lobster (split to a maximum of 2,500 of *jasus spp.*, and a maximum of 1,500 tons of *pro-jasus spp.*) or 2,500 tons of *chaceon spp.* or a mixture of both.

The uncertainty about species composition of the GS catches is due to various unknowns with respect to the resource and conditions such as weather, currents and other variables which may dictate the area and depths sampled. Additionally, while GS has an expectation and some prior knowledge that each of the researched target species exists in considerable volumes within the proposed area, the composition of catch will depend largely on results.

The lobster species will be the primary researched target species to start under the Phased Approach, but if catch rates are significantly below expectations then crab may be the targeted researched species as an alternative.

It is not expected that there will be a significant bycatch of crab when lobster is being sampled and vice versa as they tend to appear in depth ranges discrete from one another as the dominant bottom carnivore and the nature of these depth differentiations will become clearer as the exploratory research fishing progresses.

As such the tables attached at Appendix (8) show the methodology that has been used to both analyse bottom structure and estimate the size of relevant resource biomass to reach these assumptions about the volume for the researched targeted species collected and area to be surveyed.

The areas described on the table of specific features and the biomass estimates therein will define the level of the researched species collected to a maximum of 15% of estimated biomass based on the assumption of at least 1 animal per 25sqm of habitat which is less than 50% of what the resource model projects to compute the production numbers above.

This assumption about density can only be properly analysed once the exploratory research fishing has been conducted over a period of time, but is considered to be conservative based on the information described above and in the relevant appendices.

Additionally, and as stated, it is expected that a substantial number more bottom structures in addition to those already under consideration will be discovered and identified, so while the total intended retained research species will not change it will probably be spread over a greater area than currently contemplated and is the reason the area considered is described as a minimum.

The retained species estimates are based on a maximum depletion on each feature of less than 15% of the virgin biomass (based on a maximum retained levels on either crab or lobster), where there is a population density of one animal per 25sqm. The entire catch will be frozen whole aboard, so that very little onboard processing or creation of waste will occur. Should this processing methodology be altered, GS will notify MMR and SPRFMO and advise of measures to deal with waste accordingly.

It should be recognised that the analysis of structures in Appendix (6) is estimated to be less than 40% of the total structures in the chain. The experimental fishing in 1988, 1992 & 1995 covered only a handful (2 very small features in the case of the Chadderton & Cave voyages) of features, but was very productive. GS intends to explore and research the total area widely using the phased methodological approach which will take at minimum 3 years as the initial exploratory research fishery.

The estimates of biomass in the area can be considered to be high as they are based on areas with available data. As such total biomass removal when considered over the entire area will be considerably lower than estimated above.

The design and mesh size of the traps is such that only mature animals are likely to be caught. With what is known of the target species and their assumed relatively quick maturity as well as the fact that over the exploratory period the same feature is unlikely to be sampled on multiple occasions and that target species are expected to be distributed over the entire subject area, then it is expected that the total biomass reduction over the phased approach will be very low less than 5%. The exception to this will be when a feature is selected for a depletion experiment using the DeLury method.

However, it is recognised that particular features of the species encountered may require the assessment may need to be revised, noting the data to inform these decisions can only be provided through the exploratory research fishing and analysis of the results.

7 Non-target, associated and dependent species

It is largely unknown at this point exactly what other species will be encountered as by-catch. Although from previous experience GS expects the levels of by-catch to be extremely low (a very high estimate of 5% has been allowed for but it is possible and even likely that it will be considerably lower than this). The nature of these types of interactions will only be known once the exploratory research fishing begins. Data from the earlier Russian fishing on these species was by trawl, where a higher incidence of by-catch would be expected compared to traps. The pre-sorted bycatch from a 15 minute bottom contact trawl by a Russian vessel, see picture in Appendix (10) shows that fin fish bycatch can be very low. From the experience of Chadderton in 1988 in the requested research area, the only bycatch was trumpeter, which occurred in 3 or 4 traps of the 75 set and only 1 or 2 fish per trap. So, 10-20kg of bycatch compared to the 13,000+ kg of lobster caught which is less than 1%. It should be noted Chadderton was using fishing traps which impeded exit, unlike the traps that will be deployed by GS to conduct the exploratory research fishing for this application.

In several decades of trap fishing, neither Chadderton, nor Maring, have ever encountered bird or marine mammal interactions with traps and do not expect any in this exploratory research fishery. Neither Chadderton, Cave nor Petersen noted or recall any interactions in this research area during their research voyages from 1988 to 1995.

8 Planned Trips in Management Area

It is intended to engage in approximately 210 days of exploratory research fishing per annum, spread over the entire year and divided into approximately seven (7) voyages of approximately 30 days duration.

Should the approval of this exploratory research application be given by SPRFMO it is intended to commence the exploratory research fishing operations as soon as practicable after the SPRFMO Commission meeting in January 2018 and thereafter for the full duration of this Exploratory Research Fisheries Operation Plan using the phased approach which will take a minimum of 3 years.

9 Datasets and Reporting of Vessel Movement and Activities

(See further information in Appendix 13 NRC Scientific Sampling Plan)

9.1 Datasets

The following is the SPRFMO data standard for exploratory research fishing activity by potting:

1. Data are to be collected on an un-aggregated (set by set) basis.

2. The following fields of data are to be collected:

- (a) Vessel flag
- (b) Vessel name
- (c) Vessel call sign
- (d) Registration number of vessel
- (e) Vessel's IMO number (if allocated)
- (f) Set start date and time (UTC format)
- (g) Set end date and time (UTC format)

- (h) Set start position (1/10th degree resolution – decimal format)
- (i) Set end position (1/10th degree resolution – decimal format)
- (j) Intended target species (FAO species code)
- (k) Bottom depth at start of set
- (l) Bottom depth at end of set
- (m) Type of Pot deployed
- (n) Total number of Pots set
- (o) Type of bait used
- (p) Estimated catch retained on board by species (FAO species code) in live weight
- (q) An estimation of the amount of living marine resources discarded by species if possible
- (r) Were any marine mammals, sea-birds, reptiles or other species of concern caught (yes/no/unknown-Y, N, U)

Contingent on the final data record keeping and reporting, more detailed data will be collected as described further in the NRC Sampling Plan. The nominated vessel is capable of reporting and electronically transmitting this information on a daily basis if necessary.

The GS will primarily undertake a robust exploratory research fishing operation including test pot surveys, camera surveys to confirm the existence of VMEs in the research zone, biological data collection of the target species and a data collection reporting system in order to compile data sets necessary to evaluate biomass assessments and geographical distribution of the target species using traps.

Datasets provided by the authorisation holder to the Ministry of Marine Resources and any other relevant authority at the end of each voyage will comply with or exceed the following SPRFMO report template requirements:

- Annual Catch Data;
- Bottom Footprint;
- CMM 2.03 Monthly Report;
- CMM 2.05 Vessel Details;
- CMM 2.07 Port Call Request;
- CMM 2.07 Port inspection Summary;
- Fishing Activity – Potting;
- Landings (Fishing Vessel);
- VMS.

It should be noted that MMR has agreed to the appointment of a person to be in sole charge of the data collection responsibilities. The name of the company in charge is Natural Resources Consultants, Inc. (NRC) located in Seattle, Washington and Scott Goodman has been appointed to assist with scientific data collection, analyses and reporting for the project.

At the end of each trip NRC will forward a report to the Ministry of Marine Resources, Rarotonga, Cook Island summarizing catch effort, detailed maps of fished areas, summary data of depth range species were caught and numbers of retained targeted species.

In the report any discovery of VMEs will be noted and all wildlife abundance and interactions. Scott Goodman on behalf of NRC will also report on a voyage by voyage basis the size distribution and other important data collected on the main species in order to develop a robust comprehensive biomass model. Further details of NRC reporting are provided in attached materials.

9.2 Survey traps

In each location, two or three traps per week will be designated as survey traps. The survey traps will be adapted to retain as many deep-sea marine creatures as possible by cladding the trap with fine mesh. The entire contents of the trap will be bagged and retained for onshore analysis and identification. Further details are provided in Appendix 13.

A Survey Effort form (Appendix 8) will capture all background information relating to each trap or groups of traps. If GS encounters an area of particular interest for its biodiversity or potential commercial value, then additional survey traps may be deployed.

9.3 Exploratory Research Fishing Data Collection

Data about the exploratory research fishing will be collected daily in accordance with CMM 02-2017. Further details are provided in Appendix 13. There will be two daily logs:

1. A Daily Effort, Catch and Production Log to collect information about the research target species. The Daily Effort, Catch and Production (SPRFMO Fishing Activity Report) will capture operational information for each line of traps, or single or groups of traps will be described on this form. As noted above, lost gear is also recorded on a line by line or trap by trap basis, similar to the CCAMLR Conservation Measures.

2. Daily Environmental Log to record discards and waste management, wildlife abundance and interactions and mitigation measures, similar to the CCAMLR Conservation Measures. Prior to each exploratory research fishing voyage, an assessment will be made to assess whether the area might be a Vulnerable Marine Ecosystem (VME).

A decision on whether an area might be a VME will be made in accordance with CMM 03-2017 using an adaptation of the New Zealand Ministry of Fisheries VME classification form which is in line with the SPRFMO policy. The GS does not expect to identify many such areas solely because their choice of gear and method is unlikely to make such areas discoverable, but data collected from the camera study might identify VME areas.

If, in the unlikely event those significant quantities of coral or sponge are found in or attached to traps or by the camera study, then the vessel will move on in accordance with CMM 03-2017. Knowing GS will have the capability to deploy cameras to film bottom structure and benthos, GS 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 normal monthly reports.

9.4 Vessel Movement in the Management Area

The vessel and its operators will keep MMR in the Cook Islands informed of all of the vessel's activities in the Management Area. This will include notification of:

- Entry and Exit from SPRFMO waters;
- Adequate prior notice when planning a voyage into SPRFMO waters;
- Adequate prior notice of where and when the vessel plans to dock after a trip in SPRFMO waters.

9.5 Control of Vessel

While at sea the vessel will keep MMR fully informed of its location and current activity through VMS and direct email contact. While at sea, the Master will be responsible for the day-to-day operations of the vessel and ensuring compliance with all SPRFMO CMM and Cook Islands' requirements.

9.6 Reporting of Vessel Sightings

The Master will be responsible for recording details of any other fishing vessels sighted in the 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.

9.7 Vessel Monitoring System

GS will have a VMS system of an approved type aboard 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.

9.8 Observers

GS will ensure there is complete (100%) observer coverage during the phased approach as outlined in the Exploratory Fishing Application and it's anticipated this work will take a minimum of three (3) years as the plan describes. Further details of observer hiring, training and responsibilities are covered in the NRC Sampling Plan (Appendix 13).

10 Biological Sampling

Crustacean's representative of the main target species will be landed whole for on shore sampling. Samples of lobster (*Jasusspp* and *Pro-jasusspp*) and crab (*Chaceonspp*) will be bagged on a species by species basis and landed at the end of each voyage. The samples bag/s containing the crustaceans will identify the vessel, common name and scientific name (if known) of the crustaceans, approximate weight of the total samples and details of a contact person. The samples will then be sent to the Ministry of Marine Resources (MMR) or their nominated agent.

Crustaceans shall be individually wrapped; details of date, location, approximate depth, length, weight and common name will be written on waterproof paper and frozen with the sample. No less than 10 crustaceans of the target species will be landed after each voyage.

Additionally, any interesting species caught as bycatch and unable to be identified by the vessel will be bagged and frozen along with details mentioned above. Species identification will rely on existing FAO material. A species list and codes for the main species is attached (Appendix 6). Additionally, GS will have aboard the following;

1. 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.
2. Ministry of Fisheries (2005) A guide to common offshore crabs in New Zealand waters. New Zealand Aquatic Environment and Biodiversity Report No 2.
3. Tracey, D.M., Anderson, O.F., Naylor, J.R. (comps) (2011). A guide to common deepsea invertebrates in New Zealand waters (3rd edition). New Zealand Aquatic Environment and Biodiversity Report No. 86.317 p.
4. Other relevant publications as may be recommended or available.

10.1 Rick Webber MSc

Rick Webber is the Invertebrate Curator at the Museum of New Zealand. He is a marine biologist specializing in Crustacea. His research is mostly on the identity of crabs, lobsters, shrimps, the development of Scampi and especially the larvae of lobster & crabs. Rick Webber has the capacity at TE PAPA to do all biological testing as well as he works closely with NIWA and their labs when needed. Dr. Webber may assist in receiving and processing biological samples taken during the exploratory and research fishing.

Contact info:

Museum of New Zealand (TE PAPA)

55 Cable Street, PO Box 467

Wellington, 6011

New Zealand

Phone: +64 (04) 381 7000

rickw@tepapa.govt.nz

<https://www.tepapa.govt.nz/learn/research/our-curators>

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

11 Assessment of the Potential for Significant Adverse Impacts on Vulnerable Marine Ecosystems (VMEs)

By using the analysis of features included in the table at Appendix 5, and only considering features which occur at above 1000m in depth, which accounts for just 33% of the fishable area, but is where the majority of potential VMEs might be expected to occur. The total bottom contact on these areas over a full year of exploratory research fishing effort will contact just 0.0108%, or 108 one-hundredths of 1 percent of the assessed target areas. When considering the total area in the Foundation Seamount chain this percentage is significantly reduced. Additionally, the areas in which the target species are known to occur are known to be discrete from large concentrations of deep-water corals. As such the potential for SAIs on VMEs is considered to be extremely low. However, GS will take a precautionary approach and where VMEs are encountered all data will be recorded and the vessel will leave the VME area and “move-on” in accordance with the relevant CMMs.

In particular the trigger for “moving on” is likely to occur when observed damage to fishing gear rather than the recovery of onboard coral or sponge fragments due to the low probability of such benthos both becoming entangled in the mesh and then making it all the way to the surface. The majority, if not nearly all, of the features the GS has identified as of interest for exploratory research fishing 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 features.

The approach GS will undertake will be proactive towards developing and collecting data to allow comprehensive VME assessments to be undertaken by the Cook Islands in the future. With the use of the camera study GS will be able to enhance the data collection of VMEs in the research zone and will report monthly to the Cook Islands MMR.

11.1 Camera Study

GS has investigated the correct camera system to use during the camera survey/study. The Sexton Company developed a deep water camera which is currently being used worldwide. Their focus is in the fisheries science industry using these cameras for trawl work and also bottom structure analysis. NRC developed a camera study as part of this application which will include the use of three (3) cameras which will be deployed per the survey design (see Appendix 13).

The main reason for using these cameras is to compare the actual data collected during the survey to the predictive VME models which are in use today (see Appendix 12).

11.2 Cumulative Impacts

Neither GS nor MMR are aware of existing bottom fishing operations in the proposed research areas by any method. As such because of this and the near-impossibility of setting gear in the exact same place repetitively GS does not expect there to be any observable cumulative effects of fishing.

11.3 Report Writing

A voyage summary including daily reports and VME signature information and other information collected will be forwarded to the Ministry of Marine Resources, Rarotonga, Cook Islands at the

completion of each voyage. The GS will describe the bottom imprint it perceives to have left in the areas the exploratory research fishing was conducted.

Further, the Ministry of Marine Resources, on the recommendation of GS, and recognizing the limited resources of small governments has contracted with an independent scientific body, Natural Resource Consultants (NRC) located in Seattle, Washington USA. NRC will compile regular trip reports for use by MMR and SPRFMO on a monthly basis as well as produce an annual report which will be presented to SPRFMO at their annual Scientific Committee meeting.

This will include assistance with, analysis of and further advise in respect of the following; The development of bathymetric charts of the fished areas, catch rates/biomass assessments, discard data, size and gender relationships along with bottom temperatures, determination of food sources and what the target species are consuming.

NRC will also assist with the research fishing plans to insure robust survey sampling reports for each structure researched and all data are recorded and available which will confirm the data are being collected according to the operational plan. The report will be a comprehensive analysis of the operation and will report the population densities of the targeted species and the dynamics of the species population as the research plans are executed.

NRC will also analyse the camera data recorded to assist in the evaluation of potential VMEs and other bottom structures to better understand the type of bottom structures the targeted species concentrate and the resource population dynamics (see Appendix 13).

