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La Havana, Cuba, 7 to 12 October 2019

SC7-DW02

Cook Islands Exploratory Lobster Trap Fishing in the SPRFMO Area

Trips 1 and 2

Cook Islands

Including observer reports for the first 2 trips

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Cook Islands exploratory lobster trap fishing in the SPRFMO - Trips 1 and 2

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1 Executive Summary

The two-year program of exploratory trap fishing provided for by CMM14b-2018, and subsequently superseded by CMM14b-2019, has successfully completed two trips in 2019. New biological information has been collected on *Jasus caveorum* and *Chaceon* sp. The key findings are that the fishery caught primarily lobster, *J. caveorum*, most of which were male ($\sim$ 60%), and that most females were not carrying eggs (in berry). This trip provided information on populations present, target stocks and marine ecosystems. These data are being used to evaluate the effectiveness of existing mitigation measures, to ensure that the bottom trap fishery is developed through a precautionary and gradual process, in accordance with the best available scientific information. Over the coming months, the Cook Islands will screen material and analyse all data collected in more detail than the timing of the trips has allowed so far. In addition, to maximise the value of future data collection for both the Cook Islands and the fishing company, we need to gain an understanding of the distribution, dynamics and status of stocks of *Jasus caveorum* and *Chaceon* sp. At this stage, it is intended that the revised Fishery Operational Plan for the future of the exploratory fishery will be presented to SC-07 in 2019 for consideration and endorsement of a 3 - 4 year exploratory fishery in this area.

2 Purpose of paper

This paper provides SC-07 with an update on exploratory fishing for lobster and crab by the Cook Islands vessel *Altar 6* pursuant to CMM14b-2019. It also briefs the Committee on future directions of this operation and associated research and potential management arrangements.

3 Introduction

The Cook Islands submitted a proposal to the Commission of the South Pacific Regional Fisheries Management Organization (SPRFMO) Scientific Committee's 6^{th} meeting in 2018, SC-06, to carry out a 2-year exploratory research programme, for the purpose of obtaining scientific information through exploratory fishing for lobster (*Jasus caveorum* and *Projasus* sp.) and crabs (*Chaceon* sp.) using benthic traps set on a longline within the SPRFMO Conservation Area. This work aims to assess the potential for a long-term fishery in the Convention Area. The proposal was based on a precautionary ecosystems approach mandated by the SPRFMO. The proposal sought to comply with the application requirements of SPRFMO Conservation and Management Measure (CMM) 13-2016, 03-2018 and SPRFMO's Bottom Fishery Impact Assessment Standard (BFIAS). The Scientific Committee assessed the Cook Islands proposal and its conformity with CMM14b-2018. The SC noted that:

- The Fisheries Operation Plan specifies details for the third year will be dependent on the results of sampling from the first two trips and therefore the Fisheries Operation Plan for this third year will be provided at the 7^{th} meeting of the SC.
- Concerns specific for the depletion study in year 2 could be used to inform the response of the targeted species and could be improved for how to address the potential for saturation.
- The proposal addressed potential impacts on non-target stocks and VMEs, but noted the concerns on the proposed move-on rule, and concerns with the lack of details to determine the sustainability of the target stock given the catch limits.
- The proposal addressed action to mitigate impact on berried females, however, the SC also noted the concerns with the literature paper was for deep water crab species in the Pacific, yet others are for other lobster/crab in other coastal areas.

The SPRFMO Compliance and Technical Committee and Commission considered the proposal in 2019 and approved a 2-year exploratory fishery with a combined total allowable catch limit of 600 tonnes of lobster and crab for year 1 and subsequently preliminary 300 tonnes in year 2.

Preparatory and design work continued through late 2018 and 2019 and the first year of exploratory fishing, enabled through conditioning of Great Southern Fisheries High Seas Fishing Permit. Two trips were conducted by the Cook Islands demersal longline vessel *Altar 6* between March and July 2019. Preliminary results from these trips are presented in this document.

4 Methods and Results

Traps were set on a longline. The length of the mainline varied between 77 traps per line to a maximum of 200 per line. The distance between traps was normally 25m irrespective of the length of the line. However, if only 100 traps per 5000m line was used then the spacing between traps was 50m. A 75kg chain stabilizer and marked buoys were deployed at both ends of the line. Stackable top loading traps were used. The traps were 150cm diameter at the base, 75cm high and 50cm diameter at the top. The entrance to the trap was 35cm in diameter and the trap was covered with netting of 10.2cm mesh (knot to knot 5.1cm). The backbone (ground line) and float line for each string of traps was made of 26mm polypropylene rope. The traps were constructed with 'escape gaps' with 51mm diameter to allow for escapement of the small organisms. To prevent ghost fishing the trap was also fitted with a sewn in cotton string where parts of the traps' nylon mesh was cut and sewn back together with cotton string, so that if lost and not found, the cotton string will eventually degrade and the traps will remain opened. The traps were baited with ground up mackerel placed in bait jars that were attached to the inside of the trap with a snap.

A specially designed camera frame, fitted with an underwater camera was deployed three times during the trip. The frame was either deployed with or without a mesh net. The footage was retrieved from the camera's memory card and used to identify bottom structure, the benthos and potential Vulnerable Marine Ecosystem (VME) areas.

The vessel generally set lines straight after they were hauled. The soak time varied between 24 hours and 48 hours. Initially, the vessel experimented with long soak times of 48 hours and more, but later realised that shorter soak times yielded better lobster catch and tried to haul the lines within 24 hours. This was not always possible as the factory crew could not always process large catch within that timeframe.

The vessel had two observers, a Cook Islands national observer and an international observer. The observers were instructed to record the weights of the total *J. caveorum*, *Projasus* sp., *Chaceon* sp. and bycatch per trap before retained species were channeled to the factory. The non-retained bycatch was stored in a separate bin and discarded at the end of the line by lowering it to the seafloor in the first trap of the next line set. Some species were retained for further analysis ashore. The observer collected the contents of every tenth trap which equated to approximately 10% of the traps per line being sampled. Biological information for *J. caveorum* and *Chaceon* sp. such as; length, batch weight, sex, maturity stage and shell condition were collected. Bycatch information included length, alive/dead, location on the trap (inside or outside the trap), number and weight per species. Retained biological samples were bagged, tagged and frozen for further analysis ashore.

The crew did not always retain small *Chaceon* sp. These were placed in a crate and periodically discarded overboard on the opposite side of the hauling station, while still alive. This was carried out with permission from both observers.

The data were captured directly into a Microsoft Access database. Subsequently data were extracted from the database using the R (R Core Team, 2018) package RODBC and all analyses were performed in R.

4.1 Catch

Between 19th March 2019 and 20th May 2019 and 28th May and 12th July the vessel *Altar 6* fished in the South Pacific Ocean (Figure 1) on eight Seamounts (Table 1) targeting lobsters and crabs, primarily *J. caveorum* and *Chaceon* sp. The only lobsters in the catch were *Jasus caveorum* (Webber and Booth, 1995) identified through photo and physical identification by (Rick Webber from the New Zealand Museum - Te Papa) and genetically by Johan Groeneveld (Oceanographic Research Institute (ORI)). The *Chaceon* sp. is still pending identification.

Data were collected by the vessel and observers as part of a predetermined sampling and catch reporting strategy. For each set the vessel recorded the catch by species per set in a logsheet that included, location (start, middle and end of each set), date and time (of set and haul), setting speed, the trap type, target species, depth at start, middle and end of each set as well as recording various environmental parameters. In addition, the observer recorded the weight of catch for each trap and collected biological samples from every 10th trap.

Overall 120.15t was landed from the two trips and all sets recorded *Jasus* as the target species, but

Chaceon sp. were also retained and processed. An observed 119.25t of target species (99.25%) were landed, including 115.26t (95.93%) of *J. caveorum* and 3.99t (3.32%) of *Chaceon* sp. In addition, a small amount of bycatch (0.91t - 0.76%) was landed.

Most of the effort and resulting catch came from the Kopernik seamount (77t) (Table 1). The catch by set information for Kopernik, MM and Darwin A seamounts are shown in Figure 2, Figure 3, Figure 4 and Figure 5. While a few early stations on Kopernik and all stations on MM had high catch of *Chaceon* sp. the remainder of the stations were dominated by *J. caveorum*. The catch on Kopernik seamount was relatively evenly spread across sets (Figure 9) but the catch within a set was clustered and few traps had high catch with most having a lower catch (Figure 10). Catch on MM seamount was only based on three sets, all of which caught only *Chaceon* sp. (Figure 11).

When reviewing the catch data in Figure 2 and Figure 3 there appears to be some decline in catch as the trip progressed, the catch rate data showed similar trends (Figure 8). This could indicate that while fishing on Kopernik the vessel moved from areas of high to low lobster density or that catchability changed through the trip. However, looking at the order of sets over the seamount (Figure 12) there is no indication of serial use of the seamount. Soak time can also influence lobster catch, as lobsters are used to living in complex habitats they can escape traps once the bait is finished. While the first 22 sets of trip 1 had high set times (Figure 13) and low lobster catch (Figure 2 and Figure 3) the remaining sets were relatively constant at about 24h soak time. Overall shorter set times (around 24h) had higher *J. caveorum* catch per set and longer sets had slightly higher catch per set for *Chaceon* sp. (Figure 14). The high catch at the start of the trip and lower catch rates at the end of the trips (Figure 8) could indicate serial depletion and that should be investigated further once more data are available.

The catch by depth information (Figure 6 and Figure 7) shows that the *J. caveorum* and *Chaceon* sp. seem to have different depth preferences. *J. caveorum* catch and CPUE was higher in shallower water (130-300m), while *Chaceon* sp. are caught in deeper water (deeper than 300m).

4.2 Biological parameters

The International Observer was required to measure the first 40 target species (either lobsters/crabs) in every tenth trap (starting with number one). If there were less than 40 in the trap, then the observer simply measured all the individuals. The sample weight per species was recorded but not individual weight. During the size composition sampling, the total weight per trap was recorded by the National Observer. Once a minimum of 200 lobsters were measured per line (i.e. 5 traps of 40; or 20 traps of 10 lobsters, if this was all that was caught) the observer stopped measuring lobsters on that line.

The observers sampled an average of 10% of the traps per line for biological information such as length, batch weight per species, sex, maturity stage and shell condition for the target *J. caveorum* and *Chaceon* sp. Bycatch was sampled for species, length, weight, condition (dead/alive/broken or whole) and location caught on the trap.

Length data for male and female *J. caveorum* and *Chaceon* sp. are shown in Figure 15 to Figure 22. For most seamounts there are not enough data to be informative. However, Kopernik seamount did have substantial *J. caveorum* catch and length samples (Figure 16). The *J. caveorum* samples at Kopernik seamount reveal that, like most *Jasus* species, the females are smaller than the males and the catch is male dominated. This may have some advantages for future management options (see below). Overall for *Chaceon* sp. very few females were sampled, of those that were sampled, all were small relative to the males in the sample. It appears that there was some change in the population structure between trip 1 and 2 where the smaller male lobsters in the population were less available to the fishing gear than they had been on the first trip (Figure 23).

The shell state of *J. caveorum* showed that almost all had old hard shells with a small proportion having new shells (Figure 24) during trip 1. During trip 2, the proportion of lobsters with new hard shells had increased but they were still in the minority (Figure 24). New shells are a sign of recent moulting and mating (for females) who mate when their shells are soft. This indicates that the fishing may have taken place during or just after the spawning season on trip 2 for *J. caveorum*.

The observers measured and recorded berry on both lobsters and crabs and the berry state (Table 2 and Table 3). However, at this stage there were too few samples to make any conclusions. The vessel did record the number of berried females returned by set and this did increase over time. However, we do not have numbers of females not in berry but retained and unobserved in each set to compare to the number of berried females returned to sea. There is some indication that the number of berried females was increasing through the trip indicating that the end of the trip (May) could be approaching the spawning season. The observer data shows few berried females (Table 2) so there are not enough data to statistically assess changes in proportion berried through the trip in a meaningful way.

It is important to collect morphometric information for converting processed catch into a total weight or length into weight. This trip collected three measurements for *Chaceon* sp. namely carapace width, total weight and processed weight information (Figure 25 - Figure 27). While these data are useful larger samples are required to get more reliable conversion factors.

The carapace length (CL) of lobsters covering a wide size range (62 - 178 mm) were measured and each whole lobster weighed (WW). Nonlinear Regression Analysis using the R package nlstools were used to fit to the data for all lobsters combined (n = 241), females (n = 81) and males (n = 160) respectively (Figure 28 - Figure 29). The regressions were of the form WW = a x CL^b and fit the data very well with R^2 values ranging between 0.96 and 0.99.

Regressions from whole weight to tail weight and carapace length to tail weight were not done, because all lobsters were processed to whole lobster products on board the *Altar 6*. Many lobster fisheries process their catches by removing and packing lobster tails only, and discarding the carapace. Regressions and derived conversion factors between whole weight and tail weight, as well as from carapace length to tail weight are therefore still required for *J. caveorum*, so that a full set of conversion factors are available, to accommodate potential changes in processing strategy, facilitate data analyses using different metrics, or for inter-comparisons between different lobster fisheries. Therefore, additional morphometrics should be seen as a priority task for observers on future trips.

Carapace length versus whole weight regressions of females covered a smaller size range (66 - 138 mm CL) than males did (62 - 178 mm) because females did not grow as large as males (Figure 29). The regressions were very similar, and did not show a progressive increase in female weight, compared to males of the same size, with increasing size. In most other *Jasus* species, the tail becomes larger after females reach sexual maturity, hereafter females of the same length are heavier than males. Regressions of whole weight against tail weight are required to test whether tail weight of mature females increase faster than in males.

The size-at-maturity information was estimated for *J. caveorum* only (Figure 30). However, as there were very few immature females sampled, these data should be considered very preliminary at this stage. But based on these preliminary data the estimated size-at-50% maturity was estimated at 70.7 mmCL. Functional maturity was estimated from the smallest egg-bearing female (74 mmCL) and the largest female without ovigerous setae was 83 mmCL. Additional sampling with small mesh nets may provide better information in in future.

4.3 Bycatch

Overall the traps contained mostly the target *J. caveorum* and *Chaceon* sp. and there was not a lot of bycatch (Table 4) recorded in or on the traps. Most of the bycatch was *Chaceon* sp., some of which was retained but most discarded, with a number of teleosts making up the bulk of the remainder, a small amount of hard corals and other anthozoans were recorded as entangled on the trap mesh. Corals and rhodoliths are indicators of VMEs and their occurrence was noted by the vessel and the positions recorded on the chart.

With regard to VME indicator species, the observer recorded *Cnidaria stylaster* coral or hydrocoral only on four lines set on Kopernik. The fishing master, Jim England also saved the locations, as required by SPRFMO, for future reference and further analysis if needed. Rhodoliths were the most common of the benthic organisms. The underwater camera shows clips of them over a flat seabed. Where there was uncertainty on species identification, photographs were taken for further identification by Rick Webber (New Zealand Museum - Te Papa).

4.4 Species of special interest

In order to mitigate catch of seabirds, turtles and marine mammals no bait, offal, dead floating bycatch, factory offal or food waste were discarded during hauling or setting of the lines. The factory produced very little offal as *J. caveorum* were retained whole and very few *Chaceon* sp. were caught at the Kopernik seamount where the bulk of fishing activities occurred. When *Chaceon* sp. were caught and retained the offal and waste shells were ground up, retained in a holding tank and pumped out when no hauling or setting was underway.

The observers noted and recorded all the birds observed during hauling and setting operations. It was observed that sooty shearwater (*Ardenna grisea*) would sometimes land and sit on the water to feed off small bait pieces that washed off the bait jars. The area approximately 50m astern where the birds landed, was free of any fishing gear as the traps and mainline are heavy and sink fast close to the vessel. The traps landed in the water within a meter from the vessel's stern and started sinking immediately.

Sooty shearwaters and wandering albatrosses (*Diomedea exulans*) were regularly observed during setting and hauling. Apart from sooty shearwaters feeding on small bait pieces, no other bird interactions with the vessel or fishing gear was observed. One grey petrel (*Procellaria cinerea*) was observed sitting on the hauling deck. The observer moved the bird to the bow section of the vessel to prevent possible injuries from crew activities. The following morning the petrel was gone. Photos were taken of the grey petrel while on deck. The observer's camera zoom lens had a malfunction and therefore good quality bird pictures were not always possible. However, some clear pictures were recorded. Other birds observed from time to time were; black browed albatross (*Thalassarche melanophris*), grey petrel, grey headed albatross (*Thalassarche chrysostoma*) and one sighting of a pintado petrel (*Daption capense*).

4.5 Management information

One of the management measures used in lobster fisheries is using size specific gear or a size limit to reduce the catch of females. In order to assess the feasibility and impact of such a measure we compared the size of male and female lobsters in the catch (Figure 16 and Figure 33). Overall the females in the catch were smaller than the males this implies that a size limit or altered selectivity of the gear could protect the females (and thereby the spawning biomass) from exploitation.

The impact of a size limit on the fishery was explored by assessing the likely implications this could have on the operational and economics of the exploratory operations. Table 5 presents the impact on the female population and the catch of potential size limits. These data show that, for example, a size limit of 120 mmCL would exclude 99% of the females from being retained, however, this would result in only 36% of the current catch being retained, while a size limit of 100 mmCL would protect 39% of the females and allow for the retention of 79% of the current catch. While these data are preliminary (based on a single seamount) additional information from subsequent trips and more seamounts could allow for a more in depth analysis of this type of measure. Alternative measures such as altering the traps has not been considered yet.

5 Discussion

During these trips eight seamounts were fished (Table 1). *J. caveorum* were only caught at Kopernik seamount in large volumes. *Chaceon* were landed in small volumes but at all seamounts (Table 1). Whether there are few or no *J. caveorum* at the other seamounts or whether there is in interaction between the *Chaceon* sp. and *J. caveorum* that prevents the *J. caveorum* entering the trap is as yet unknown. Alternatively, longer set times may be more conducive to higher crab catch or facilitate lobster escape thereby skewing the species composition of the traps. However, depth seems to have the strongest impact on catch (Figure 6 and Figure 7). This may need further investigation when more areas are fished and more data comes to hand allowing meaningful analysis.

Soak time was high initially but lower and more similar (∼24h) between sets from set 21 onward on trip 1 and maintained throughout trip 2, and setting on Kopernik seamount was not undertaken in a sequential manner across the seamount. This relatively random setting along with lower catch and catch rates later in the trip (Figure 2, Figure 3 and Figure 8) may be an indication that catch early in the trip negatively impacted the catch later on in the trip at the same location. In addition, the overall CPUE from trip 2 was lower than that of trip 1, and the CPUE at the start of trip 2 was 14% lower than the start of trip 1, but at this stage the reason for this (e.g. changes in biomass; seasonal availability; or lobster catchability) are currently unknown and only further fishing will be able to shed some light on this. These trends should be investigated further after subsequent trips.

Overall the target of 10% sampling coverage was reached for traps and *J. caveorum* sampled, but *Chaceon* were frequently over or under sampled particularly on trip 1 (Figure 31 and Figure 32). Samples tend to be over sampled from very small hauls and under sampled from very big hauls where the catch in the first five traps is large. However, the impact of this is slight and overall the sampling strategy results the 10% sampling target being met.

As few *Chaceon* sp. were landed, there are not enough data to make meaningful interpretations on the size distribution of individuals from the catch. However, for *J. caveorum* good samples were obtained. Like many other *Jasus* species the males reach a larger size than females. This size difference may create management opportunities (see below). There also appeared to be a change in the population structure between trips 1 and 2 where the smaller male lobsters in the population were less available to the fishing gear than they had been on the first trip (Figure 23). *Jasus frontalis* is known to undertake long-shore and inshore offshore migrations (Roman et al., 2018) and it is possible that *J. caveorum* may undertake some spatial movement.

Crustacean shell state can provide information on the moulting cycle. These data can be informative in deciding when to tag them for growth increment information and when the spawning season may commence. The *J. caveorum* sampled here almost all had shells that were in an old hard state, indication that moulting had occurred some time previously. Very few individuals had new hard shells and that, along with the change in proportion of berried females through the trip as well as the few berried females samples, indicate that the fishing operation occurred prior to the main spawning period during trip 1. This time of year would be good time to tag lobsters for assessing growth. Prior to moulting, lobsters commit a lot of energy to the production of a new shell, if they get tagged once the new shell is made, but prior to moulting, growth estimates are likely to reflect actual growth as the tag effect is thought to be minimised. For *Chaceon* sp. very few females were landed (Table 3) so information on reproduction is limited.

The size-at-maturity information was estimated for *J. caveorum* only (Figure 30). However, as there were very few immature females sampled, these data should be considered very preliminary at this stage. But based on these preliminary data the estimated size-at-50% maturity was estimated at 70.7 mmCL. Additional sampling with small mesh nets may provide better information in in future and is recommended for future trips.

Overall there was not a lot of bycatch (Table 4) recorded in or on the traps. Most of the bycatch was *Chaceon* sp. with a number of teleosts making up the bulk of the remainder. Small amounts of hard corals and other anthozoans were recorded as entangled on the trap mesh. Some of the species observed in the cameras (Rhodoliths) and entangled on the nets (corals) are indicators of VMEs. These incidents were noted and the areas where they occurred (mostly on the seamount slope will be avoided on future trips. No birds, marine mammals or sea turtles were entangled in the gear during the fishing operations.

5.1 Risk assessment

5.1.1 Assessment of data poor fisheries (MSC methodology)

Data on which to base fisheries management advice are generally absent or sparse in new or exploratory fisheries, and most RFMOs then require that a Precautionary Approach is followed. As part of such an approach, a formal Risk-Based Framework (RBF) can be used in data-limited fisheries. To assess the risks associated with the experimental trap fishery for *J. caveorum*, an established RBF methodology used in Marine Stewardship Council (MSC) (`www.msc.org`) assessments of data-limited fisheries, or of fisheries that lack quantitative stock status assessments, was used.

The RBF methodology is easy to implement and relies on intrinsic life history traits of fished species, and on their susceptibility to capture. The MSC has recently used RBF methodology in formal assessments or pre-assessments of several insular *Jasus* species around islands or on seamounts in the South Atlantic (*Jasus tristani* at the Tristan da Cunha archipelago), Southern Indian Ocean (*Jasus paulensis* at St Paul and Amsterdam Islands) and in the South Pacific (*Jasus frontalis* at the Juan Fernandes and Desventuradas Islands). These three species are very similar to *J. caveorum* from the Foundation Seamount chain, and we used a similar RBF framework to assess the vulnerability of *J. caveorum* to fishing pressure.

A Productivity and Susceptibility Analysis (PSA) tests the vulnerability of a fished stock relative to predetermined measurable attributes and score rankings. PSA assumes that the overall vulnerability of a fished species to impacts from fishing depends on two characteristics: 1. the productivity of a species/stock based on life history traits that determine whether it could sustain or recover from fishery-related impacts; and 2. the susceptibility of the species/stock to impacts from fishery-specific activities.

5.1.2 Productivity analysis

The Productivity analysis relies on scoring six criteria for invertebrates: average age-at-maturity; average maximum age; fecundity; reproductive strategy; trophic level and density dependence (Table 6). Even though the information is not yet available for *J. caveorum* per se, the categories are relatively broad, and good approximations could be made based on information from other *Jasus* species. In *J. caveorum*, the average age-at-maturity and maximum age were estimated as 5-15 years and 10-25 years, respectively, and both attributes were therefore scored at medium risk (score=2; see MSC scoring tables in FCR 2.0). Even the smallest mature females will produce >20,000 eggs per year, thus carrying low risk (score=1). The reproductive strategy of rock lobsters is broadcast spawning, therefore also low risk (score=1). The trophic level of *J. caveorum* is somewhat ambiguous, because its diet is unknown - although it will likely feed on algae (a herbivore; trophic level 2) and scavenge for small / dead organisms in a predatory way (trophic level 3). A plausible trophic level estimate is therefore 2.75-3.25, which places it at medium risk (score=2). Strong compensatory dynamics at low population size is expected, as in other *Jasus* species (Pollock, 1991), and density dependence is therefore also scored at low risk (score=1).

5.1.3 Susceptibility analysis

The susceptibility analysis relies on scoring 4 attributes: availability, or areal overlap of fishing effort with stock concentrations; encounterability, or the position of the stock relative to the fishing gear; selectivity of the gear type; and the level of post-capture mortality (Table 6). For *J. caveorum*, availability was scored as high risk because lobsters are concentrated on seamount pinnacles which can be exhaustively covered by traps (score=3). For target species, the default score for encounterability is also 3 (high risk). Lobsters smaller than the size-at-maturity were infrequently caught in Trips 1 and 2, and if needed they can be released with high expected survivorship (low risk; score=1). For target species, the default score for post-capture mortality is also 3 (i.e. high mortality rate).

5.1.4 Comparison of PSA results with other insular trap fisheries for *Jasus*

Scores for the PSA are shown in Table 6, for *J. caveorum*, *J. paulensis* and *J. frontalis*. The scores were similar for the 3 species - which is unsurprising because they have similar life history and habitats, and are all fished with traps, using similar fishing strategies. PSA scores indicate a low intrinsic risk category. The low risk category implies that populations can sustain trap fishing pressure in well managed fisheries. This conclusion is supported by the fact that 2 of 4 trap fisheries for insular *Jasus* species are MSC certified (i.e. they have been assessed as well-managed sustainable fisheries) - with a third one (*J. paulensis*) now entering full MSC assessment (`www.msc.org`).

5.2 Management information

There are a number of management options available for lobster fisheries including the setting of Total Allowable Catch (TAC), Total Allowable Effort (TAE), size limits, trap mesh size rules and close seasons. In assessing these options, it will be necessary to take into account a range of factors, including biological (e.g. size-at-first maturity, growth rates etc.), as well as fishery-related (type, efficiency and selectivity of gear, practicality of management measures etc.). While the size considerations presented here are potentially viable there are other impacts of measures like this. Lobsters get injured while being handled. The most common injury is broken limbs and antennae. Research on *Jasus lalandii* has shown that leg loss decreases the time to the next moult and decreases the growth rate of lobsters (Brouwer et al., 2006). In order to reduce injuries, and air exposure, installing sorting grids and chutes that return the smaller lobsters directly to the sea would be beneficial if a size limit were to be considered as an option. Alternatively allowing these individuals to escape as the trap is lifted through changing the mesh size may be preferable due to the depth of the fishery and relatively small size of the seamounts, making it difficult to return small lobsters back to the seamount alive. These and other options could be considered as the fishery develops.

Corals and rhodoliths are indicators of VMEs their occurrence was noted by the vessel and the positions recorded on the chart. Additional work is still needed to assess the video footage of sets to assess the benthos. In the interim areas with indicator species for VMEs should be avoided in future fishing operations. This strategy was employed on Trip 2 and the bycatch of corals and Cnidarians was reduced on trip 2. Initial indications are that the corals appear to be more abundant on the seamount slope and if this trend persists fishing could be restricted to fishing only on the flat surface of the seamounts in future.

6 Recommendations for future fishing trips

- Collect morphometric information from *J. caveorum* including
  - Carapace length;
  - Tail width
  - Whole weight; and
  - Tail weight;
- Continue the collection of morphometric information from *Chaceon* sp. including:
  - Carapace width
  - Whole weight;
  - Processed weight; and
  - Half crab weight.
- Tag lobsters in pre-moult condition to assess the growth rates and get estimates of fishing mortality;
- Collect fecundity information from *Chaceon* sp. and *J. caveorum*;
- Collect still camera footage of the benthos from each set to assess the benthic environment;
- Use small mesh nets on a sub-sample (4 out of 10) of the sample traps to collect biological information on smaller size classes of the lobsters and crabs (the small mesh traps must be identified separately in the database);
- In areas where catch rates are very low the observer should get biological samples from each trap;
- Collect bottom temperature data;
- Collect lobster length by depth stratum information.

References

Brouwer, S., Groeneveld, J., and Blows, B. (2006). The effects of appendage loss on growth of South African West Coast rock lobster *Jasus lalandii*. *Fish. Res.*, 78:236–242.

