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*La Havana, Cuba, 7 to 12 October 2019*

### SC7-DW22

Exploratory lobster trap fishing: Analyses of the biology of *Jasus caveoruum*

*Cook Islands*

7<sup>th</sup> Meeting of the Scientific Committee  
La Havana, Cuba, 7-12 October 2019

Cook Islands exploratory lobster trap fishing in the SPRFMO  
Analyses of the biology of the target species *Jasus caveorum*  
based on information from two exploratory trips  
conducted on the FV Altar 6 from  
March – July 2019

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Research Undertaken on behalf of  
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Exploratory Trap Fishing Protocol (CMM 14b-2019)

Fishing conducted under the flag of the Cook Islands and the mandate of the  
*Ministry of Marine Resources*  
Government of the Cook Islands

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## 1. Executive summary

This paper should be read in conjunction with SC7-DW02 (Cook Islands exploratory lobster trap fishing in the SPRMO – Trips 1 and 2) and provides supporting information on the biology and stock structure of rock lobster *Jasus caveorum*. The condition of the stock at the onset of the exploratory fishery was assumed to be pristine, because it has not previously been exploited on a commercial basis. The supporting information was obtained from previous studies on *Jasus* lobsters in the literature and from two exploratory fishing trips to the Foundation Seamount Chain by the FV Altar 6 in 2019. Because the data cover only a short timeframe (first arrival at seamounts early April; last departure late June), and the catchability of lobsters depend on seasonal biological cycles, inferences remain uncertain, and need to be strengthened by collecting more information over a full annual cycle.

Key findings were that *J. caveorum* display characteristics that are typical of other well-studied *Jasus* species, such as: a limited latitudinal distribution range between 30°S and 45°S; preference for rocky habitats in shallow waters (<200 m depth); larger males than females in adult size classes; a greater abundance of males in the larger size classes; an egg-bearing season that starts at the onset of winter (Apr-Jun); high fecundity and broadcast spawning; limited movements but potential segregation by size or sex to achieve biological prerogatives; presence of several yearly cohorts in an area at any one time; sexual maturation at a relatively large size (>70 mm CL); and most likely (but not apparent from the data) a very long drifting phyllosoma larval stage with high dispersal potential.

The short-term effects of exploratory trap-fishing on the lobster stock on Kopernik seamount matched the theoretical expectation of fishing on a previously unexploited resource, that abundance of the target species would decrease over time. The nominal CPUE (catch-per-unit-effort) trend, measured as kg/trap-lift and as the numbers of lobsters caught (n/trap-lift) on a weekly basis, declined over the duration of the two trips, although weekly CPUE values varied. Between the end of trip 1 and the start of trip 2, a small improvement in catch rate was apparent. Although not conclusive, this is likely due to the redistribution of remaining lobsters on the seamount to occupy vacated habitats. There was also a gradual decrease in the average CL of all captured lobsters, except for males whose CL increased between Trips 1 and 2. Changes in CL are expected when fishing down populations as larger slower growing individuals are typically selectively removed faster than they can be replaced when fishing on a previously "unfished" stock.

The increase in catches of large males seen during trip 2, is likely (but not conclusively) a result of a seasonal increase in their catchability associated with behavioural change as the fishery moved closer to the critical breeding period.

We recommend that a more thorough statistical analysis of CPUE using GLM or other methodology would be prudent using a longer time series and a reference set that might include influencing variables before drawing any firm conclusions on changes in abundance.

## 2. Objective of this paper

To provide background information on the distribution and biology of *Jasus* spp. from the published literature, and to provide supporting analyses on the biology and stock structure of *Jasus caveorum* based on sampling undertaken on the FV Altar exploratory trips from March-July 2019.

## 3. Distribution and fisheries for *Jasus* spp. in southern waters

The rock lobster genus *Jasus* comprises of 6 species that all occur in temperate southern hemisphere waters, circumglobally in a band between the latitudes 30°S and 45°S (Figure 1) (Holthuis 1991; Weber and Booth 1995). Two of the species occur adjacent to large landmasses, where they support major commercial fisheries – these are *Jasus lalandii* (west and southwest South Africa) and *Jasus edwardsii* (southern Australia, Tasmania and New Zealand).

The other 4 *Jasus* species all occur around small isolated islands and on non-emergent seamounts (Figure 1), and except for *J. caveorum*, they support managed commercial fisheries. The fisheries are for *Jasus tristani* in the south Atlantic (Tristan da Cunha archipelago; some 400 t per year) for *Jasus paulensis* in the southern Indian Ocean (St Paul and Amsterdam islands; 350 t per year) and for *Jasus frontalis* in the southeast Pacific (Juan Fernandez and Desventuradas islands; 80 – 100 t per year) (Jefferies et al. 2013; [www.msc.org](http://www.msc.org)). These three fisheries all rely on trapping and have long histories of exploitation, extending at least over the past 50 years. The fishery for *J. tristani* at Tristan da Cunha (active since 1949; Glass 2014) has been certified as well-managed by the Marine Stewardship Council (MSC) since 2011, and the fishery for *J. frontalis* has been MSC-certified since 2015. The French fishery for *J. paulensis* at St Paul and Amsterdam islands (since 1950) voluntarily entered a full MSC assessment in 2019. All three fisheries are considered to be sustainable over the long term under the present management regimes.