11.4 Dr. Malcolm Clark and Dr. Ashley Rowden

Drs. Malcolm Clark and Ashley Rowden are experts on deep-sea ecosystems and have worked extensively on VMEs in the South Pacific and Southern Oceans. Both are based at National Institute of Water and Atmospheric Research (NIWA) located in Wellington, NZ and may assist with the detailed evaluation of all observed and reported VME information collected during the Great Southern exploratory fishing and research activities.

Contact Info:

Dr. Malcolm Clark

Principal Scientist-Fisheries

NIWA

www.niwa.co.nz

malcolm.clark@niwa.co.nz

12 Conservation & Management Measures

02-2017 Standards for the Collection, Reporting, Verification and Exchange of Data

GS will implement the requirements of this CMM. In particular, the data fields as described in Annex V of the CMM will be collected and the requirements for the collection of Observer & VMS data will be provided for.

03-2017 Bottom Fishing in the SPRFMO Convention Area

GS will implement the requirements of this CMM and recognises its importance in terms of managing sensitive resources and ecosystems.

05-2016 Establishment of the Commission Record of Vessels Authorised to Fish in the SPRFMO Convention Area

GS will ensure that it provides to MMR the full data requirements of this CMM, with updates as they occur from time-to-time, to ensure that the CMM can be fully complied with.

06-2017 Establishment of the Vessel Monitoring System in the SPRFMO Convention Area

GS will comply with the requirements of this CMM as described above.

07-2017 Minimum Standards of Inspection in Port

GS shall comply with this CMM, in particular the data and reporting requirements as described to facilitate the Member or CNCP Port State conducting inspections as necessary aboard the vessel.

09-2017 Minimising Bycatch of Seabirds in the SPRFMO Convention Area

Although this CMM does not directly apply to trapping operations and additionally because the vessel will not be discharging significant amounts of processing waste (if any) it is not expected that there will be potentially harmful interactions with seabirds. However, if interactions with seabirds are observed whereby the birds are at risk of entanglement or entrapment this will be reported to MMR and appropriate measures adopted to mitigate the risk.

10-2017 Establishment of Compliance and Monitoring Scheme in the SPRFMO Convention Area

GS will ensure that all data and records required to enable MMR to comply with this CMM are submitted in a timely and accurate manner.

12-2017 Regulation of Transshipment and Other Transfer Activities

As stated above it is not the intention of GS to engage in transshipment activities, but is aware of the requirements of this CMM should transshipment become necessary or desirable for operations.

13-2016 Management of New and Exploratory Fisheries in the SPRFMO Convention Area

GS has endeavoured through this application and Fisheries Operation Plan to comply fully with the requirements of this CMM.

13 Conclusions

MMR recognizes its limited resources and has indicated above that it will contract outside expertise to assist with the Scientific Analysis and Impact Assessments related to this Exploratory Research Fishery. It is considered that because very little is known about the resource or the targeted species expected to be encountered that the only practicable way to gather data is to engage in an exploratory research fishery along the lines described herein.

Cook Islands therefore requests the SPRFMO Scientific Committee, recognizing its expertise, to consider this application carefully and to make recommendations, if necessary, for additional information or analysis, which the Cook Islands will undertake to provide to the SPRFMO Commission before it finally meets to consider this application in January 2018.

Appendix 1

John Chadderton Fishing History Fremantle, Australia

Commenced fishing in 1964 in Australia. Fishing Scallops, Rock Lobster, Prawns and Fin Fish.
After qualifying as Master continued in that capacity pioneering and expanding fisheries in to Northern Australia.

1969 purchased first vessel forming Timor Shipping & Charter Co. (Position CEO)
By 1975 owning three vessels covering Cargo, Ocean Salvage & Fishing.

1976 based from Singapore formed Timor International Fisheries, (Position CEO) fishing Lobster in the Southern Indian Ocean progressively developing across the vast expanses to 52Deg South.
Discovering previously unknown fisheries resources while charting the undersea terrain, providing data to Scripps Institute in addition to producing record volumes of lobster.

Expanded activities into pioneering the Aquaculture of Green Mussels - *Perna viridis* (MAFCO) Pte, (Position CEO) to become the largest Mussel producer in the Southern Hemisphere at the time producing 1,800 tons per month. Additionally while adding Fish Farming and Mud Crab Production to supply international markets.

1980 formed Antarctic Fishing & Oceanographic Research Co AFORCO (Position CEO) to fish and develop new fishing opportunities across the Southern Ocean with larger and more sophisticated vessels.
Pioneered the production of and transport of Live Southern Rock Lobster from the Southern Ocean on the vessel directly to Japan. Transporting 600 tons live per voyage. Made new lobster discoveries changing forever the known distribution of lobsters in the region.

1981 Pioneered the first live export of Champagne Crab/*Hypothalassia armata* to Japan from Western Australia.

1985 Pioneered the grow out of Southern Rock Lobster (*Jasus edwardsii*) from Puerulus stage to market size in 2.5 years.

1987 expanded research and fishing activities in to the Tasman Sea and Southern Pacific with the purchase of an additional vessel based out of New Zealand.
Revealed the presence of lobster across the Tasman and that Australian lobster phyllosoma drifted to NZ, working closely with NZ Marine Biologists and Wellington Museum on new discoveries which led to the knowledge that Aust and NZ Rock Lobsters were the same species (*Jasus edwardsii*).

1988 Conducted 10,000-mile fisheries research voyages East of New Zealand discovering new resources of lobster and fish, including surveying the Pitcairn Islands EEZ.
Discovered many new seamounts, another new species of lobster and expanded the known distribution of (*Jasus edwardsii*) to the Louisville Ridge and discovery other lobster, later named (*Jasus caveorum*).

Developed the Giant Spider Crab (*Jaquinotia Edwardsii*) fishery 500 miles South of NZ establishing the live export to Japan, 1000 ton research development quota, while providing a full quantitative resource survey for NZ Fisheries Dept. Pioneered the at sea live holding of NZ Rock Lobster based in Fiordland holding 180tons, flying live to Christchurch for direct export to Japan.

Conducted the first research and development fishery project for Sea Cucumber (*Stichopulmollisin*) in Fiordland New Zealand with the AFORCO vessel Mata-Whao-Rua.

Pioneered the discovery of highly productive Scampi (*Metanephrops challenger*) resource at the Auckland Islands, NZ.

1993 formed Northern Australian Fisheries Pty Ltd, (Position CEO) owning a large 30,000 hook/ day auto liner to research and develop a Deepwater Red Snapper (*Etelis Carbunculus*) fishery in the Northern Territory, Australia.

Re-established the Northern Australian Sea Cucumber (*Holothuriascabra*) Fishery completely changed the traditional processing methods, developed new techniques to frozen form, now the market standard.

2002 established in partnership Bilyara Holdings Pty Ltd (Position CEO) purchasing a 33mtr vessel, converting it to a dedicated live Deepwater Red Crab (*Chaceon*) and lobster(*Pro-Jasus*) vessel to research & fish the central Indian Ocean, operating from Fremantle & exporting to Japan.

2016 Research & development in partnership for a new Southern Pacific Deepwater Lobster & Crab fishery project, utilizing the most advanced technology and information progressing to the formation of Great Southern Fisheries PL and the conversion of a vessel to a dedicated trap long liner, the Great Southern.

Mark F Maring
Fishing History
Portland, Oregon USA

Mr. Maring has been working in the Fishing business for the past 40 yrs. He started his career as a deck hand on king crab vessels in Alaska. During his time fishing in Alaska he also attended Oregon State University and graduated in 1979.

After graduation Mr. Maring continued working in the fishing business and started out by building an oyster farm in Oregon, which was the basis of his senior thesis before his graduations. This business grew from only growing oysters to buying and selling several different seafood products in this region. This business expanded and once again Mr. Maring moved back to Alaska to develop this sector of the business by manufacturing black cod and halibut in areas of Alaska that were not being serviced.

In 1985 the first fishing vessel was purchased, a 54 meter crab vessel which participated in the developing snow crab fishery in the Bering Sea. From this development and over a period of years a fleet of six crab catcher vessels was developed participating in several crab fisheries in Alaska.

During this same time frame a new style vessel was built, the crab catcher processor. The first C/P was built in 1989 which allowed the development of not only larger harvesting capacity but also control of the marketing of the fishery products the company produced.

Over a period of ten years the company built, converted or purchased four C/P's for the Alaskan crab fishery. The company also entered the hook and line fisheries by purchasing vessels which could not only catch but also process the catch on board. This project grew into three vessels which targeted black cod in the Aleutian Islands which had not been completely explored because of the remote location which made it hard for a straight catcher boat to operate.

These small C/P vessels could reach remote fishing areas and produce a high quality products processed on board.

During the early 90's the Russian fishery started to open and Mr. Maring negotiated one of the early J/V agreement with a Russian company to use a few of the larger crab C/P's to operate in Russian waters. This operation developed into a much larger organization and the original group of three vessels was sold directly to the Russian partner. From this involvement in Russia the company developed many different operations managing Russian fleets and buying and selling additional crab C/P's from US groups to Russian partners.

Because of the move to Russia out of the Alaskan waters the company found other International opportunities to explore with a seasoned staff having the capabilities to work overseas. This developed into several different projects and also the first step into the scientific work the company completed developing new fisheries. The company conducted an exploratory black cod fishery in the Mexican Pacific Ocean deep water zone which the local fleet did not have the expertise.

The company was required to work with the Government scientist in order to understand the resource most did not know existed. Because of this relationship with the Mexican Government the company also found a semi deep water crab that was not known at the time the company discovered. This project turned into a couple of vessels and a processing plant on shore to develop the market for this product. Both of these project required a close relationship with the scientific community knowing the resource was not well known which gave the company great experience working in this field.

The company also was involved with the developing the snow crab fishery in Greenland by taking one of the Russian built vessels the company owned and relocating that vessel from the Russian Far East to Greenland. Again the company had experience in overseas fishing operations and the development of the fishery was completed.

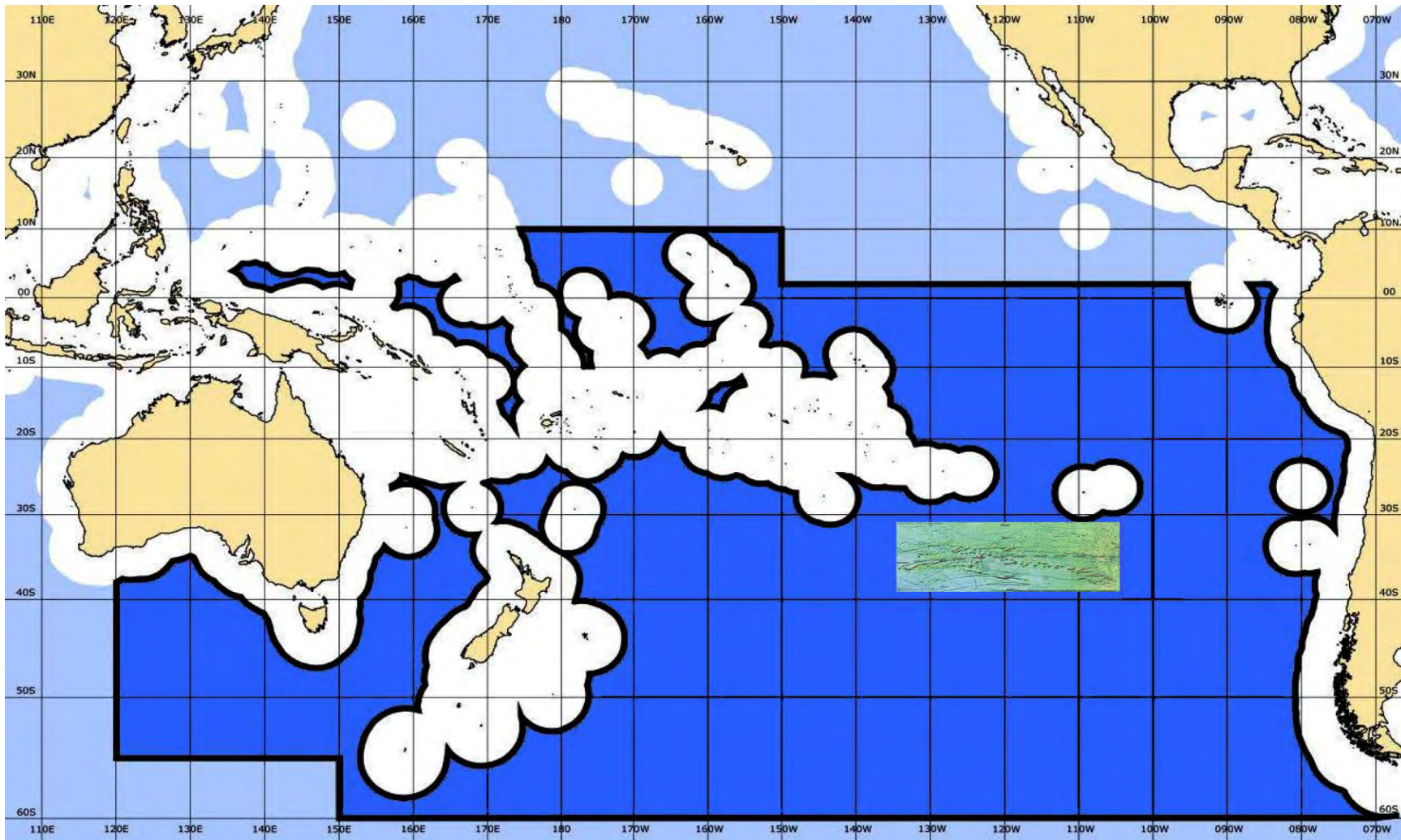
In early 2003 Mr. Maring engaged in a scientific project in Alaska targeting snow crab research. There had always been some concerns in the way the Alaska snow & king crab fisheries were being evaluated to determine the harvest rates and the condition of the stocks. Along with a few other concerned partners they formed a group and started what is known today as the Bering Sea Research Foundation. This is the largest joint Government and industry scientific group in the USA and has a great track record working with Government bodies at the State and Federal levels. The Foundation today enjoys a great working relationship with most Government bodies and conducted some very important work in the field of crab science.

Around 2009 Mr. Maring engaged in a plan to develop a relatively unknown king crab stock in Argentina. This project involved working with the Government scientist in Argentina to confirm the base line of the stock and developed a two vessel fleet comprised of two 54 meter C/P's to operate in this fishery. This

operation has performed well and the fishery seems to be stable and growing as the markets for these products have become internationally known.

As an overview Mr. Maring has been involved in fisheries, from Alaska, Russian Far East, Mexico, Greenland, Norway and Argentina during his career developing fisheries working with Government bodies and scientific partners. The operation was mainly focused on bottom trap fishing with some long line fishing, but the main direction has been in bottom trap fishing.