Pollock, D. (1991). Spiny lobsters at Tristan da Chuna, South Atlantic: inter-island variations in growth and population structure. *S. Afr. J. mar. Sci.*, 10(1):1–12.

R Core Team (2018). R: A Language and Environment for Statistical Computing. Technical Report https://www.R-project.org/, R Foundation for Statistical Computing, Vienna, Austria.

Roman, C., Ernst, B., Thiel, M., Manriquez, P., and Chamorro, J. (2018). Spatio-temporal migratory dynamics of *Jasus frontalis* (Milne Edwards, 1837) in Alexander Selkirk Island, Juan Fernández archipelago, Chile. *PLoS ONE*, 13(7):e0200146.

Webber, W. and Booth, J. (1995). A new species of Jasus (Crustacea: Decapoda: Palinuridae) from the eastern south Pacific Ocean. *New Zealand Journal of Marine and Freshwater Research*, 29(4):613–622.

Tables

Table 1: Observed catch from trips 1 and 2.

Seamount	*Jasus* (t) trip 1	*Chaceon* (t) trip 1	Total catch (t) trip 1	*Jasus* (t) trip 2	*Chaceon* (t) trip 2	Total catch (t) trip 2	Total catch (t)
Darwin A	0.00	0.00	0.00	0.01	0.16	0.16	0.16
GB	0.00	0.35	0.35	0.00	0.00	0.00	0.35
Jenner	0.00	0.00	0.00	0.05	0.10	0.15	0.15
Kopernik	76.15	0.86	77.01	39.06	0.15	39.21	116.22
Linne b	0.00	0.41	0.41	0.00	0.00	0.00	0.41
Mendel	0.00	0.68	0.68	0.00	0.00	0.00	0.68
Mendeleiev	0.00	0.40	0.40	0.00	0.00	0.00	0.40
MM	0.00	0.89	0.89	0.00	0.00	0.00	0.89

Table 2: Observed Sex and berry state of all *Jasus* sampled on trips 1 and 2.

Size Bin (mm)	Berry stage 1	Berry stage 2	Berry stage 3	Mature female	Immature female	Male
0-10	0	0	0	0	0	1
60-70	0	0	0	0	2	1
70-80	0	1	0	38	7	28
80-90	4	35	4	537	2	194
90-100	10	78	3	1477	0	525
100-110	10	85	9	1896	0	1019
110-120	7	45	4	977	0	1338
120-130	0	0	0	57	0	1278
130-140	0	0	0	2	0	1298
140-150	0	0	0	2	0	1416
150-160	0	0	0	4	0	1306
160-170	0	0	0	1	0	289
170-180	0	0	0	0	0	11

Table 3: Observed Sex and berry state of all *Chaceon* sampled on trips 1 and 2.

Size Bin (mm)	Berry stage 1	Berry stage 2	Berry stage 3	Mature female	Immature female	Male
60-70	0	0	0	0	0	1
70-80	0	0	0	0	0	3
80-90	0	0	0	2	0	4
90-100	1	1	0	3	1	15
100-110	0	0	1	0	0	50
110-120	0	0	2	2	0	96
120-130	0	0	0	3	0	152
130-140	0	0	0	0	0	154
140-150	0	0	0	0	0	54
150-160	0	0	0	0	0	13
160-170	0	0	0	0	0	4
170-180	0	0	0	0	0	1

Table 4: Observed bycatch (numbers) from trips 1 and 2.

Species	Trip 1	Trip 2
Anthozoa	9	0
Blue shark	1	0
Chaceon geryons nei	674	48
Cnidarians nei	40	34
Cusk-eels nei	8	5
Echinoderms	2	60
Hard corals, madrepores nei	2	0
Hydrozoans	1	3
Marine shells nei	5	0
Porae	1	2
Scorpionfishes, redfishes nei	4	2
Siliceous sponges	3	1
Tarakihi	11	3
Trumpeters nei	1	0

Table 5: Impact of a size limit on the catch showing the percentage of females protected (below size limit) and percent of the total catch retained.

Limit (CL mm)	Females excluded from catch	Percent catch retained
70	0.04	99.98
80	0.91	99.45
90	11.89	93.91
100	41.50	78.96
110	79.25	57.39
120	98.75	40.45
130	99.83	30.92
140	99.87	21.63
150	99.91	11.51
160	99.98	2.15
170	100.00	0.08
180	100.00	0.00

Table 6: Comparative PSA scores for three insular *Jasus* species using the Marine Stewardship Council scoring methodology: 1 = low risk; 2 = medium risk; 3 = high risk

Scientific name	Productivity Scores						Susceptibility Scores				Final Score	
	Average age-at-maturity	Average max age	Fecundity	Reproductive strategy	Trophic level	Density Dependence	Availability	Encounterability	Selectivity	Post-capture mortality	Final PSA score	MSC Risk category
Jasus frontalis	2	2	1	1	2	1	2	3	3	1	94	Low
Jasus paulensis	2	2	1	1	2	1	3	3	1	3	91	Low
Jasus caveorum	2	2	1	1	2	1	3	3	1	3	91	Low

Figures

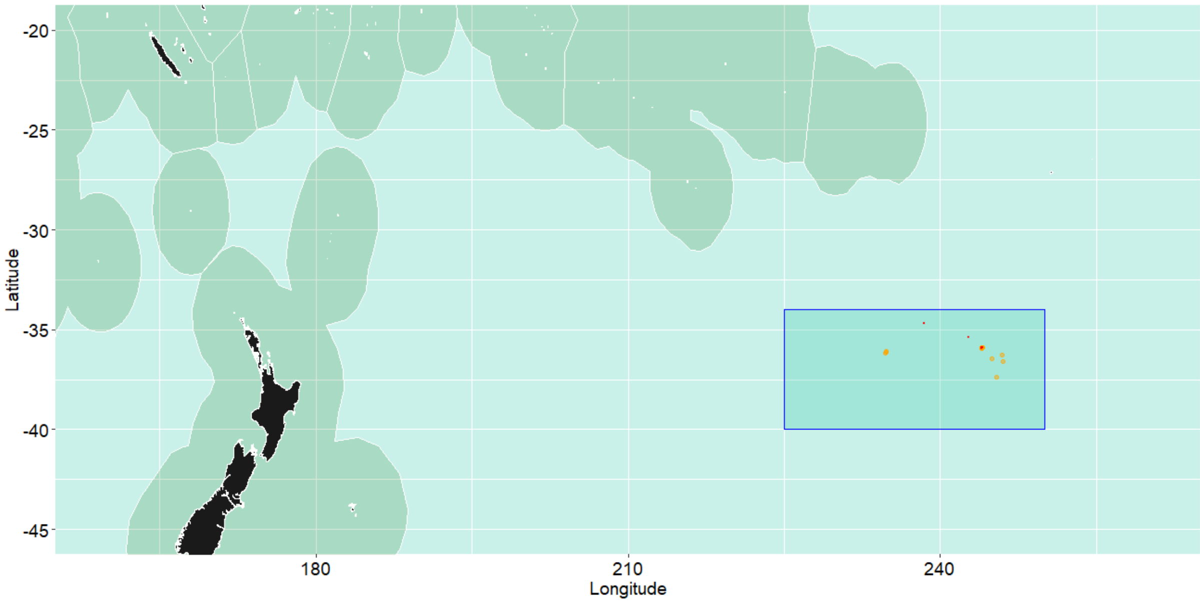


Figure 1: Map showing the South Pacific with the exploratory fishing area (blue box) and location of the fishing events from trip 1 (red dots) and trip 2 (orange dots).

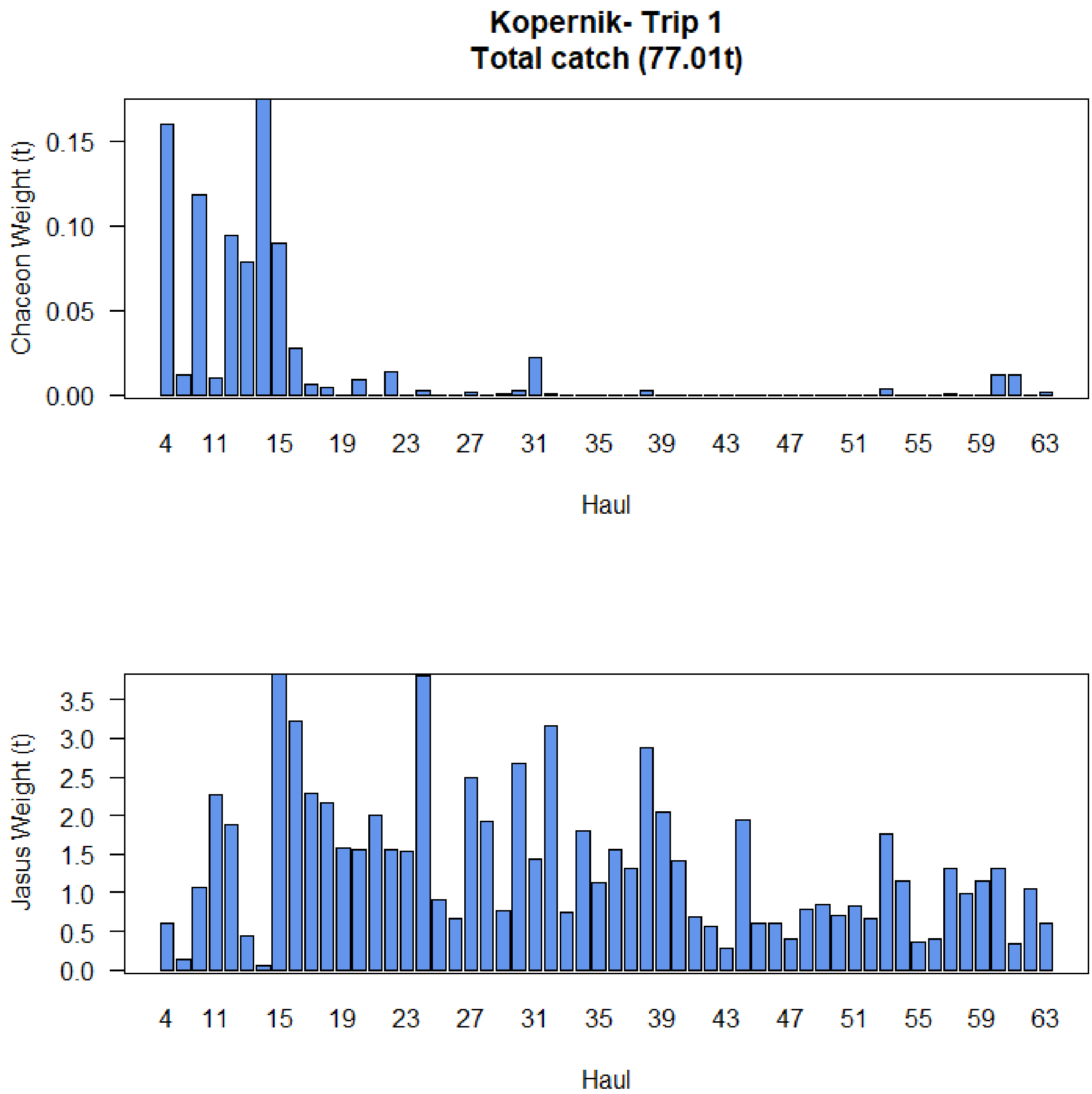


Figure 2: Total weight of crabs (upper panel) and lobsters (lower panel) from each haul from Kopernik seamount on trip 1.

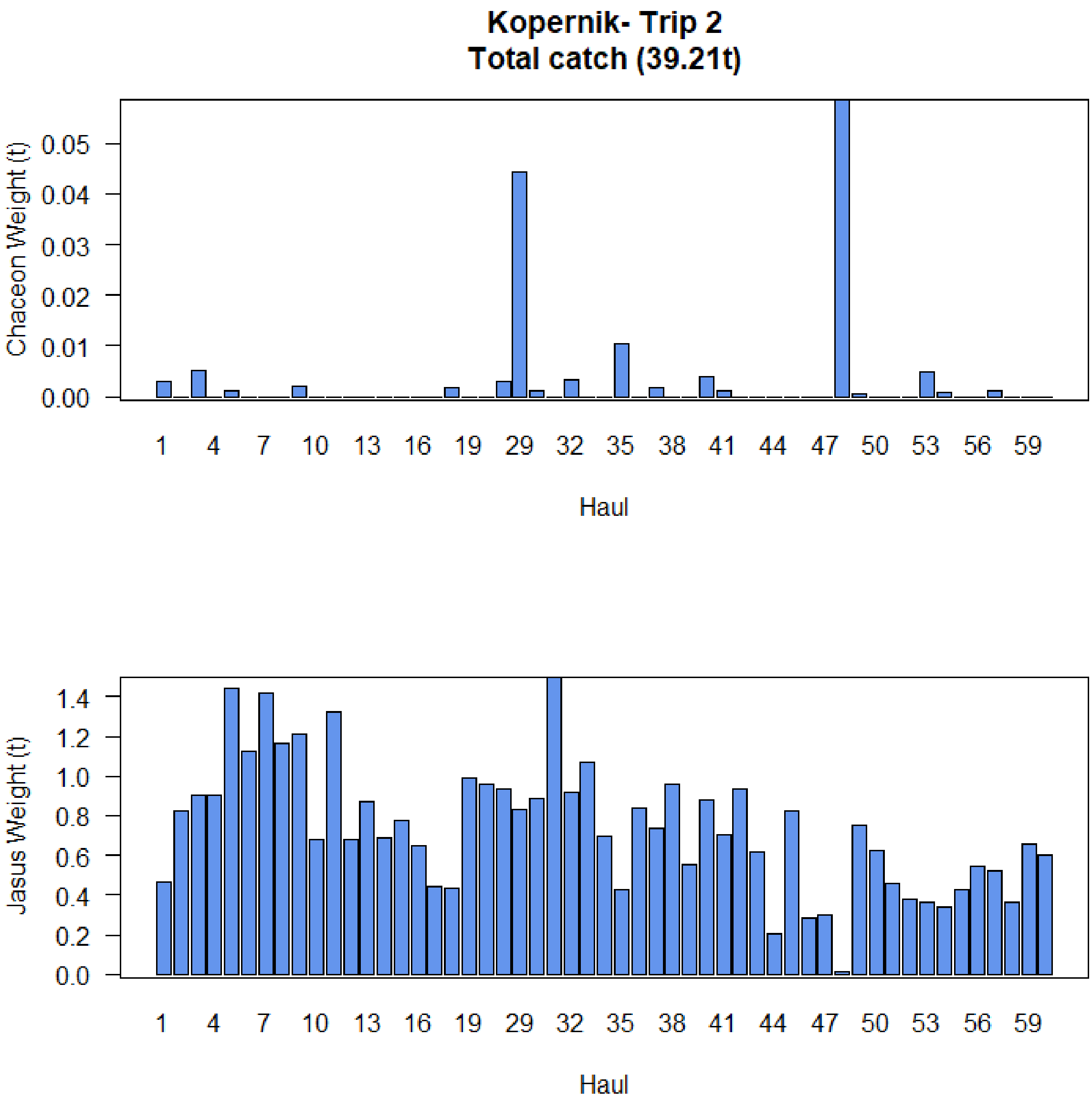


Figure 3: Total weight of crabs (upper panel) and lobsters (lower panel) from each haul from Kopernik seamount on trip 2.

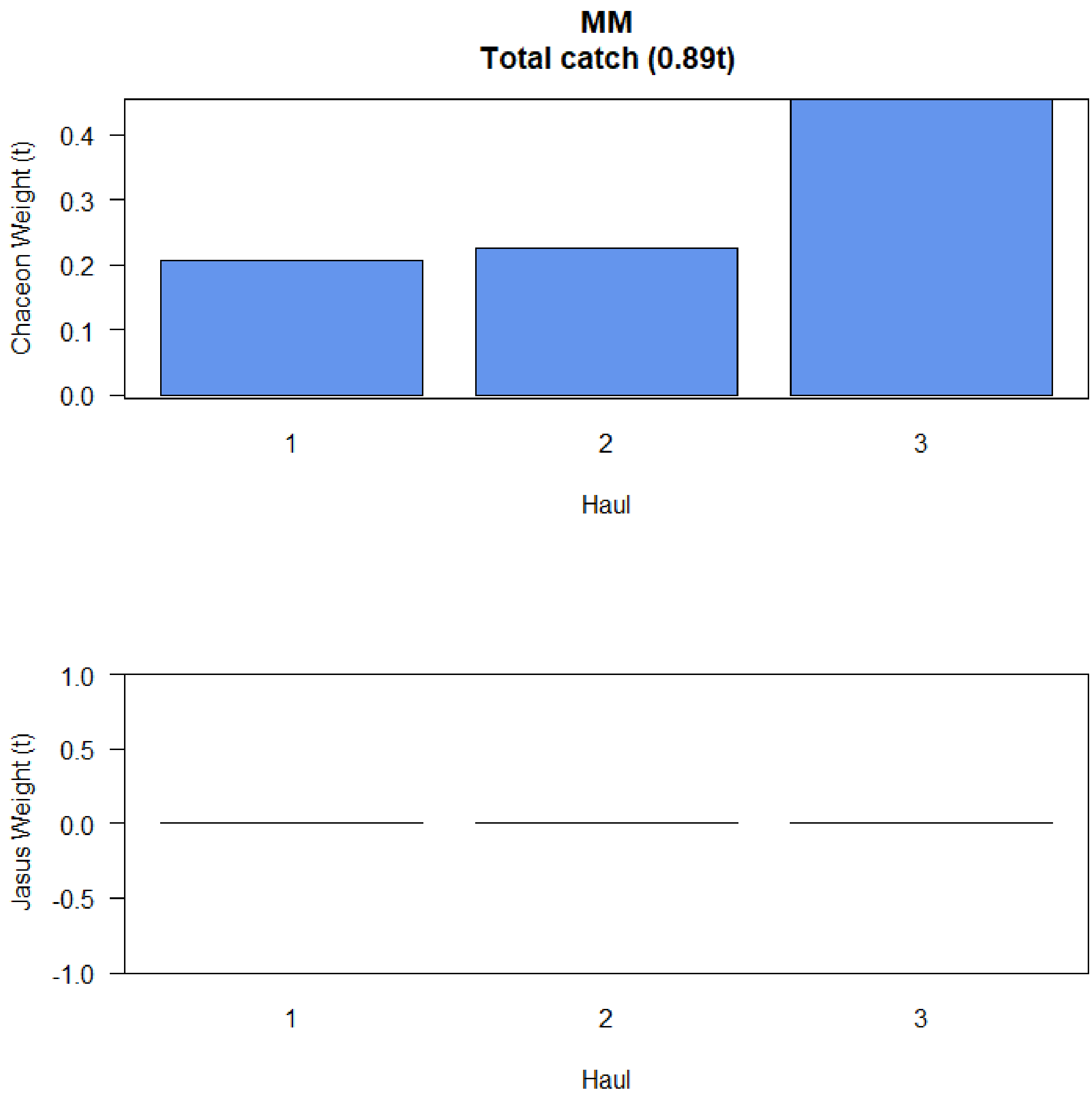


Figure 4: Total weight of crabs (upper panel) and lobsters (lower panel) from each haul from MM seamount from trip 1.

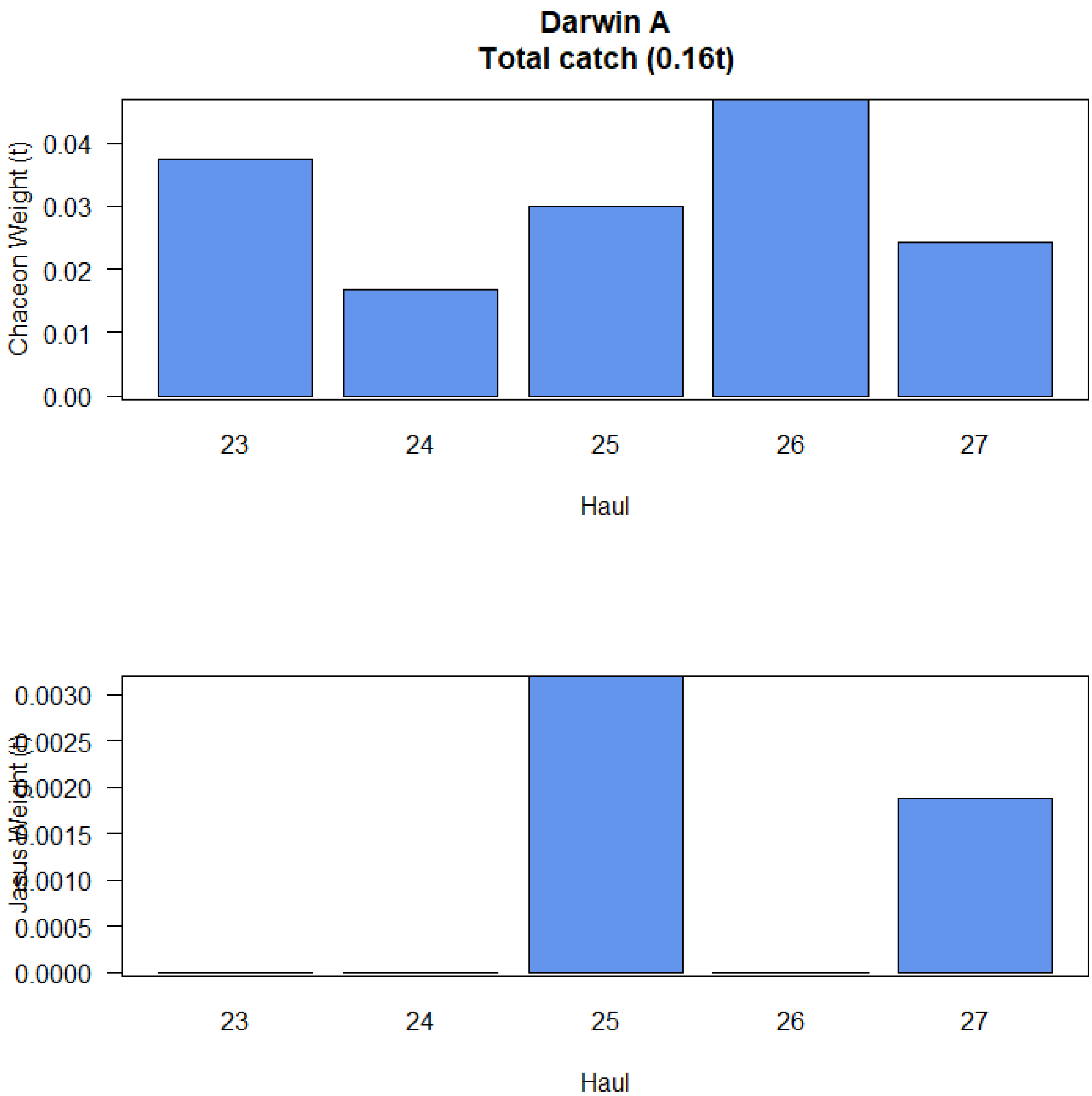


Figure 5: Total weight of crabs (upper panel) and lobsters (lower panel) from each haul from Darwin A from trip 2.

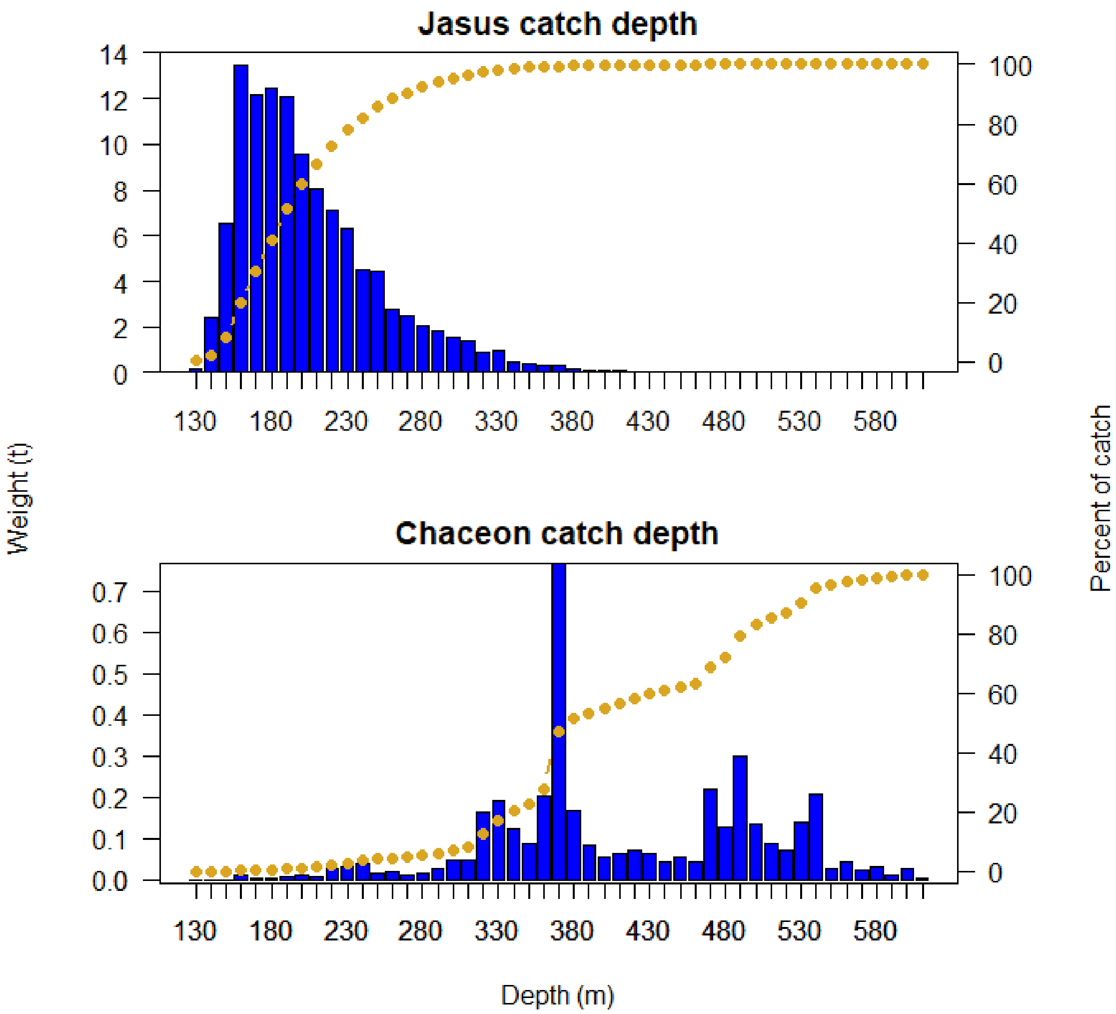


Figure 6: Total weight of lobsters (upper panel) and crabs (lower panel) by depth from all seamounts and both trip 1 and 2. Blue bars are the catch by depth bin and the gold dotted line is the cumulative proportion of the catch. Depth was estimated for each trap through interpolation depending on its position relative to the start, middle or end of the set where depth recordings were made.