## 4. Life history of *Jasus* lobsters

The 5 *Jasus* species for which long-term information is available (i.e. excluding *J. caveorum*) are biologically and morphologically very similar (Booth 2006) and there is relatively little genetic divergence between them (Ovenden et al. 1997; von der Heyden et al. 2007; Groeneveld et al. 2012). They also have similar reproductive strategies, including late maturation, slow growth and broadcast spawning (reviewed by Jefferies et al. 2013), with larvae that drift in ocean currents for months or years, implying a high dispersal potential. *Jasus* females reach sexual maturity between 3 and 7 years of age, at an average carapace length (CL) of between 53 and 104 mm (Table 1).

Mature females moult early in winter followed soon after by mating, during which a short-lived spermatophore is attached by the male onto the sternum of the female. Egg-extrusion follows right after this, with fertilization taking place externally, and the extruded eggs then attaching to the ovigerous setae on the abdomen of the female. The brood period during which eggs remain attached to the female range from 2.5 to 6 months, during which larvae develop through 4 macroscopically distinguishable stages. Eggs hatch into drifting phyllosoma larvae during spring or early summer. Webber and Booth (1995) observed *J. caveorum* females with eggs during winter, suggesting a similar winter brood period to the other 5 *Jasus* species.

Females produce only 1 brood of eggs per year. The egg clutch size depends on the size of the breeding female, ranging from 7000 eggs in a very small *J. tristani* female to >600 000 eggs in large *J. edwardsii* or *J. frontalis* females (Table 1) (Pollock and Goosen 1991; Jefferies et al. 2013).

The drifting larval period of *Jasus* is very long, with phyllosomas spending between 7 and 24 months in the plankton. During this period they moult through several developmental stages (11 stages identified for both *J. edwardsii* and *J. lalandii* larvae; Kittaka 1988; Kittaka et al. 2005), and may be dispersed by ocean currents over vast areas – potentially as far as 6000 km from Tristan da Cunha

(south Atlantic) to St Paul and Amsterdam Islands (southern Indian Ocean) (Groeneveld et al. 2012). The high dispersal potential can explain the occurrence of isolated lobster populations occurring on seamounts that are very isolated or far apart. The phyllosoma finally undergoes a metamorphosis into a short-lived puerulus larvae, which can swim directionally and settles on the seafloor, thus resuming its benthic life history phase.

## 5. Ecology and behaviour

*Jasus* are shallow-water lobsters that mainly inhabit rocky reefs and foul ground from the intertidal zone to about 200 m depth, with some species extending to 400 m depth (Jeffs et al. 2013). Webber and Booth (1995) found *J. caveorum* at depths of 140 – 180 m. *Jasus* are nocturnal, emerging from their dens to feed at night. They are opportunistic feeders, ingesting a wide variety of sessile organisms – primarily molluscs, crustaceans, polychaetes and echinoderms, and sometimes algae. The diet of *J. tristani* at Tristan da Cunha archipelago includes a large percentage of kelp, sponges and bryozoans, reflecting feeding in impoverished reef habitats (Blamey et al. 2019). The diet of *J. caveorum* is yet unknown but may similarly be affected by the general paucity of benthic fauna at isolated seamounts. Beurois (1974) reported high levels of cannibalism in the deep-sea populations of *J. paulensis* at St Paul and Amsterdam islands.

Tagging studies have shown that most *Jasus* species exhibit high site fidelity and are resident most of the year, moving less than 3 km from tagging sites. *Jasus* often undertake seasonal inshore-offshore movements associated with moulting and breeding, but these generally take place over short distances. Movements are sometimes sex or size specific – for example, mature females of *J. edwardsii* in New Zealand move inshore to moult prior to breeding in winter and remain there until spring when they move out to deeper waters to release their eggs (MacDiarmid 1991). Males only move inshore for a brief period during winter for mating and moulting, and then move to deeper waters to feed over the sand. Although they sometimes occur, long-distance migrations are uncommon in *Jasus* spp. (Linnane et al. 2005). Given their distribution on seamount pinnacles, *J. caveorum* is most likely restricted to short movements up and down the slope of seamounts, potentially related to recruitment of juveniles, moulting, mating and egg-bearing.

## 6. Recruitment and density dependence

It remains unclear whether *Jasus* occurring on seamounts or around isolated islands rely on self-recruitment (i.e. larvae originating from a specific seamount will be caught up in eddies near the seamount, and return to it to settle after completing the larval phase), or whether recruitment relies on a mixed pool of drifting larvae, originating from various sources (von der Heyden et al. 2007; Groeneveld et al. 2012). This is an important factor, because reliance on self-recruitment alone would make isolated seamount populations highly vulnerable to overfishing (viz. collapse of *J. tristani* populations at Vema Seamount during the 1960s, without subsequent recovery; Heydorn 1969). To the contrary, a pool of larvae originating from many sources (fished and unfished) will provide a buffer against recruitment overfishing on a specific seamount.