Appendix 2
Area of Proposed Exploratory Fishing Research



Appendix 3

THE SEA FLOOR PROJECTION OF FOUNDATION SEAMOUNTS WITHIN THE EXPLORATORY FISHING RESEARCH AREA

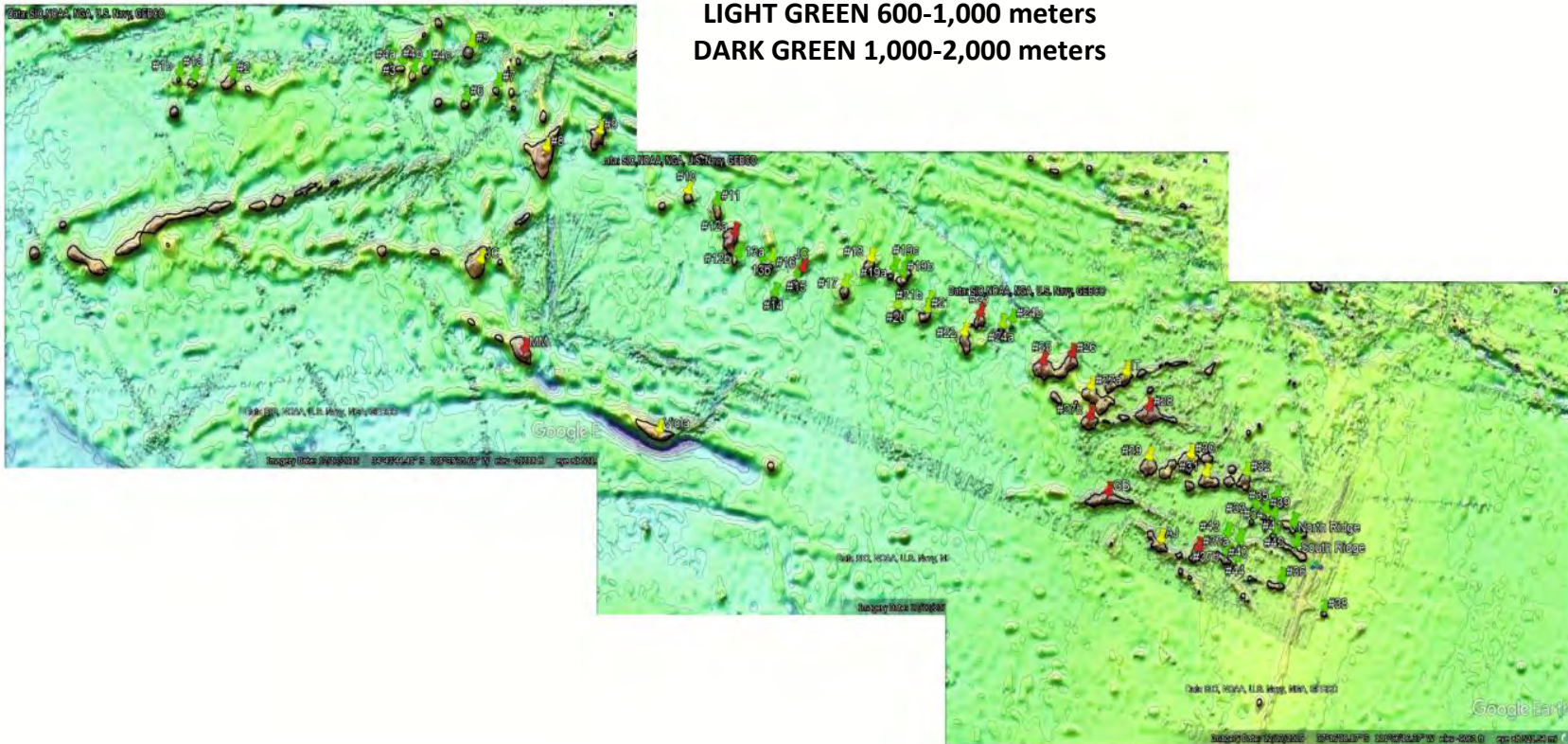
Pin Legend

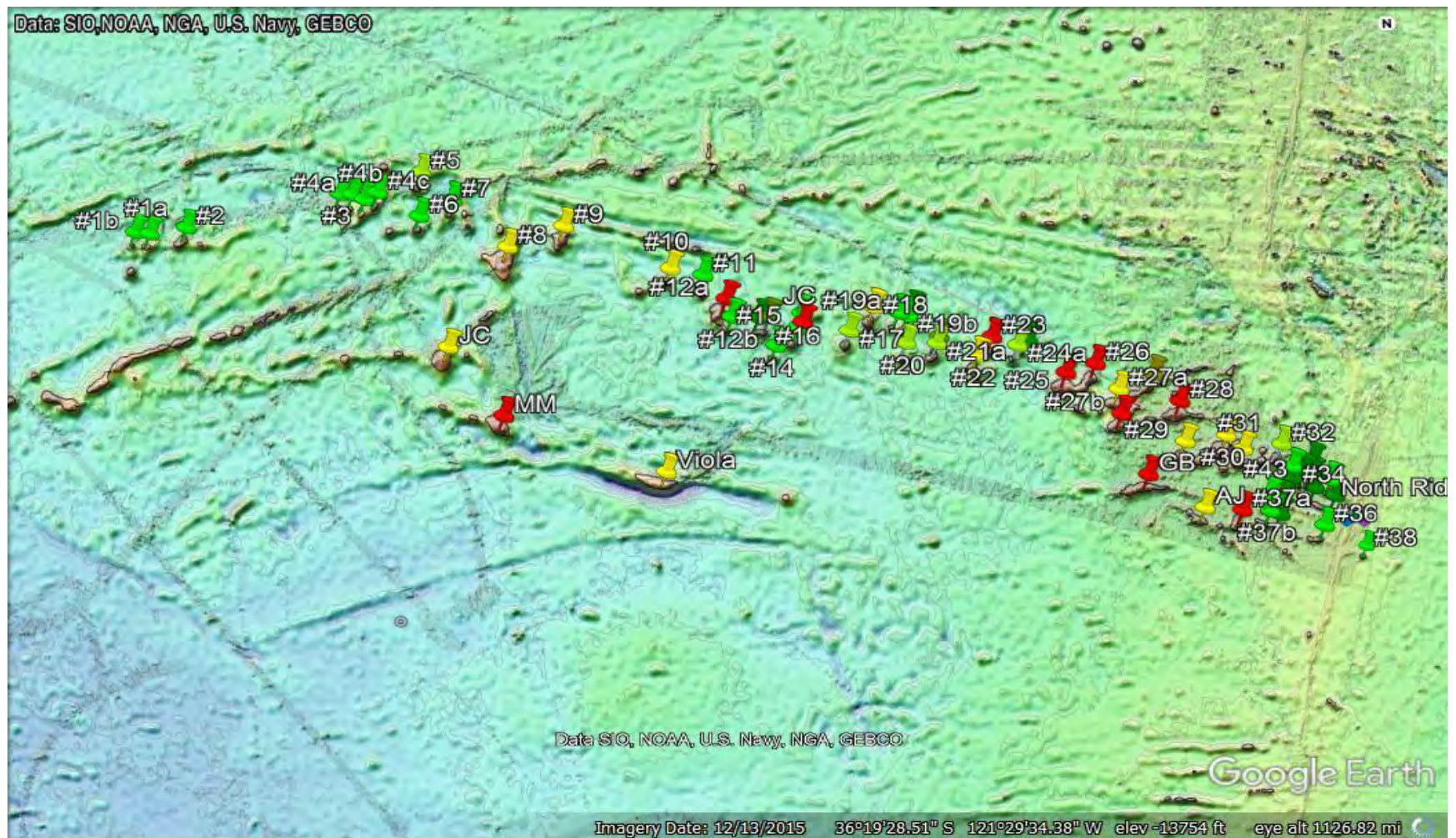
RED 0-400 meters

YELLOW 400-600 meters

LIGHT GREEN 600-1,000 meters

DARK GREEN 1,000-2,000 meters





Appendix 4

TYPE & CONFIGURATION OF TRAPS TO BE USED IN THE EXPLORATORY RESEARCH FISHING



Appendix 5

***Pro-Jasusspp*Lobsters**

The genus is represented by two species (*P. Parkeri* and *P. bahamondei*); each living in widely separated regions of the Southern Ocean. It should be highlighted that both species of this genus have a circumpolar Antarctic distribution, between 15°S and 48°S. The spiny lobsters (family Palinuridae) possibly invaded the deep-sea from shallower rocky reef areas and then radiated, suggesting a southern hemisphere origin for the group.

Subsequent diversification appears to have been driven by the closure of the Tethys Sea and the formation of the Antarctic Circumpolar Current (Tsang *et al.*, 2009; Palero *et al.*, 2009).

P. parkeri has been reported in the Atlantic Ocean: South-West Africa (Stebbing, 1902, 1910); Indian Ocean: south-east Africa and St. Paul Island; Pacific Ocean: south-eastern Australia and New Zealand; at depths of 370 to 880 m.

Geographical distribution: this species is abundant on submarine ridges, especially east of Peru (Prosvirov, 1990; Rudjakov *et al.*, 1990; Parin *et al.*, 1997) where it has been commercially fished by industrial vessels (Parin *et al.*, 1997; Arana & Venturini, 1991). It is also found around the Desventuradas Islands and the Juan Fernández Archipelago (Dupré, 1975; George, 1976; Retamal, 1981, 1994; Andrade, 1985; Báez & Ruiz, 1985; Retamal & Arana, 2000; National Geographic-Oceana, 2014) and in the O'Higgins Seamount (39°55'S, 73°52'W), off the central coast of Valparaíso, Chile (Báez & Weinborn, 1983).

This lobster was also recorded in the Juan Fernández ridge during exploratory fishing operations for orange roughy (*Hoplostethus atlanticus*), but was misclassified as *Sclerocangronatrox* (Lillo *et al.*, 1999). The presence of *P. bahamondei* is wide spread, being registered sporadically in areas adjacent to the Chilean continental coast, approximately between Huasco (28°28'S) and Constitución (35°20'S) (Andrade & Baez, 1980; Andrade, 1987; Retamal, 1981, 1994) (Fig. 4), being caught mainly in trawl fishing operations targeting nylon shrimp (2008), the frequency of occurrence for the Chilean jagged lobster in 29 evaluation cruises for demersal crustaceans off the central Chilean coast was 27.6%.

Depth distribution: of this species has been recorded at depths between 225 and 2300 m Chilean jagged lobsters have been captured at depths on the South American continental slope the bathymetric range of this species is between 175 and 2300 m

Environment / SEAMOUNT REPORT

Bottom morphology: of the dorsal or submarine Ridges constitute the most highlighted south-western Pacific prominence. This ridge is made up of numerous seafloor elevations, extending towards the southeast-northeast for about 1100 km and is 200 km wide, being subducted under the South American plate off the coast of Peru. It includes several seamounts differing greatly in form, summit depth, degree of isolation and oceanographic conditions (Parin *et al.*, 1997).

This ridge attaches to the Salas y Gómez Ridge, at around 83°W, running east to west up to the junction with East Pacific dorsal, with Easter Island (27°08'S, 109°25'W) and Salas y Gómez Island (26°27'S, 105°28'W) as emerging peaks near the Nazca Ridge, are the Desventuradas Islands

The Nazca Ridge is of volcanic origin, by effect of eruptions recorded in the Easter hotspot and the displacement of the oceanic plate moving eastward at a speed of about 10-18 cm yr⁻¹. The presence of this ridge divides the ocean floor in two basins; the Peruvian basin and the Chilean basin.

A detailed description of the seamounts is provided in this submission. According to Parin et al. (1997), the summits of the Nazca ridge seamounts show remnants of coral atolls, suggesting that after the Miocene, these summits would have been 300-375 m higher than at present, so that many of the peaks would have formed islands. At present, several of these mountains possess the shape of guyots with vast flat summits, possibly caused by abrasion during the sinking process. In the central part of the ridge some of the mountains have summits at depths of 240-500 m and other at depths of 850-950 m, with depths of over 3500 m between them.

Based on the experience accumulated in fishing operations conducted on these mountains (Arana & Soto, 1994), it has been determined that the distribution of the Chilean jagged lobster is concentrated mainly on the edges of the guyots and their outer slopes towards greater depths, and not in the centre of the plateaus where abundances proved to be significantly lower.

The Juan Fernández ridge consists of a long, narrow chain of seamounts of volcanic origin that that extending perpendicular to the coast of South America, from about 84°W to the O'Higgins Seamount nears the edge of the Chilean Trench, somewhat north of Valparaíso (Chile) (Vergara & Morales, 1985). Emerging seamount summits of this ridge are the islands of Robinson Crusoe (33°37'S, 78°50'S), Santa Clara and Alejandro Selkirk (33°45'S, 80°45'W). The average depth of the seabed around this ridge is 4025 m, but some peaks rise up to depths of 225 to 425 m from the sea surface.

Some of these seamounts present a reduced summit, with one or two peaks, while others present a mild depression towards their centre denoting the presence of ancient craters, followed by abruptly declining slopes which descend to the ocean floor (~ 4000 m).

The continental slope of South America exhibits characteristics of a subduction zone, with a narrow continental shelf and a steep slope descending to the Peru-Chile trench. The continental shelf and continental slope have a generally flat bottom with muddy sediments. Nevertheless, in certain places, there are irregular structures and slab formations that make it unfeasible to conduct bottom trawling. These places could possibly produce settlements of *P. Bahamondeipuerulus*, which would allow the development of this species in specific locations along the continental border.

Oceanographic conditions: in the South-Eastern Pacific

Vertical distribution

The vertical distribution and migratory behaviour of the Chilean jagged lobster were investigated by way of visual observation from a Russian submarine. The vertical distribution of lobsters was determined on the basis of water oxygen concentration (Pakhorukov et al., 2000). The authors observed uniform abundances of *P. bahamondei* at the top of the mountains, with the occasional presence of higher

density local clusters, while this crustacean was found in more disperse quantities on the continental slope. Despite investigations conducted by U.S., Japanese, Russian (Parin et al., 1997) and Chilean ships the area of the South Eastern Pacific Ridge is still poorly studied and the composition of its fauna requires further analysis. The catch (in weight) from traps deployed on the summits and slopes of the central seamounts of this ridge tends to be composed exclusively of Chilean jagged lobsters, whereas if the traps are deployed at greater depths (e.g., on the seamount slopes), golden crabs (*Chaceonchilensis*) constitute a higher proportion of the catch.

In the Desventuradas islands and Juan Fernández Archipelago the lobster *Jasus frontalis* is exploited by artisanal fisheries by means of traps deployed at depths of 0-200 m. In the former islands lobster extraction is a sporadic activity, whilst in the latter islands it is a permanent activity.

Due to the distribution of this species in the South-eastern Pacific, it is probable that phyllosomas are present in a vast area of this ocean, which is characterized by the existence of numerous eddies and various surface and subsurface currents. This would explain the possibility of settlements in places with appropriate floor depths and oceanographic conditions suitable for the habitation of this lobster far distant to the West on the Foundation Sea Mount Chain.

The Juan Fernandez crab (*Paromolarathbuni*) is distributed between 100 and 300 m and, below that depth, possibly down to 2000 m, the golden crab (*Chaceonchilensis*) (Retamal & Arana, 2000). Chilean jagged lobsters are occasionally caught while fishing for golden crab or on those occasions when lobster traps are set deeper than usual.

An industrial fishery for benthonic crustaceans by means of bottom trawls exists along the Chilean continental coast, between Huasco and Constitución. This fishery targets yellow squat lobsters (*Cervimunida johni*), red squat lobsters (*Pleuroncodes monodon*) and nylon shrimps (*Heterocarpus reedi*), although at greater depths, red royal shrimps or "gambas" (*Haliporoides diomedae*) and razor shrimps or "camarones navaja" (*Campylonotus semistriatus*) are also caught.

However, when trawling is conducted near slab stone or rocky seafloor, *P. bahamondei* specimens appear in the catch. In fishing explorations for Chilean jagged lobster conducted off the coast of Valparaíso using Fathom Plus traps, the most abundant crustaceans in the by-catch were king crabs (*Glyptolithodes cristatipes*), nylon shrimps, spider crabs (*Libinia aganaria*) and deep-sea hairy crabs (*Trachycarcinus hystericus*) (Arancibia, 2001).

Biomass / Resource Calculation Basis

According to Pakhorukov et al. (2000) the total biomass of *P. bahamondei* just on the Nazca ridge alone may range between 8,000 and 10,000 ton, providing a basic biomass around 84 ± 44 kg ha⁻¹.

The data used to estimate the biomass was from an experimental commercial fishing operation conducted over 6 months of fishing time. In the above-mentioned period, 187,669 traps were deployed with an average of 706 traps day⁻¹. Of this total, with an average of 28,000 trap per month.

Within 6 months of actual production of Chilean jagged lobster reached 354.8 ton.

Upon analysing the monthly catch per unit of effort (CPUE) it was determined the overall average CPUE for the period was 1.8kg per trap per day but peaking at periods to 2.7 kg trap⁻¹, with frequent catches of 30-50 lobsters per trap.



In both areas the biomass was greater immediately over the western slopes of seamounts, probably because of local upwelling. Bottom invertebrate communities of the seamount summits are characterized by strong dominance of a few species. At depths less than 400 m the spiny lobster *Projasusbahamondei* is dominant to the east. At greater depths shrimps are most abundant, in various combinations.