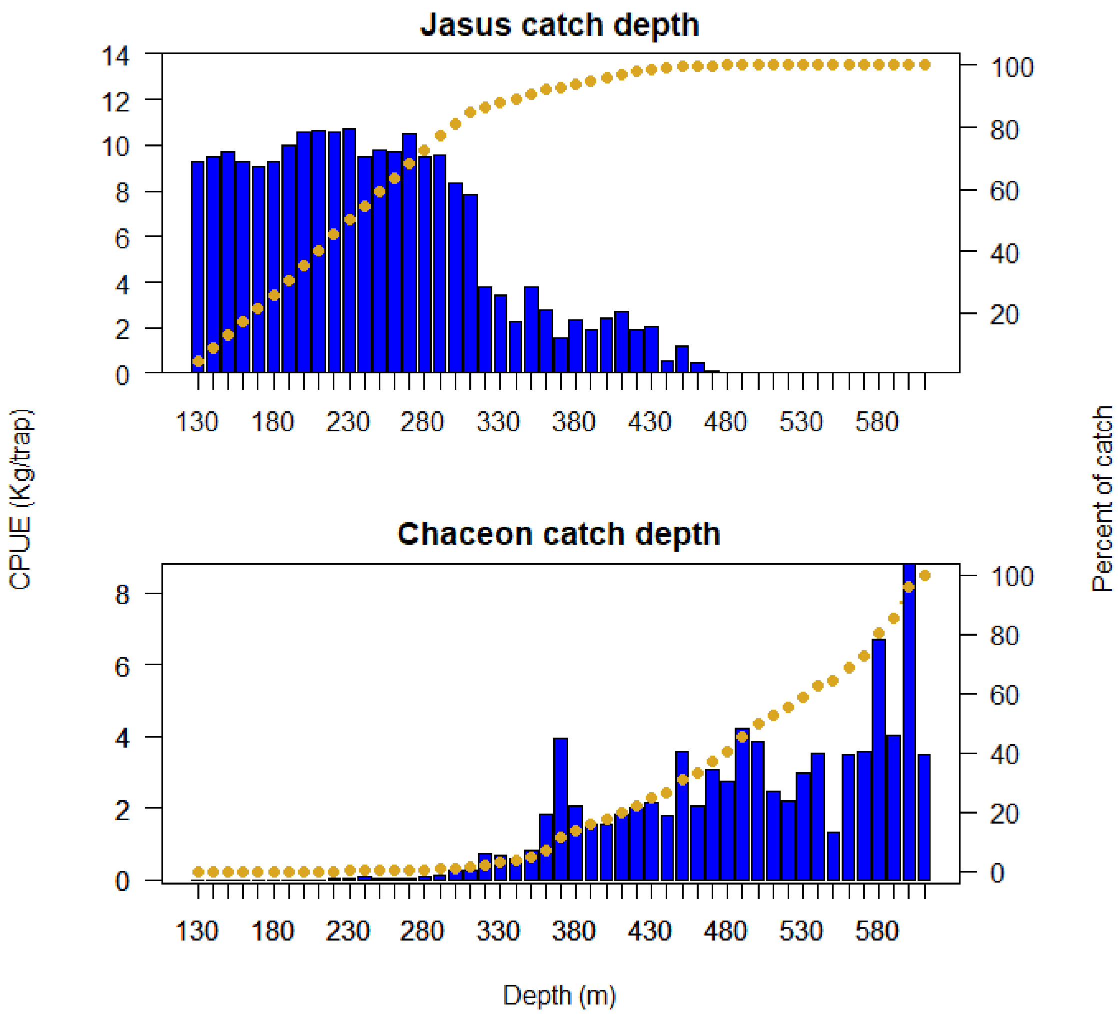


Figure 7: Catch per trap lobsters (upper panel) and crabs (lower panel) by depth from all seamounts and both trip 1 and 2. Blue bars are the catch by depth bin and the gold dotted line is the cumulative proportion of the catch. Depth was estimated for each trap through interpolation depending on its position relative to the start, middle or end of the set where depth recordings were made.

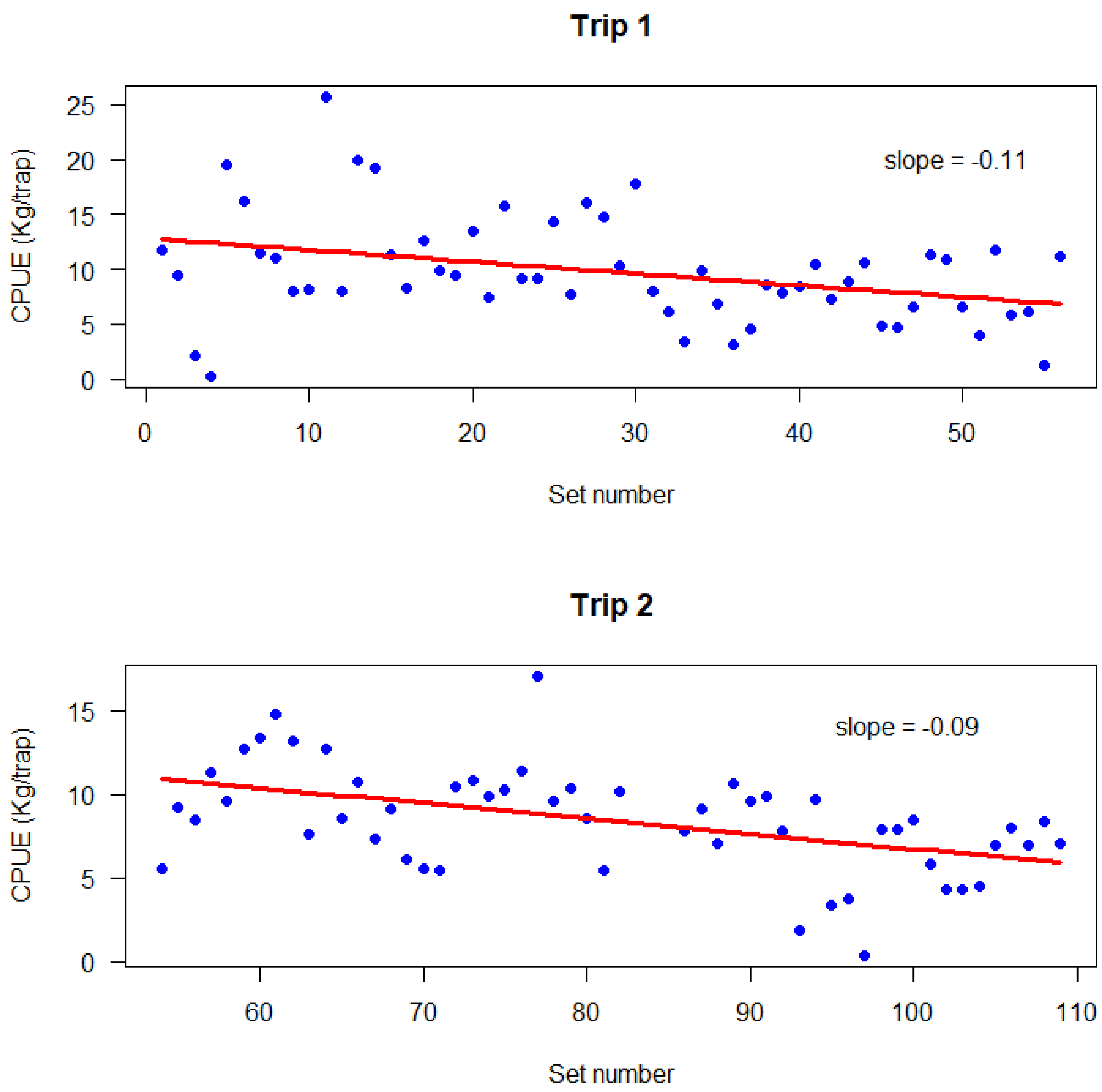


Figure 8: CPUE of lobsters by trip from each haul from Kopernik seamount. The red line indicates the trend and the slops indicates the overall change in CPUE from the start to end of each trip.

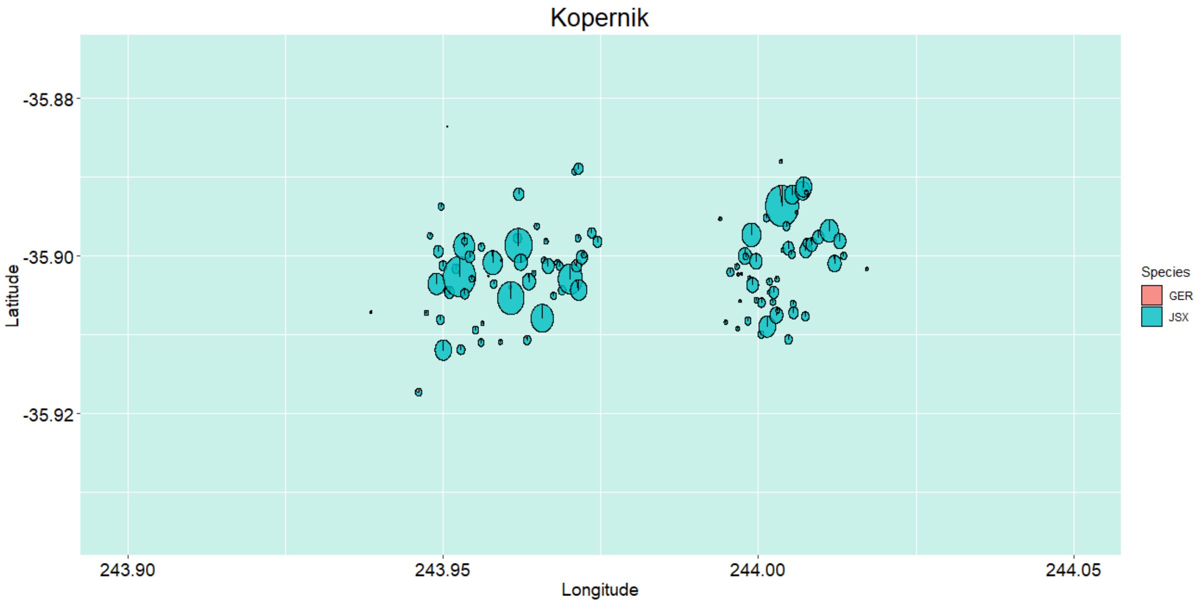


Figure 9: Catch distribution of crabs and lobsters from Kopernik seamount. Showing the catch volume at the middle of the set for both trip 1 and 2.

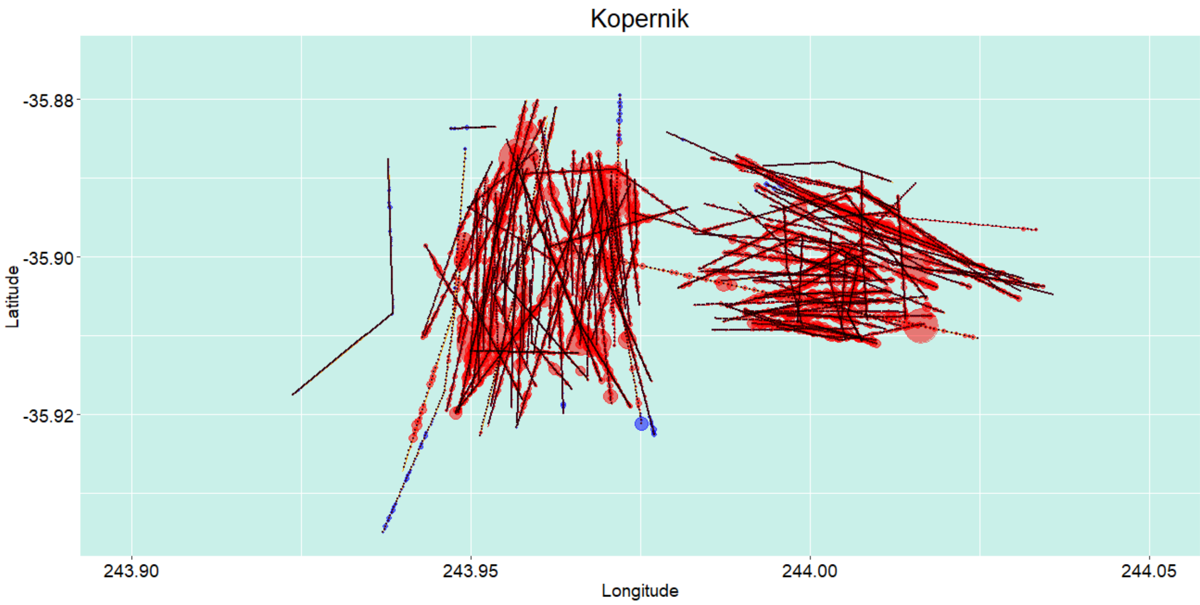


Figure 10: Catch distribution of crabs (blue) and lobsters (red) from Kopernik seamount showing the catch per trap from both trip 1 and 2. Trap positions were interpolated from the start, middle and end of set.

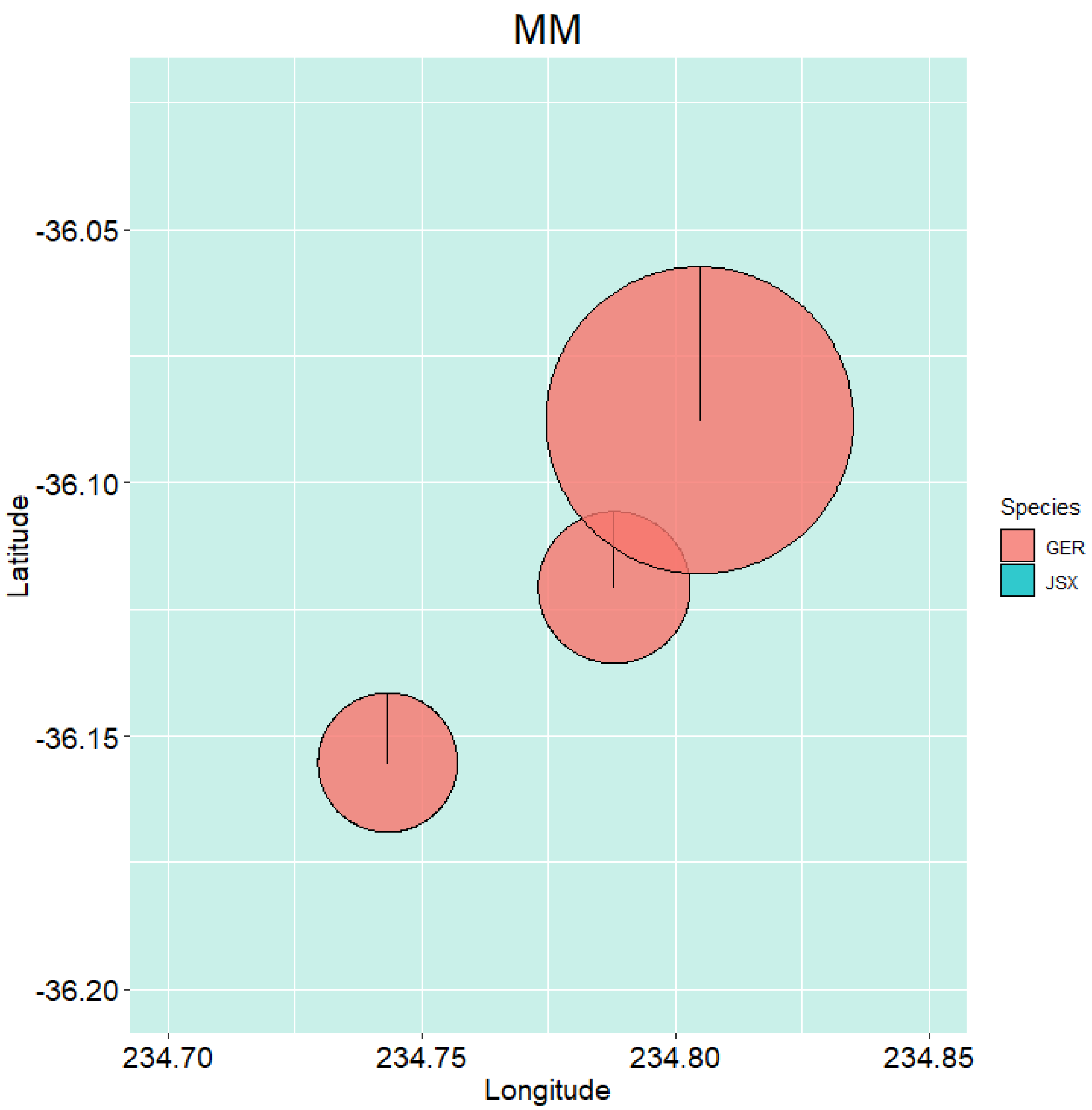


Figure 11: Catch distribution of crabs and lobsters from MM seamount.

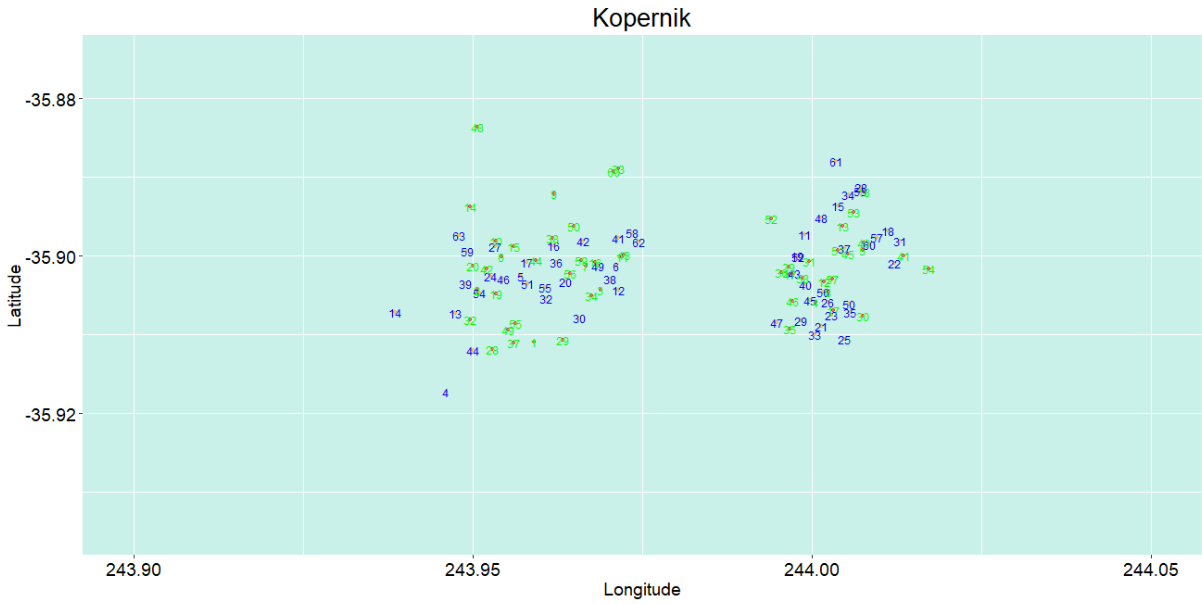


Figure 12: Set order on the Kopernik Seamount for trip 1 (blue) and trip 2 (green).

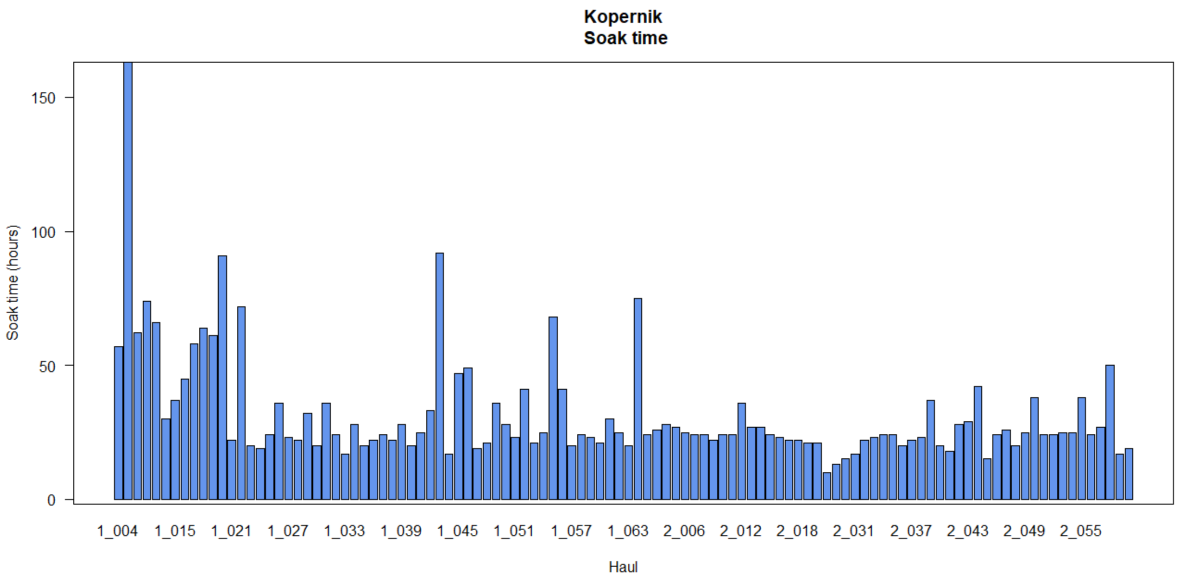


Figure 13: Trap soak time for sets on the Kopernik seamount for trip 1 and trip 2.

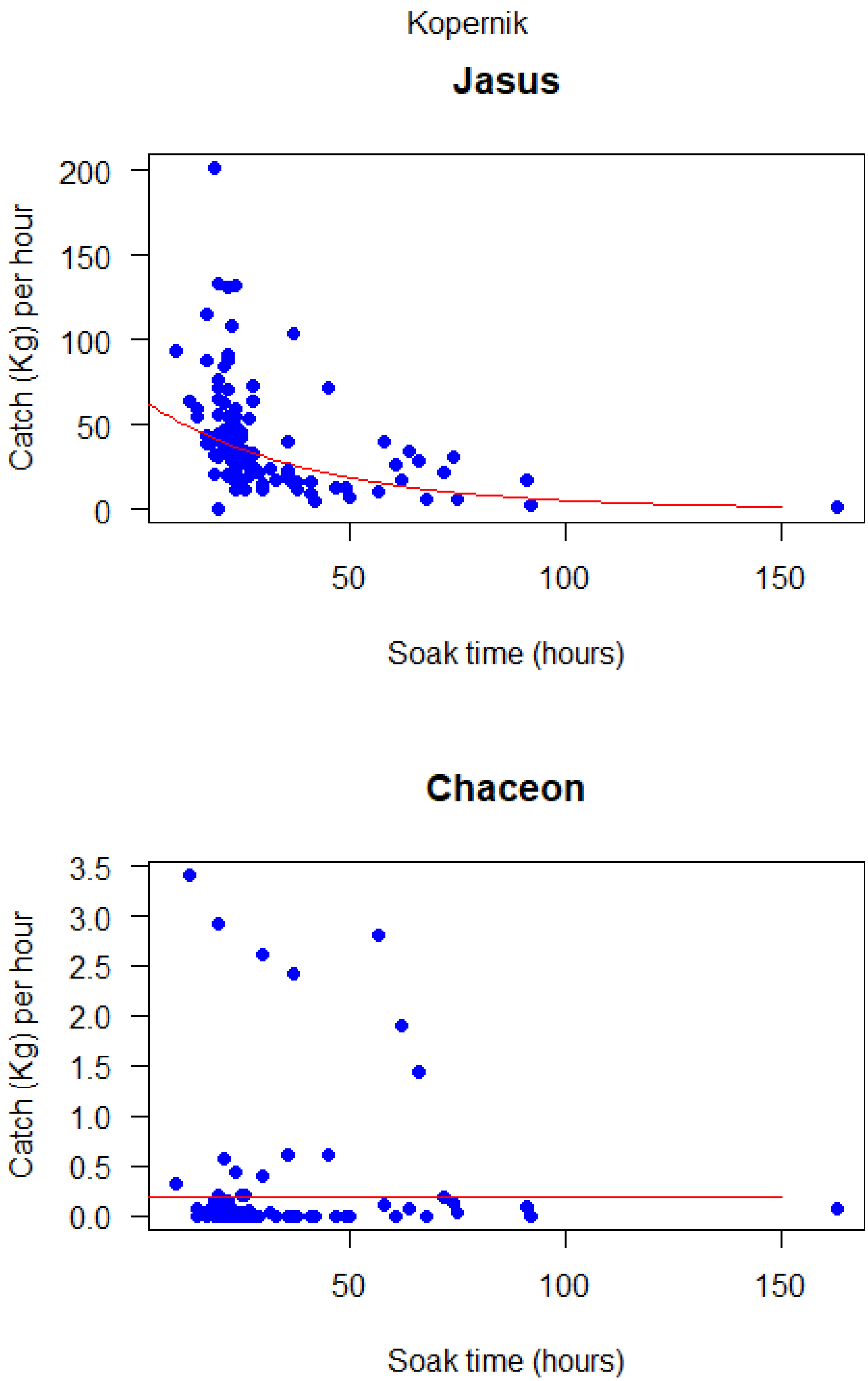


Figure 14: Catch vs soak time for crabs and lobsters on the Kopernik seamount for sets on trip 1 and 2.

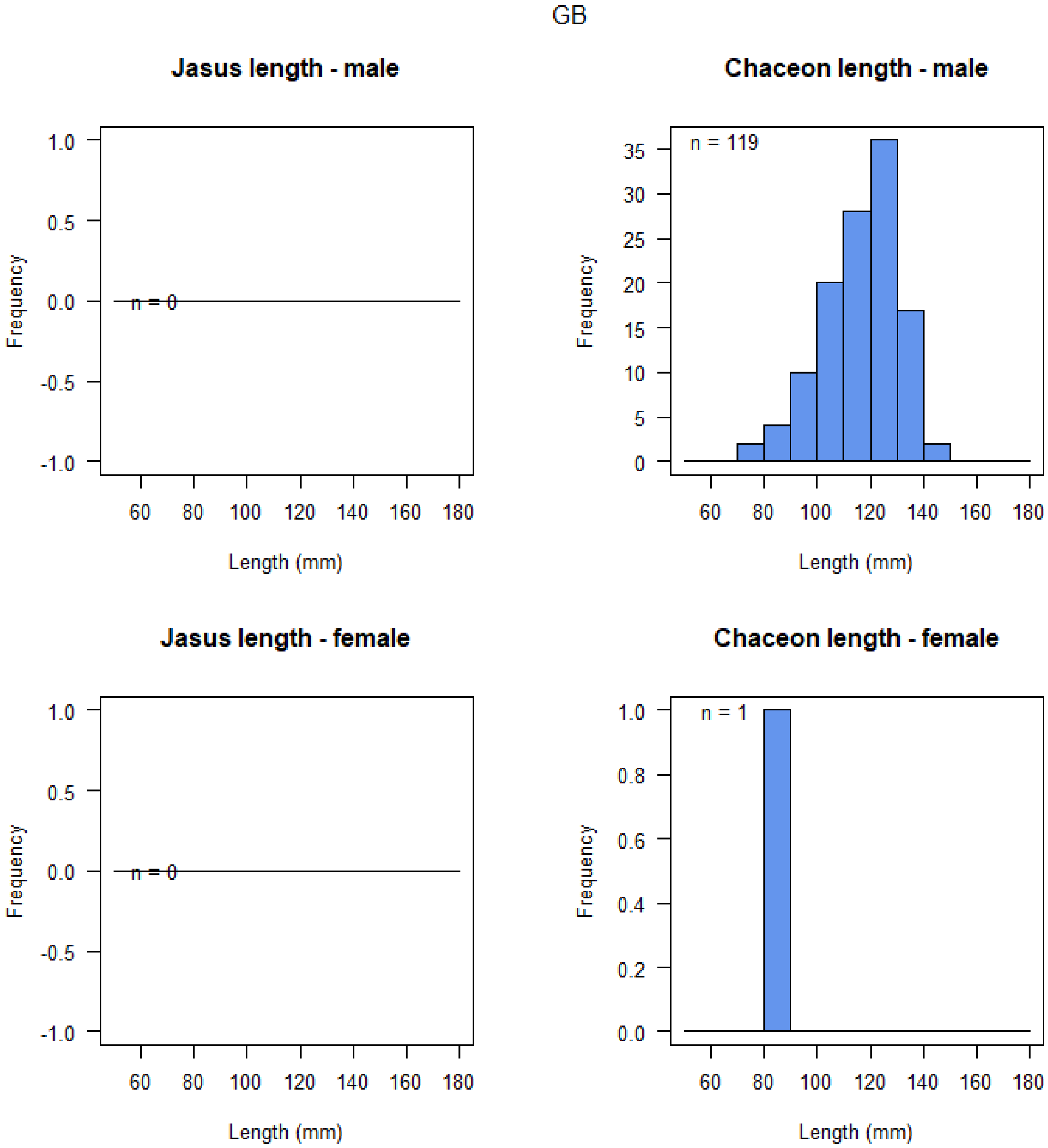


Figure 15: Length by sex of lobsters and crabs on the GB seamount from trip 1.