Recruitment strength is typically highly variable between years (or cohorts), because it depends on favourable oceanographic conditions during the long larval dispersal phase. Factors that may affect survival rates of phyllosomas during dispersal, and hence the numbers that arrive at benthic settlement habitats, include the strength and direction of ocean currents, sea surface temperature, nutrition and predation rates. These may differ year-on-year.

After successful settlement to the seafloor, the availability of shelter (crevices) for juveniles is crucial to limit predation by fish. A compensatory density-dependence has been shown for *J. tristani*, whereby lobsters grow faster at lower densities, because of increased per capita food availability (Pollock 1991). Note that seamounts without adequate shelter for settlers or juvenile lobsters may not be able to support viable lobster populations, because of high predation pressure on recently

settled juveniles. This may explain the apparent absence of *J. caveorum* on some of the seamounts sampled on the Foundation seamount chain, even when pinnacles reach shallower depths.

## 7. Interpretation of preliminary results from Trips 1 and 2

Data collected during the 2 trips are provided in SC7-DW02, but additional information is provided here to aid the interpretation of key observations. Criteria used to distinguish egg-bearing stage (reproductive season) and shell state (moulting) are provided in Table 2.

Key observations from the biological information collected for *J. caveorum* during the 2 trips are shown in Table 3. The sex ratio in trap catches was dominated by males during both trips (Figure 2). The smallest mature female, based on presence of ovigerous setae (CT, which indicates that physiological maturity has been reached) measured 74 mm CL. The smallest egg-bearing female (which indicates functional maturity) measured 79 mm CL. Eggs carried externally by females were predominantly in early developmental phases (Stage 1 – orange yolk; and Stage 2 – orange yolk with small black eyespots; see Table 2a for egg-bearing stages). The majority of lobsters were in a pre-moult condition (old hard shell) but the proportion of post-moult lobsters (new hard shell) increased during trip 2 (see Table 2b for shell conditions). Males were much larger than females, as a result of a decline in female growth rates after they become sexually mature (Figure 3). Male lobsters caught during trip 2 were larger than those caught during trip 1, but the average size of females remained constant (Figure 4).

The information provided here is interpreted in Table 4, within the context of known life history characteristics and population dynamics expected of *Jasus* lobsters. Note that the interpretations are preliminary, and that seasonally collected data over a 1-year period, at least, are required to confirm them.

## 8. Nominal CPUE trends

Nominal CPUE was calculated as the total weight of lobsters caught per trap-lift (kg/trap) and as numbers of lobsters caught per trap-lift (lobsters/trap) and averaged over weekly intervals so that short-term trends could be visualized. CPUE trends were derived for Kopernik seamount only, because too few lobsters were caught on other seamounts. Overall, CPUE averaged 8.65 kg/trap for soak-times of 24-h, and 7.07 kg/trap for 48-h soak times.

By weight, CPUE was highest during the 2nd week of fishing of trip 1 (Figure 5) when it averaged 17.1 kg/trap, but then declined gradually over the next 4 weeks to 7.2 kg/trap during the last week of trip 1. Overall, the decline in weekly CPUE was 68% over the 5 week fishing period, excluding week 1. We assumed that the low average CPUE measured during the first week of fishing on trip 1 (5.6 kg/trap) was associated with the process of familiarisation with the fishing grounds and have excluded it as being an underestimate of relative abundance.

Only 3 weeks of fishing was conducted during trip 2. Whereas the initial trip 2 CPUE values were higher than at the end of trip 1 (9.24 kg/trap), the CPUE declined to 6.9 kg/trap during the last week of fishing during trip 2. Although kg/trap declined by about 3.4% per week over the fished period (trips 1 and 2 combined) the fit to the data was insignificant ( $R^2 = 0.078$ ).

By numbers of lobsters caught per trap (Figure 6), CPUE was also highest during week 2 of fishing of trip 1 (29.6 lobsters/trap) but declined to 4.3 lobsters/trap during the last week of trip 1. CPUE increased to 9.7 lobsters/trap at the start of trip 2, some 4 weeks after leaving the ground on Trip 1. We hypothesize that between trips redistribution of lobsters had likely taken place. Thereafter nominal CPUE as measured by lobsters/trap remained relatively stable over the 3 weeks of trip 2. Overall, for both trips combined, the nominal CPUE trend measured as numbers of lobsters caught per trap-lift declined by about 8.2% per week over the fished period, although again a simple linear regression suggested a poor fit to the data ( $R^2 = 0.11$ ).