Bottom invertebrates were obtained on 22 seamounts at depths from 162 to 1900 m (Mironov and Detinova, 1990). One hundred and thirty samples of bottom invertebrates were collected; of these 54 samples were taken with shrimp otter-trawls, 39 with Sigsbee (Agassiz) trawls, 24 with baited traps, eight by bottom grabs and five by geological dredges.

Most stations were located on the flat tops of the guyots. Altogether more than 350 fish samples were collected, mainly by bottom trawls, from 22 seamounts, depths from 160 to 1600-2000 m. As in the case of bottom invertebrates, most samples were taken on the flat tops of guyots at depths of 160-580 m. In seven out of the 37 most successful hauls the spiny lobster *Projasusbahamondei* strongly dominated by weight. These catches were obtained on the tops or upper slopes. One group of widely distributed communities dominated by spiny lobsters over 450m. The communities also changed with increased depth: from dominance by spiny lobsters and shrimps, at depths of 350-400 m.

The composition of baited trap catches also demonstrates a change with the geographic position of a seamount (Mironov and Detinova, 1990) (Figure 3). The traps caught many spiny lobsters *Projasusbahamondei* and crabs *Chaceonchilensis* while further west catches consisted mostly of the crab.

To evaluate the degree of stability in the size-weight structure of the populations of spiny lobster *Projasus bahamondei*, comparisons were made between sets of data obtained during September-October, 1980, February, 1982 and April, 1987 (Rudjakov et al., 1990). It was found that populations inhabiting the summits of seamounts consisted of animals of two size-weight groups, one approximately twice the weight of the other and 1.2-1.4 times as long. These two groups were treated as two subsequent stages in the moulting cycle.

Seasonality in lobster reproduction

It is possible that during February to April (the sampling period in 1982 and 1987) most lobsters have not yet reached the age of the animals in the dominant size group in October, 1980 (Rudjakov et al., 1990). These modal sizes may correspond to possibly reaching maturity in 3 to 5 years, respectively. In this study no evidence was found of genetic isolation of lobster populations on individual seamounts and the authors concluded that the pelagic larval stage in *P. bahamondei* is long enough to overcome the distances between neighbouring Seamounts.

These accords with existing data on the larval biology of related lobster the communities of bottom invertebrates classified according to dominant taxa, carnivores, such as spiny lobsters *Projasus bahamondei*.

Feeding in the group of animals require further investigation

Fedorov and Chistikov (1985) have shown that carnivorous animals form up to 99.9% of the biomass in the bottom communities on the summit of the Seamounts. To account for such a strong predominance of benthic consumers the following sequence of cause-and-effect features was proposed: the formation of quasi-stationary eddies over the summit, enhancement of productivity in these eddies, a high abundance of macro plankton and mesopelagic fish in the deep scattering layer (DSL), the concentration of macro plankton and pelagic fish in the vicinity of the bottom during the daytime descent of the DSL on to the flat top of the seamount, consumption of the DSL animals by demersal and benthopelagic fish, and consumption by the spiny lobsters of the remains of fish food.

Knowledge of the hydrodynamics and biology of the waters surrounding the Seamounts seems to support the ideas of Fedorov and Chistikov (1985).

Current-topography interactions, including formation of eddies, local upwelling and closed circulation patterns called Taylor columns, are well known in various areas of the World Ocean and have a profound impact on seamount ecosystems (Darnitsky, 1979; Darnitsky et al., 1986; Boehlert and Genin, 1987; Boehlert, 1988).

Over the Seamounts, stationary cyclonic and anticyclonic eddies identified as Taylor columns have been reported and the biomass of plankton near the western slopes of the mount was found to be two to three times higher than at a distance from the seamount (Grossman, 1978; Amarov and Korostin, 1981; Kolodnitsky and Kudryavtsev, 1982; Fedorov and Chistikov, 1985; Gevorkyan et al., 1986).

The “settling” of the DSL on the summits has been observed on south-east Pacific seamounts

Finally, the lower limit of the distribution of *P. bahamondei* on this seamount coincided with the daytime position of the DSL and the stomachs of these spiny lobsters contained the remnants of DSL animals, such as squids, shrimps and gonostomatid fishes (Fedorov and Chistikov, 1985). Thus, the prevalence of carnivores on the summit of these Seamounts is likely to be the consequence of the enhanced productivity of surrounding waters (Fedorov and Chistikov, 1985; Fedorov, 1990). This interest in the biota of seamounts has several causes. One is that unusually dense concentrations of valuable fishes and invertebrates of great commercial importance are found on some seamounts. This richness is thought to be related in part to the occurrence of baroclinic perturbations above and around underwater rises (e.g. Hubbs, 1959; Borets and Kulikov, 1986; Uchida et al., 1986; Rogers, 1994)

Some seamounts are rare examples of relatively closed ecosystems in the open ocean whose populations have developed sophisticated adaptations to withstand the risk of propagules being lost by the currents (Rudjakov and Tseitlin, 1985; Parker and Tunnicliffe, 1994). Another reason for interest in seamounts, especially to biogeographers, is the great diversity of seamounts in summit depths, geomorphological features and degree of geographic isolation.

The endemism of the fauna of some seamounts or underwater ridges is very high in comparison with other marine areas of the same size (Newman and Foster, 1983; Mironov, 1985b, 1994).

Foundation Seamount Calculations

Appendix 6

Seamount No.	Seamount	Depth Range	Length Miles	Width Miles	Sq/Miles A	B	C	D	Description	Comments
					0-400M	400-600M	600-1,000	1,000-2,000		
1. #1a	Ampere a	1,500-2,000	6.00	3.00				18	2 Circular Structures	Scattered Cones
2. #1b	Ampere b	1,400-2,000	10.00	4.00				40	Linear Structure	Scattered Cones
3. #2	Archiminds	1,260-2,000	10.00	3.00				30	Linear Structure	Flat Uneven Summit
4. #3	Aristotelis	1,340-2,000	6.00	3.00				18	Linear Structure	Flat Summit
5. #4a	Avogadro a	1,460-2,000	6.00	4.00				24	Linear Structure	Flat Summit
6. #4b	Avogadro b	1,780-2,000	4.00	2.50				10	Linear Structure	Flat Summit
7. #4c	Avogadro c	1,060-2,000	7.00	4.00				28	Linear Structure	Steps on Flank
8. #5	Becquerel	600-1,000	6.00	4.50			27		Circular Structure	Flat Summit
		1,000-2,000	22.00	3.00				66	Circular Structure	Sharp Basement Line
9. #6	Bohr	1,060-2,000	8.00	6.00				48	Circular Structure	Smooth Flanks
10. #7	Bouguer	1,860-2,000	1.00	1.00				1	Elongated Volcanic Cones	Southern Flank
11. #8	Buffon	400-600	13.50	3.50		47			N-S Elongated Structure	Scattered Cones
		600-1,000	40.00	2.00			80		N-S Elongated Structure	Sharp Basement Line
		1,000-2,000	45.00	4.00				180	N-S Elongated Structure	
12. #9	Celsius	400-600	5.00	5.00		25			Star-like Structure	Flat Summit
		600-1,000	27.00	3.00			81		Star-like Structure	Gentle Slopes
		1,000-2,000	30.00	1.00				30	Star-like Structure	
13. #10	Curie	400-600	2.00	1.00		2			Seamount Structure	Flat Summit
		600-1,000	8.00	1.50			12		Seamount Structure	Smooth Basement Line
		1,000-2,000	8.00	1.00				8	Seamount Structure	
14. #11	Da Vinci	1,000-2,000	14.00	6.00				84	Conical Elongated Structure	Summit Cones, Gentle Slope
15. #12a	Darwin a	300-400	10.00	5.00	50				Elongated Structure	Flat Summit Plateau
		400-600	20.00	2.00		40			Elongated Structure	No Basement Line
		600-1,000	22.00	1.00			22		Elongated Structure	No Basement Line
		1,000-2,000	25.00	2.00				50	Elongated Structure	
16. #12b	Darwin b	1,000-2,000	5.00	5.00				25	Conical Structure	Summit Cones
17. #13a	Einstein a	600-1,000	2.00	2.00			4		Elongated Conical Structure	Summit Cones, Gentle Slopes
		1,000-2,000	18.00	2.00				36	Elongated Conical Structure	
18. #13b	Einstein b	1,340-2,000	6.00	6.00				36	Elongated Conical Structure	Summit Cones, Gentle Slopes
19. #14	Fahrenheit	940-2,000	4.50	4.50				20	Conical Structure	Sharp Borders
20. #15	Faraday	860-2,000	6.00	6.00				36	Conical Structure	Summit Cones
21. #16	Fermi	840-2,000	2.00	2.00				4	Conical Structure	Elongated Summit
22. #17	Fleming	600-1,000	4.00	4.00			16		Conical Structure	Circular Flat Summit
		1,000-2,000	20.00	3.00				60	Conical Structure	Smooth Basement Line
23. #18	Galilei	400-600	4.00	4.00		16			Conical Structure	Circular Flat Summit
		600-1,000	20.00	1.00			20		Conical Structure	Smooth Borders
		1,000-2,000	20.00	2.00				40	Conical Structure	
24. #19a	Herschel a	1,040-2,000	4.00	4.00				16	Conical Structure	With Fift Zones
25. #19b	Herschel b	1,000-2,000	8.00	8.00				64	Conical Structure	With Rift Zones
26. #19c	Herschel c	920-2,000	6.00	6.00				36	Conical Structure	With Rift Zones
27. #20	Hippocrate	600-1,000	4.00	4.00			16		Conical Structure	Gentle Slopes
		1,000-2,000	16	4				64	Conical Structure	
28. #21a	Hubble a	600-1,000	4.00	2.00			8		Elongated Structure	3 Summits, Gentle Slopes
		1,000-2,000	22.00	2.00				44	Elongated Structure	
29. #21b	Hubble b	840-2,000	6.00	4.00				24	Elongated Structure	3 Summits, Gentle Slopes

Foundation Seamount Calculations
Appendix 6 continued...

30. #22	Humboldt	400-600	2.00	2.00		4			Circular Structure	Flat Summit
		600-1,000	14.00	2.00			28		Circular Structure	Smooth Borders
		1,000-2,000	26.00	2.00				52	Circular Structure	
31. #23	Jenner	300-400	4.00	4.00	16				Elongated Structure	Flat Summit
		400-600	6.00	1.00		6			Elongated Structure	Gentle Slopes
		600-1,000	10.00	2.00			20		Elongated Structure	Smooth Basement Line
		1,000-2,000	14.00	2.00				28	Elongated Structure	
32. #24a	Kelvin	600-1,000	1.00	1.00				1	Conical Structure	Elongated Summit
		1,000-2,000	3.00	3.00				9	Conical Structure	
33. #24b	Kepler	1,400-2,000	2.00	2.00				4	Conical Structure	Elongated Summit
34. #25	Kopernik	180-400	6.00	4.00	24				Circular Structure	Flat Summit
		400-600	16.00	2.00		32			Circular Structure	Scattered Cones
		600-1,000	30.00	3.00			90		Circular Structure	Gentle Slopes
		1,000-2,000	32.00	2.00				64	Circular Structure	
35. #26	Lavoisier	200-400	2.00	2.00	4				Circular Structure	Flat Summit
		400-600	6.00	2.00		12				
		600-1,000	20.00	1.00			20		Circular Structure	Smooth Basement, Lateral Cones
		1,000-2,000	30.00	2.00				60	Circular Structure	
36. #27a	Linne a	600-1,000	6.00	6.00				36	Flat Summit Structure	Gentle Slopes
		1,000-2,000	28.00	4.00				112	Flat Summit Structure	Gentle Slopes
37. #27b	Linne b	200-400	4.00	4.00	16				Circular Structure	Flat Summit
		400-600	14.00	2.00		28				
		600-1,000	14.00	2.00			28		Circular Structure	Uneven Slopes, Rifts Zones
		1,000-2,000	18.00	4.00				72	Circular Structure	
38. #28	Mendel	150-400	7.00	3.00	21				Elongated Structure	Flat Summit
		400-600	19.00	1.00		19				
		600-1,000	30.00	1.00			30		Elongated Structure	Broad Volcanic Area
		1,000-2,000	40.00	3.00				120	Elongated Structure	
39. #29	Mendeleiev	200-400	2.00	2.00	4				Circular Structure	Flat Summit
		400-600	14.00	1.00		14				
		600-1,000	12.00	2.00			24		Circular Structure	Gentle Slopes
		1,000-2,000	25.00	2.00				50	Circular Structure	
40. #30	Mercator	400-600	5.00	6.00		30			Elongated Structure	Flat Summit
		600-1,000	20.00	1.00			20		Elongated Structure	Lateral Cones, Smooth Basement Line
		1,000-2,000	30.00	3.00				90	Elongated Structure	
41. #31	Newton	400-600	3.00	1.50		5			Elongated Structure	Flat Summit
		600-1,000	10.00	1.00			10		Elongated Structure	Broad Volcanic Area
		1,000-2,000	20.00	3.00				60	Elongated Structure	
42. #32	Ohm	600-1,000	2.00	2.00				4	Elongated Structure	Flat Summit, Broad Volcanic Area
		1,000-2,000	20.00	2.00				40	Circular Structure	
43. #33	Pascal	1,160-2,000	3.00	3.00				9	Polygonal Structure	Gentle Slopes
44. #34	Pasture	1,300-2,000	4.00	4.00				16	Circular Structure	Polygonal Shape
45. #35	Pauling	1,600-2,000	15.00	2.50				38	Three Structures	Flat Summit, Two Craters
46. N. Ridge	N. Ridge	1,500-2,000	12.00	3.00				36	Elongated Structure	Volcanic Ridge, Flat Summit, 6+ Cones
47. #36	Planck	1,440-2,000	10.00	4.00				40	Elongated Structure	Flat Summit, Gentle Slopes
48. #37a	Platon	300-400	2.50	1.50	4				Flank Structure	Rift Zone
		400-600	4.00	2.00		8			Flank Structure	Rift Zone
		600-1,000	16.00	4.00			64		Flank Structure	Rift Zone
		1,000-2,000	24.00	6.00				144	Flank Structure	Rift Zone

Foundation Seamount Calculations

Appendix 6 continued...