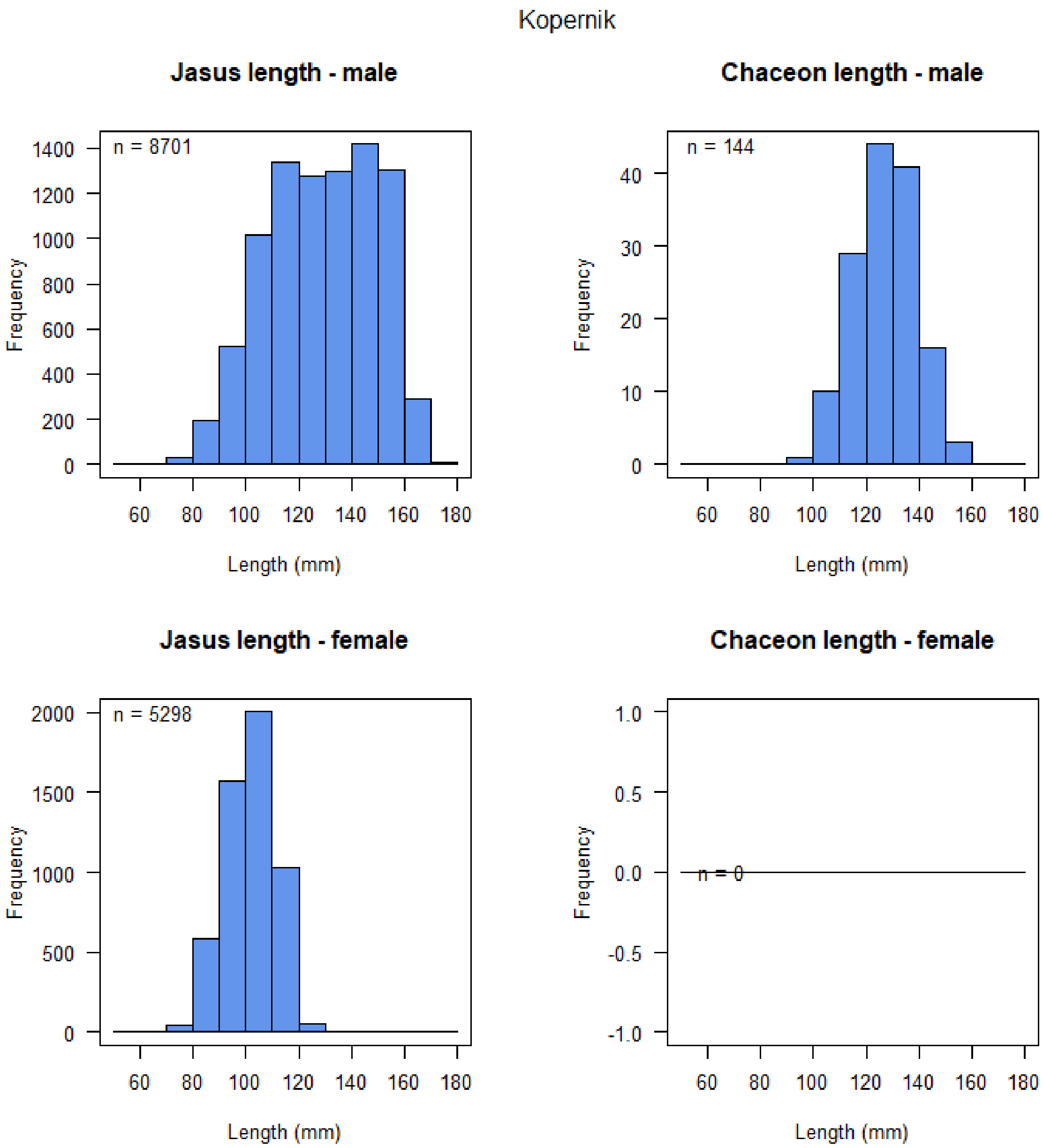


Figure 16: Length by sex of lobsters and crabs on the Kopernik seamount from trip 1 and 2.

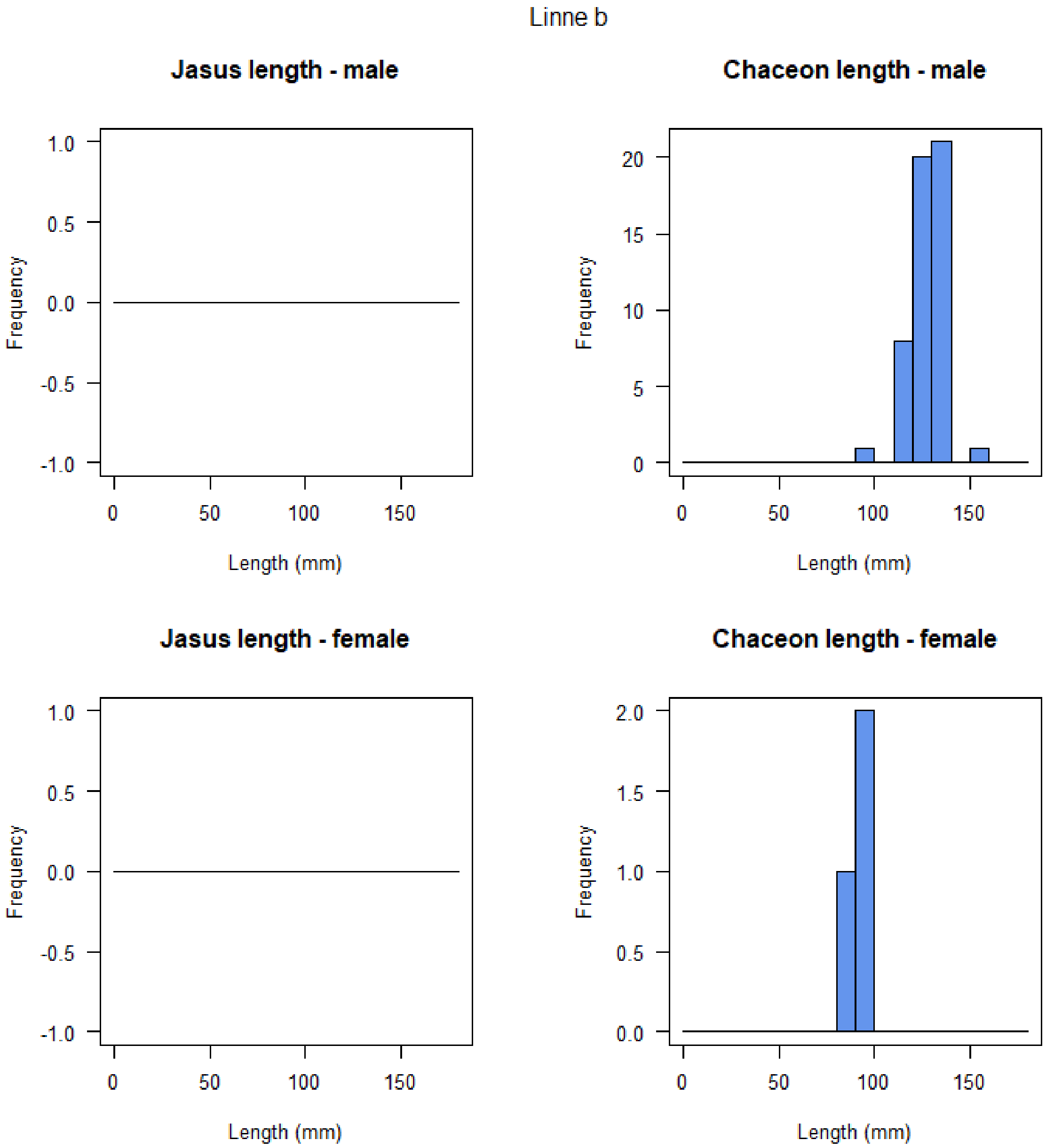


Figure 17: Length by sex of lobsters and crabs on the Linne b seamount from trip 1.

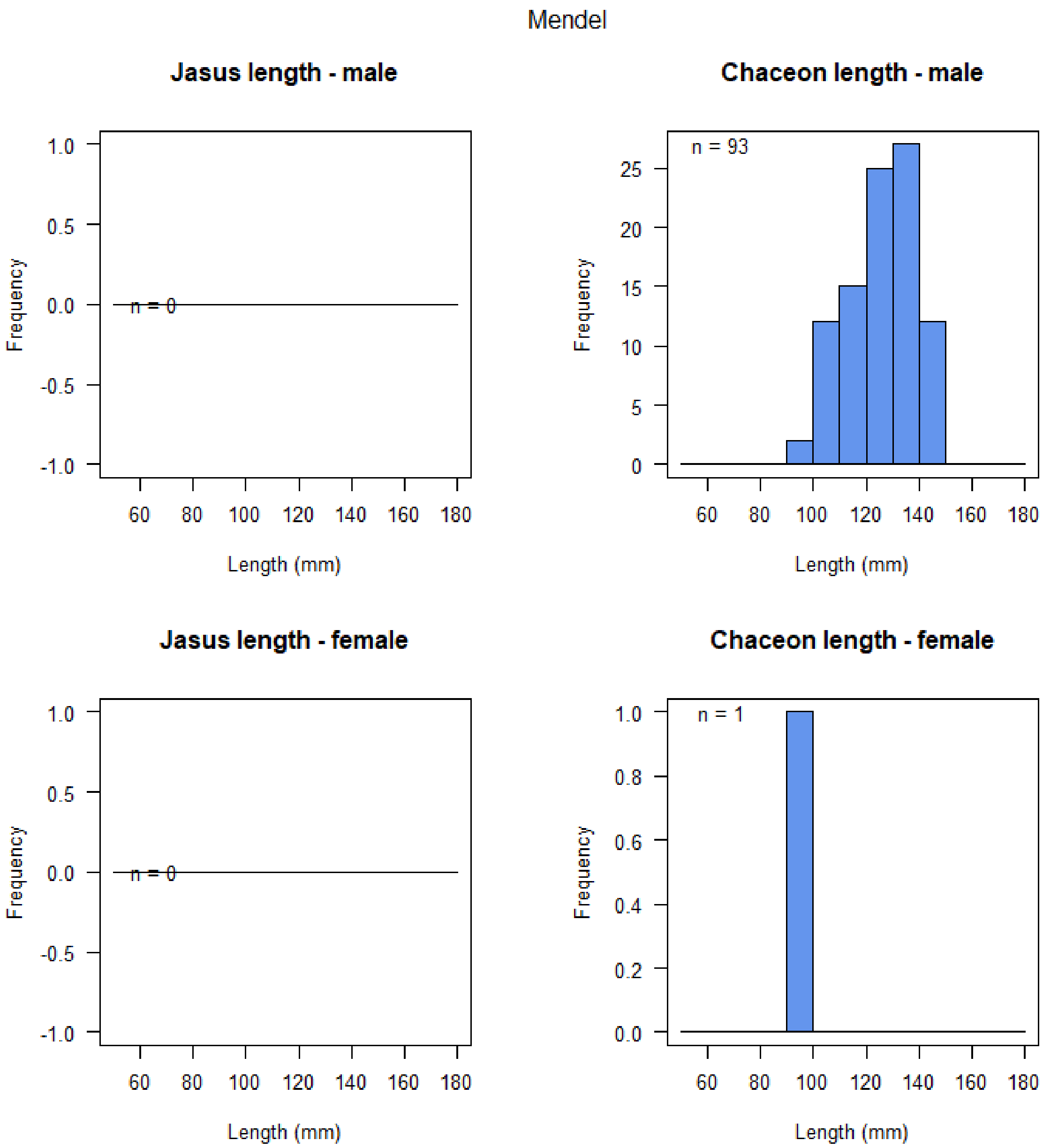


Figure 18: Length by sex of lobsters and crabs on the Mendel seamount from trip 1.

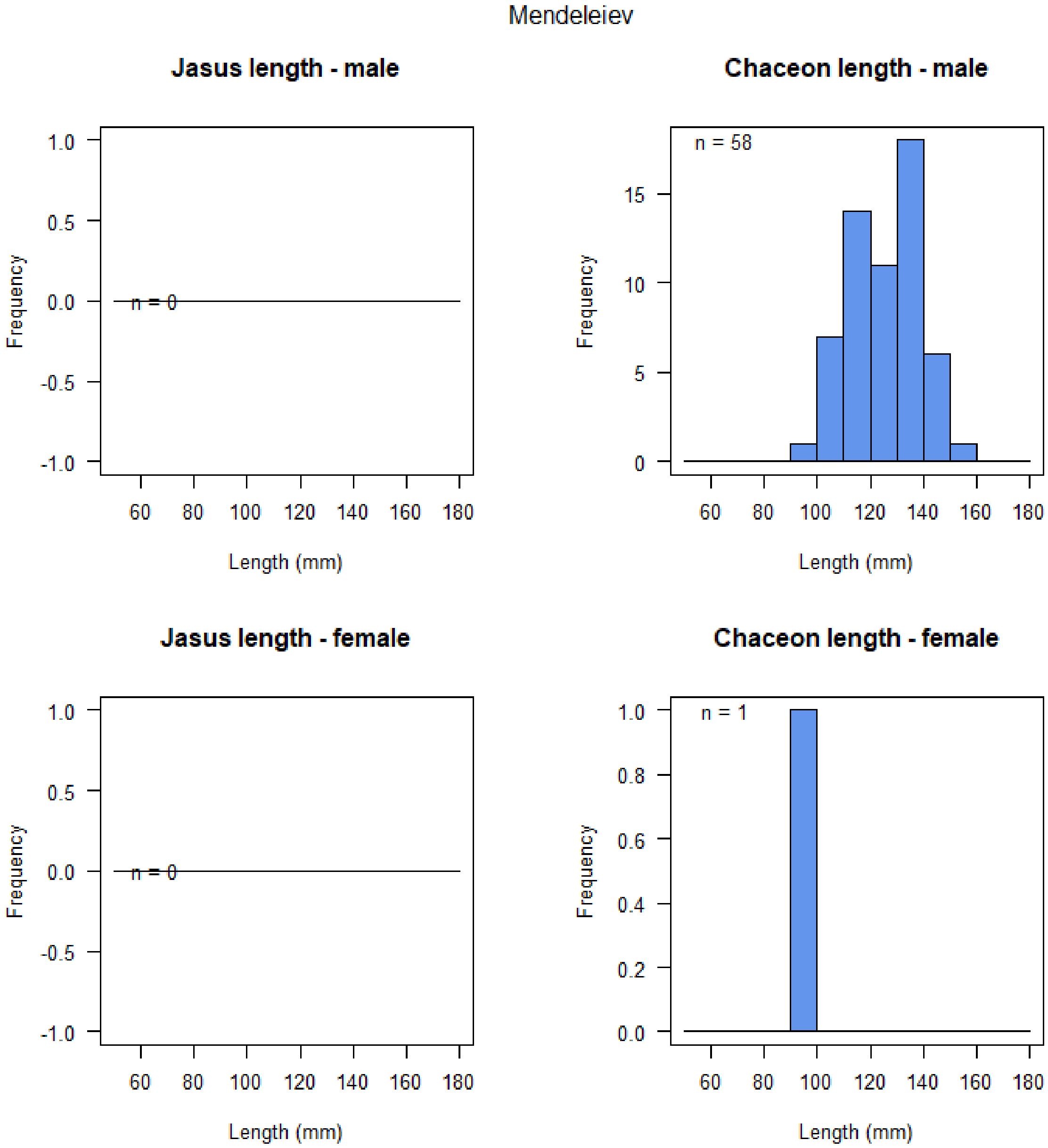


Figure 19: Length by sex of lobsters and crabs on the Mendeleiev seamount from trip 1.

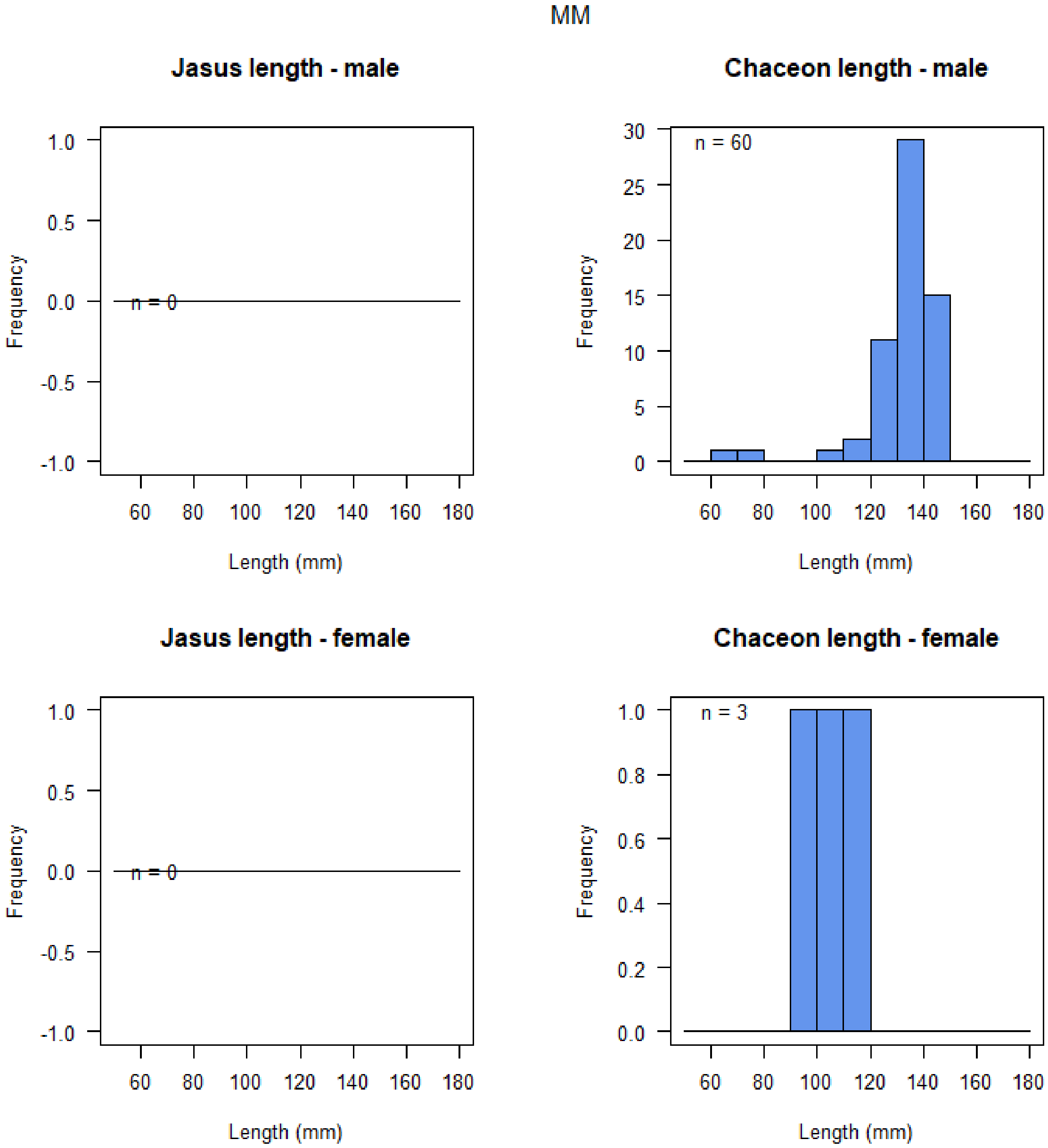


Figure 20: Length by sex of lobsters and crabs on the MM seamount from trip 1.

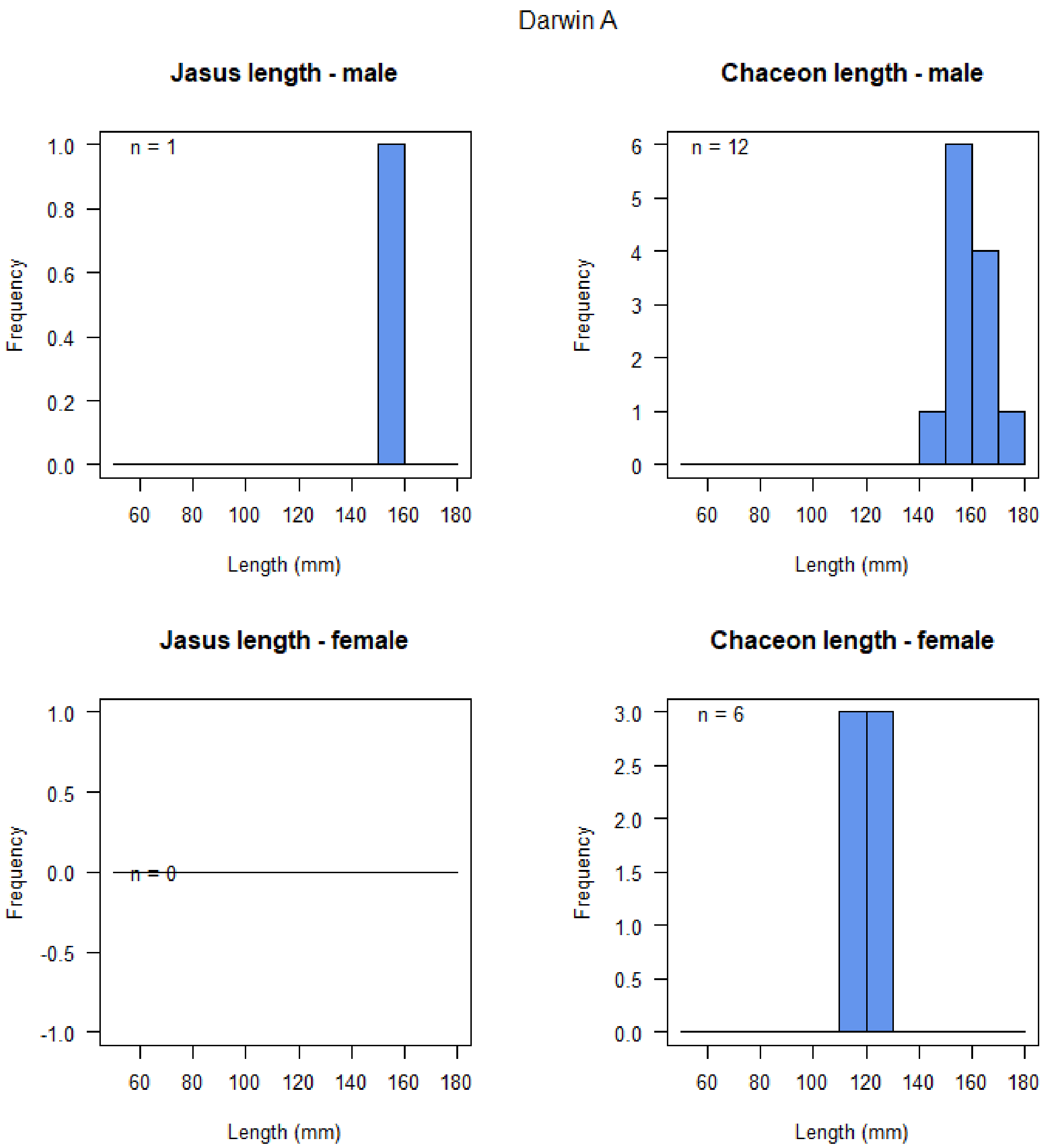


Figure 21: Length by sex of lobsters and crabs on the Darwin A seamount from trip 2.

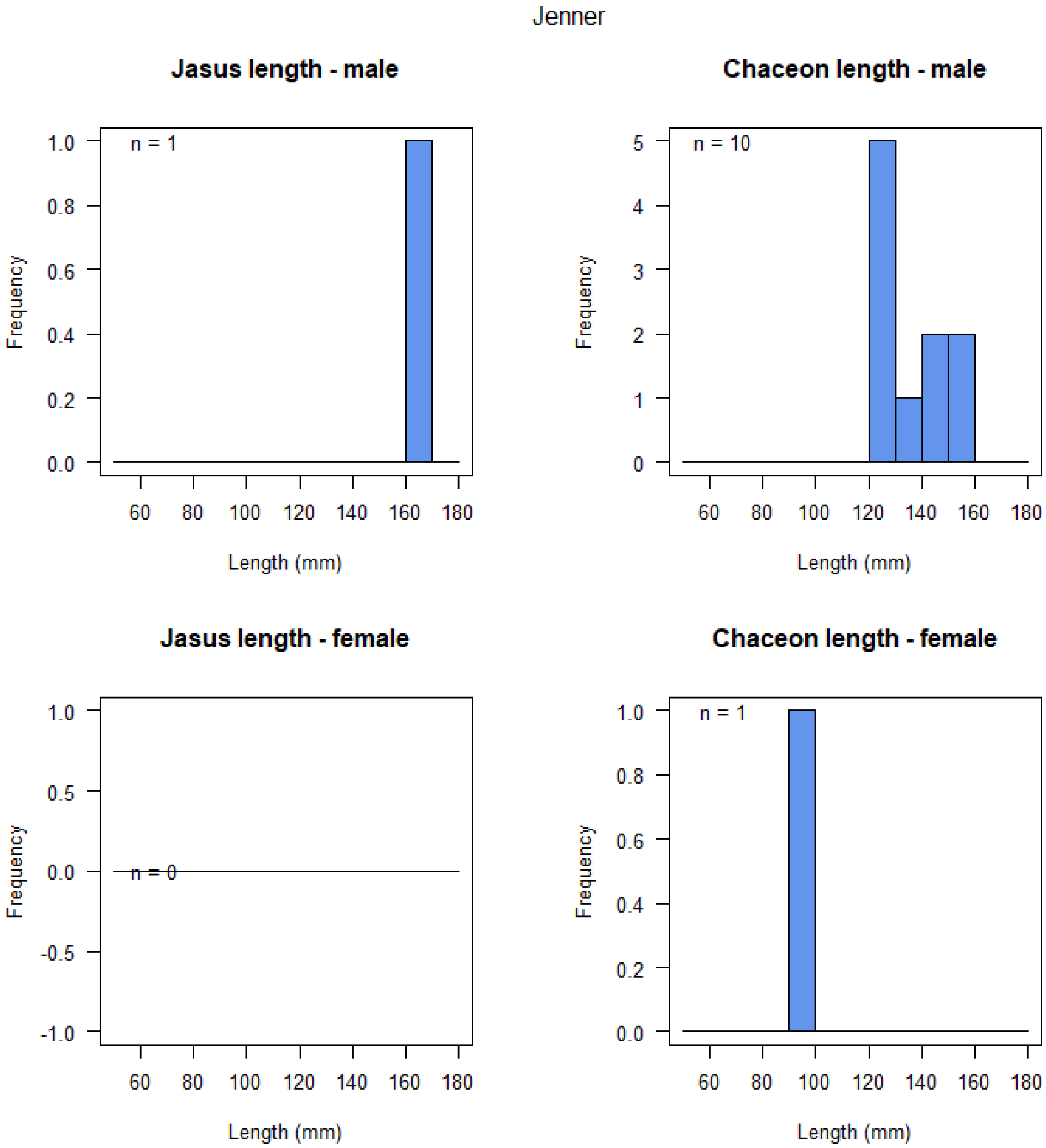


Figure 22: Length by sex of lobsters and crabs on the Jenner seamount from trip 2.