While the catch rate trend as suggested by nominal CPUE-trends indicates a gradual depletion, this is expected to occur when fishing on an unexploited resource. Further, short-term changes in availability that might affect catchability are likely affected by lobster movements, moulting, mating, egg-bearing and spawning (Ziegler et al. 2003). For example, the increase in catches of large males during trip 2, compared to trip 1 (Figures 5 & 6) rather reflects an increase in catchability of large males than an increase of large males in the lobster population on Kopernik. It is also likely that the average CL of lobsters on Kopernik will decline over time with continued fishing pressure. Lobster growth rates are typically slow (particularly in large size classes) and unlikely to sustain removals of very large individuals by fishing (Table 5). However although growth rates of smaller lobsters are faster than for larger ones (Jefferies et al. 2013), total biomass of the lobster population on Kopernik is likely to be sustained at a relatively lower level than currently exists when the population structure comprises of proportionately more smaller lobsters than larger ones (as is the current case).

We therefore suggest a more thorough statistical analysis of catch rate using GLM or other methodology would be prudent using a longer time series and a reference set that might include influencing variables before drawing any firm conclusions on changes in abundance.

## 9. Conclusions

Key findings were that *J. caveorum* display characteristics that are typical of other well-studied *Jasus* species, such as: a limited latitudinal distribution range between 30°S and 45°S; preference for rocky habitats in shallow waters (<200 m depth); larger males than females in adult size classes; higher trap-selectivity for males; an egg-bearing season that starts at the onset of winter (Apr-Jun); high fecundity and broadcast spawning; limited movements but potential segregation by size or sex; presence of several yearly cohorts in an area at any one time; sexual maturation at a relatively large size (>70 mm CL); and most likely (not in data) a very long drifting phyllosoma larval stage with high dispersal potential.

The short-term effects of exploratory trap-fishing on the lobster stock on Kopernik seamount matched the theoretical expectation of fishing on a previously unexploited resource, that abundance of the target species would decrease over time.



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## Figures and Tables

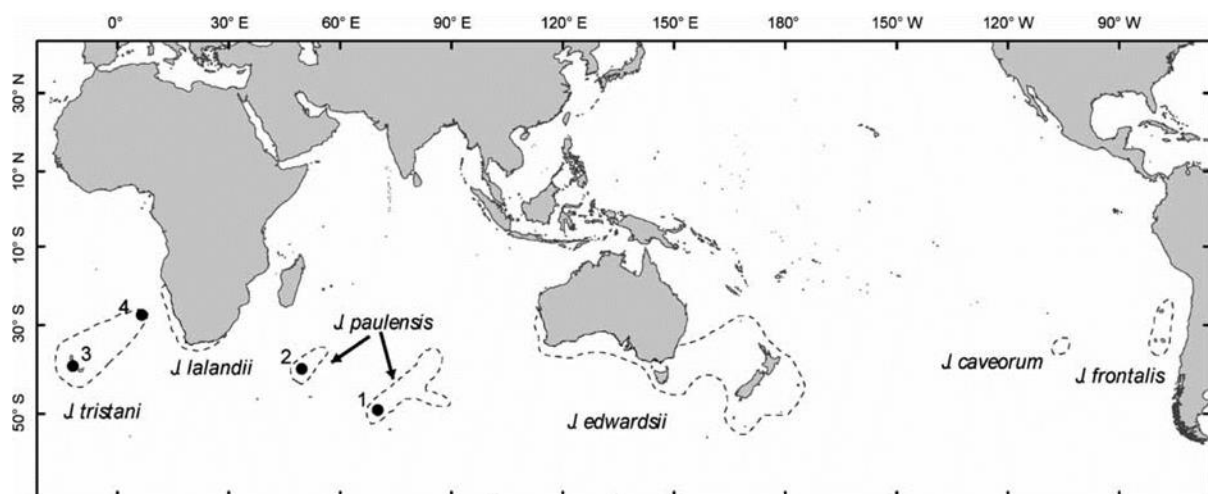


Figure 1: Distribution of *Jasus* rock lobsters in the mid-latitude (30–45°S) southern hemisphere based on Booth (2006)