49. #37b	Richter	980-1,000	8.00	6.00				48	Elongated Structure	Flat Summit, Gentle Slopes
50. #38	Rutherford	1,180-2,000	10.00	3.00				30	Circular Structure	
51. #39	Schrodinger	1,420-2,000	5.00	2.00				10	Polygonal Structure	Flat Plateau, Gentle Slopes
52. #40	Volta	2,340/up	3.00	3.00				9	Circular Structure	Elongated Summit, Conical Shape
53. #41	Watt	1,580-2,000	7.00	4.00				28	Polygonal Structure	Flat Summit, two higher areas
54. #42		1,400-2,000	3.00	3.00				9	Polygonal Structure	Flat Summit, Gentle Slopes
55. S. Ridge	S. Ridge	1,500-2,000	30.00	5.00				150	Elongated Structure	Flat Summit W/Crater & Gentle Slopes
56. #43		1,460-2,000	6.00	3.00				18	Polygonal Structure	Flat Summit W/Crater
57. #44		2,160/up	2.00	2.00				4	Elongated Structure	Flat Summit, Polygonal Shape
58. New #1	JC	400-600	6.00	6.00		36			Elongated Structure	
		600-1,000	9.00	6.00			54		Elongated Structure	
		1,000-2,000	33.00	3.00				99	Elongated Structure	
59. New #2	MM	150-400	9.00	6.00	54				Elongated Structure	Flat Summit with Cones
		400-600	12.00	2.00		24			Elongated Structure	
		600-1,000	24.00	1.00			24		Elongated Structure	
		1,000-2,000	36.00	2.00				72	Elongated Structure	
60. New #3	Viola	600-1,000	7.50	3.00				23	Elongated Structure	Flat Summit
		1,000-2,000	21.00	7.50				158	Elongated Structure	
61. New #4	GB	150-400	4.00	2.00	8				Elongated Structure	Flat Summit
		400-600	15.00	2.00		30			Elongated Structure	
		600-1,000	20.00	2.00			40		Elongated Structure	
		1,000-2,000	25.00	2.00				50	Elongated Structure	
62. New #5	AJ	400-600	4.00	4.00		16			Elongated Structure	Flat Summit
		600-1,000	10.00	2.00				20	Elongated Structure	
		1,000-2,000	15.00	2.00				30	Elongated Structure	
63. New #6	IT	400-600	2.00	2.00		4			Circular Structure	Flat Summit
		600-1,000	6.00	2.00			12		Circular Structure	
		1,000-2,000	12.00	2.00				24	Circular Structure	
Total Sq/Miles					201	398	834	2,922		
Total Sq/Km					520	1,030	2,159	7,569	11,277	

1. % of Area	0-2,000 Meters	4.61%	9.13%	19.14%	67.11%	100.00%
2. % of Area	0-600 Meters	33.54%	66.46%			1,550

Appendix 7

Historical Fishing Report

Operator Name	Description	John Chadderton	Joe Cave	Jim Petersen	Total
Year Fished Foundation	Year Fished	1988	1992	1995	
1. Number of Pots Fished		15	50	120	185
2. Number of Days Fished		5	16	22	43
3. Number of Pots hauled		75	400	1,320	1,795
4. Number of pots hauled per/day		15	25	60	100
5. Lobster Catch (Tails)	M/T	4.50	6.60	19.80	30.90
6. Total Live Lobster Production	KG	13,636	20,000	60,000	93,636
7. Average Production per/pot	LBS	401	110	100	115
8. Average Production per/pot	KG	182	50	45	52
9. Production per/pot	Weighted Average KG	26.48	10.68	29.13	25
10. Average Size of Lobsters	Weighted Average Grams	1,500	1,667	1,500	1,536
11. Number of Lobsters per/pot	Weighted Average	121	30	30	43.48
12. Number of Lobsters per/pot	Weighted Average	17.65	6.41	19.42	43.48
13. Total Number of Lobsters		9,091	12,000	40,000	61,091
14. Percentage of Catch		14.56%	21.36%	64.08%	100.00%
15. Bottom Contact	Sq/Meters	150	500	1,650	2,300
16. Pot Size	Sq/Meter Per/Pot	2	1.25	1.25	1.28
17. Catch Per/Meter	10	606	240	242	266

Resource Calculations (0 to 2,000 meters)

Appendix 8

1. Foundation Seamounts	Seamount Numbers	Species	Gram Per Species	Biomass %	Sq/km	Sq/miles	Sq/meters	10 1 per 10 Sq/M	25 1 per 25 Sq/M	50 1 per 50 Sq/M	75 1 per 75 Sq/M	100 1 per 100 Sq/M
								M/T	M/T	M/T	M/T	M/T
a. Seamounts A 0-400 meters	12A, 23, 25, 26, 27b 28, 29, 37a, GB, MM	Jasus Caveorum	1,500	100%	520	201	520,000,000	78,000	31,200	15,600	10,400	7,800
b. Seamounts B 400-600 meters	8, 9, 10, 12a 18, 22, 23 25, 26, 27b, 28, 29,30,31 37a, JC, MM, GB, AJ, IT	Jasus Caveorum Projasus Parkeri	1,500 150	20% 80%	1,030	398	1,030,000,000	30,900 12,360	12,360 4,944	6,180 2,472	4,120 1,648	3,090 1,236
c. Seamounts C 600-1,000 meters	5, 8, 9, 10, 12a, 13a 17, 18, 20, 21a, 22, 24a 25, 26, 27a, 27b, 28, 29 30, 31, 32, 37a, JC, MM Viola, GB, AJ, IT	Projasus Parkeri Chaceon Red Crab	150 500	50% 50%	2,159	834	2,159,000,000	16,193 53,975	6,477 21,590	3,239 10,795	2,159 7,197	1,619 5,398
d. Seamounts D 1,000-2,000 meters	63 Seamounts below 1,000 M	Projasus Parkeri Chaceon Red Crab	150 500	25% 75%	7,569	2,922	7,569,000,000	28,384 283,838	11,354 113,535	5,677 56,768	3,785 37,845	2,838 28,384
Total					11,278	4,355	11,278,000,000	503,649	201,460	100,730	67,153	50,365
2. Total Biomass								M/T	M/T	M/T	M/T	M/T
a. Jasus Caveorum								108,900	43,560	21,780	14,520	10,890
b. Projasus Parkeri								56,936	22,775	11,387	7,592	4,074
c. Chaceon Crab								82,359	32,944	16,472	10,981	8,236
Total								248,195	99,278	49,639	33,093	23,200
3. Harvest Levels				Harvest Rate				M/T	M/T	M/T	M/T	M/T
a. Jasus Caveorum				15%				16,335	6,534	3,267	2,178	1,634
b. Projasus Parkeri				15%				8,540	3,416	1,708	1,139	611
c. Chaceon Crab				15%				12,354	4,942	2,471	1,647	1,235
Total								37,229	14,892	7,446	4,964	3,480
4. Bottom Contact	Pot Pulls per/day	Fishing days per/yr	Pot Size M				Sq/Meter Bottom Contact	% of Bottom Contact				
a. Seamount A	600	210	1				126,000	0.0242%				
b. Seamount B	200	210	1				42,000	0.0041%				
c. Seamount C	0	0	1									
Total	800	210	1				168,000	0.0108%				

Appendix 9

Vulnerable Marine Ecosystems Signature form

Date

Trap line set time

Taxon	Code	Common name	Threshold weight (kg)	Actual weight (kg)	VME indicator level
PORIFERA	ONG	Sponges	50		3
CNIDARIA					
Anthozoa (class)					
Alcyonacea (order)	SOC	Soft and runner corals	1		3
Gorgonacea (order)	GOC	Sea fans, sea whips	1		3
Scleractinia (order)	SIA	Stony corals	30		3
Antipatharia (order)	COB	Black corals	1		3
Pennatulacea (order)	PTU	Sea pens			1
Actiniaria (order)	ANT	Anemones			1
Hydrozoa (class)	HDR	Hydrochorals, stylasterids	5		3
ECHINODERMATA					
Crinoidea (class)	CRI	Feather stars			1
Brisingida (order)	BRG	Armless stars			1
Diversity Index		Count the numbers of taxon from the Actual weight column, if any. Do not enter weight, a number from 1 to 10 is required, where 10 is the max number.			
Total VME score					

Name of Vessel: **Great Southern**

Time & position that hauling of gear commenced.

Time:

Position:

Was the vessel master informed of the total VME score before next set occurred. Yes No If VME is triggered id the vessel move 5 nautical miles from the position of hauling of the gear before commencing the next set.

Yes

No

INSTRUCTIONS FOR COMPLETION OF VME SIGNATURE FORM AND COLLECTION OF SPECIMENS

Instructions:

1) Please try to identify any by catch down to the finest taxonomic level possible on the list given below. If the specimen is not included on this list then ignore it for VME determination but include it in normal catch sampling for benthic materials.

2) If it is included in the list, enter the total weight (kg) in the actual weight column. Include a specimen if only one category. Unidentifiable coral is included as taxon if needed. Corals that can be identified should be considered at the appropriate taxonomic level even if dead.

3) If the actual weight is greater than the threshold weight, circle the corresponding VME indicator level row. Sum the number of taxon in the actual weight column and enter the total in the diversity index row for the event.

4) Sum the circled VME indicator column and enter in the total VME score row for the event. If the total VME score is greater than or equal to 3, the area is considered to have evidence of a VME. 5) Take a photograph of the organisms so the general scale and composition of the bycatch can be determined at a later date.

6) At the end of trip provide the data to the Ministry of Marine Resources, Avarua, Rarotonga, Cook Islands. INSTRUCTIONS FOR THE COLLECTION OF SPECIMENS AT SEA If you are not confident that you can identify the organism to species, genus, or family level, then you are encouraged to use the generic codes provided in the pictorial guide (pages 9–18) NIWA Invertebrate Guide and ask that you retain the specimen (if possible) for identification ashore. Specimens are required to be collected only when they:

INSTRUCTIONS FOR THE COLLECTION OF SPECIMENS AT SEA

If you are not confident that you can identify the organism to species, genus, or family level, then you are encouraged to use the generic codes provided in the pictorial guide (pages 9–18) NIWA Invertebrate Guide and ask that you retain the specimen (if possible) for identification ashore. Specimens are required to be collected only when they:

- cannot be identified confidently
- are caught in an unusual depth or region
- are specifically requested for research purposes.

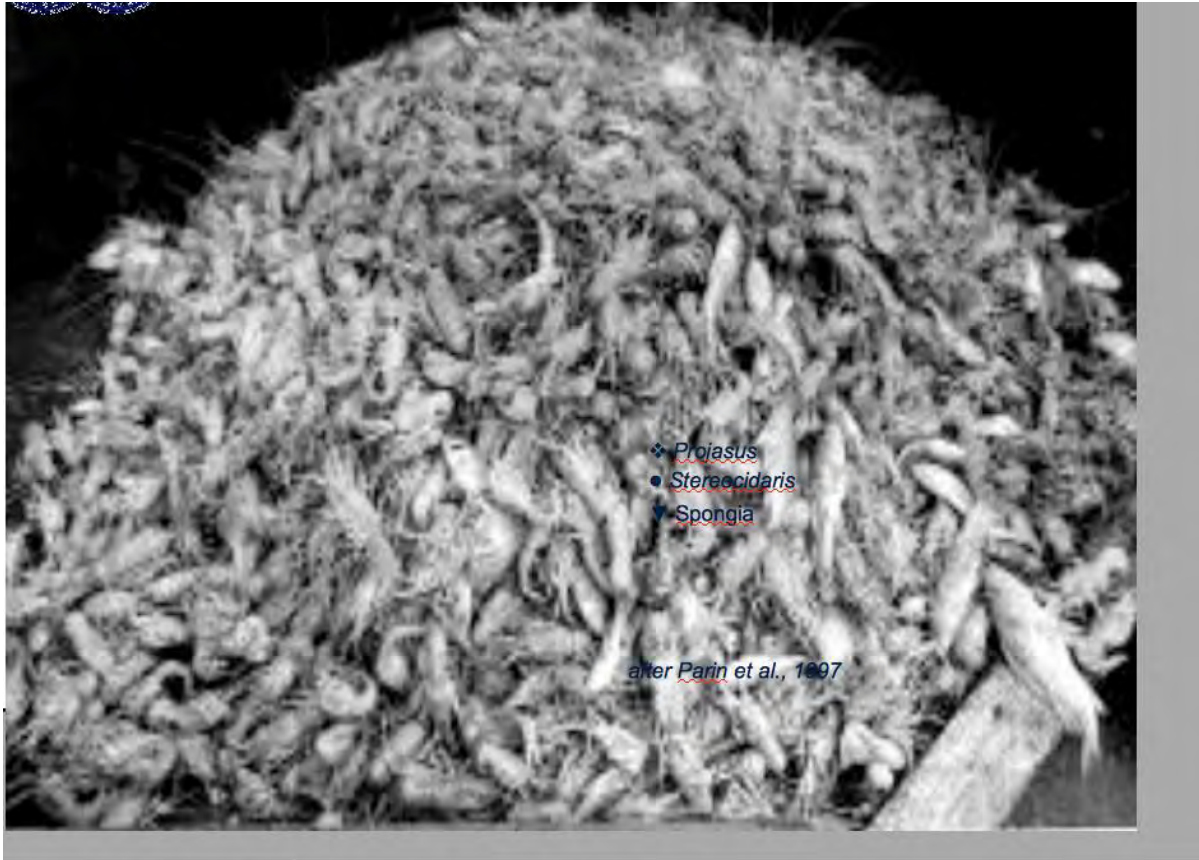
If samples or subsamples are retained, the following instructions should be followed.

Handling instructions

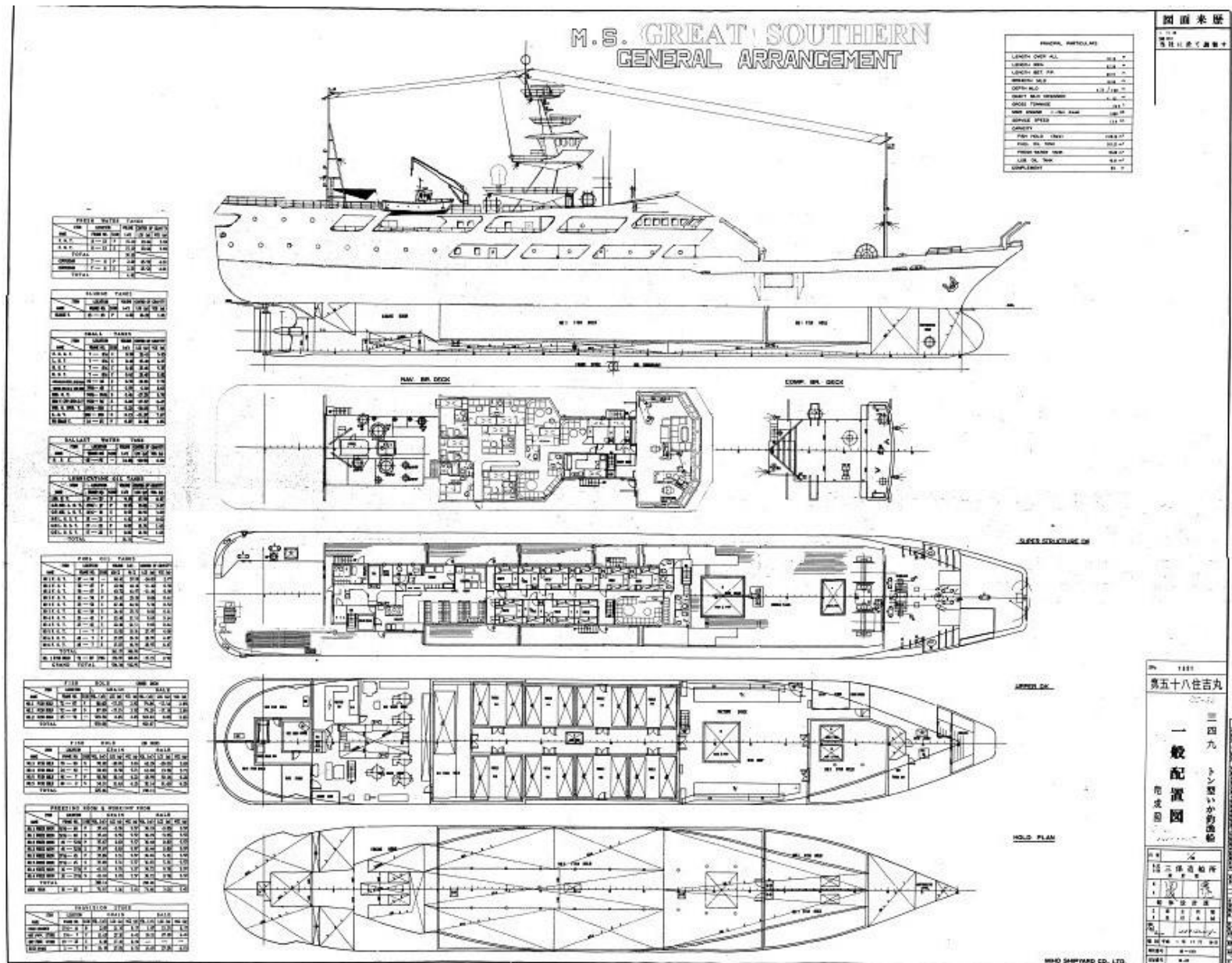
Place the benthic sample or representative subsample of the organism in a plastic bag, separating the groups/species (particularly the sponges). Write the trip number and station number (or lat and long) on a label, in pencil, and put inside the bag. Freeze immediately. If the organism is fragile (e.g., a crab or prawn), place in a container of seawater and freeze. Dead shells are not to be recorded on catch forms, but dead shell specimens can be retained for taxonomists

Appendix 10

Unsorted catch of Pro-Jasus from a 15min sample trawl taken North of the Foundation Seamount Chain



Please see attached Schematic of the vessel



Appendix 12

Camera Information

www.electromechanica.com/portfolio/uvas/

www.thesextonco.com







NATURAL RESOURCES CONSULTANTS, INC.