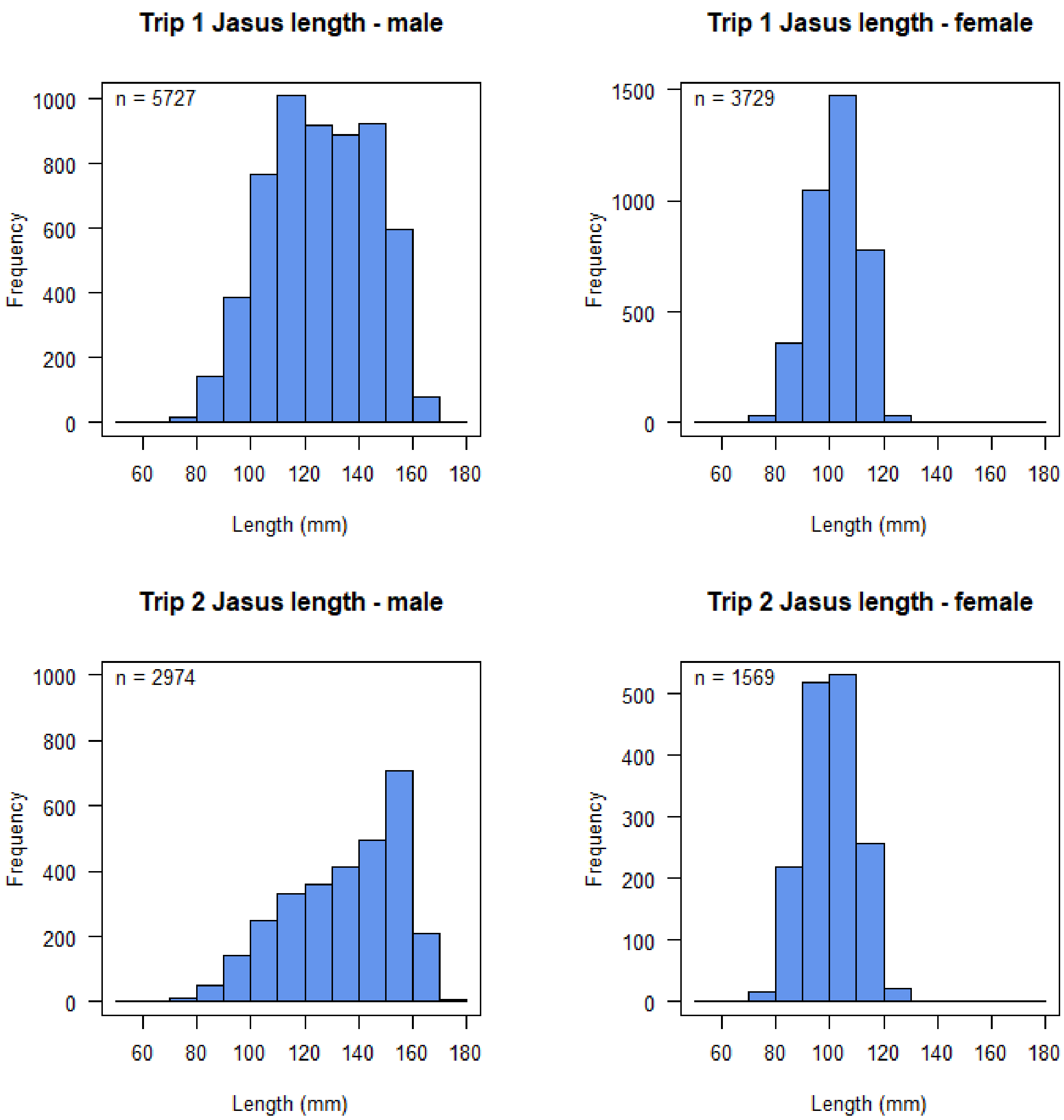


Figure 23: Length by sex of lobsters on the Kopernik seamount from trip 1 and 2 separated.

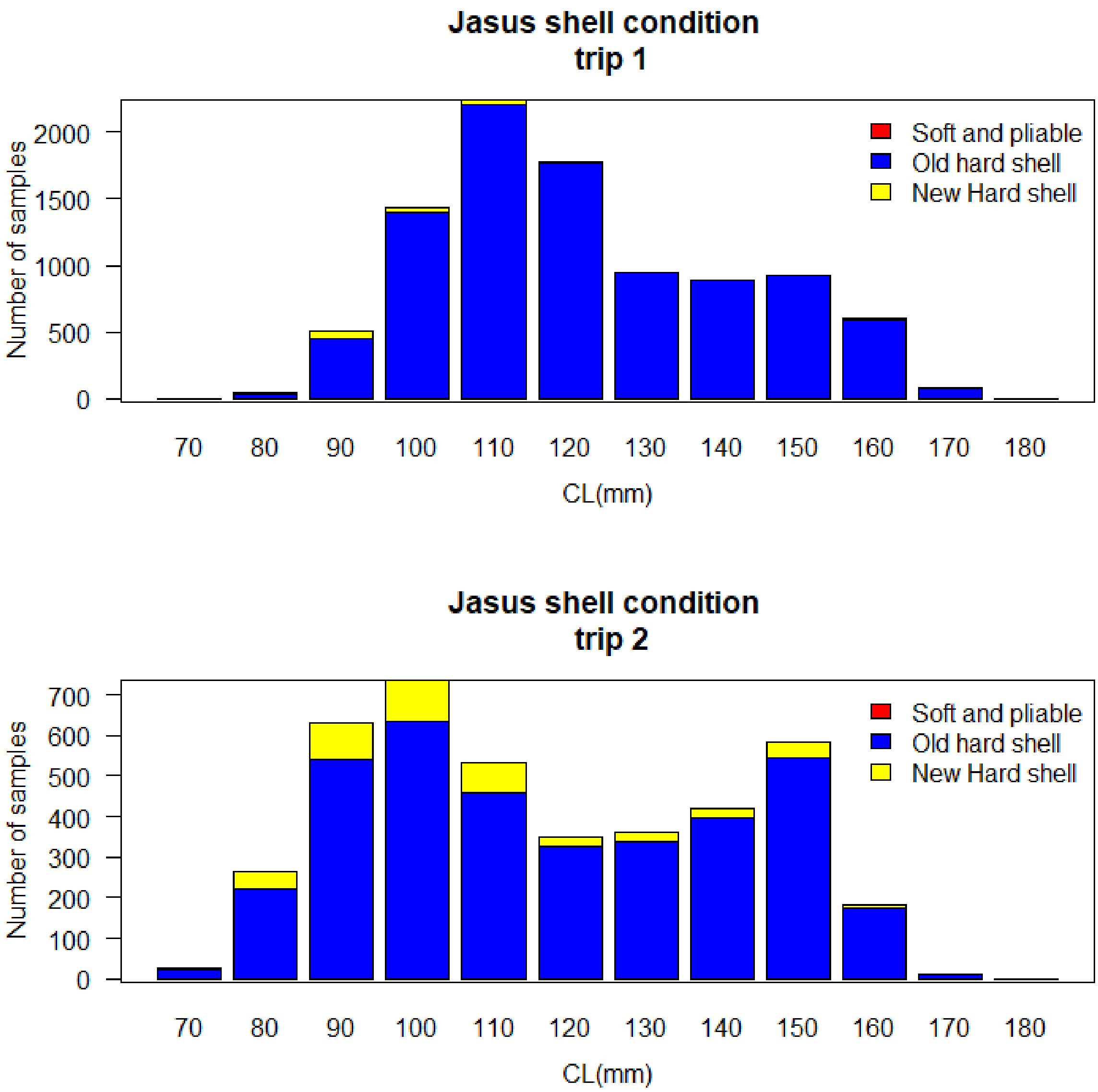


Figure 24: Shell state from *J. caveorum* sampled on trip 1 and 2.

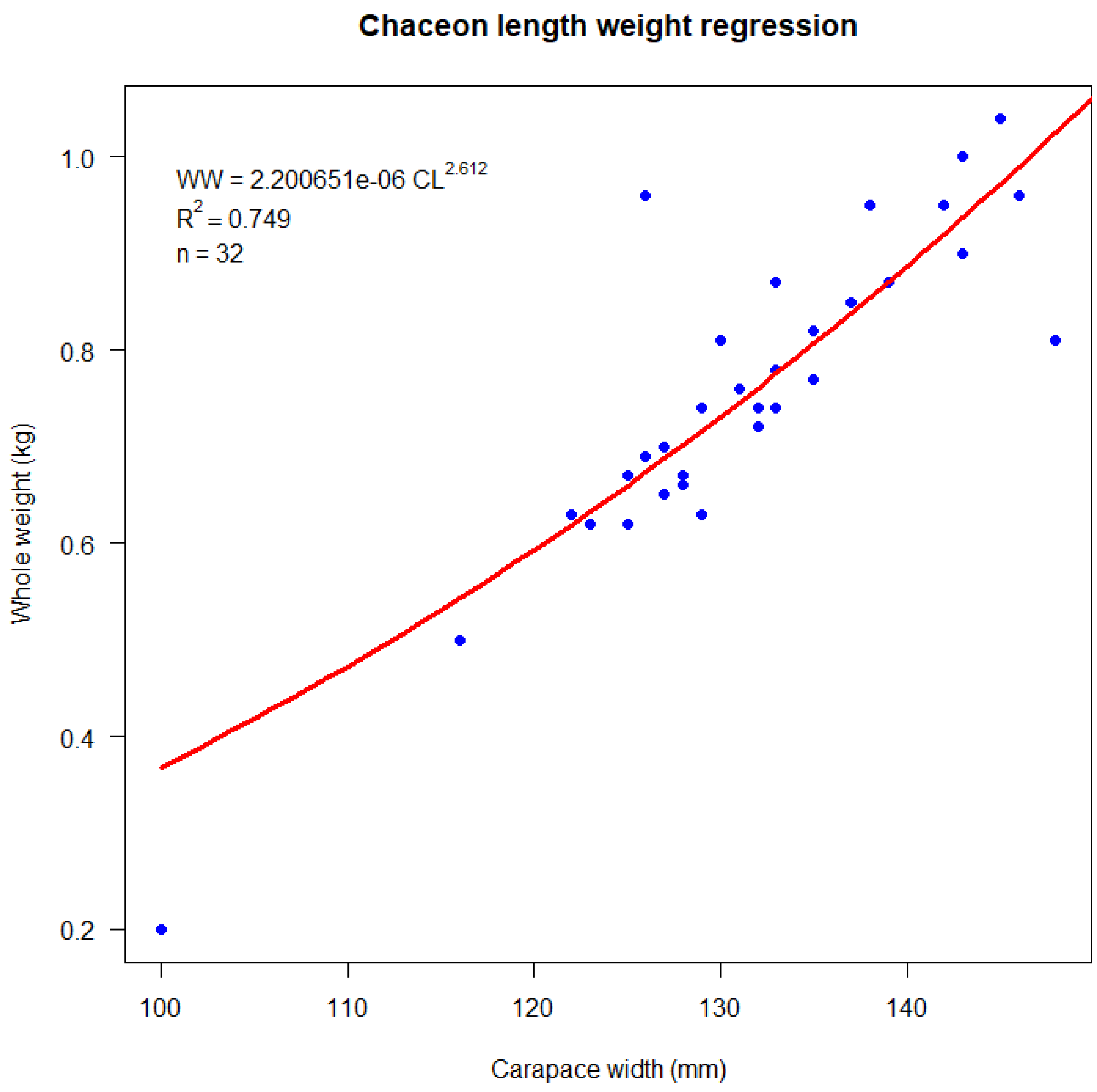


Figure 25: Length weight regression for carapace width vs. whole weight for *Chaceon* sp. sampled on trip 1 and 2.

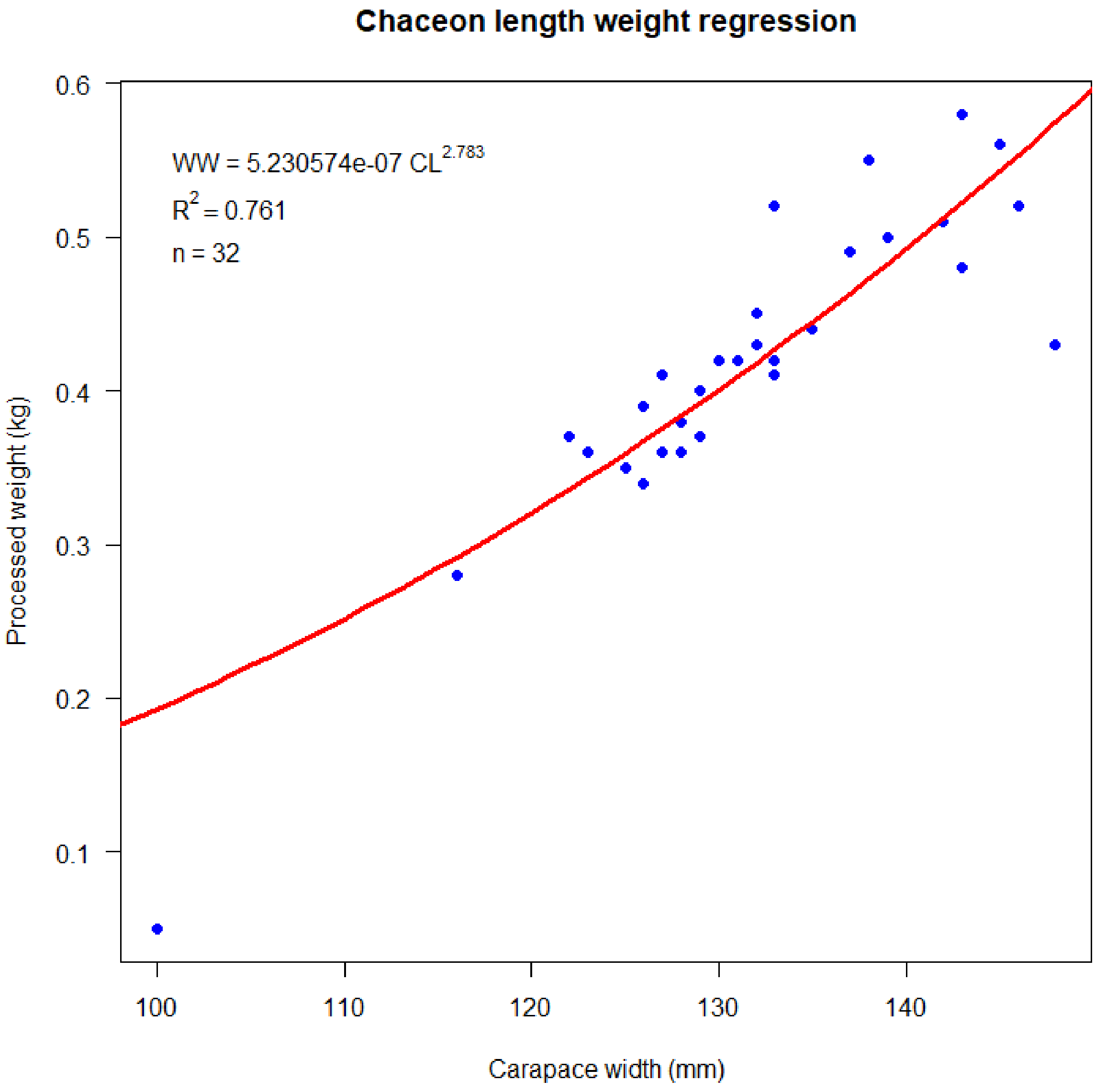


Figure 26: Length weight regression for carapace width vs. processed weight for *Chaceon* sp. sampled on trip 1.

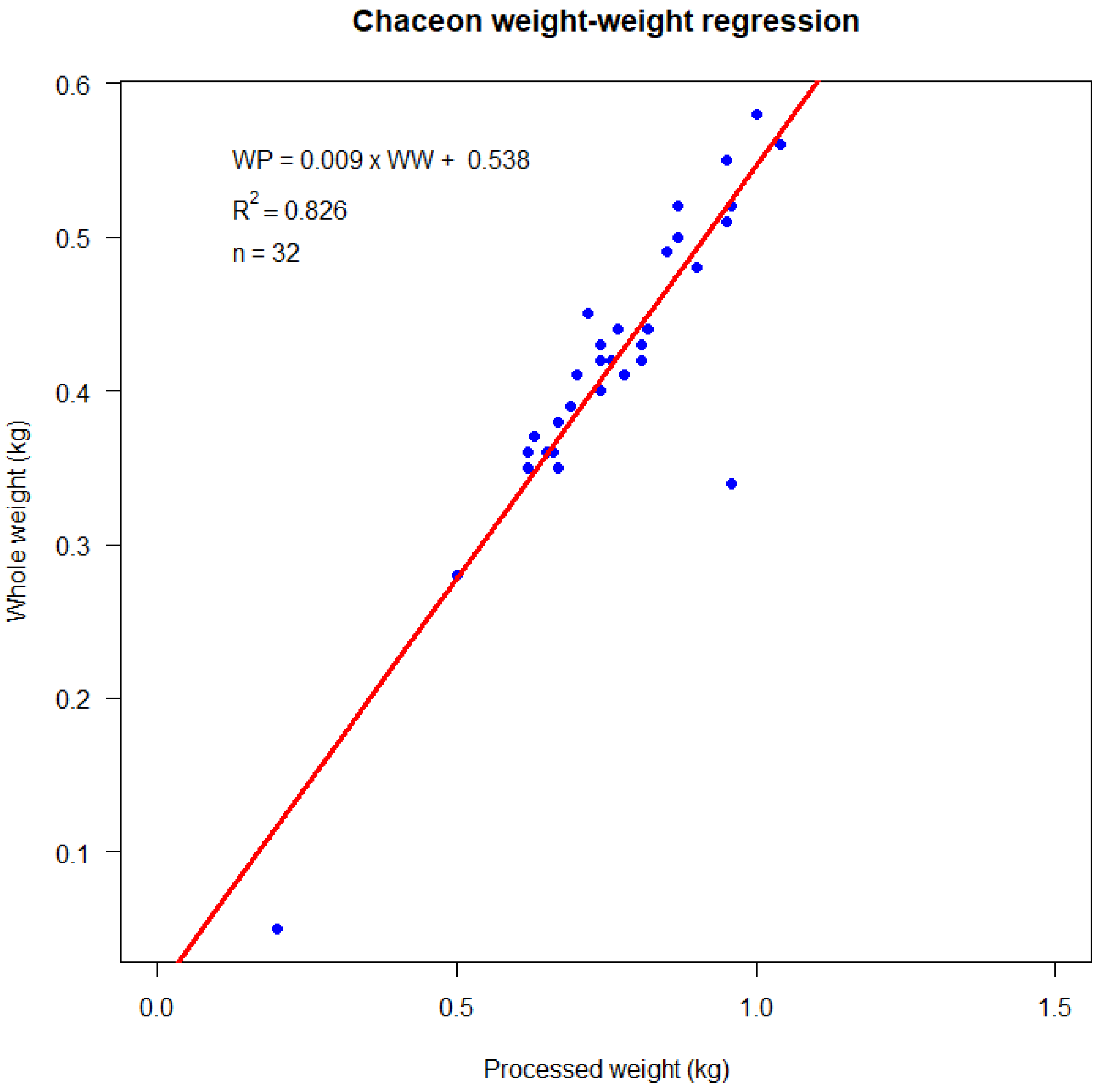


Figure 27: Length weight regression for whole weight vs. processed weight for *Chaceon* sp. sampled on trip 1.

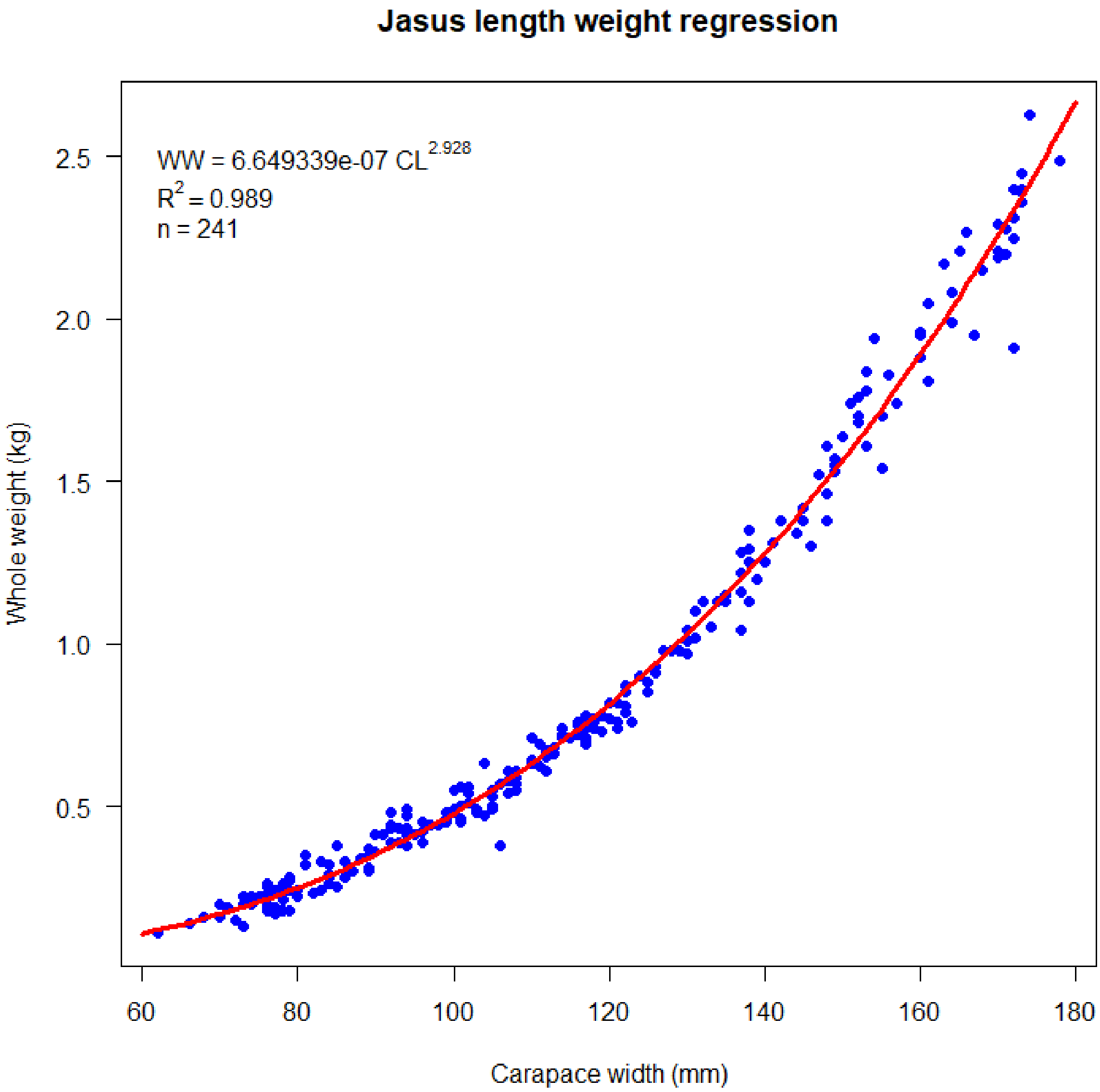


Figure 28: Length weight regression for carapace length vs. whole weight for all *J. caveorum* sampled on trip 1 and 2.

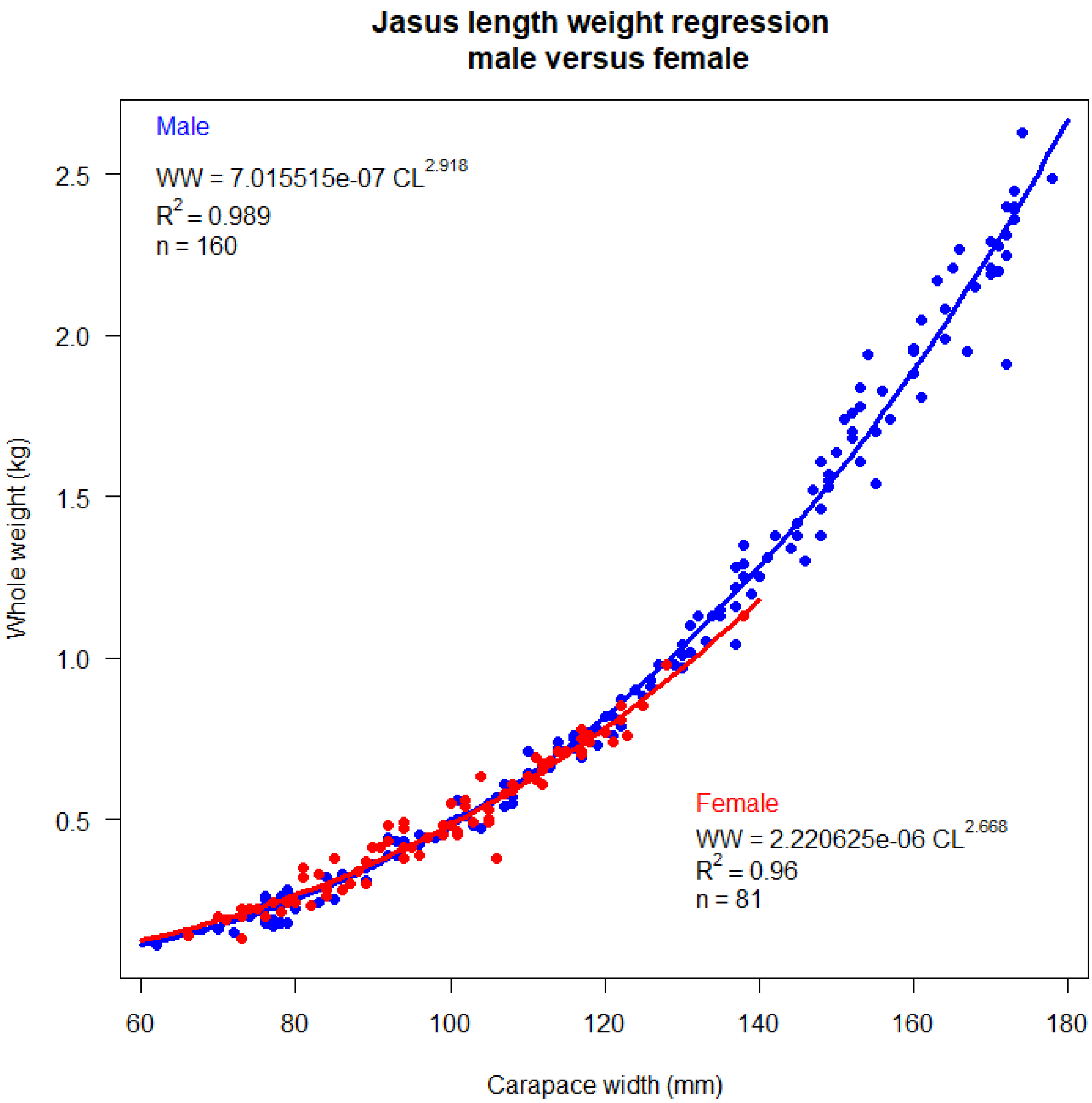


Figure 29: Length weight regression for carapace length vs. whole weight for male and female *J. caveorum* sampled on trip 1 and 2.

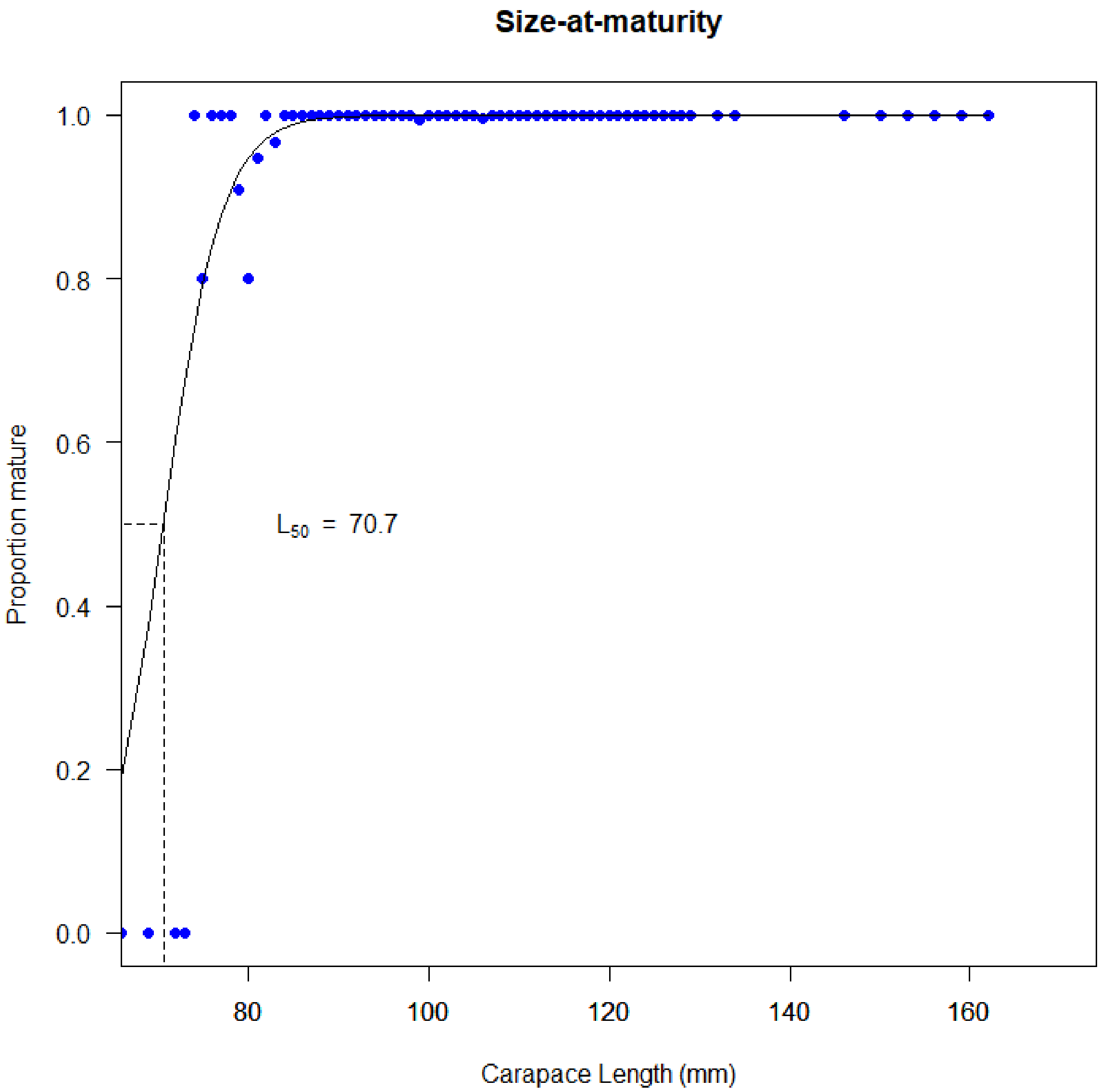


Figure 30: Size-at-maturity of *J. caveorum* from trip 1 and 2 sampled at all seamounts.