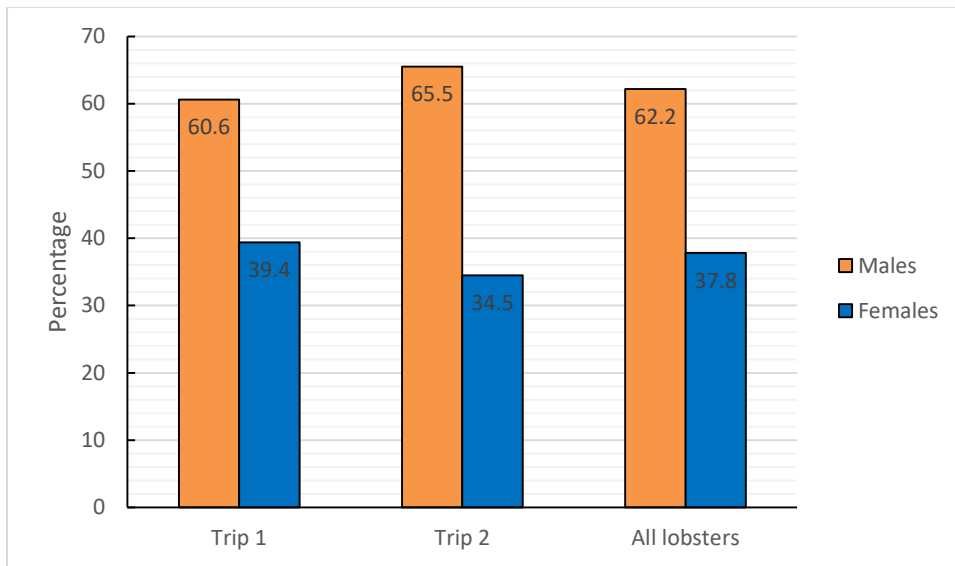


Figure 2: Sex ratios show male dominance in trap catches

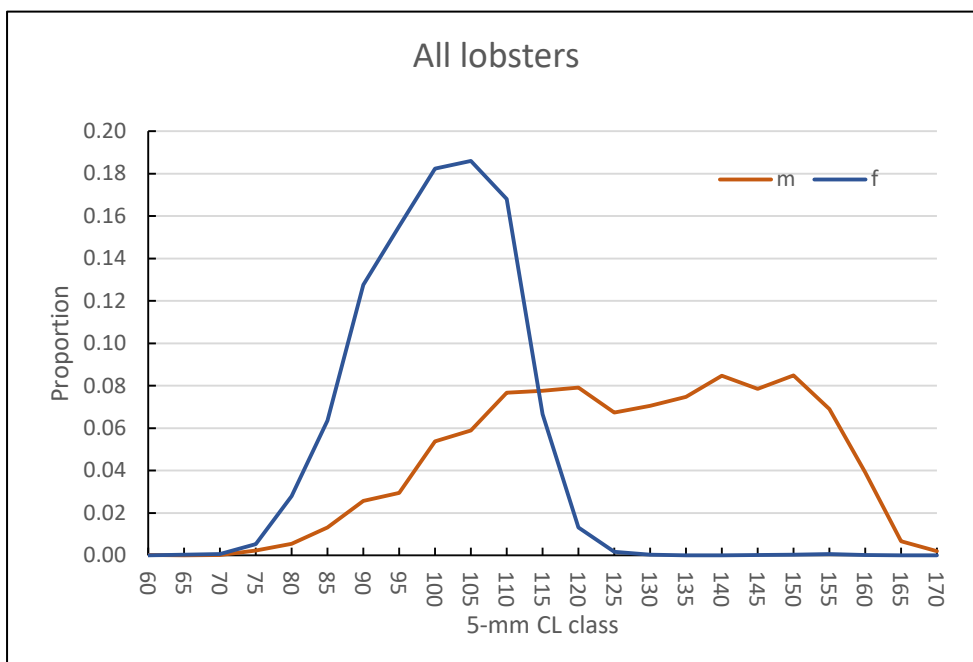


Figure 3: Male *Jasus caveorum* become larger than females, as a result of a sharp decline in female growth rates after they become sexually mature.