4039 21ST AVENUE WEST, SUITE 404
SEATTLE, WASHINGTON 98199
TELEPHONE: (206) 285-3480
FAX: (206) 283-8263
<http://nrccorp.com>

Appendix 13 Scientific Sampling Plan

For Exploratory Fishing
of F/V Great Southern
Targeting Deep-Water
Lobster and Crab Species

Prepared for:
Mr. Ben Ponia
Secretary of Marine Resources
Ministry of Marine Resources
Government of the Cook Islands

October 31, 2017

Introduction

This scientific sampling plan is intended to inform the collection of biological and fishery catch data from catches of deep-water lobster and crab species from exploratory fishing of the *F/V Great Southern* conducting fishing operations in the South Pacific Regional Fisheries Management Organization (SPRFMO) areas of interest. The *Great Southern* fishing permit application is under consideration and the information included in this sampling plan is part of supporting materials for that application.

This sampling plan includes information to address how catch data taken primarily from exploratory fishing efforts may be informative for improving the scientific information and understanding of management options for the lobster and crab target species in the area of interest. It is acknowledged that there is a lack of information to inform management of the target species in the area. This plan lays out preliminary steps in an effort to improve on that basis of information. The sampling plan includes preliminary details for two primary elements of data collection; 1) a number of elements integrated into the exploratory fishing and 2) plans for separate experimental work.

The biological sampling that is integrated into the exploratory fishing operation covers the following:

- Observer training and requirements
- Catch counting (including bycatch and discards)
 - a. Data recording
 - b. Deck sampling
 - c. Subsampling procedures
 - d. Weighing catches
 - e. Hard copy & electronic logbook data recording options
- Species sampling
 - a. Whole specimen collection
 - b. Tissue or blood sampling

The experimental fishing elements in this sampling plan cover three methods:

- Randomized exploratory fishing plan
- Controlled/limited scale depletion study
- Placement of small mesh traps within experimental strings of gear

Considerations of Scale – the Area of Interest

The exploratory fishing area of interest consists of distant-water, high seas seamounts and adjacent fishing grounds that cover an expansive area of approximately 2.1 million square kilometers (~612,000 square nautical miles) (Figure 1). The grounds are near 35° South latitude approximately 2,500 nautical miles away from both New Zealand to the west and southern Chile to the east. 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 sampling plan 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 exploratory fishing and research.

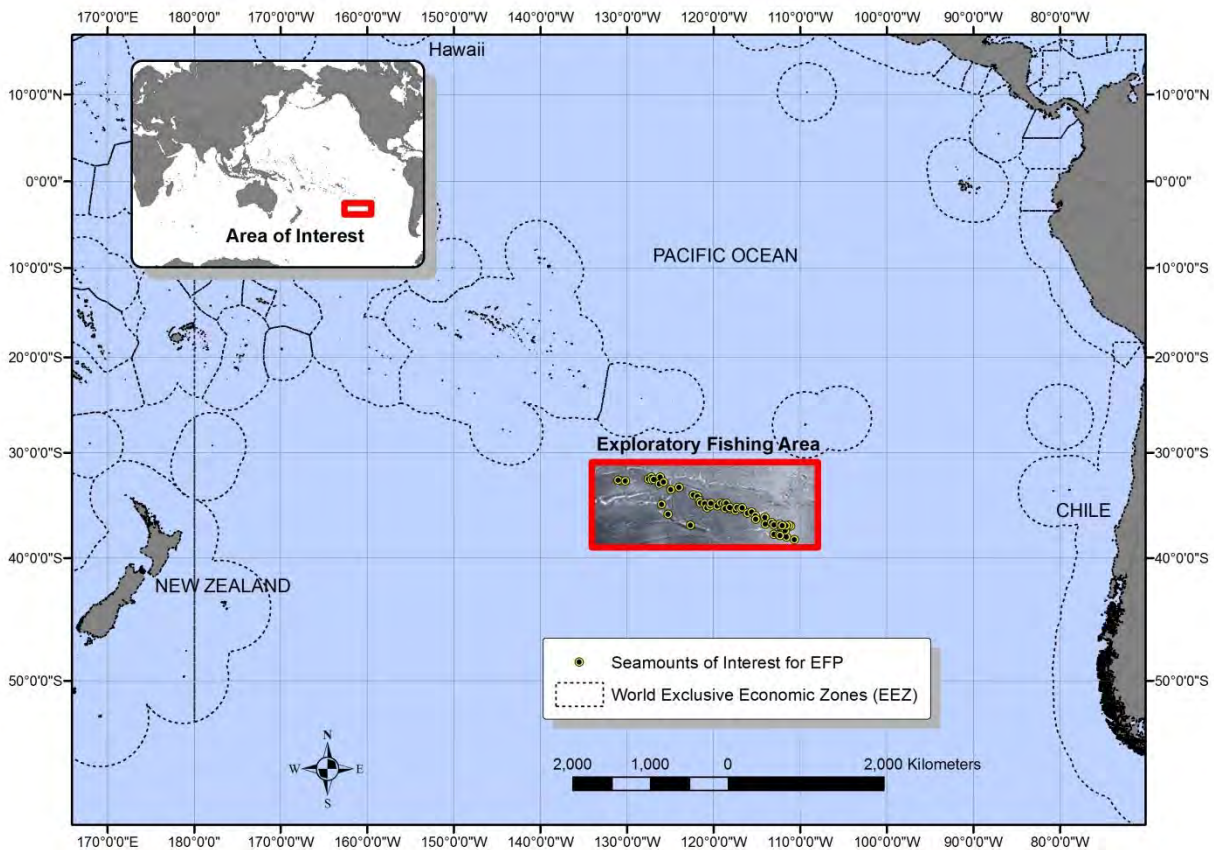


Figure 1. Proposed exploratory fishing and research area for *F/V Great Southern* in the South Pacific Ocean. Source: NRC

Observer Training

Observers are an important component of the *F/V Great Southern* exploratory fishing and will provide an important independent means of catch and bycatch accounting during exploratory fishing. The number of observers onboard is currently planned to be one (1) but will be considered as research plans are further developed. Observers for the *F/V Great Southern* experimental fishing should be fully trained prior to being selected and deployed onboard. Details of training are provided below but a few general guidelines cover safety, flexibility, and capabilities of observers. Training should importantly begin with cold water safety certification and familiarity of the likely conditions working at sea. Observers should be competently trained in record keeping and reporting which will include familiarity with species identification, data elements required, biological measurements, and a number of specific catch accounting procedures specific to the exploratory fishing plan and deck layout of the *F/V Great Southern*. Observers should generally be fit individuals that are capable of comfortably lifting 25 kg, donning an immersion survival suit in 60 seconds or less, entering the water in an immersion suit and climbing into a floating life raft. For record keeping purposes, observers should generally be very capable of using scientific instruments to measure specimens,

accurately record, write and communicate orally, and to function as a normal, productive boat-mate for extended at sea periods.

Catch Counting

Catch counting will be completed as a regular part of exploratory trap fishing on the *Great Southern*. Counting will occur in both numbers and weight when appropriate. All species will be documented in retained catch, and discarded catch will be identified to the species level if possible. For retained catch there will be a two-level counting system, first, on deck where each trap is dumped sorted and retained and discarded individuals are enumerated by hand. The first level (on deck) of counting may be overseen by an observer but will mostly be recorded by the vessel crew during the regular operations. A sorting area or table may act as a temporary holding area to accumulate the retained catch from more than one trap before being taken below for further counting during processing. An observer work station will also be setup to allow for the observer work to be done safely and efficiently as part of the exploratory fishing, record keeping/reporting and catch accounting process.

Observers and crew may work together for catch counting and in cases where sequential traps are not chosen by the observer for further detailed sampling the total counts by species will be estimated as accurately as possible on deck and then reconciled with product weights. Crewmen that are working directly with catch handling will also be trained to basically duplicate the first level, general catch counting that the observer may also do. It is assumed that most lobster retained will be processed frozen, whole which will allow for on deck and processed counts and weights to be reconciled closely. In cases where retained individuals are too large to be processed whole there will be a method to account for whole-round weight when the tailed product for these large individuals is processed.

Data Recording

The data recording will be completed in as accurate and precise manner as possible. On deck logbook summaries may be kept which may include notebooks, data forms, and electronic logging systems. The standard data recorded will include at least the following information which may be broken out into more than one reporting format depending on the observer activity:

General catch accounting (for all traps, all strings, all exploratory fishing activity)

- Vessel name
- Skipper name
- Observer name
- Date of fishing deploying traps
- Date of fishing hauling traps
- Start latitude of string (taken from wheelhouse GPS)
- End latitude of string (taken from wheelhouse GPS)
- Start time of string deployment
- End time of string deployment
- Number of traps set in string
- Depth at first trap of string (taken from wheelhouse instruments)
- Depth at mid-trap of string (taken from wheelhouse instruments)

- Depth at last trap of string (taken from wheelhouse instruments)
- General weather conditions during fishing setting gear
- Seastate during fishing setting gear
- General weather conditions during fishing hauling gear
- Seastate during fishing hauling gear
- Water temperature at string start (both surface and bottom, taken from deck deployed instruments)
- Water temperature at string end (both surface and bottom, taken from deck deployed instruments)
- Number of traps sampled by observer in string
- Individual trap number in string selected by observer
- Total number retained by species per trap
- Who counted retained species per trap observer/crew?
- Total number retained by species per string
- Total weight retained by species per trap
- Who weighed retained species per trap observer/crew?
- Total weight retained by species per string
- Total number discarded by species per trap
- Who counted discarded species per trap observer/crew?
- Total number discarded by species per string
- Total weight discarded by species per trap
- Who weighed discarded species per trap observer/crew?
- Total weight discarded by species per string

Detailed catch accounting will be for observed traps and/or special sampling traps/strings and will include at least the above and further details below:

- Lobster/crab species present in trap for retention?
- Lobster/crab species whole haul or subsample in trap?
- Lobster/crab carapace length and sex by species (several records per trap)
- Indications of reproductive change – females gravid?
- Shell conditions per individual measured (clean v. dirty, new v. old, etc.)
- Specimen weights taken for selected individuals (in grams on Marel scale)
- Biological samples including blood or tissue samples taken (Y/N?)
- Other species present in trap (Y/N?)
- Bycatch species recorded if present
- VME, coral or sponge presence in trap (Y/N?)
- VME, coral or sponge species recorded if possible
- Pictures taken for trap catch (Y/N?)
- Estimate of or measured total weight for bycatch by species if possible

Deck Sampling

Deck sampling gear will be required to assist with the counting and measuring of lobster, crab and other species catch. The gear should include 12-24 plastic totes capable of holding the complete contents of a trap in a single tote. The gear should include several plastic baskets to sort the catch by species, size and sex into groups. A deck-mounted motion compensated Marel scale should be acquired to weigh all catch totes or baskets. Measuring devices should be marine grade manual or electronic calipers, marine grade clipboards, and waterproof write-in-rain

data forms/notebooks. A deck computer or electronic data logger should also be acquired if feasible to facilitate quick data recording and data entry. The redundancy of all deck gear including electronics is critical to sampling in the expected conditions on deck, so there should be extras for all critical gear.

Each trap will be brought onboard by the *Great Southern* crew. If the trap is selected to be sampled by the observer it will be moved to the observer sampling area. If the trap is to be processed without observing it will be dumped into a general catch sorting area where the catch will be sorted and counted. For general **catch (not sampled by the observer) each trap's catch will be documented** by splitting out species and sex (if possible) for all retained and discarded catch. Deck sampling should include the weighing of total catch per trap above deck, also, especially when it is not feasible to complete accurate counting of individuals.

For observer sampled traps the catch will be dumped and sorted into the observer area. The observer will strive for whole haul sampling if possible. For each trap sampled, the observer will measure and record the detailed information (see detailed catch records above) for each individual captured. Calipers will be used to measure the carapace lengths to the nearest tenth of one millimeter. Electronic waterproof manual calipers or electronic auto-logging calipers may be used by the observer as long as all individual specimen data is safely logged and backed up frequently onto onboard computer systems.

Deck sampling procedures should progress without interrupting the pace of fishing unless there is a gear problem or important biological reason to change the pace of fishing (excessive catch, gear damage, or other).

Subsampling Procedures

Subsampling procedures should be used only when an observer sampled trap has too large/high of catch to whole haul sampled. Subsampling should be done by weight if possible but can be accomplished by numbers, generally following the methods described below.

If it is obvious that all catch can be processed then all lobsters/crab should be **quickly sorted into baskets regardless of size for measuring. If this can't be gauged** then continue with sorting for either whole haul or subsampling. Sometimes the **determination for subsampling won't be made until all commercial lobsters/crab** catch has been sorted. If there are a large number of lobsters/crab, designate multiple baskets for the species and sort by size class and sex, keeping lobsters/crab of similar size and shell condition together. Ensure that baskets are being filled with approximately the same number of lobsters/crab in each basket. An example of a possible set could be 3 baskets full of mature female lobsters/crab shell condition new, 1 basket full of mature female lobsters/crab shell condition old, and 2.5 baskets full of juvenile male lobsters/crab shell condition new. Near the beginning of sorting, it may be evident that only a few large lobsters/crab are in the catch, and near the end of sorting it may be evident that only a few small lobsters/crab are in the catch – in each case, isolate these lobsters/crabs into designated baskets for whole haul sampling during data recording. Some or all of

these lobsters/crab can be pulled out from the catch and set aside at any time during sorting.

Once baskets of lobsters/crab are ready to be processed after sorting, each basket should be weighed. For each basket set that represents too many individuals to whole haul measure than a subsample should be removed from that basket, weighed and then processed. The removed (subsampled weight) can either be taken separately or can be the difference of the basket with the subsample removed. The subsampled lobsters/crab should be isolated for complete measurement, and any other data recording. These lobsters/crab are the representative that will be expanded back – by a subsampling factor – over the total catch (from that basket set) of that species, sex and size group. The subsample factor by weight is calculated as the total sample weight divided by subsampled weight which will yield a factor >1 . For example if the catch is sorted and yields one partial basket of female lobsters (*Jasus* spp.) and 8 full baskets of male lobsters (*Jasus* spp.) then the males would be subsampled only. If all 8 male baskets weight 64.3 kg, and 9.4 kg are selected out as a portion to subsample, then the subsample (expansion) factor would be 6.84 (64.3 kg divided by 9.4 kg).

For instances where subsampling is an obvious requirement to process the catch and a faster method is needed, the subsampling may be completed by selecting 1 from a subset in groups to process that category of the catch quickly. For example if there are several hundred presorted lobsters that are small juveniles then a selection such as 1 of every 5 may be applied to process that volume of catch. The measurement would proceed with the observer removing 5 individuals from the catch, measuring 1 and then discarding the other 4 – and continuing with this process until all catch is counted. In this case, the subsample (expansion) factor would be 5, as calculated based on count not weight.

In some cases where subsampling would be required to process very high volumes or counts of a complex catch, a combination of the above processes could be used to provide an equally robust subsampling method and expansion factor.

Weighing Catches

Catches of retained species should be weighed both at landing and sorting (by tote/basket), and as processed and packed. For species sizes that are processed whole there should be relatively little difference between the weights taken on deck and weights taken as product. Accurate, motion compensated scales should be present both on deck and in the processing facilities below deck of the *Great Southern*. For instances where the pace of fishing or volume of catch does not allow for on deck counts of individuals retained, there will be a subsample of the retained catch set aside from time to time to measure, which will allow for size/weight information to be understood for catch volumes that may come onboard during periods where the observer is not active. During normal research/fishing operations, individual specimen weights may be taken occasionally to develop two relationships for further reconciling both catch/product weights and scientific information. For the catch and product weights, individuals or counts of individuals in whole, clean, round condition may be taken and compared with the same

individuals after processed (e.g. round v. tailed weights). For the scientific information, a number of specimens may be weighed per species, size and sex group, that will allow for a length to weight (growth function) to be estimated. This information may be very informative during analyses to assess differing product yields and/or differing growth functions of the same species across areas.