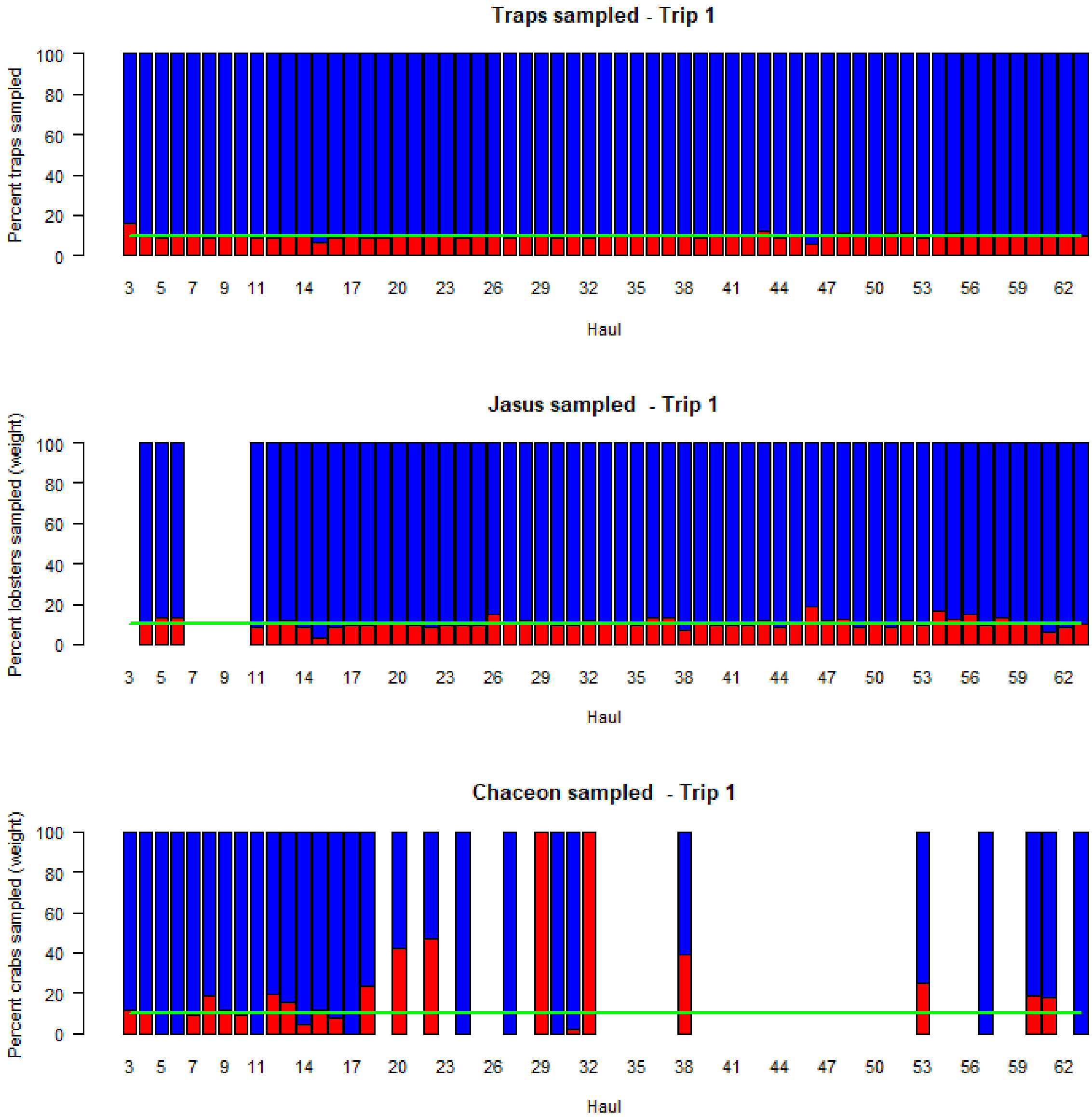


Figure 31: The proportion of traps, *J. caveorum* and *Chaceon* sp. sampled relative to the number of traps set and catch weight for trip 1. The red bars indicate the sampling effort or catch, blue bars indicate effort or catch not sampled and the green line represents the 10% target sample.

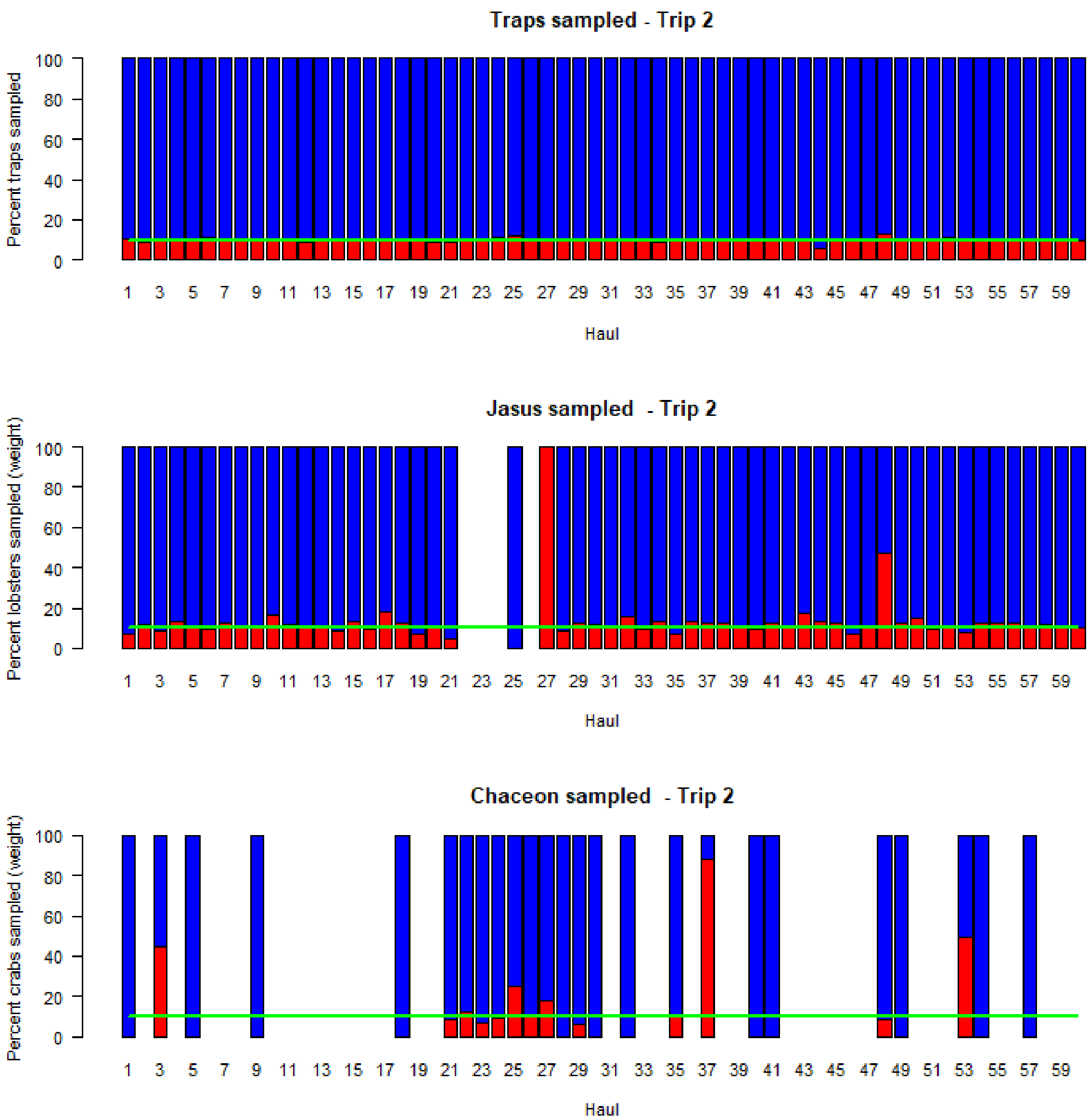


Figure 32: The proportion of traps, *J. caveorum* and *Chaceon* sp. sampled relative to the number of traps set and catch weight for trip 2. The red bars indicate the sampling effort or catch, blue bars indicate effort or catch not sampled and the green line represents the 10% target sample.

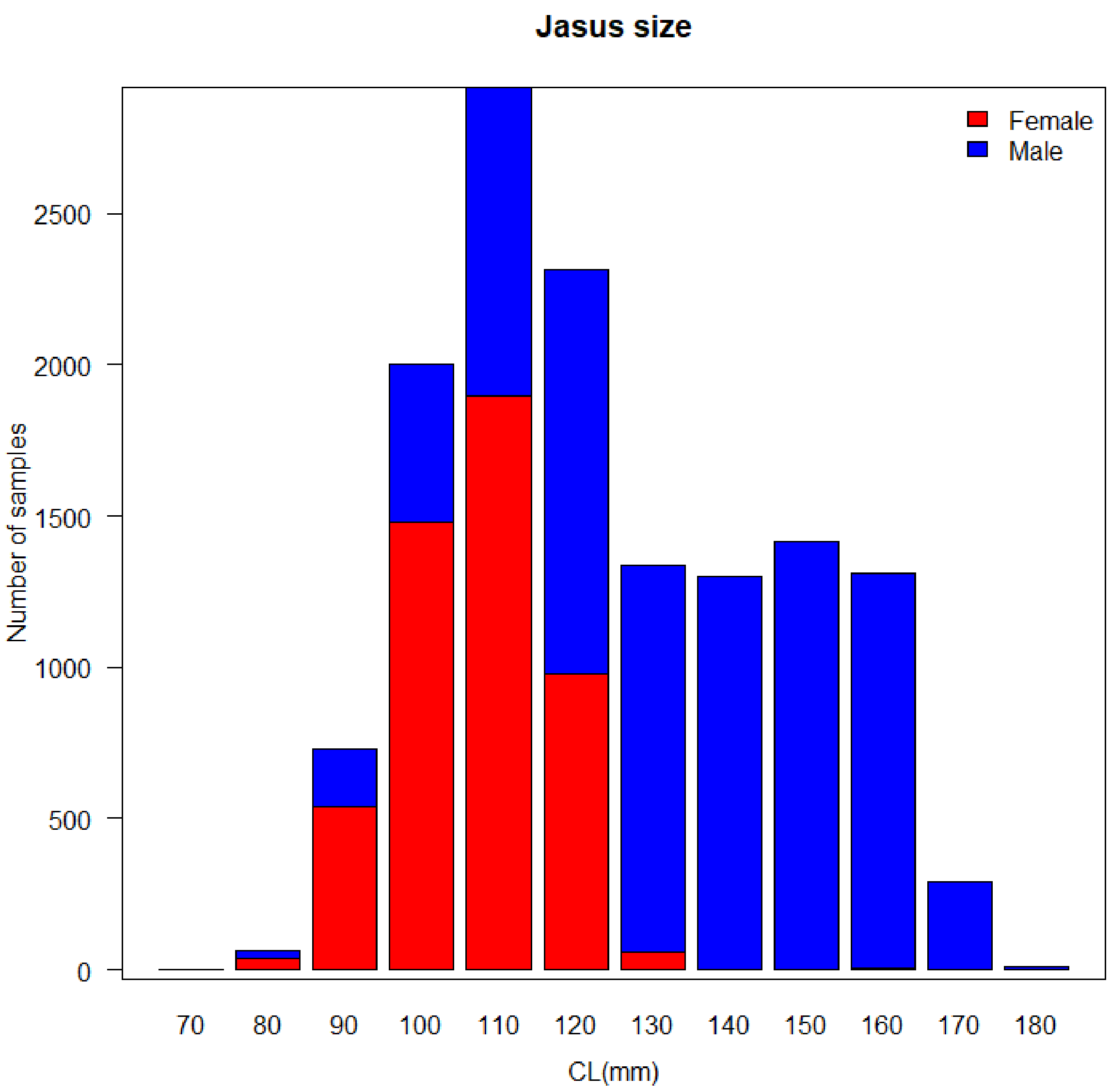


Figure 33: Size vs. sex for *J. caveorum* sampled on trip 1 and 2.

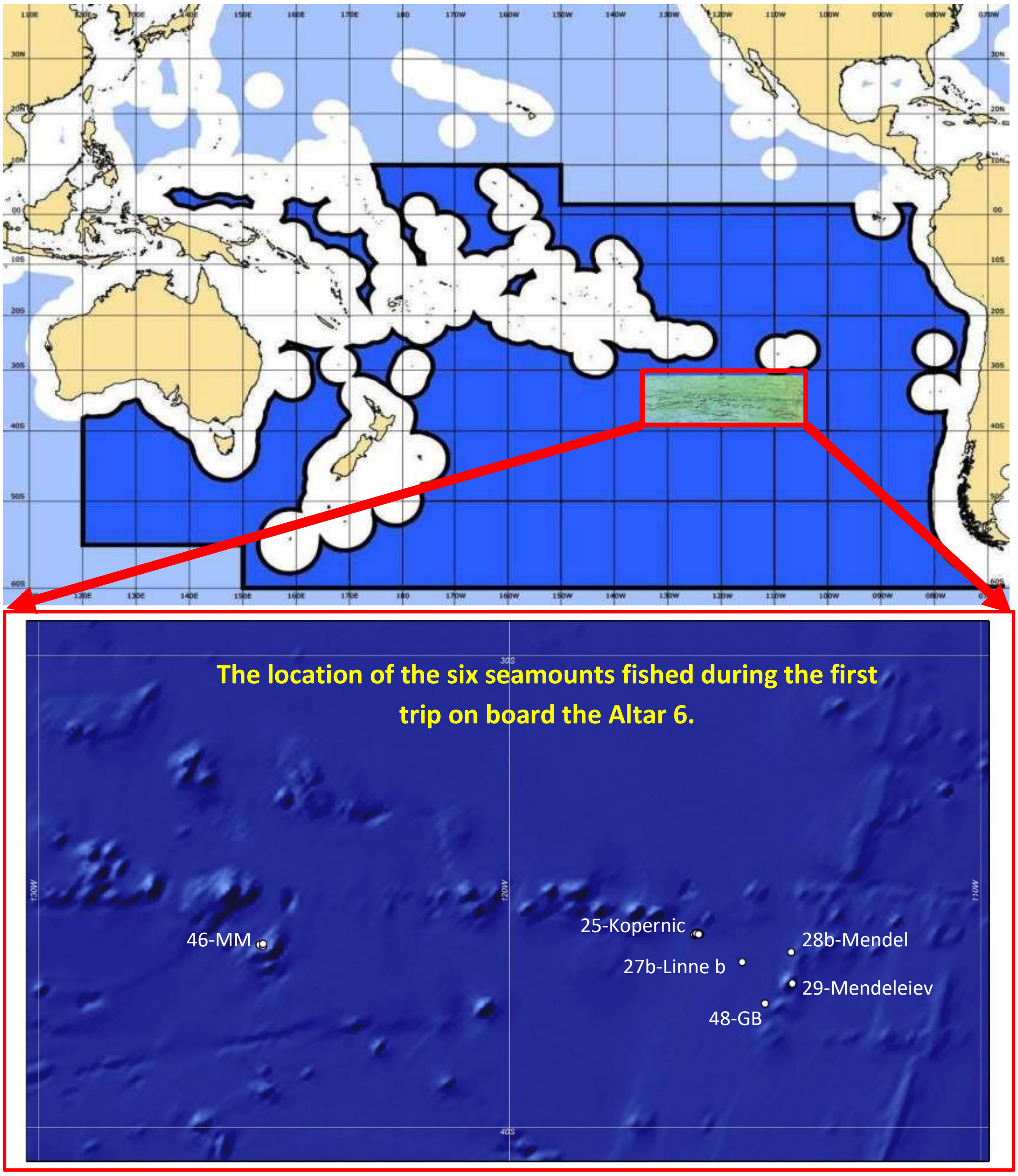
SPRFMO Scientific Observer Exploratory Potting Fishery Cruise Report

Observer Name(s)	Eddie Higgins – CapMarine
Vessel Name	ALTAR 6
Vessel Type	Longline Potting Fishery
Area	SPRFMO Management Area: Foundation Seamount Chain
Cruise Dates (boarding to disembarkation)	From: 19/03/2019 To: 20/05/2019

The cruise report contains a summary of the cruise information, as well as for general commentary and feedback on each trip, particularly for details which are not captured in the Observer Database. Observers are encouraged to attach photos and diagrams in this cruise report where appropriate to aid in descriptions. On completion, please review this report and the electronic database to ensure that details between the two documents are consistent.

1. TRIP SUMMARY

In an agreement between Great Southern Fisheries and Capricorn Marine Environmental (CapMarine) (Pty) Ltd., National Observer, Mr Saiasi Sarau and International Observer, Mr Eddie Higgins were deployed on board the Cook Island registered fishing vessel, the *Altar 6* from 19/03/2019 to 20/05/2019. This was the first of three planned trips. The purpose of the trips is to collect scientific data to evaluate the long-term fishery potential for lobster (*Jasus caveorum.* and *Projasus sp*), and crab (*Chaceon sp*) along the Foundation Seamount Chain (FSC) within the South Pacific Regional Fishery Management Organisation (SPRFMO) Convention Area (refer to figures below). CMM 14b-2019 calls for a survey of eight seamounts over three trips, each with a maximum of 30 fishing days. The maximum harvest level is 900 tonnes of green weight of *Jasus, Projasus* and *Chaceon* combined.



The location of the six seamounts fished during the first trip on board the Altar 6.

Data were collected according to the sampling strategy outlined in the briefing notes **Briefing notes_SPRFMO_LobsterPotSampling** (Annexure 11) and captured in the electronic Access Database **SPFRMO_Lobster_V8 - Altar 6_17.05.19.** Additional information per trap was captured in the excel spreadsheet **SPRFMO_Altar 6_Trap Tally-spreadsheet_20.5.2019.** Note that an updated and improved version of the database **SPFRMO_Lobster_V9 - Altar 6** is available for the next trip

The summary tables below indicate the number of traps set, species weight (kg) caught, the sampled weights per species and the percentage observer coverage per seamount (Table 1). Overall, 80211 kg was caught, of which 76148 kg (95%) was *Jasus*, 3585 kg (4%) was *Chaceon* and the remainder 514 (1%) was bycatch. The observers sampled an average of 10% of the traps per line for biological information such as length, batch weight per species, sex, maturity stage and shell condition for the target *Jasus* and *Chaceon* spp. Bycatch was sampled for length, weight, condition (dead/alive/broken or whole) and location caught on the trap. Table 2 shows the sampled weight per bycatch species per area.

While all bycatch was weighed for all traps (each trap was emptied when brought on board and Observers recorded if there were any VME indicator species. Further Observer procedure required that 10% of all traps were sampled in detail including recording of target species, and other fish or crustacean bycatch species incidentally caught as well as recording (number and weight) of any invertebrate, molluscs and coral species either in or attached to the traps and lines. These records are provided in Tables 1 & 2 below. Note that in terms of CMM 03-2014 and now CMM03-2019 (amended), observer sampling protocol for VMEs indicator species was followed. It was noted that for Cnidaria species fragments attached to the netting were recorded by the observer on 40 of the 8423 traps hauled (this occurred on the edges of Kopernik Seamount). At no stage however were the thresholds reached for any species (VME indicator or other) as specified in CMM03-2019 (see para 10.6).

The spatial distribution of the *Jasus*, *Chaceon* and bycatch catches can be found in Annexure 10. The vessel started fishing on Seamount 46-MM, moved to 25-Kopernic, then to 27b- Linne b, 48-GB, 29 Mendeleiev, 28b- Mendel and finally back to 25-Kopernic where it remained for the rest of the trip. All *Jasus* catches were taken on 25-Kopernic, whereas the *Chaceon* catches were mostly taken from seamount 46-MM.

Table 1. Summary of the number of traps set, catch weights (kg) and percentage sampled by the observers per seamount

Area_ID	Seamount	Traps set	No traps Sampled	% traps sampled	Tot (kg) Jasus	Jasus Sample (kg)	% Jasus sampled	Chaceon Tot. (kg)	Chaceon Sampled (kg)	% Chaceon sampled	Bycatch (kg)	Bycatch Sample (kg)	% bycatch sampled	Total catch (kg)
25	Kopernik	7735	812	10	76148	7580	10	859	87	10	388	49	13	77359
27b	Linne b	96	10	10				407	37	9	10	4	39	418
29	Mendeleiev	96	10	10				403	47	12	3	1	21	406
46	MM	303	28	9				886	53	6	100	13	13	986
48	GB	98	10	10				352	66	19	5			357
28d	Mendel	95	10	11				678	64	9	7			685
Total		8423	880		76148	7580		3585	352		514	67		80211
Average				10			10			11			21	

Table 2 Summary of the weight per bycatch species sampled by the observers per seamount

Area_ ID	Traps sampled for bycatch	Bathylasmatidae (kg)	Cnidaria : Anthozoa (kg)	Blue shark (kg)	Chaceon (Kg)	Cnidaria spp (kg)	Cusk-eels (kg)	Echinoderms (kg)	Anthozoa (St. coral/madrepores (kg)	Hydrozoans (kg)	Molluscs (shell) (kg)	Scorpion/ redfish (kg)	Siliceous sponges (kg)	Trumpeter (kg)
25	99		1.13	29	126.89	5.69	3.18		0.07	1.16	0.14		1.61	7.24
27b	10	4			36.21									
29	11				46.55							0.56		
46	55				119.45	0.37	6.48	0.06			0.27	1.51		4.1
48	10				65.6									
28d	10				63.8									
Total	195 of 8423	4	1.13	29	458.5	6.06	9.66	0.06	0.07	1.16	0.41	2.07	1.61	11.34
Occurrence (traps)[1]			9			40		2	2	5	1		3	
Frequency[2]			0.1%			0.5%		0.02%	0.02%	0.06%	0.01		0.04%	

Note: 1. Bycatch was quantified for 100% of traps. i.e. traps were emptied and bycatch separated from target species. Occurrence is the number of sampled traps in which bycatch was quantified and species identified.

Note: 2. Frequency is the % occurrence of each group in the traps hauled (applied only to potential species that may or may not be definitive of a VME – associated species).

2. CRUISE DETAILS

First section of the cruise	
Port of departure:	Manta, Ecuador
Date of departure:	19/03/2019
Arrival on fishing grounds:	05/04/2019
Start fishing:	05/04/2019
End fishing:	06/05/2019
Depart fishing grounds:	06/05/2019
Port of return:	Callao, Peru
Date of return:	20/05/2019

3. FISHING OPERATIONS

3.1. Operations and Gear

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

The *Altar 6* (Figure 1, Annexure 1) was converted for dedicated use to deploy and retrieve longline strings of traps for setting in deep water. The original longline hauling deck was enclosed and converted to a processing factory (Figure 3, Annexure 1 and Annexure 7). The "roof" of the factory served as the hauling deck (Figure 2, Annexure 1). The observer station was enclosed on the way to the fishing grounds (Figure 11, Annexure 1). Traps were set from the stern upper deck. Each mainline or backbone consisted of 5120m of 26mm polypropylene float line (Figure 4, Annexure 1) with a 4m "Ganyon" of 16mm polypropylene float line spliced into the mainline with a "becket" (Figure 5, Annexure 1) every 25m where the bone (Figure 6, Annexure 1) of the 1m trap bridle (16mm Polypropylene line) was attached. The length of the mainline varied between 77 traps per line to a maximum of 200 per line and the distance between traps was mainly 25m irrespective of the length of the line. However, if only 100 traps per 5000m line was used then the spacing between traps was

50m. A 75kg chain stabilizer and marked buoys was used at both ends of the line (Figure 12, Annexure 1).

Stackable top loading traps (Figure 7, Annexure 1) were used. The traps were 150cm diameter at the base, 75cm high and 50cm diameter at the top. The entrance to the trap was 35cm in diameter and the trap was covered with netting of 10.2cm mesh (knot to knot 5.1cm). The backbone (ground line) and float line for each string of traps was made of 26mm polypropylene rope with each trap on each string spaced 25m apart. The traps were constructed with “escape gaps” (Figure 8, Annexure 1) with 51mm diameter to allow for escapement of the small organisms. The trap was also fitted with a sewn in cotton string where parts of the traps’ nylon mesh was cut and sewn back together with cotton string, so that if lost and not found, the cotton string will eventually degrade and the traps will remain opened so ghost fishing doesn’t occur (Figure 8b, Annexure 1). See Figures 2.1. – 2.5, Annexure 2 for more information on the cotton string.

The traps were baited with ground up Mackerel placed in bait jars that were attached to the inside of the trap with a snap (Figure 9, Annexure 1)

A specially designed camera frame, fitted with an underwater camera (Figure 10, Annexure 1) was deployed three times during the trip. The frame was either deployed with or without a mesh net. The footage was retrieved from the camera’s memory card and used to identify bottom structure, the benthos and potential Vulnerable Marine Ecosystem (VME) areas.

The vessel generally set lines straight after they were hauled. The soak time varied between 24 hours and 48 hours. Initially the vessel experimented with long soak times of 48 hours and more, but later realised that shorter soak times yielded better lobster catches and tried to haul the lines within 24 hours. This was not always possible since the factory crew could not always process large catches fast enough. Also sometimes it would take much longer to haul stuck and/or broken lines resulting in these lines being hauled from the other end.

Because all the lines were set in a relatively small area i.e. 3nm x 2nm on the Kopernic seamount where all the *Jasus* were caught (Figure 13, Annexure 1), new lines could not be hauled at night for fear of buoy line entanglement with the propeller. Hauling therefore started shortly after sunrise. While the mainline was being hauled in, it was stopped every 25m to unhook a trap. The bait jars were unclipped, the trap-zip unfastened and the catch was shaken out of the trap together with the bait jars (Figure 14, Annexure 1). The bait jars were emptied into a bin at the hauling station that was emptied only once the whole line has been hauled. No bait was discarded during setting or hauling of the line.

The catch was pushed towards the “trap tally” scale (Figure 15, Annexure 1) where the observer recorded the weights of the total *Jasus, Projasus, Chaceon* and bycatch (Annexure 8) per trap before retained species were channelled to the factory The non-retained bycatch was stored in a separate bin and discarded at the end of the line. Some species were retained a “bio-sample” for further analysis ashore. The observer collected the contents of every tenth trap which equated to approx. 10% of the traps per line for biological data for the target species such as; length, batch weight, sex, maturity stage and shell condition. Bycatch information included length, alive/dead, location on the trap (inside or outside the trap), number and weight per species. Retained biological samples were bag, tagged and frozen for further analysis ashore

The vessel crew did not always retain small *Chaceon*. These were placed in a crate and periodically discarded overboard on the opposite side of the hauling station, while still alive. This was carried out with from permission both observers.