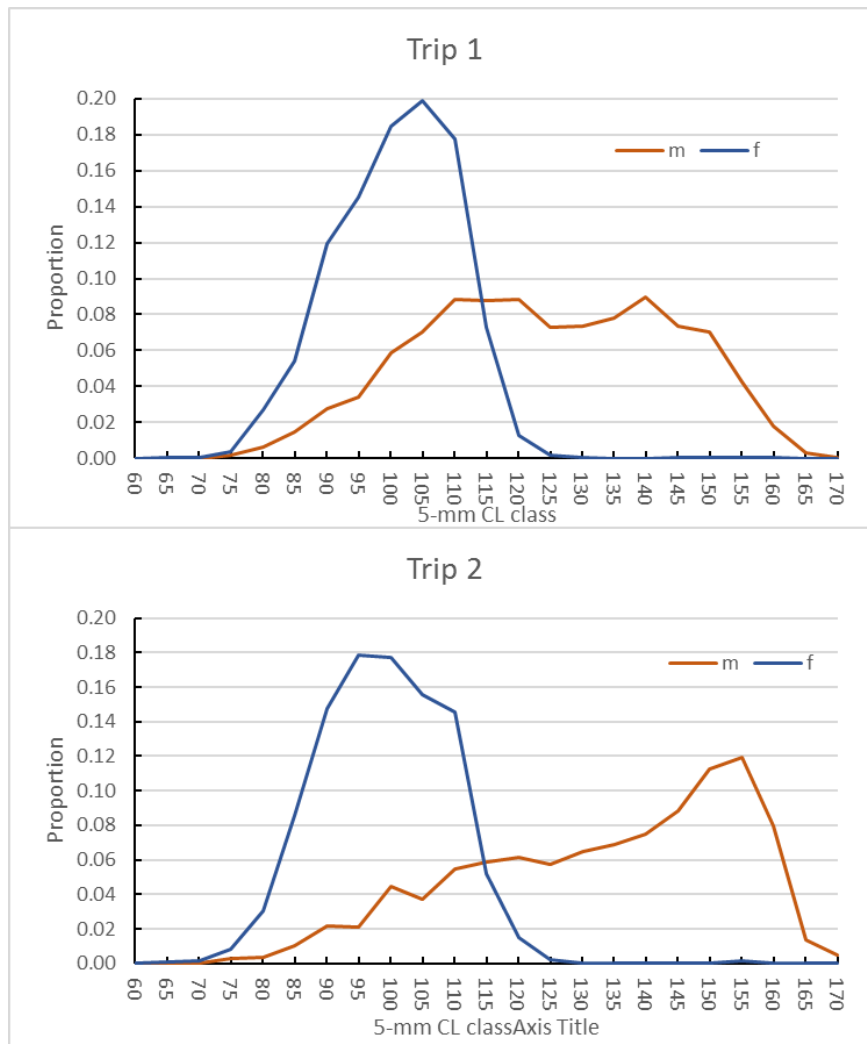


Figure 4: Male lobsters caught during trip 2 were larger than those caught during trip 1, but the female mode remained constant.

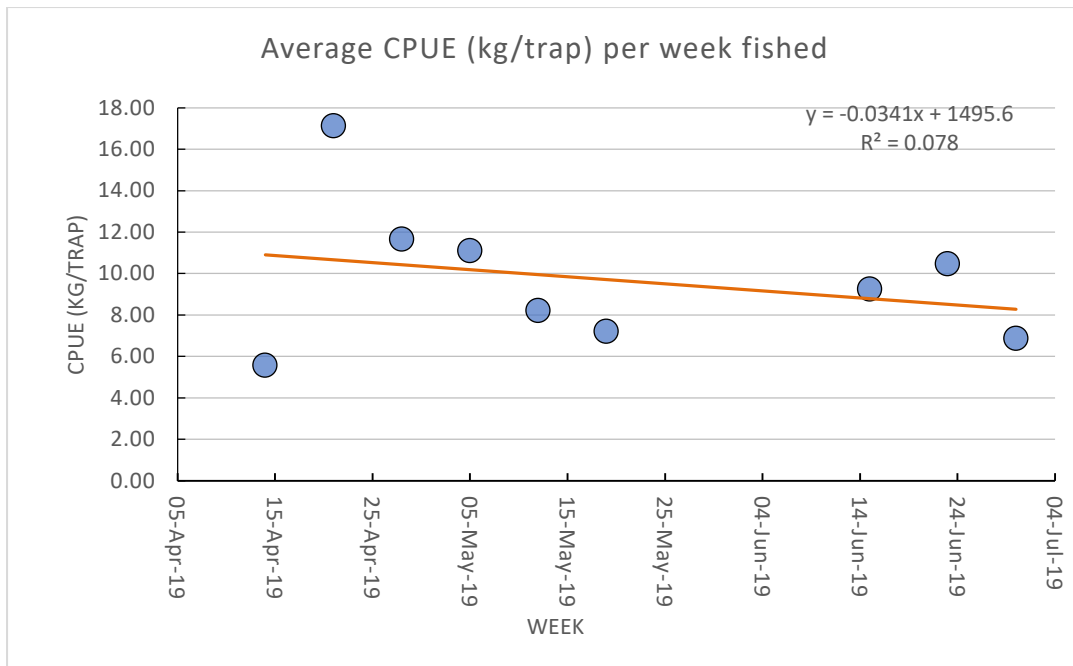


Figure 5: Average weekly CPUE (kg/trap) of all lobsters caught at Kopernik during trips 1 and 2