Species Sampling

Scientific samples of species from the catch may prove to be very important in understanding the potential commercial and ecological importance of the lobsters and crabs in the exploratory fishing area. As a very remote, high seas area, there is the potential to capture and observe new species, and to validate the presence of existing species with the collection of samples. The ability to verify species and varieties of both lobster and crab from the catch, at a later time in the laboratory may prove to be invaluable. Immediate verification of species will rely on known information and field guide information referenced in the *Great Southern* application including: A guide to common deep sea invertebrates in New Zealand waters, NZ Aquatic Environment and Biodiversity Report No. 1, 2 and 86. Whole specimen collection will follow typical protocols for the freezing whole, or preserving in formalin solution whole methods. Whole specimen collection schedules and detail methods may be overseen by shellfish researchers in either Chile or New Zealand. In addition to whole specimens, both tissue and/or blood samples may be taken from lobsters and crab in the catch. Project partners are investigating further logistics of what samples may be of most interest for new or ongoing research and where lab work may be completed.

Randomized Exploratory Fishing Plan Methods

The potential bias from using CPUE data alone to understand the abundance and biomass of an unexploited or unassessed stock of invertebrates could be high. A random or semi-random fishing strategy along with a method for the observer to take random or semi-random sample traps will likely lend to more utility from the exploratory fishing lobster and crab CPUE. The methods could be used together or independently to draw samples from fished areas and samples from total traps fished. Given the large, remote scale of the proposed fishing area, a randomized approach to the pattern of deploying strings of fishing traps alone should be narrowed in space to be applied in Phase 2 following but could be part of Phase 1 exploratory fishing. Trap placement could be selected based on a semi-random known starting grid of defined target depths within an exploratory fishing area (Figure 2).

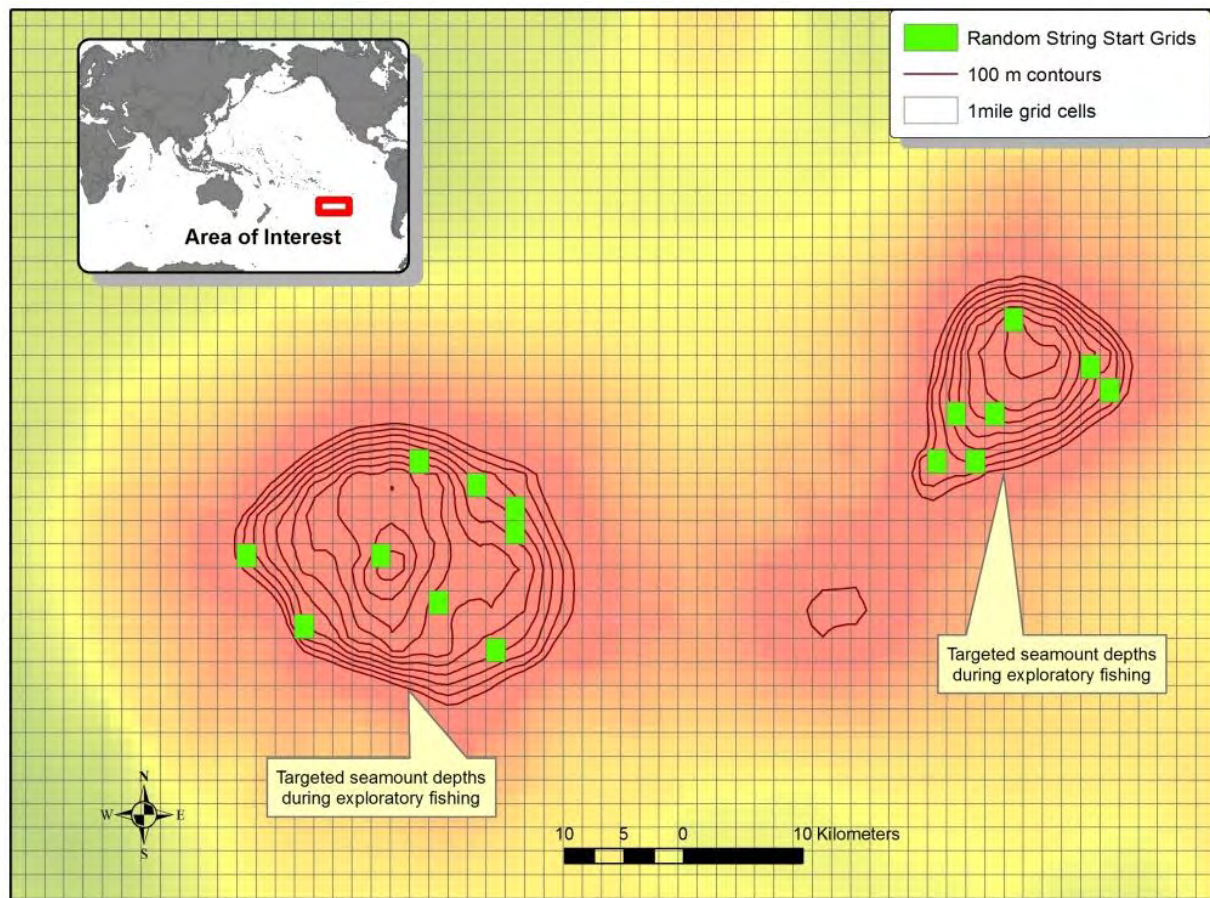


Figure 2. Example of randomly selected starting positions on seamounts of interest for research and exploratory fishing lobster/crab trap strings. Source: NRC

Randomized Exploratory Fishing Plan – Observer Data

A challenge to strategic planning for the collection of data using observers onboard exploratory fishing is to estimate the rate of trap retrieval (e.g. how many traps come onboard in a given time period) and to estimate how long it will take an observer to process the biological sampling work from a single trap of average catch. Based on the information provided in the exploratory fishing plan for the F/V *Great Southern*, observer work for randomizing the sampled traps is based on the following assumptions: a 24 hour fishing period will be 85% time efficient (about 20.4 hours of actual fishing), one observer will work approximately 12 hours per day, one trap will take 30 minutes on average to process for measuring, three (3) standard mesh traps and three (3) small mesh traps will be selected from each string of gear for sampling by the observer, four (4) strings of gear will be fished each day, and each string of gear will have 200 traps deployed approximately 25 meters apart. There are likely changes to these plans and assumptions which are expected to be flexible, dependent on conditions onboard the boat during exploratory and research fishing activity.

Exploratory Fishing Pace Info - traps hauled per day and minutes per trap at rail

	0.75	0.80	0.85	0.90	0.95	1.00 Hrs Efficiency/Day
Target	Hrs Fished/Day					
Traps/Day	18.00	19.20	20.40	21.60	22.80	24.00
500	2.16	2.30	2.45	2.59	2.74	2.88
550	1.96	2.09	2.23	2.36	2.49	2.62
600	1.80	1.92	2.04	2.16	2.28	2.40
650	1.66	1.77	1.88	1.99	2.10	2.22
700	1.54	1.65	1.75	1.85	1.95	2.06
750	1.44	1.54	1.63	1.73	1.82	1.92
800	1.35	1.44	1.53	1.62	1.71	1.80
850	1.27	1.36	1.44	1.52	1.61	1.69
900	1.20	1.28	1.36	1.44	1.52	1.60
950	1.14	1.21	1.29	1.36	1.44	1.52
1000	1.08	1.15	1.22	1.30	1.37	1.44

Observer Process Pace Info - traps monitored per day

Observer Work Day

12	Pct Traps Observed/Day											
Target	2.45	2.23	2.04	1.88	1.75	1.63	1.53	1.44	1.36	1.29	1.22	Min/Trap
Obs/Min/Trap	500	550	600	650	700	750	800	850	900	950	1000	# Traps/Day
5	0.29	0.26	0.24	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.14	
10	0.14	0.13	0.12	0.11	0.10	0.10	0.09	0.08	0.08	0.08	0.07	
15	0.10	0.09	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	
20	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	
25	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	
30	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02	
35	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	
40	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	
45	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
50	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	
55	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	
60	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	
65	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	
70	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
75	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
80	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
85	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
90	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

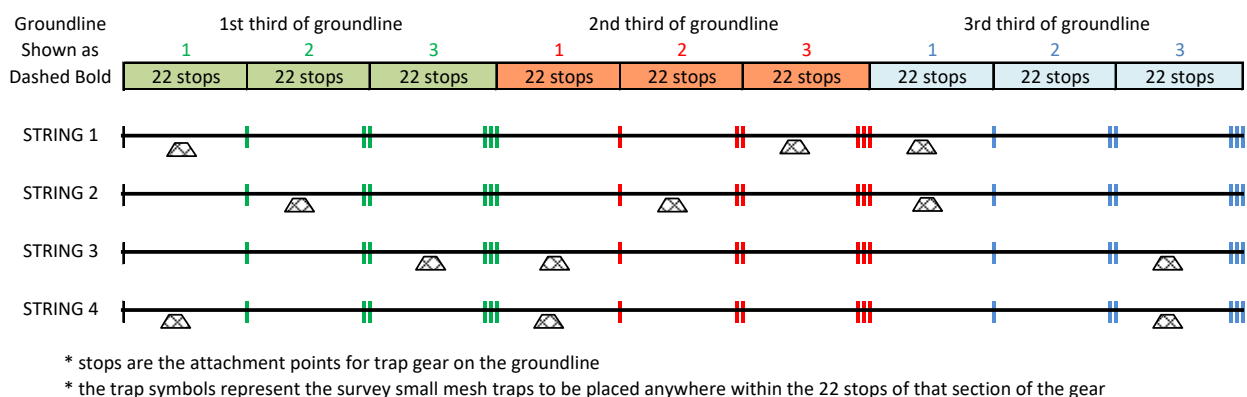
Small Mesh Traps Placement & Observer Selection of Traps

Small mesh "survey" traps should be purchased before Phase 1 fishing and deployed during regular operations of exploratory and research fishing. The current **"standard" gear plans call for traps with 5 cm stretch mesh covering the trap.**

Small mesh "survey" traps should be the same traps structurally and functionally except be covered in 2cm stretch mesh. Current exploratory fishing plans call for the acquisition of 3,000 total traps to be fished in strings of 200 pieces of gear. This would account for 15 strings of 200 traps each if all gear is grouped this way. For a 200 trap string the expected spacing between traps is 25 meters and total string length is estimated at approximately 5,000 meters. The purchase of 90 small mesh **"survey" traps would allow for 3** small mesh traps to be fished per string, for an average of one survey trap per ~1,670 meters. The purchase of 90 traps is expected to be two (2) complete sets (redundant backups) of a complement of 45 traps each – based on all 15 strings having three (3) survey traps each.

The actual placement of the survey trap should be determined on a semi random basis where the trap count per string is split into 3 sub-lengths (~66 traps each). For ease of preparations on deck and determining the placement of a survey trap

within three (3) portions each with 66 options, each third of the groundline should have simple color coded marks (embedded/fixed) that would be easy to identify for **crewmembers and observers as "sections 1, 2 and 3 or the three sections."** For example, the groundlines could have three green markers set as one green mark at 22 stops, two green marks at 44 stops, and three green marks at 66 stops (where "stops" are defined as snap-on points of trap gear to the groundline). In the next section the groundline could have the same except red marks, and in the last section, the groundline could have the same except blue marks. Each color section would get one survey trap, semi-randomly chosen from 1, 2 or 3. The determination of this plan would be completed before each day of exploratory fishing so that gear preparation, stacking and baiting can proceed as normal. An example of this could be the following: for a day of fishing 4 strings of gear, the semi-random survey pot placement scheme could be (1,3,1 for String 1) (2,2,1 for String 2) (3,1,3 for String 3) and (1,1,3 for String 4) and would follow the diagram below:



This design could allow for relative ease with the pre-placement of baited standard traps and survey traps into staging area and stacks of gear. Adjustments to this preliminary design could be made if desired for further simplification. For retrieval of sampled traps, the observer would follow the same protocol and would select all survey traps deployed for processing. To obtain the comparative catch information between the two gears, survey trap v. standard trap, the observer would also select the adjacent standard trap on either side of the survey trap for processing. This would mean that pairs of traps would come up for the observer processing, but would be selected in a randomized manner, and also account for information used for some measure of the standard gear fishing selectivity (size composition for the two gears).

Potential Depletion Study Methods

A reduced scale DeLury Depletion experiment is a planned component of methods during the exploratory fishing and research efforts for the *Great Southern*. Given that Phase 1 efforts will spread exploratory fishing effort across the seamounts in the area of interest to determine general species composition, and general spatial extent, it is planned that the depletion work would be completed during Phase 2.

A depletion study would follow methods that are closest to DeLury (1954) where an area would be identified (from Phase 1 results) and research fishing would

commence to carefully measure repetitive declines in CPUE to be later analyzed for estimating relative population abundance and biomass of the target species. The analytic methods may take a variety of forms (including a depletion model) and will be further investigated before Phase 2. This sampling plan outlines the important components of executing the field work including some detail of methods specification, controls on fishing effort, spatial design, standardization of gear, and other to reduce bias in the data collected.

The selection of an area for the depletion experiment should be carefully considered. A selected area with too much influence from other areas, or too many unknowns would likely bias the data collected. A very high catch area or a very low catch area (reviewing Phase 1 results) should not be selected. A relatively small, medium-density (CPUE) area would likely be a statistically strong choice for the depletion study without being too prescriptive, or limiting the utility of how the study may inform estimates of biomass, or consideration of relative CPUEs across other areas (Figure 3).

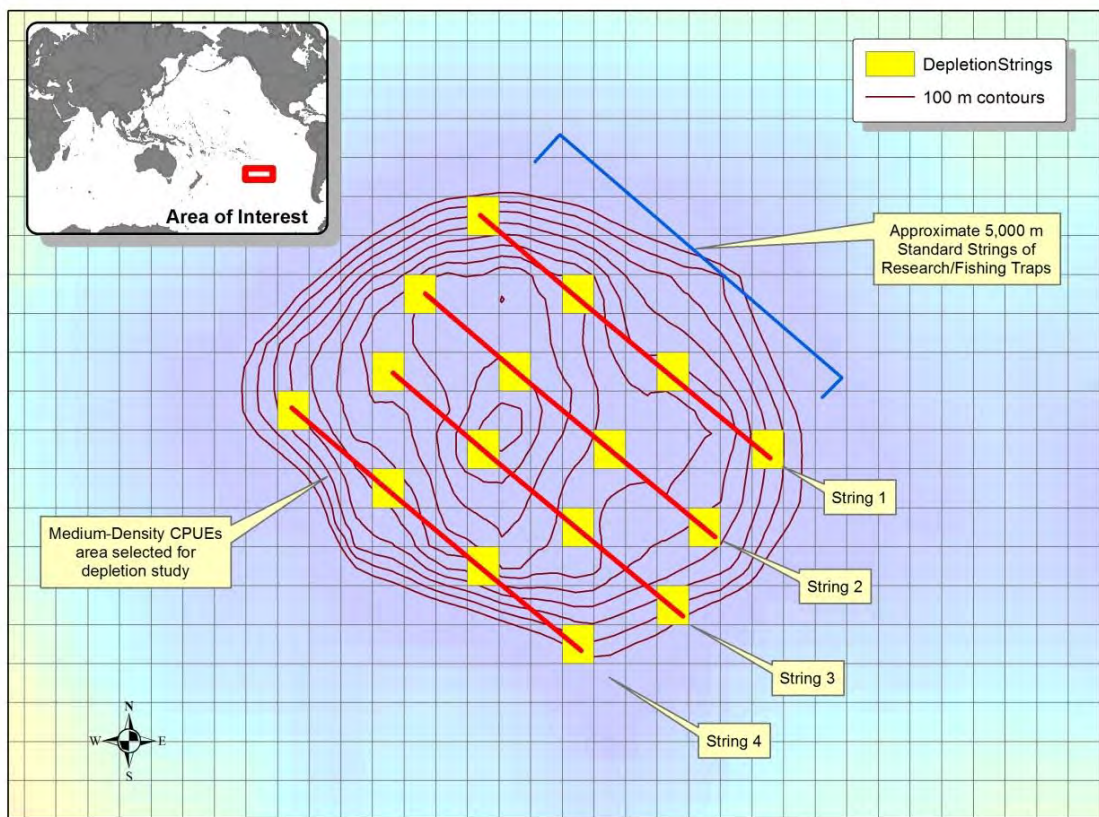


Figure 3. Depletion study example area with plotted strings of research traps for controlled methods during repetitive trap fishing. Source: NRC

The control methods for the depletion study should be closely followed but should be flexible enough and accessible enough during the work to modify if there are complications. Complications may be directly related to fishing results that include low or no catch, or high catches that do not appear to be declining during the repeated fishing in the same area, which may be related to immigration from adjacent areas. The methods should rely on standardized *Great Southern* exploratory fishing approaches that include:

- using the standard traps in strings of 200 units of gear without the placement of small mesh traps
- using the same bait for all traps fished during the depletion experiment
- controlling soak times as much as possible for all traps
- recording the start, middle and end locations (possibly more) of all strings to closely control the spatial aspect of trap fishing footprint
- observer selection of the same traps per string in each repetitive set of the gear (which may include potentially increasing the number of sampled traps per string above 24 traps per day)
- recording the information used to calculate CPUE per species per string consistently per each set of the gear

Without further information available to inform the selection of the area (spatial feasibility) or changes in relative CPUE (catch processing feasibility), further refinement of methods is a framework. Close consideration should be taken to monitoring the catch in real-time to assess if the spatial scale should be adjusted. Further, if CPUEs are remaining constant, then study options should account for further time requirements to continue with fishing until CPUE declines can be documented. In general, a single seamount should be the target area of the depletion study. The string length at 200 traps and spacing between pots should be held with the same methods as the standard gear in the other exploratory fishing if possible. However, if prior information on CPUEs (Phase 1) reflects that only a smaller portion of a seamount has lobsters then a smaller scale study area would fit with a feasible gear change (100 trap string), and this could be considered a reasonable option.