3.2. Lost Fishing Gear

Gear type	Date	Latitude	Longitude	Comments
Pots & Mainline	15/04/2019	35°54.588 s	116°03.166 w	123 x Pots and 3800m x 26mm polypropylene float line.
Inflatable Buoy	12/04/2019	37°22.329 s	114°35.011 w	1 x buoy only, Gale force wind Markings: Altar 6 , 5B
Inflatable Buoy	13/04/2019	36°27.655 s	115°04.901 w	1 x buoy only, Gale force wind Markings: Altar 6 , 4A
Pot	22/04/2019	35°53.401 s	116°02.004 w	1 x Pot broken off at ganyon
Pot	23/04/2019	35°54.257 s	115°58.397 w	1 x Pot broken off at ganyon
Inflatable Buoy	01/05/2019	35°54.519 s	116°00.596 w	1 x buoy only, Gale force wind. Markings: Altar 6 , 10A
Pots & Mainline	01/05/2019	35°54.526 s	116°02.709 w	89 x Pots and 2225m x 26mm polypropylene float line.
Chain stabilizer	06/05/2019	35°54.806 s	116°02.511 w	75kg steel chain sabilizer

Comments: See Annexure 4 for photographs of above marine debris.

4. CATCH DETAILS (species)

The table below shows a summary of the number of traps, green weight and processed weight per seamount per species.

Seamount number and name	Number of traps set	Species	Deck scale green weight discarded	Deck scale green weight retained	Vessel processed weight retained	Product Type
25-Kopernic	7735	*Jasus*	0	76148.34	71962	Whole
		Chaceon	139.07	719.97		
27b-Linne b	96	*Chaceon*	34.75	372.55		
48-GB	98	*Chaceon*	0	351.95		
29-Mendeleiev	96	*Chaceon*	40.49	362.61		
d-Mendel	95	*Chaceon*	69.3	608.28		
46 – MM	303	*Chaceon*	512.04	373.56		
All areas total		*Chaceon*	795.65	2788.92	1206	Legs

Before any factory processing, the National Observer and the vessel crew were required to record the weight per target and bycatch species per trap, as well as whether the trap was missing, damaged or not damaged.

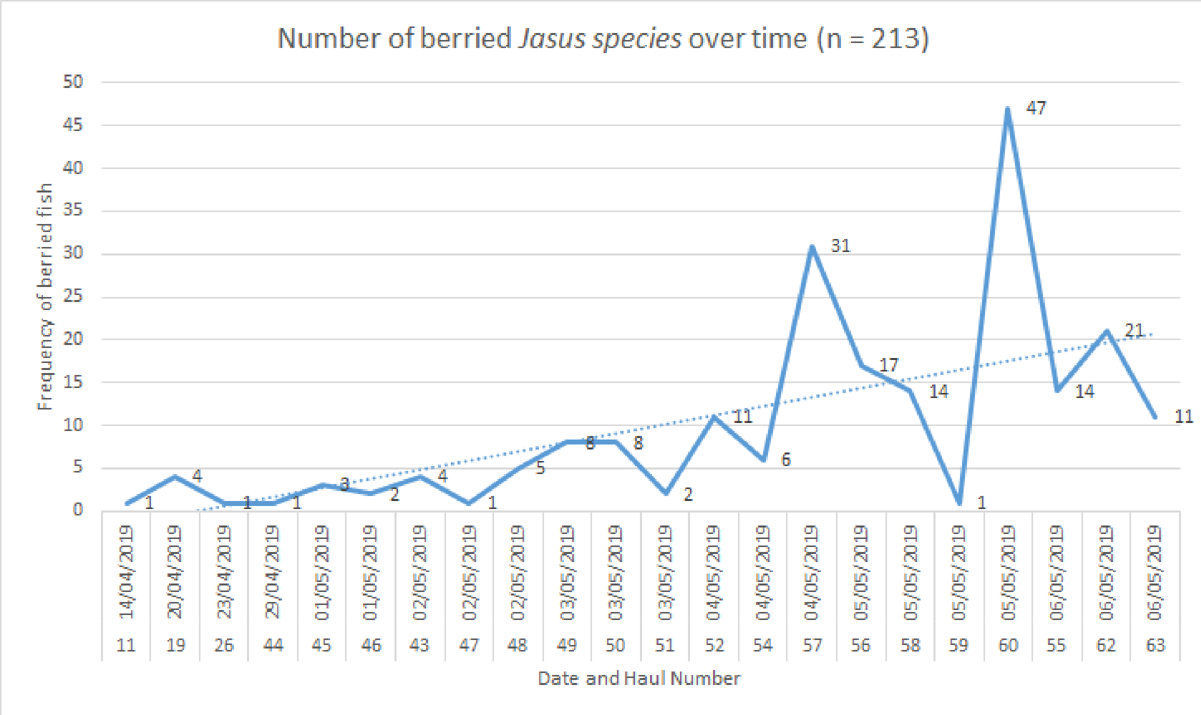
The product type for *Chaceon* was legs and abdomen only, with the shell and gills removed. All *Jasus* were retained whole and only 213 females in berry were discarded (Altar 6_Trip_1_ First lobster for the trip 11-04-2019). It was not possible to obtain *Chaceon* processed weights per area as some catches were processed together from the same area on the same day. The observer calculated the green weight on a trap-by-trap basis using a deck scale. The processed weights of both *Jasus* and *Chaceon* were supplied by the crew.

5. BIOLOGICICAL DATA SUMMARY

The International Observer was required to measure the first 40 target species (either lobsters/crabs) in every tenth trap (starting with number one). This was to achieve a 10% sampling coverage per line. If there were less than 40 in the trap, then the observer measured all the species. The sample weight per species was recorded as it was not necessary to weigh individuals during the size composition sampling since the total weight per trap was recorded by the national observer. Once a minimum of 200 lobsters was measured per line (i.e. 5 pots of 40; or 20 pots of 10 lobsters, if this was all that was caught) the observer stopped measuring that line. For lobsters (*Jasus* and *Projasus*) and crab (*Chaceon*) the following information was recorded;

- Trap number
- Species
- Sample weight (per species per trap)
- Measure type
- Lobster length = CL (mm); crab length = CW (mm)
- Sex & berry stage = F1 – F4, BF - Female with berry, FM – female mature, I – female immature, M – Male, NF – no female maturity defined
- Shell condition = 1-3
- Retained Sample No = If samples are retained i.e. bagged and tagged, please record the serial number for the species on the database as well as on the label in the bag. This also includes blood or tissue samples taken.
- Photos of unknown species labelled with the Retained Sample No

The number of berried *Jasus* females increased steadily with time (graph below), which implies that April and May does not fall over the peak spawning period. Note, the data includes all berried females caught throughout the trip and not just from the observer's random sample.



The same tenth trap was also sampled for bycatch information (Appendix 8 Bycatch 1 and Appendix 8, Bycatch 2). Unknown species were retained for ashore identification and the serial numbers corresponded to the label in the sample bag. Bycatch data included;

- Species code for all the invertebrate (particularly VMEs) and vertebrate bycatch species in the trap.
- Live/Dead = alive, dead or unknown
- Location = inside the trap, outside the trap or on the line
- Retained (Y/N)
- Condition = broken or whole
- Number
- Weight (kg)
- Bio Sample Number = bycatch serial number

With regard to VME indicator species, the observer recorded *Cnidaria stylaster* coral or Hydrocoral only on 4 lines set on Kopernic. The area in which these were found have been recorded on the chart (Altar 6_Trip_1_). The fishing master, Jim England also saved the locations as required by SPRFMO for future reference and further analysis if needed. Rhodoliths *Coralline algea* were the most common of the benthic organisms. They came in different colours. Some appeared alive with green or purple colours and others almost white and worn away. The underwater camera shows clips of them strewn over a flat seabed. Where there was uncertainty on species Identification, photographs were taken for sending on to specialists. Ref. Rick Webber from the New Zealand Museum (Altar 6_Trip_1_ Most common Cnidaria).

5.1. Biological Samples Retained

NO	Sample number**	Photo	Recorded in database	Species
1	1-1-1-King (CEX)	Yes	Yes	*Cusk-eels nei*
2	1-1-20-GER	Yes	Yes	*Chaceon*
3	1-1-40-Red (SCO)	Yes	Yes	*Trumpeters nei*
4	1-1-70-UKN (TRU)	Yes	Yes	*Trumpeters nei*
5	1-1-100-GER	Yes	Yes	*Chaceon*
6	1-4-29-JSX	Yes	Yes	*Jasus*
7	1-4-60-JSX	No	Yes	*Jasus*
8	1-4-70-JSX	Yes	Yes	*Jasus*
9	1-4-10-GER	Yes	Yes	*Chaceon*
10	1-6-22-UKN	Yes	Yes	Unknown
11	1-8-80-GER	No	Yes	*Chaceon*
12	1-8-90-GER	No	Yes	*Chaceon*
13	1-12-50-JSX	Yes	Yes	*Jasus*
14	1-16-1-DMO	No	No	*Siliceous sponges*
15	1-16-78-Rock (CNI)	No	Yes	Rock
16	1-16-98-JSX	No	No	*Jasus*
17	1-17-113-JSX	Yes	No	*Jasus*
18	1-18-1-JSX	Yes	Yes	*Jasus*
19	1-18-110-JSX	Yes	Yes	*Jasus*
20	1-19-122-CNI	Yes	No	*Cnidarians nei*
21	1-19-101-JSX	Yes	No	*Jasus*
22	1-19-00-JSX	Yes	No	*Jasus*
23	1-26-FAC-JSX	Yes	No	*Jasus*
24	1-28-1-JSX	Yes	Yes	*Jasus*
25	1-32-20-JSX	Yes	Yes	*Jasus*
26	1-34-Unknown-JSX	Yes	No	*Jasus*
27	1-36-30-AJH	Yes	Yes	*Anthozoa*
28	1-36-10-jsx	Yes	Yes	*Jasus*
29	1-36-20-JSX	Yes	Yes	*Jasus*
30	1-39-31-UKN	Yes	No	*Unknown*
31	1-45-20-JSX	Yes	Yes	*Jasus*
32	1-47-42-ukn	Yes	No	*Unknown*
33	1-43-33-JSX	Yes	Yes	*Jasus*
34	1-43-33-JSX	Yes	Yes	*Jasus*
35	1-43-57-JSX	Yes	Yes	*Jasus*
36	1-14-82-GER	Yes	No	*Chaceon*
37	1-14-87-GER	Yes	No	*Chaceon*
38	1-14-1-GER	Yes	Yes	*Chaceon*
39	1-14-20-GER	Yes	Yes	*Chaceon*

NO	Sample number**	Photo	Recorded in database	Species
40	1-14-60-GER	Yes	Yes	*Chaceon*
41	1-14-130-JSX	Yes	Yes	*Jasus*
42	1-14-130b-JSX	Yes	Yes	*Jasus*
43	1-50-12-JSX	Yes	Yes	*Jasus*
44	1-53-1-JSX	Yes	Yes	*Jasus*
45	1-53-60-JSX	Yes	Yes	*Jasus*
46	1-53-80-JSX	Yes	Yes	*Jasus*
47	1-56-Fac-JSX	Yes	No	*Jasus*

** Sample number key: Trip number -Set number -Trap number-Species code i.e. 1-1-20-GER

Samples no 1 to 30 (refer to table above and Altar 6_Trip_1_ Bio samples -New Zealand Museum) were retained in the vessel freezer and upon arrival in Lima were couriered to:

Mr. Rick Webber; 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

Samples 31 to 47 will be used for genetic analysis and delivered (after the second trip) to;

Johan Groeneveld. Senior Scientist. Oceanographic Research Institute (ORI)
Direct Tel: +27 (31) 328 8180   Fax: +27 (31) 328 8188
1 King Shaka Avenue, Point, Durban 4001 KwaZulu-Natal South Africa
jgroeneveld@ori.org.za

The observer managed to sample the contents of all the traps in the volumes that they came up on the line, except for Set 24 trap 40, where a sub-sample of 34.04kg from the total trap weight of 48.9kg, was sampled. Apart from this one trap the observer sampled every other trap and weighed all the lobster and *Chaceon* in that trap. The weights from the trap tally scale was not exactly the same as the weight from the observer scale. The trap tally scale had a modified weighing platform and in rolling sea conditions, it did not fully stabilise on a value. A midpoint value therefore had to be taken as the weight for that trap. The difference however was not that significant. This can be seen when comparing the observer sample weights to the trap tally weights.

6. SEABIRD, TURTLE AND MARINE MAMMAL INTERACTIONS WITH VESSEL

6.1. Mitigation Measures

No bait, offal, dead floating by catch, factory offal or food waste were discarded during hauling or setting of the lines. The factory produced very little offal as the *Jasus* were retained whole and very few *Chaceon* were caught in the Kopernic seamount where the bulk of fishing activities occurred. When *Chaceon* were caught and retained the shells were ground up, retained in a holding tank and pumped out when no hauling or setting was conducted.

The observers noted and recorded all the birds observed during hauling and setting operations. It was observed that the Sooty shearwater (*Ardenna grisea*) would sometimes land and sit on the water to feed off some small bait pieces that washed off from the bait jars. The area approximately 50m astern where the birds landed, was free of any fishing gear as the traps and mainline had already disappeared below the surface. The traps landed in the water within a meter from the vessel's stern and started sinking immediately.

Sooty shearwaters and Wandering albatrosses (*Diomedea exulans*) were regularly observed during setting and hauling. Apart from the Sooty shearwater feeding on small bait pieces, no other bird interactions with the vessel or fishing gear was observed. On 10/04/2019 a Grey petrel (*Procellaria cinerea*) was observed sitting on the hauling deck. The observer moved the bird to the bow section of the vessel to prevent possible injuries during vessel crew activities. The following morning the petrel was gone. Photos were taken of the Grey petrel while on deck. The observer's camera zoom lens had a malfunction and therefore good quality bird pictures were not always possible. However, a few half decent pictures were recorded (Annexure 3). Other birds observed from time to time were; Black browed Albatross (*Thalassarche melanophris*), Grey Petrel, Grey headed Albatross (*Thalassarche chrysostoma*) and one sighting of a Pintado petrel (*Daption capense*).

7. WASTE AND DEBRIS

7.1. Vessel Waste Disposal Procedures

The bait boxes had no packaging bands. The blue plastic lines were all retained and stored in a bag on the upper deck. The cardboard boxes had no plastic tape strips of any kind and were discarded overboard after lines were set. All plastic and non-biodegradable material were retained and stored in huge plastic bags on the lower deck of the stern area. When a large bag was full it would be tied shut with string and a new one made available. The kitchen separated food and other waste and when the non-biodegradable small black garbage bags were full it was deposited into the big bag astern. There were water filled bottles tied up in four different locations for smokers to discard their cigarette butts into. Once the cigarette bottles were full, the whole bottle was discarded into the big bag astern and a new bottle half filled with water was hanged in its place.

8. Marine Debris at Sea

The section of line picked up on 02/05/2019 was full of marine life (Annexure 4) Organisms were taken from the marine growth, photographed and some frozen in water as a biological sample.

Date	Description	Latitude	Longitude	Hauled aboard (Y/N)	Size (m)	Weight (kg)	Photograph attached (Y/N)
08/04/2019	Net covered inflatable buoy	35°47.40-S	117°49.40-W	Yes	0.70	0.7kg	Yes
11/04/2019	Section of Polly propylene line	35°54.24-S	116°01.16-W	Yes	10	5kg	Yes
20/04/2019	Section of Polly propylene line	35°53.96 S	116°0.294-W	No			Yes
02/05/2019	Section of Polly propylene line and 3 buoys	35°54.51 S	116°3.679 -W	Yes	25	30kg	Yes

9. ILLEGAL, UNREPORTED AND UNREGULATED (IUU) VESSEL AND GEAR SIGHTINGS

Apart from the fishing gear noted above, no other gear was sighted. No vessels were sighted during the entire fishing period.

10. ADDITIONAL INFORMATION

10.1. Operational Issues

The observer had a good working relationship with the Cook Island observer. They shared duties, database and other information on a daily basis. The observers had access to all parts of the vessel including the communication systems. The vessel experienced some problems with e-mail but was rectified towards the end of the fishing period. The crew were helpful and assisted in securing samples selected by the observer. No problems were experienced with regards to crew attitudes.

10.2. Observer Tasks

It happened a few times that a part of the selected lobster sample spilled over the basket and landed in the factory chute. The sample was then discarded and the first trap thereafter was selected. On a few other occasions the observer was doing the trap tally and the person responsible for selecting samples neglected to retain the specified sample in time and the crew already channelled the specific trap's catch to the factory. In these cases, the observer would select the first pot thereafter and then continue with every tenth pot as per the original sequence.

10.3. Observers Database

The observer experienced minor problems with the database but it was rectified after communicating with the CapMarine land-based staff via e-mail. Some suggestions to make it more user friendly were communicated to these staff members to be rectified and included in the database for the next trip.

10.4. Observer Cruise Report

The observer experienced problems with completing section four "catch details" because the factory did not separate the processed weights by area. Catches on three different seamounts were processed on the same day and could not be compared individually with the different trap tallies.

10.5. Educational Material

There were no fish or bird Id guide books onboard the vessel. The observer totally relied on the Pdf ID guides secured shortly before the trip but was unable to identify some species because it simply could not be found in the available digital ID guides. The observer is certain that the same bycatch fish species will be encountered on the second trip and suggest that CapMarine look at the bycatch Annexures, study the observer's photographs and supply him with a by catch id guide that includes the species codes. This would also be helpful for the training of the new relief Cook island observer.

10.6. SPRFMO VME

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

South Pacific	**Annex 5**	**Annex 6A**	**Paras 26-33**
SPRFMO CMM 3-2019	Sponges (Porifera: Demospongiae and Hexactinellidae) Stony corals (Scleractinia: Solenosmilia; Goniocorella; Oculina; Enallopsammia; Madrepora; Lophelia) Black corals (Antipatharia) True soft corals (Alcyonacea: all taxa excluding Gorgonacea) Sea fans octocorals (Informal group Gorgonacea: Holaxonia; Calaxonia; Scleraxonia) Sea pens (Pennatulacea) Anemones (Actiniaria) Hydrocorals (Stylasteridae)	one tow for a single VME indicator taxa Sponges 50kg Stony corals 250kg Black Corals 5kg True soft corals 60kg Seafan octocorals 15kg Anemones 40kg **Annex 6B** one tow for three or more different VME indicator taxa 1-5 kg per VME indicator group (seem measure for details)	Report encounter. Move 1 nmile. Temp closure. Review by SC

11. RECOMMENDATIONS

A small-mesh size net on traps

The standard mesh size will be retained and sampled in the same way as on trip 1, but it would be useful to introduce some small-mesh traps as well, to assess the relative abundance of smaller lobsters and crabs. A total of five small-mesh traps should be made up, and fitted to the line, exactly in the same way as the normal traps. Each time the line is hauled, the observer should sample these five traps, along with the standard mesh-traps. For example, if the line consists of 100 traps, then the catches would be measured for five small-mesh traps and five standard mesh traps (10% sampling). If 200 traps, then measure the 5 small-mesh traps and 15 standard mesh traps. etc. In this way our normal sampling regime is maintained, while we add the test with small-mesh traps.

Temperature gauges

Is has been recommended that a temperature gauge is attached to a trap, which is marked clearly. It's preferable to attach it to a trap that is regulary sampled for size composition, if possible.

Genetic samples

Five Jasus, five Projasus and five Chaceon samples have been requested for genetic analysis. Break of a leg with some muscle tissue inside, and then cut it in half to make sure the ethanol gets through the shell to the tissue. Fill the tube to the top with the ethanol and store it in the freezer. Fill the ethanol up from time to time as it gets sucked into the tissue and can also evaporate.

Relationship between catch composition (and catch rate) and depth at which a trap is set

We need the approximate depth of at least some of the traps sampled. There are three depth soundings made per line (start, mid and end). We recommend that the observer samples the traps at these points, so that we will have the numbers / size / species composition per trap as well as the depth for that trap.

Projasus

The Projasus may simply be too small to be retained by the present mesh size. Look out for them when you use the small-mesh traps.

Length-weight data for Jasus caveorum

The observer must measure a few Jasus per line for CL, Total length (TL), whole weight (WW) and tail weight (TW). Tail weight should be the tails removed by the factory in the normal way, not cut off. In the end (after the trip) it would be good to have a nice broad size range covered (50 – 170 mm CL) and equal numbers of males and females (50 – 100 of each sex), if possible.

Video recording

Would be good to see the video records of lobsters approaching and entering / exiting traps.

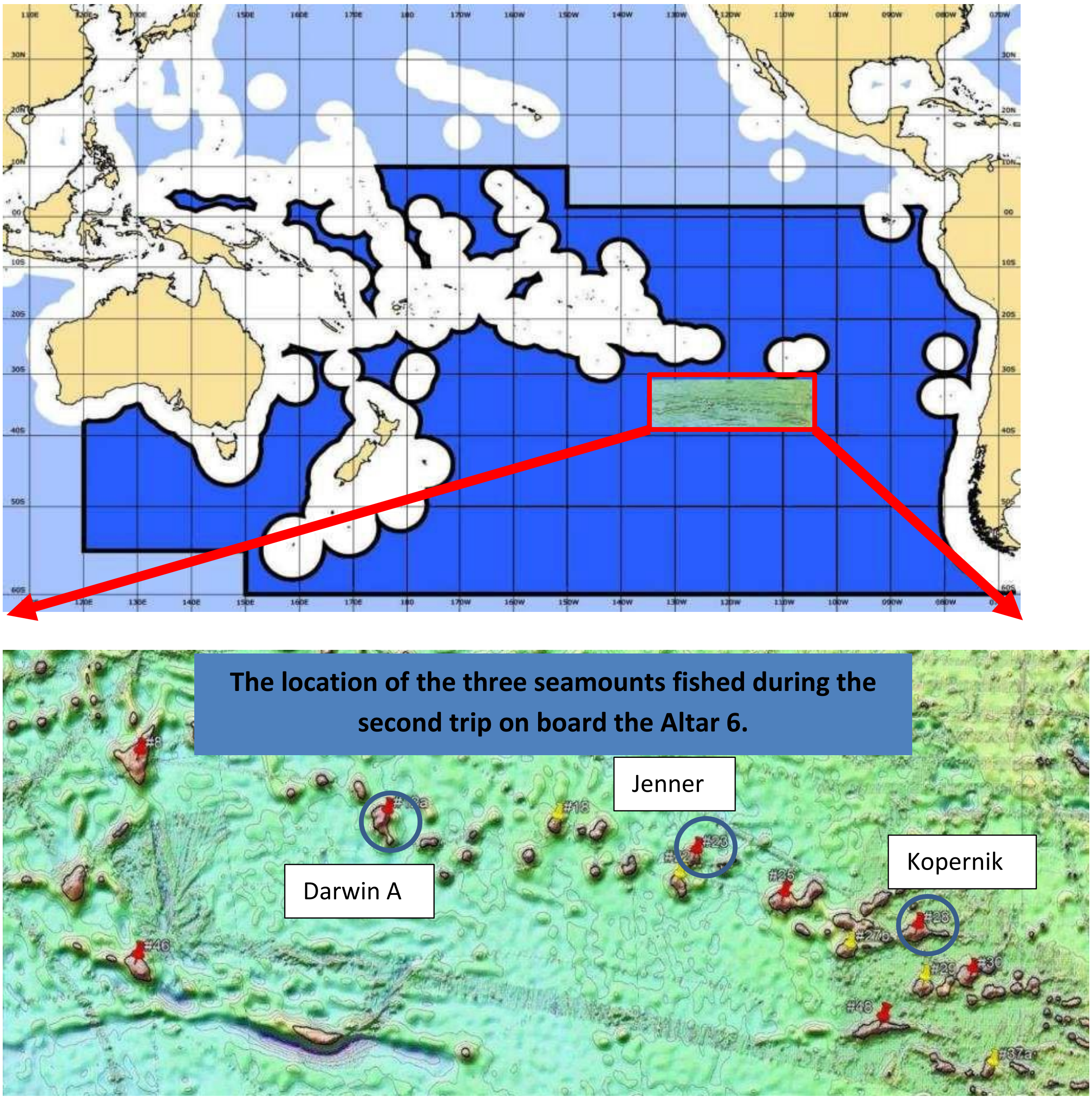
SPRFMO Scientific Observer Exploratory Potting Fishery Cruise Report – Trip 2

Observer Name(s)	Eddie Higgins – CapMarine
Vessel Name	ALTAR 6
Vessel Type	Longline Potting Fishery
Area	SPRFMO Management Area: Foundation Seamount Chain
Cruise Dates (boarding to disembarkation)	From: 27/05/2019 To: 12/07/2019

The cruise report contains a summary of the cruise information, as well as for general commentary and feedback on each trip, particularly for details which are not captured in the Observer Database. Observers are encouraged to attach photos and diagrams in this cruise report where appropriate to aid in descriptions, and the wording in italics provides guidance for the narrative sections. On completion, please review this report and the electronic database to ensure that details between the two documents are consistent.

1. TRIP SUMMARY

National Observer, Mr Brett Apsny and International Observer, Mr Eddie Higgins were deployed on board the Cook Island registered fishing vessel, the *Altar 6* from 27/05/2019 to 12/07/2019. This was the second of three trips. The purpose of these trips is to collect scientific data to evaluate the long-term fishery potential for lobster (*Jasus caveorum* and *Projasus spp*.), and crab (*Chaceon spp.*) along the Foundation Seamount Chain (FSC) within the South Pacific Regional Fishery Management Organisation (SPRFMO) Convention Area (refer to figures below). CMM 14b-2018 calls for a survey of eight seamounts over three trips, each with a maximum of 30 fishing days. The maximum harvest level is 1,000 tonnes of green weight for the combined species of *Jasus*, *Projasus* and *Chaceon.*



The location of the three seamounts fished during the second trip on board the Altar 6.

Data were collected according to the sampling strategy outlined in the briefing notes **Briefing notes_SPRFMO_LobsterPotSampling** (Annexure 15) and captured in the electronic Access Database **SPFRMO_Lobster_V9 - Altar 6_Data_11.7.19.** Additional **i**nformation per trap was captured in the excel spreadsheet **SPRFMO_Altar 6_Trap Tally_Trip 2_ spreadsheet_11.7.19** and **t**he observer's daily log was recorded in **Altar 6_HIGGINS_ Daily Log_Trip 2**. Note that an updated and improved version of the database was used for the second trip.

The summary tables below indicate the number of traps set, species weight (kg) caught, the sampled weights per species and the percentage observer coverage per seamount (Table 1). Overall, 60 lines were set and 39 864 kg was caught, of which 39 109 kg (98%) was *Jasus*, 403 kg (1%) was *Chaceon* and the remaining 351 kg (1%) was bycatch. The observers sampled an average of 11% of the traps per line for biological information such as length, batch weight per species, sex, maturity stage and shell condition for the target species i.e. *Jasus* and *Chaceon*. Bycatch was sampled for length, weight, condition (dead/alive/broken or whole) and location caught on the trap. Table 2 shows the sampled weight, occurrence (traps) and frequency (%) per bycatch species per area. Table 3 is a reference table to show the FAO species code, common name and scientific names for all species caught during trip 1 and 2.

The spatial distribution of the *Jasus*, *Chaceon* and bycatch catches on Kopernik can be found in Annexure 16. The vessel started fishing at Seamount 25-Kopernik, moved to 23-Jenner, then to 12a-Darwin A, and finally back to 25-Kopernik where it remained for the rest of the trip. The majority of the *Jasus* catches were taken from 25-Kopernik, whereas the *Chaceon* catches were mostly taken from seamount 23-Jenner and 12a-Darwin.