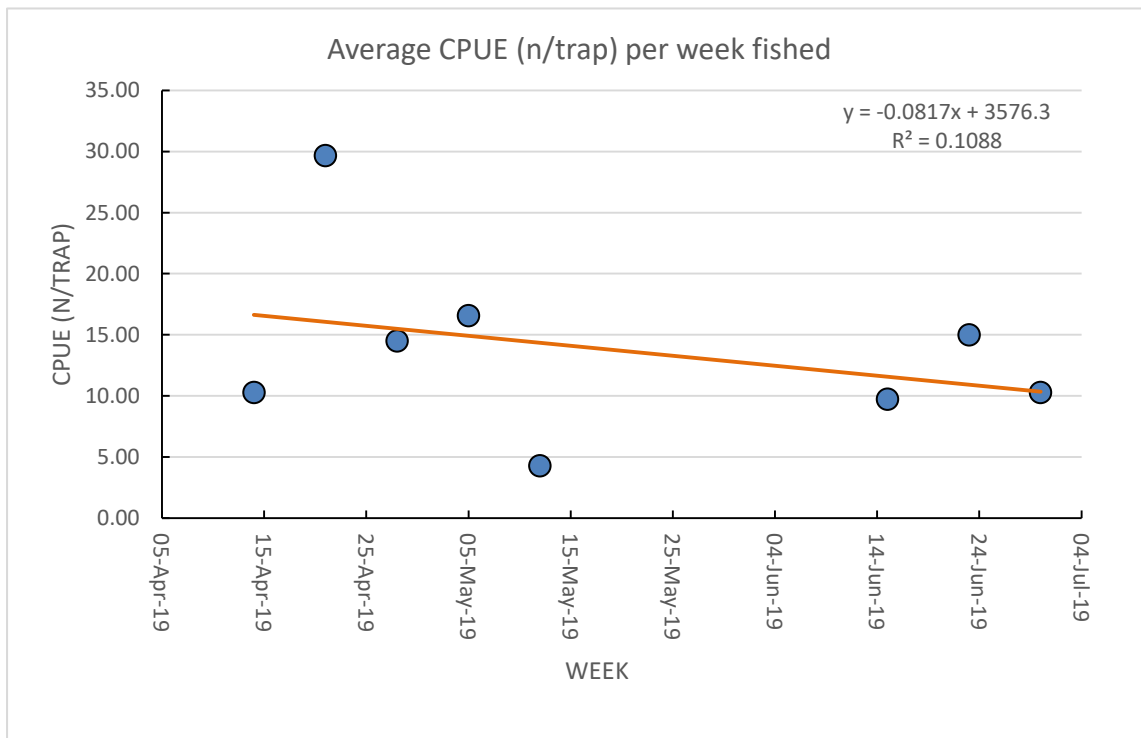


Figure 6: Average weekly CPUE (n/trap) of all lobsters caught at Kopernik during trips 1 and 2

Table 1: Reproductive parameters for 5 *Jasus* spp. obtained from a review by Jeffs et al. (2013)

	<i>J. edwardsii</i>	<i>J. lalandii</i>	<i>J. paulensis</i>	<i>J. tristani</i>	<i>J. frontalis</i>
Location	Australia & New Zealand	South Africa	St Paul & Amsterdam islands	Tristan da Cunha archipelago	Juan Fernandez & Desventuradas
Size at maturity (CL, mm)	63-104	53-65	65-75	56-60	75-77
Age at maturity (Yrs)	3-7	5			7
Egg-bearing season	Win/Spr	Win/Spr	Win	Win	Win/Spr
Hatching	Spr	Spr	Spr	Spr/Sum	Spr/Sum
Brood period (mo)	3.5	2.5-4	4-6	4-6	2.5-6
Batch size (x10 <sup>3</sup> )	44-660	33-490		7-137	61-524
Duration of phyllosoma (mo)	12-24	14-18			
Duration of puerulus (days)	9-25	Days to weeks			

Table 2: Criteria used to distinguish egg-bearing stages during embryo development, and to determine shell state as an indicator of moult condition

a) Macroscopically distinguishable egg-bearing (berry) stages	
Stage 1	Bright orange (yolk) with no black eyespots.
Stage 2	Orange with small black eyespots visible.
Stage 3	Brown with larger black eyespots.
Stage 4	Brown, stringy, scratched-open by females. Often only vestiges visible.
b) Shell state as assessed from hardness and encrusting growth	
Shell state 1 (Moulting)	Soft shell, jelly-like or thinly hardened. Easily buckled when applying pressure. Lobster has moulted within past few days. Lobsters do not feed when in a soft-shelled condition
Shell state 2 (Pre-moult)	Old hard shell, thick and very solid under pressure, encrusted with algae, barnacles or other shellfish. Lobster has not moulted for many months
Shell-state 3 (Post-moult)	New hard shell, strong but not as thick as in Stage 2. Shell clean, without marine growth. Lobster moulted relatively recently (past month)

Table 3: Summary of biological data collected by observers during trips 1 and 2.

<i>Jasus caveorum</i>	Trip 1		Trip 2		All lobsters	
	N	%	N	%	N	%
Sample	9457		4545		14002	
Males	5728	60.6	2976	65.5	8704	62.2
Females	3729	39.4	1569	34.5	5298	37.8
Immature (F)	8	0.2	3	0.2	11	0.2
Egg-bearing	37	1.0	258	16.4	295	5.6
Stage 1 (bright orange)	11	0.3	20	1.3	31	0.6
Stage 2 (orange & black eyespots)	24	0.6	220	14.0	244	4.6
Stage 3 (brown & large eyespots)	2	0.1	18	1.1	20	0.4
Stage 4 (brown strings, scratched)	0	0.0	0	0.0	0	0.0
Shell hardness 1 (soft)	1	0.0	0	0.0	1	0.0
Shell hardness 2 (old hard, encrusted growth)	9251	97.8	4046	89.0	13297	95.0
Shell hardness 3 (new hard, clean)	205	2.2	499	11.0	704	5.0

Table 4: *Jasus caveorum*. Preliminary interpretation of findings during trips 1 and 2 relative to known life history characteristics of *Jasus* lobsters and population dynamics expected of *Jasus*

Attribute	Finding	Interpretation
Sex ratio (M : F)	Male dominated both trips Trip 1 (61 : 39) Trip 2 (65 : 35) All trips (62 : 38)	Several potential explanations.  1) Because of different growth rates, there are more and larger males in the exploitable size range of the population  2) Trap-selectivity promotes capture of males because they are larger / more aggressive or better retained by the mesh-size used.  3) Females less active between April & June because of onset of the reproductive season.  4) Females less abundant in fished areas, because they have moved deeper to moult / reproduce
Catches of immature females	Only 0.2% of captured females were sexually immature	1) Immature female lobsters are rarely caught. Trap mesh-size selective for larger lobsters.