Assuming the standard exploratory fishing methods, the depletion study could take 10 to 30 days of the *Great Southern's* time on the study grounds. A three (3) day soak period would account for 3-4 repetitive cycles of the 4 strings of gear being fished in the same location at a 10-day study level. Increasing up to 30 days may account for 10 repetitive cycles of the gear through the area. A smaller scale depletion study with a lower amount of gear placed across a smaller total area may allow for a more efficient documentation of declining CPUE in less time committed to the depletion experiment. Further development of this experimental option will be completed and presented with full methodology, including details of the descriptive statistical considerations and tests in later Phase 2 sampling methodology.

Camera Study

A fully developed camera study to systematically provide information on VMEs or other target resource or bycatch species will be developed in later sampling plans separately or in collaboration with NRC. During the proposed exploratory fishing and research, submarine video cameras may be dropped periodically when evidence of very high CPUE, gear damage, anomalous substrate, or sensitive bycatch areas are observed. Camera systems should be configured separately from gear to be capable of a sled-drop or other fast-cast drop system. Cameras may also be attached to traps for observation of gear function and the recording of the substrate near the footprint of the gear. Camera systems will utilize a pressure switch that will trigger at a specified depth to turn on, which will engage LED lighting and also the video recording switch. The recording of information is expected to be on a SD micro memory chip which is removable from the camera after retrieval. Review of the video footage is able to be completed by uploading the SD memory directly to an onboard computer. Immediate and periodic review should occur to assess if there are modifications to the camera configurations, settings, or lighting that will improve the quality of video recorded. Examples of video footage should clearly show target specimens on the substrate as shown in video screen captures below (Figure 4).

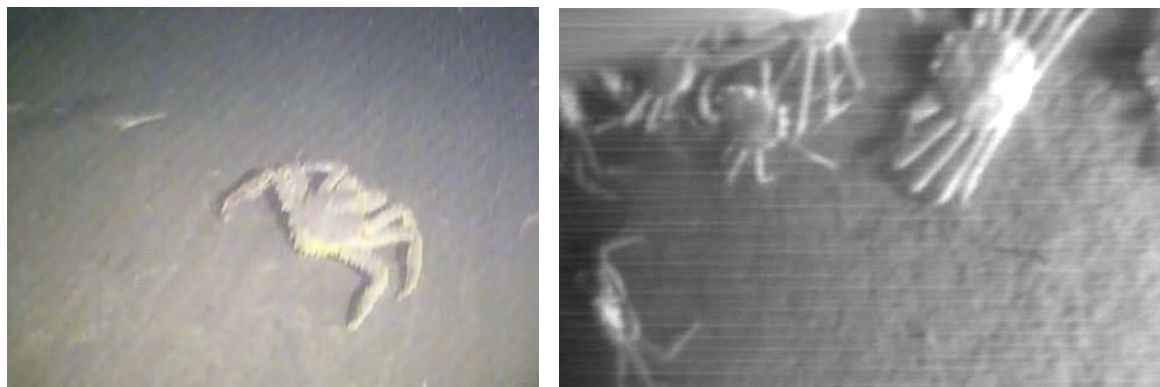


Figure 4. Example screenshots from video footage of submarine video used during invertebrate trawl surveys in the Bering Sea, Alaska. Source: NRC.



NATURAL RESOURCES CONSULTANTS, INC.

4039 21ST AVENUE WEST, SUITE 404
SEATTLE, WASHINGTON 98199
TELEPHONE: (206) 285-3480
FAX: (206) 283-8263
<http://nrccorp.com>

Appendix 14 Catch Reporting & Information Summary Plan

For Exploratory Fishing
of F/V Great Southern
Targeting Deep-Water
Lobster and Crab Species

Prepared for:
Mr. Ben Ponia
Secretary of Marine Resources
Ministry of Marine Resources
Government of the Cook Islands

October 31, 2017

Introduction

This catch reporting and information summary plan is intended to inform the collection of catch data, analyses and reporting format of information back to the Ministry of Marine Resources (MMR), Government of the Cook Islands. The plan lays out information guidelines that will allow for the credible documentation of all record keeping, reporting and analyses of information collected during the exploratory and research fishing of Great Southern. The plan includes details of reporting frequency, catch data types, biological summaries, spatial detail, and some details of reporting logistics.

Catch data

The primary data from the exploratory fishing will be to document the retained catch of the targeted species of lobsters and crab. Lobster species included in these summaries are *Projasus parkeri*, *Jasus caveorum*, and other potentially encountered *Jasus* species. Crab species included in these summaries are Chaceon species. Discards of these species will also be documented. Bycatch species will also be enumerated by number and weight for all strings where traps are sampled by the observer.

The exploratory fishing effort will also be documented on a string and trap basis. Plans call for 200 traps per string but accurate counts will be made if this changes. The total count of traps hauled (trap lifts) will be tabulated and will be the denominator for the calculations of Catch per Unit Effort (CPUE). The exploratory fishing will be conducted by a single vessel as planned, and will provide accurate **spatial records of where gear is fished to be able to estimate the total “footprint”** of fished traps per area and in aggregate.

Biologically important information will be summarized for all species captured. For lobster and crab species, the observer information (sampling methods) will allow for the reporting of sex ratios, size compositions, shell conditions, and observed measures of reproductive status. Reporting will provide the length compositions

per sex, per species, per area. Aggregated reporting will also be able to group summaries across areas or species.

Reports will be prepared at regular intervals (to be determined) that will provide summaries of each voyage, trip, and each exploratory fishing area. Monthly reports will be provided. Seasonal reporting will be compiled which will account for all complete records of exploratory fishing for that season. The Phase 1 reporting and summaries are expected to provide a wide range of relative catches by species densities, magnitude, intensity and area. Later Phases of the exploratory and research fishing will be informed by review and summary of the prior data.

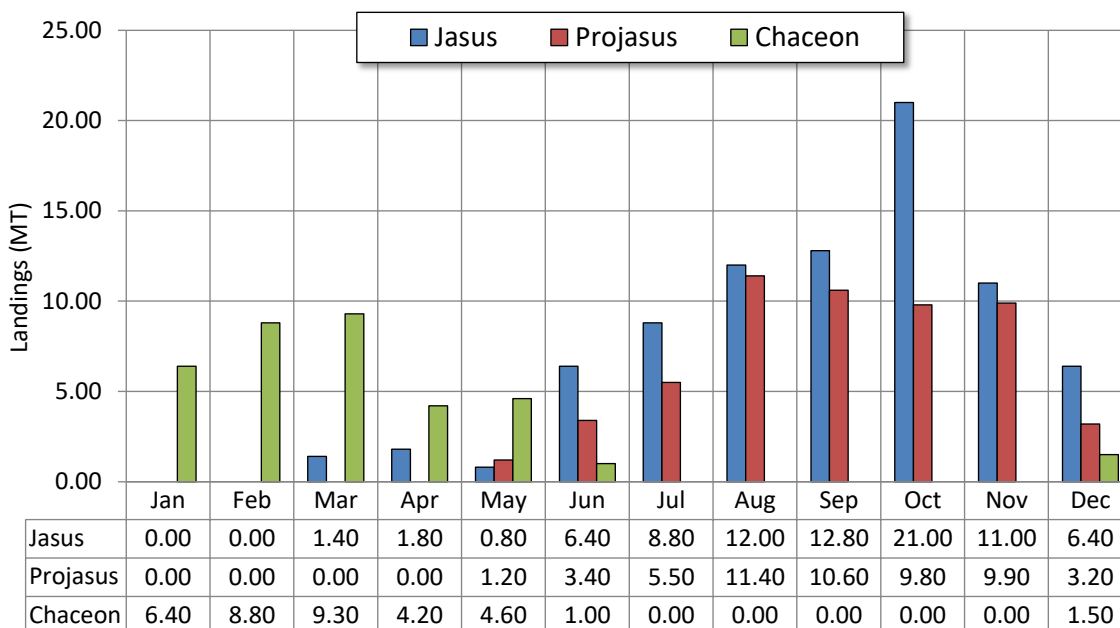
A comprehensive database will be compiled from all reported data as described by the fields below:

Data type - catch or production	Total number discarded by species per trap
Vessel name	Who counted discarded species per trap observer/crew?
Skipper name	Total number discarded by species per string
Observer name	Total weight discarded by species per trap
Area or Seamount name	Who weighed discarded species per trap observer/crew?
Date of fishing deploying traps	Total weight discarded by species per string
Date of fishing hauling traps	Lobster/crab species present in trap for retention?
Start latitude of string (taken from wheelhouse GPS)	Lobster/crab species whole haul or subsample in trap?
End latitude of string (taken from wheelhouse GPS)	Lobster/crab carapace length and sex by species (several records per trap)
Start time of string deployment	Indications of reproductive change - females gravid?
End time of string deployment	Shell conditions per individual measured (clean v. dirty, new v. old, etc.)
Number of traps set in string	Specimen weights taken for selected individuals (in grams on Marel scale)
Depth at first trap of string (taken from wheelhouse instruments)	Biological samples including blood or tissue samples taken (Y/N?)
Depth at mid-trap of string (taken from wheelhouse instruments)	Other species present in trap (Y/N?)
Depth at last trap of string (taken from wheelhouse instruments)	Bycatch species recorded if present
General weather conditions during fishing setting gear	VME, coral or sponge presence in trap (Y/N?)
Seastate during fishing setting gear	VME, coral or sponge species recorded if possible
General weather conditions during fishing hauling gear	Pictures taken for trap catch (Y/N?)
Seastate during fishing hauling gear	Estimate of or measured total weight for bycatch by species if possible
Water temperature at string start (both surface and bottom)	Product form - whole frozen, tailed
Water temperature at string end (both surface and bottom)	Product weight in kg
Number of traps sampled by observer in string	Product count per kg
Individual trap number in string selected by observer	Product species
Total number retained by species per trap	Product voyage and trip number
Who counted retained species per trap observer/crew?	Product area
Total number retained by species per string	Product catch date
Total weight retained by species per trap	Product processing date
Who weighed retained species per trap observer/crew?	Product condition
Total weight retained by species per string	Product size grade

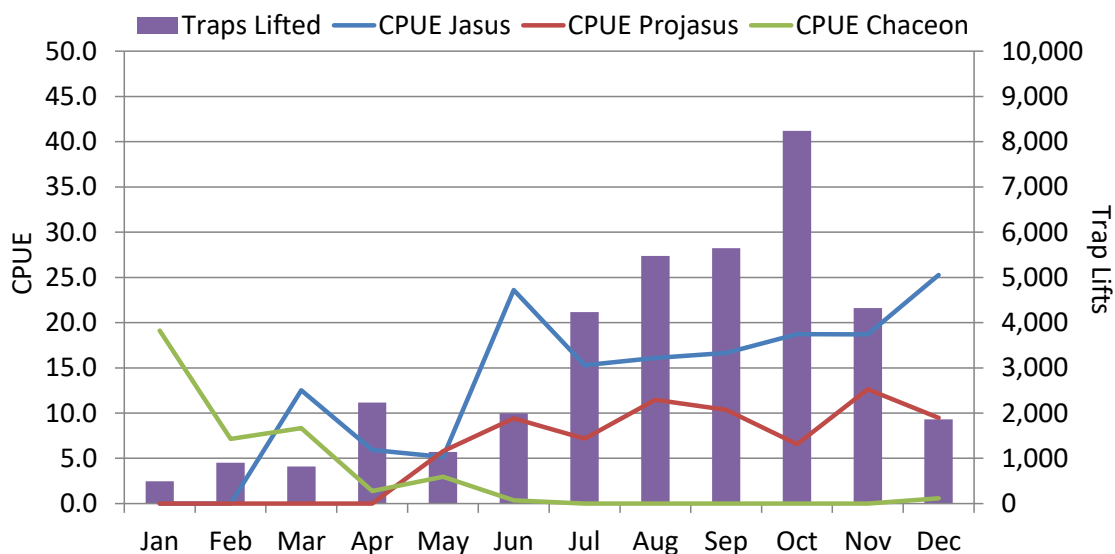
The database will be a combined effort, catch and production database which can be summarized in aggregate or split to look specifically at each component. An important component of record keeping and reporting will be the accurate positional information for all trap strings so that the database can be incorporated into GIS.

The spatial review of information will be a critical component from both a biological and a productivity perspective. A regular part of NRC reporting will be to produce GIS summary maps for the areas, species, and activities of interest. Examples of reporting tables by month, species, area, and product are shown below and the format may be revised when actual data is received and compiled.

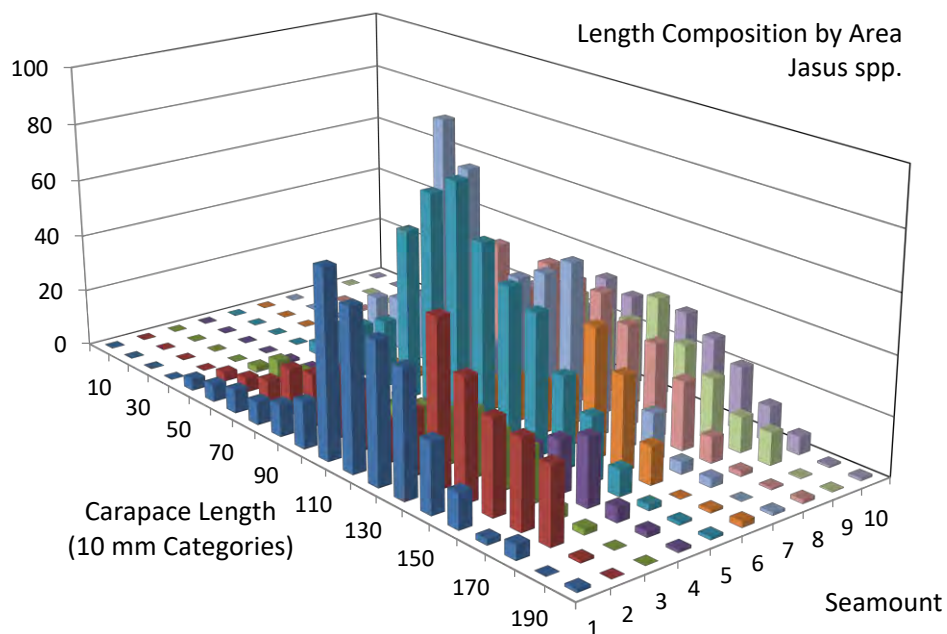
Monthly production summary, available by area: (example table)



Monthly CPUE summary, available by area: (example table)



Length composition by species and area – available per species/sex/month/season:
(example chart)



Further NRC summary information will reflect full tabular and spatial reporting. Spatial reporting will also include the expansion of CPUE information across areas during the phased approach, which is expected to include estimates of relative abundance and biomass with variance. Further development of reporting procedures and requirements will continue as some plans for exploratory and research fishing are further refined.