Table 1. Summary of the number of traps set, catch weights (kg) and percentage sampled by the observers per seamount

Area_ID	Seamount	Traps set	Traps Hauled	No traps Sampled	% traps sampled	Tot (kg) Jasus	Jasus Sample (kg)	% Jasus sampled	Chaceon Tot. (kg)	Chaceon Sampled (kg)	% Chaceon sampled	Bycatch (kg)	Bycatch Sample (kg)	% bycatch sampled	Total catch (kg)
12a	Darwin A	364	363	44	12	5	1.88	37	155.36	21.24	14	58.99	34.19	58	219.43
23	Jenner	142	142	15	11	47	2.14	5	99.70	9.62	10	12.25	14.01	114	158.95
25	Kopernik	4547	4455	500	11	39057	4450.27	11	148.06	15.13	10	280.18	22.85	8	39486.39
Total		5053	4960	559		39109.23	4454.29		403.12	45.99		351.42	71.05		39864.77

Table 2 Summary of the weight per bycatch species sampled by the observers per seamount

Seamount	Traps sampled for bycatch	Bathylasmatidae (kg)	Chaceon (Kg)	Cnidaria . (kg)	Demospon-giae	Echinoderms (kg)	Genypterus	Hydrozoans (kg)	Nemadactylus douglasii	Nemadactylus macropterus	Scorpaenidae
Darwin A	29		20.9	0.03		0.28	3.89		7.42		1.67
Jenner	9		9.66				4.35				
Kopernik	37	2.55	15.99	2.1	1.03			0.37		0.81	
Total	75	2.55	46.55	2.13	1.03	0.28	8.24	0.37	7.42	0.81	1.67
*Occurrence (traps)		2	33	19	1	7	3	3	2	3	2
**Frequency (%)		0.04	0.65	0.38	0.02	0.14	0.06	0.06	0.04	0.06	0.04

* Bycatch was quantified for 100% of traps. i.e. traps were emptied and bycatch separated from target species. Occurrence is the number of sampled traps in which bycatch was quantified and species identified.

** Frequency is the % occurrence of each group in the traps hauled

Table 3. Bycatch species reference table showing FAO code, Common name and Scientific Name

FAO code	Common name	Scientific name
AJH	Anthozoa	Anthozoa
BSH	Blue shark	Prionace glauca
BWY		Bathylasmatidae
CDD	Porae	Nemadactylus douglasii
CEX	Cusk-eels nei	Genypterus
CNI	Cnidarians nei	Cnidaria
CSS	Hard corals, madrepores nei	Scleractinia
DMO	Siliceous sponges	Demospongiae
ECH	Echinoderms	Echinodermata
GER	Chaceon crabs nei	Chaceon
HQZ	Hydrozoans	Hydrozoa
JSX	Rock lobsters nei	Jasus
MSH	Marine shells nei	Ex Mollusca
SCO	Scorpionfishes, redfishes nei	Scorpaenidae
TAK	Tarakihi	Nemadactylus macropterus
TRU	Trumpeters nei	Latridae

2. CRUISE DETAILS

First section of the cruise	
Port of departure:	Callao, Peru
Date of departure:	27/05/2019
Arrival on fishing grounds:	07/06/2019
Start fishing:	10/06/2019
End fishing:	28/06/2019
Depart fishing grounds:	30/06/2019
Port of return:	Callao, Peru
Date of return:	12/07/2019

3. FISHING OPERATIONS

3.1. Operations and Gear

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

The *Altar 6* (Figure 1, Annexure 1) was converted for dedicated use to deploy and retrieve longline strings of traps for setting in deep water. The original longline hauling deck was enclosed and converted to a processing factory (Figure 3, Annexure 1 and Annexure 7). The "roof" of the factory served as the hauling deck (Figure 2, Annexure 1). The observer station was enclosed on the way to the fishing grounds during trip 1. Traps were set from the stern upper deck. Each mainline or backbone consisted of lengths varying between 3700m and 900m of 26mm polypropylene float line (Figure 4, Annexure 1) with a 4m "Ganyon" of 16mm polypropylene float line spliced into the mainline with a "becket" (Figure 5, Annexure 1) every 25m where the bone (Figure 6, Annexure 1) of the 1m trap bridle (16mm Polypropylene line) was attached. The length of the mainline varied between 33 traps per line to a maximum of 145 per line and the distance between traps was mainly 25m irrespective of the length of the line. A 75kg chain anchor and marked buoys was used at both ends of the line (Figure 12, Annexure 1).

Stackable top loading traps (Figure 7, Annexure 1) were used. The traps were 150cm diameter at the base, 75cm high and 50cm diameter at the top. The entrance to the trap was 35cm in diameter and the trap was covered with netting of 10.2cm mesh (knot to knot 5.1cm). The backbone (ground line) and float line for each string of traps was made of 26mm polypropylene rope with each trap on each string spaced 25m apart. The traps were constructed with “escape gaps” (Figure 8, Annexure 1) with 51mm diameter to allow for escapement of the small organisms. The trap was also fitted with a sewn in cotton string where parts of the traps’ nylon mesh was cut and sewn back together with cotton string, so that if lost and not found, the cotton string will eventually degrade and the traps will remain opened so ghost fishing doesn’t occur (Figure 8b, Annexure 1). See Figures 2.1. – 2.6, Annexure 2 for more information on the cotton string.

The traps were baited with ground up Mackerel placed in bait jars that were attached to the inside of the trap with a snap (Figure 9, Annexure 1)

The vessel generally set lines straight after they were hauled but sometimes two lines would be hauled consecutively and then set again after sunset. The reason for this was to optimise the use of daylight as no new lines would be hauled after dark. The soak time varied; 87% of the lines were soaked 24 hours, one line was soaked for five days and another for only 7 hours. The vessel tried to haul the lines within 24 hours. This was not always possible because often it would take much longer to haul stuck and/or broken lines resulting in less time to haul line in daylight.

Since all the lines were set in a relatively small area i.e. 3nm x 2nm on the Kopernik seamount, where the majority of the *Jasus* were caught (Annexure 3), new lines could not be hauled at night for fear of buoy line entanglement with the propeller. Hauling therefore started at sunrise. While the mainline was being hauled in, it was stopped every 25m to unhook a trap. The bait jars were unclipped, the trap-zip unfastened and the catch was shaken out of the trap together with the bait jars (Figure 14, Annexure 1). The bait jars were emptied into a bin at the hauling station that was emptied only once the whole line has been hauled. No bait was discarded during setting or hauling of the line. The vessel generally used more bait per trap for trip 2 compared to trip 1, i.e. three bait jars per trap instead of only two.

The catch was pushed towards the “trap tally” scale (Figure 15, Annexure 1) where the observer recorded the weights of the total *Jasus*, *Chaceon* and bycatch (Annexure 4) per trap before retained species were channelled to the factory. The non-retained bycatch was stored in a separate bin and discarded at the end of the line. The observer collected the contents of every tenth trap which equated to approx. 10% of the traps per line for biological data for the target species such as; length, batch weight, sex, maturity stage and shell condition. Bycatch information included length, alive/dead, location on the trap (inside or outside the trap), number and weight per species. Retained biological samples for genetic bar-coding were tagged and retained in vials filled with surgical alcohol for further analysis ashore.

The vessel crew did not always retain the unfavourable, small and egg bearing *Chaceon*. These were placed in a crate and periodically discarded overboard on the opposite side of the hauling station, while still alive. This was carried out with permission from both observers.

3.2. Lost Fishing Gear

Gear type	Date	Latitude	Longitude	Comments
Pot and Inflatable buoy	11/06/2019	35°53.698 s	116°02.999 w	1 x Pots and 1 x buoy only. Markings: Altar 6 , 7B
Pots & Mainline	13/06/2019	35°54.206 s	116°02.730 w	3 pots and 75m of 21mm polypropylene mainline
Pots & Mainline	13/06/2019	35°54.216 s	115°59.466 w	3 pots and 75m of 21mm polypropylene mainline
Pot	19/06/2019	34°40.634 s	121°33.595 w	1 x Pot broken off at ganyon
Pot	23/06/2019	35°54.449 s	116°03.124 w	1 x Pot broken off at ganyon
Pots & Mainline	23/06/2019	35°54.043 s	116°01.875 w	12 pots and 300m of 21mm polypropylene mainline
Pots	24/06/2019	35°54.125 s	115°59.693 w	2 x Pots broken off at ganyon
Pots & Mainline	26/06/2019	35°53.898 s	116°02.456 w	61 pots and 1525m of 21mm polypropylene mainline
Pots & Mainline	26/06/2019	35°54.216 s	115°59.859 w	3 pots and 75m of 21mm polypropylene mainline
Pots & Mainline	27/06/2019	35°53.496 s	116°02.206 w	3 pots and 50m of 21mm polypropylene mainline

Attempts to recover gear (traps and line) lost on trip one were unsuccessful, and was not attempted on trip 2. The total number of pots lost during trip 2 was 93, and a total length of 2225 m of mainline was also lost. The total number of pots lost during trip 2 was 89 and 2225m of mainline.

4. CATCH DETAILS (species)

The table below shows a summary of the number of traps, green weight and processed weight per seamount per species.

Catch details - Observer/Vessel Figures						
Area	Number of traps set	**Species**	Deck scale green weight discarded	Deck scale green weight retained	Vessel weight retained	Product Type
25-Kopernik	4542	**Jasus**	1301.97	37759.08	35680	**Whole**
		Chaceon	11.62	136.44	40	Legs
23-Jenner	142	**Jasus**	0.94	46.06	50	**Whole**
		Chaceon	17.13	82.57	30	Legs
12a-Darwin A	364	**Jasus**	0	5.08	0	**Whole**
		Chaceon	38.82	116.54	70	Legs
All areas total	5053	**Jasus**	1302.91	37810.22	35730	**Whole**
		Chaceon	67.57	335.55	140	Legs

Before any factory processing, the National Observer and the vessel crew were required to record the weight per target and bycatch species (batch weight) per trap, as well as whether the trap was missing, damaged or not damaged.

The product type for *Chaceon* was legs and abdomen only, with the shell and gills removed. All *Jasus* were retained whole and 2360 females in berry (approx. 1300 kg) were discarded alive. The observer calculated the green weight on a trap-by-trap basis using a deck scale. The processed weights of *Chaceon* were supplied by the crew.

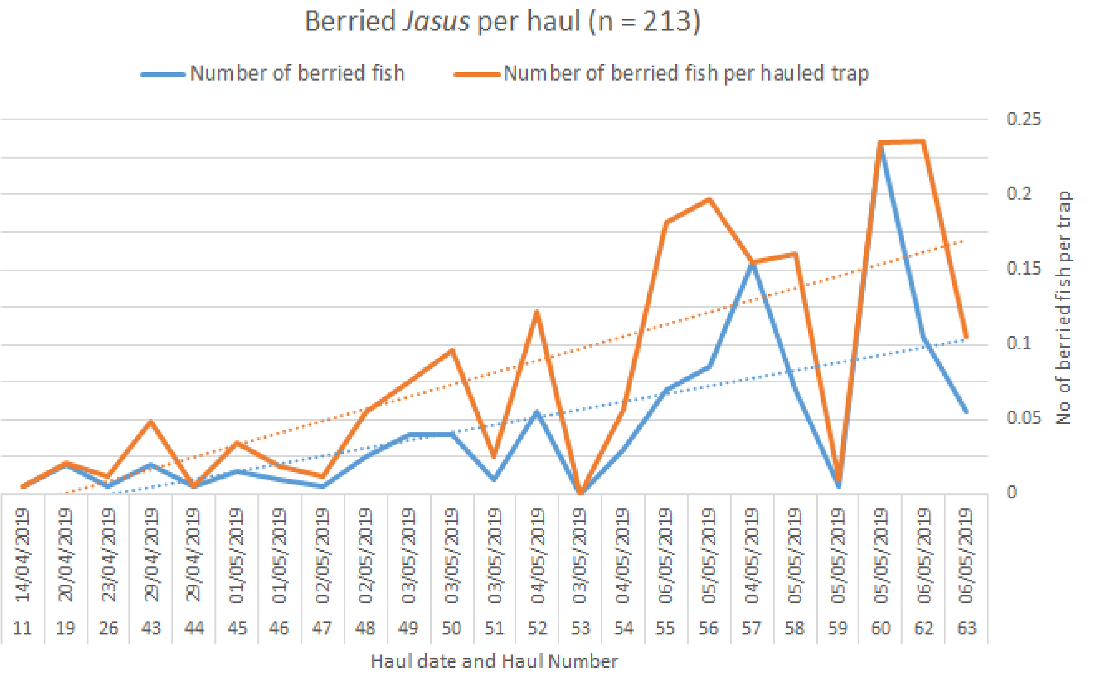
5. BIOLOGICAL DATA SUMMARY

The International Observer was required to measure the first 40 target species (either lobsters/crabs) in every tenth trap (starting with number one). This was to achieve a 10% sampling coverage per line. If there were less than 40 specimens in the trap, then the observer measured all of them. The sample weight per species was recorded. It was not necessary to weigh individuals during the size composition sampling since the total weight per trap was recorded by the National Observer. The observer measured all the lobster and crab in all the sampled traps. For lobsters (*Jasus* and *Projasus*) and crab (*Chaceon*) the following information was recorded;

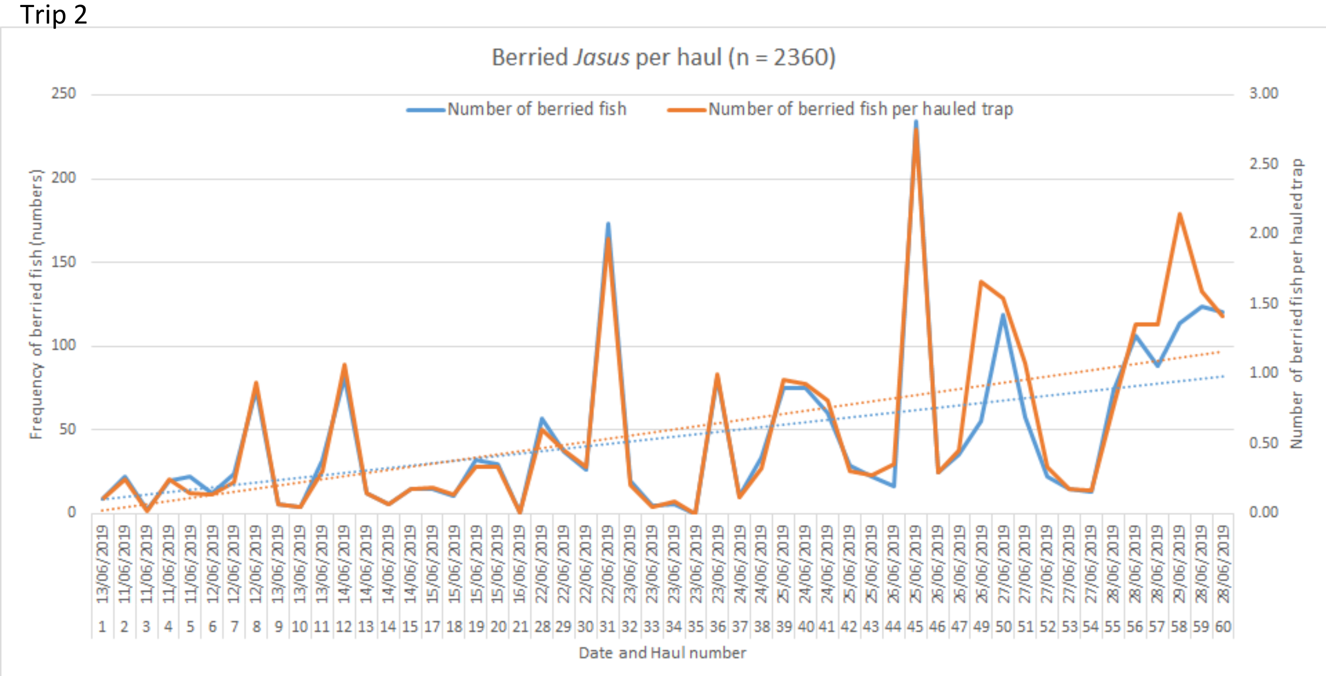
- Trap number
- Species
- Sample weight (per trap)
- Measure type
- Lobster length = CL (mm); crab width = CW (mm)
- Sex & berry stage = F1 – F4, BF - Female with berry, FM – female mature, I – female immature, M – Male, NF – no female maturity defined
- Shell condition = 1-3
- Retained Sample No = If samples are retained i.e. bagged and tagged, the serial number for the species was recorded on the database as well as on the label in the bag. This also includes blood or tissue samples taken.
- Photos of unknown species labelled with the Retained Sample No

The number of egg-bearing *Jasus* observed during Trip 2 was higher than those observed during trip 1 (graphs below), indicating the onset of the egg-bearing season in June. Females in different egg bearing stages (Figure 1 to 4, Annexure 5,) were observed and recorded as such in the database when they appeared in the traps sampled by the observer. The egg bearing females were sorted from the rest of the catch by the crew and observer after each trap was weighed on the trap tally scale. The females were counted as they were removed from the trap tally scale and weighed together at the end of every line (Figure 5, Annexure 5). The crew then took the crate or crates of egg bearing females to the setting deck where they were placed into the second trap after the anchor (Figure 6, Annexure 5). This trap, dubbed the “berry pot” had no bait in and the cotton string that prevents ghost fishing was cut. With the exception of three traps the “berry pots” always came up empty when the specific line was hauled. A total of 29 traps with no bait and holes in was used on 29 different lines.

Trip 1



Trip 2



The same tenth trap was also sampled for bycatch information (Annexure 4). Unknown species were photographed and copies sent to CapMarine for identification. Bycatch data collection requirements included;

- Species code for all the invertebrate (particularly VMEs) and vertebrate bycatch species in the trap.
- Live/Dead = alive, dead or unknown

- Location = inside the trap, outside the trap or on the line
- Retained (Y/N)
- Condition = broken or whole
- Number
- Weight (kg)
- Bio SampleNumber = bycatch serial number

One potential Vulnerable Marine Ecosystem (VME) was identified on the seamount Kopernik. This area have been marked with a black circle on the chart (Annexure 6). The VME indicator, Cnidaria *Stylaster coral or Hydrocoral* came up in significant numbers on one line. The fishing master, Bob Lesman saved the positions of the VMEs on the vessel plotter.

Rhodoliths *Coralline algae* were the most common of the benthic organisms. They came in different colours. Some appeared alive with green or purple colours and others almost white and worn away. (Annexure 4).

5.1. Biological Samples Retained

Jasus tissue samples for genetic analysis were collected from five males and five females. These samples (sections of the legs) were placed in vials filled with surgical alcohol and stored in the vessel's freezer hold (see table below).

Tissue samples for genetic analysis				
NO	**Set Number**	**Sex**	**CL**	**Weight**
F1	20	FM	113	0.67
F2	20	FM	100	0.48
F3	20	FM	118	0.71
F4	20	FM	104	0.52
F5	20	FM	103	0.55
M1	20	M	145	1.36
M2	20	M	129	1.03
M3	20	M	152	1.69
M4	20	M	134	1.1
M5	20	M	117	0.73

Samples will be delivered to;

Johan Groeneveld. Senior Scientist. Oceanographic Research Institute (ORI)
Direct Tel: +27 (31) 328 8180 Fax: +27 (31) 328 8188
1 King Shaka Avenue, Point, Durban 4001 KwaZulu-Natal South Africa
jgroeneveld@ori.org.za

The observer managed to sample the contents of all the traps and the volumes that came up on the line was achievable. The observer sampled every other trap and weighed all the lobster and *Chaceon* in that trap. The weights from the trap tally scale were not exactly the same as the weight from the observer scale. The trap tally scale had a modified weighing platform and in rolling sea conditions, it did not fully stabilise on a value. A midpoint value therefore was recorded as the weight for that trap. The difference was not that significant for the *Jasus* and the overall crew weights were only on average 2% larger than the observer's weights. The *Chaceon* crew weights however, were 13% larger than the observer's. This can be seen when comparing the observer sample weights to the trap tally weights.

6. SEABIRD, TURTLE AND MARINE MAMMAL INTERACTIONS WITH VESSEL

6.1. Mitigation Measures

No bait, offal, dead floating bycatch, factory offal or food waste were discarded during hauling or setting of the lines. The factory produced very little offal as the *Jasus* were retained whole and very few *Chaceon* was caught and processed at the Kopernik seamount, where the bulk of fishing activities occurred. When *Chaceon* were caught and retained the shells were ground up, retained in a holding tank and pumped out when no hauling or setting was conducted.

The observers noted and recorded all the birds observed during hauling and setting operations. The international observer noted a substantial increase in the abundance and number of species that were observed during trip one. It was observed that the Sooty shearwater (*Puffinus griseus)* and Black browed Albatross (*Thalassarche melanophris*) would sometimes land and sit on the water to feed off some small bait pieces that washed off from the bait jars. The area approximately 50m astern where the birds landed was free of any fishing gear as the traps and mainline had already disappeared below the surface. The traps landed in the water within a meter from the vessel's stern and started sinking immediately.

Black browed Albatross (*Thalassarche melanophris*) and Buller's Albatross (*Thalassarche bulleri)* were regularly observed during setting and hauling. Apart from the Sooty shearwater and Black browed albatross feeding on small bait pieces, no other bird interactions with the vessel or fishing gear was observed. The observer regularly took pictures of the birds following the vessel during hauling and setting. These pictures were recorded (Annexure 13). Other birds observed from time to time were; Salvin's Albatross (*Thalassarche salvini),* Wandering Albatross (*Diomedea exulans),* Northern giant Petrel (*Macronectes halli),* Cape Petrel (*Daption capense),* Black Petrel *(Procellaria parkinsoni)* and an unidentified shearwater species.

7. WASTE AND DEBRIS

7.1. Vessel Waste Disposal Procedures

The bait boxes had no packaging bands. The blue plastic liners were all retained and stored in a bag on the upper deck. The cardboard boxes had no plastic tape strips of any kind and were discarded overboard after lines were set. During set number 22 the observer noticed that small pieces of the blue plastic liner came out of the bait jars as they were being emptied at the hauling station (Figure 4, Annexure 8). He informed the fishing master and the captain of the presence of plastic in the bait that was discarded overboard at the end of each haul. The fishing master and captain responded by instructing the crew to take better care when removing the blue liners from the frozen bait. In addition the hauling crew was instructed to look out for any plastic when they empty the bait at the hauling station. An extra container was placed at the hauling station that was used by the haul-crew to place any plastic they might find when emptying the bait jars (Figure 5, Annexure 8). All plastic and non-biodegradable material were retained and stored in huge plastic bags on the lower deck of the stern area (Figure 2, Annexure 8). When a large bag was full it would be tied shut with string and a new one made available. The kitchen separated food and other waste (Figure 1, Annexure 8) and when the non-biodegradable small black garbage bags were full it was deposited into the big bag astern. There were water filled bottles tied up in four different locations for smokers to discard their cigarette butts into (Figure 3, Annexure 8). Once the cigarette bottles were full, the whole bottle was discarded into the big bag astern and a new bottle half filled with water was hanged in its place.

8. Marine Debris at Sea

Date	Description	Latitude	Longitude	Hauled aboard (Y/N)	Size (m)	Weight (kg)	Photograph attached (Y/N)
13/06/2019	Section of Polly propylene line	35°54.20-S	116°02.73-W	No	100		Yes
14/06/2019	Section of Polly propylene line, 3 buoys and section of angle iron	35°54.14-S	115°59.51-W	Yes	250	50kg	Yes
24/06/2019	Section of Polly propylene line	35°54.37 S	115°59.15-W	No	100+		Yes

Comments: See attachment (Annexure 9)

9. ILLEGAL, UNREPORTED AND UNREGULATED (IUU) VESSEL AND GEAR SIGHTINGS

Apart from the fishing gear noted above, no other gear was sighted. No fishing vessels were sighted. Only one other vessel was sighted during trip two. **Vessel name:** Princess Royal, **Type:** Cargo, Name: Princess Royal, **Position:** Approximately 5nm from Altar 6 position- 35°54.317 S, 116°01.993-W, **Date:** 23/06/2019 (Annexure 10).

10. ADDITIONAL INFORMATION

10.1. Operational Issues

The observer had a good working relationship with the Cook Island observer. The Cook Island observer was responsible for the trap tally and the international observer for sampling. The observers had access to all parts of the vessel including the communication systems. The crew were helpful throughout and together with the MMR observer, the two observers were assisted in securing samples selected by the observer[1].

[1] Note: An incident between the two observers was reported at the end of the trip. CapMarine debriefed their observer on return to base (Cape Town) to understand the nature of the incident. It was established that an empty milk carton was thrown in jest in the mess room. The company queried the observer if the working relationship with the MMR observer was affected and understood that no malice was associated with the throwing of the carton and that the two observers had had a good working relationship. The company raised a disciplinary note for the record but agreed that no further action was needed.

10.2. Observer Tasks

It happened a few times that a part of the selected lobster sample spilled over the basket and landed in the factory chute. The sample was then discarded and the first trap thereafter was selected. On a few other occasions the observer–doing the trap tally and the person responsible for selecting samples neglected to retain the specified sample in time and the crew already channelled the specific trap's catch to the factory. In these cases, the observer would select the first trap thereafter and then continue with every tenth trap as per the original sequence.

10.3. Observers Database

The observer experienced no problems with the new database and found it more user friendly than the first version.

10.4. Observer Cruise Report

The observer experienced no problems with completing the trip report. Tables to be extracted from the database were left open for completion by CapMarine.

10.5. Educational Material

There were no fish or bird Id guide books onboard the vessel. The observer totally relied on the Pdf ID guides secured shortly before trip 1 but was unable to identify some species because it could not be found in the available digital ID guides. Only two new species were encountered on the second trip. The observer e-mailed pictures to Cap Marine to assist in identification

10.6. Bottom temperature

The vessel supplied three thermometers to the observer in the attempt to record the bottom temperature. The thermometers were tied to the inside of a trap before it was set. Although the thermometers were not physically damaged they could not serve the purpose and no bottom temperatures could be obtained. When the thermometers were retrieved after being submerged in 200m deep water the mercury had separated in various places and the needle indicating the minimum and maximum temperatures had disappeared (Annexure 11). Attempts to obtain the bottom temperatures were abandoned after all three thermometers were damaged. Purpose made marine grade thermometers should rather be used for measuring bottom temperature.

10.7. Small mesh traps

In order to experiment with smaller mesh traps the vessel acquired a length of sardine fishing net with a mesh size smaller than the standard mesh of the traps. Sardine net mesh size was 28mm knot to knot and the standard mesh was 51mm knot to knot. The vessel crew fitted the small mesh net over the standard size mesh on the inside of the trap as they deemed the sardine net not suitable to cover a trap on its own. They informed the observer that the net was too soft, thin and stretchy. Five traps were fitted with the small mesh. Only when the fishing operations started the observer realised that only the sides of the traps were covered in the small mesh and the bottom section of the trap with the draw string to empty it of the contents had standard mesh (Annexure 12). Since the traps were hauled at an angle and not straight up, the observer decided to continue with the experiment regardless of the small mesh trap design flaw.

A string with 106 traps was selected for the placement of the small mesh traps and every twentieth trap on the line was selected for the placement of the small mesh. The observer samples would then consist of five standard mesh traps and five small mesh traps. The observer experienced difficulty in placing the traps in the pre-selected slots. The reason for this was that the traps were not clearly marked as small mesh traps and the first few times the crew had accidently buried the small mesh traps under and among multiple standard mesh traps. After the first two unsuccessful attempts the crew managed to keep the small mesh traps separated from the rest and three successful deployments were managed. The observer counted the traps with a tally counter as they were set and instructed the crew when to insert a small mesh trap as per pre-selected positions. On the fourth deployment of the small mesh the line broke twice and 61 traps were lost with three small mesh traps among them. The observer also noted on the last haul that one of the small mesh traps came up with the net torn and came to the conclusion that the small mesh net was not strong enough to withstand the "assault" from the sharp spiny appendages of the large lobster. The line and trap numbers of the small mesh traps were recorded in the trip spreadsheet.

10.8. Damaged traps

During observations at the hauling station the observer noted that some traps, mostly the recycled damaged traps did not close properly around the "zip" drawstring. Lobster would sometimes hang halfway through these openings or even fall out before the trap was opened. By the size of the openings the observer estimated that small to medium sized lobster would be able to escape through these openings (Annexure 14).