Size at maturity of females	<p>Method 1 – Presence of CT Smallest mature = 74 mm CL</p> <p>Method 2 – Presence of eggs Smallest egg-bearing = 79 mm CL</p> <p>Logistic curve based on CT L50 = 71 mm CL</p>	<p>1) Preliminary analysis of limited ovigerous setae and minimum size at egg-bearing data show that females reach physiological maturity at 74 - 79 mm CL (they have CT present), with egg-bearing starting after reaching 80 mm CL</p> <p>2) Logistic curve underestimates L50 because of too few data points</p> <p>3) Moulting (and growth) takes place between emergence of CT (physiological maturity) and first batch of eggs (functional maturity)</p>
Percentage of egg-bearing females	<p>Trip 1 (1.0%) Trip 2 (16.4%)</p>	<p>1) Trip 1 (April to early-May) took place before the beginning of the egg-bearing season</p> <p>2) Trip 2 (late-May to end-Jun) took place during the early part of the egg-bearing season</p> <p>3) Both percentages are low compared to expected values during breeding season (&gt;50%)</p>
Percentage per egg stage (stages 1 – 4)	<p>Trip 1 (% per egg-stage): Stage 1 = 30% Stage 2 = 60% Stage 3 = 10% Stage 4 = 0%</p> <p>Trip 2 Stage 1 = 8% Stage 2 = 85% Stage 3 = 7% Stage 4 = 0%</p>	<p>1) Most females had eggs in Stages 1 and 2 between April and end-June, confirming that fishing took place early in the egg-bearing season</p> <p>2) More egg-batches were in stage 2 during trip 2 (85%) compared to trip 1 (60%), confirming the progression of the breeding season into the winter.</p> <p>3) No egg-batches were in stage 4, therefore hatching has not yet occurred</p>
Shell state & moulting	<p>Trip 1 Old hard (pre-moult) = 98% New hard (post-moult) = 2%</p> <p>Trip 2 Old hard (pre-moult) = 89% New hard (post-moult) = 11%</p>	<p>1) Approx. 10% of lobsters moulted between trips 1 and 2.</p> <p>2) Female moulting is followed immediately by mating and the extrusion of eggs.</p> <p>3) Soft-shelled lobsters (first few days after moulting) don't feed and therefore don't enter traps – hence explaining their absence in trap catches</p>
CL composition by sex	Average CL $\pm$ Std (all data)	1) Males become much larger than females, as a result of a sharp decline in female



	<p>Both sexes = <math>119 \pm 22</math> mm  Males = <math>129 \pm 20</math> mm  Females = <math>102 \pm 10</math> mm</p>	<p>growth rates after they become sexually mature.</p> <p>2) The average CL of 119 mm is large for exploited <i>Jasus</i> populations and is expected to decline over time as a result of removal (mining) of accumulated large individuals</p>
CL composition by trip	<p>Trip 1  Both sexes = <math>117 \pm 20</math> mm  Males = <math>126 \pm 19</math> mm  Females = <math>103 \pm 9</math> mm</p> <p>Trip 2  Both sexes = <math>123 \pm 24</math> mm  Males = <math>135 \pm 21</math> mm  Females = <math>101 \pm 10</math> mm</p>	<p>1) Male lobsters caught during trip 2 much larger than those caught during trip 1, but female avg CL constant</p> <p>2) Several potential explanations</p> <p>3) Large males more aggressive than smaller males during trip 2 because of mating – thus enter traps more readily</p> <p>4) Spatial segregation of the population by size – large males move to shallower waters (where they are more accessible to traps) to mate</p> <p>5) Smaller males moult earlier than large ones – thus not as active</p>
CL composition by depth	No data	<p>1) Depth-wise segregation by size or sex expected to occur seasonally as a result of movements to achieve moulting, mating or reproduction</p>
Length weight regressions WW = lobster Whole Weight	<p>Both sexes  <math>WW = 6.649e-07CL^{2.928}</math>  <math>R^2 = 0.989</math></p> <p>Males  <math>WW = 7.702e-07CL^{2.918}</math>  <math>R^2 = 0.989</math></p> <p>Females  <math>WW = 2.221e-06CL^{2.668}</math>  <math>R^2 = 0.96</math></p>	<p>1) High <math>R^2</math> values – regressions fit the data well</p> <p>2) Formulae can be used, with high confidence, to convert between lobster size and weight</p> <p>3) Regression coefficients typical of isometric growth (approaching 3.0)</p>

Table 5: Weekly change in mean CL (mm) during fishing in Trip 1, and larger mean CL of males caught during Trip 2

Week ending	Mean CL (mm)	Mean CL (mm)
	Males	Females
<b>TRIP 1</b>		
14-Apr-19	128.1	103.0
21-Apr-19	127.0	104.0
28-Apr-19	127.9	103.0
05-May-19	123.8	102.0
12-May-19	117.6	100.0
<b>TRIP 2</b>		
15-Jun-19	137.3	102.5
23-Jun-19	137.1	100.8
30-Jun-19	131.1	100.0