Cruise Report ZDLT1-07-2020

Hake demography

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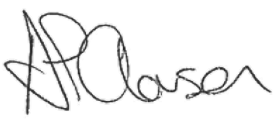

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1.0 Introduction

Since the establishment of the regulated fisheries in the Falkland Islands, annual catches of common hake (*Merluccius hubbsi*) have ranged from 1,414 t (1994) to 53,320 t (2019). In recent years, catches and CPUE have exceeded significantly mean catches from 1987 to 2019. Annual catches since 2015 all rank within the top eight since 1987; the other three include 1987, 1988, and 1989. To date, in 2020, over 30,000 t have been reportedly caught in Falkland Islands waters; a feat only accomplished twice previously (1988 and 2019). Common hake has become the most abundant finfish species of commercial importance in Falkland Islands waters.

The distribution of common hake extends from 22°S (Brazil) to 55°S (Argentina) along the eastern coast of South America and the Patagonian and Falkland Shelves (Cousseau & Perrotta 1998). Morphometrics (e.g. Bezzi & Perrotta 1983), genetics (e.g. Roldán 1995), and otolith morphology (e.g. Ruarte 1997) have suggested the existence of at least two distinct stocks of common hake in Argentine waters (northern and southern stocks delimited by 41°S). Conversely, biological tag studies have identified three separate stocks in Argentina (Sardella & Timi 2004) originating from different spawning areas: (1) the Argentine-Uruguayan Common Fishing Zone (AUCFZ) (34 to 41°S); (2) San Matias Gulf (41 to 44°S); and San Jorge Gulf (south of 44°S). These results are supported by otolith microchemistry (Renzi et al. 1999). Common hake caught in Falkland Islands waters are considered to belong to the same stock as San Jorge Gulf (Sardella & Timi 2004).

Spawning times for the different common hake stocks in Argentine waters vary. For instance, the "southern stock" spawns inshore between November and April (peaking in December and January) in waters of *c.* 50 m depths along the Argentine coast (Macchi et al. 2004) before undergoing seasonal feeding migrations from April in deeper waters of the Shelf down to 800 m (Bezzi et al. 1995). Conversely, the spawning peaks for the "northern" stock of the AUCFZ occur in April and May (Ehrlich & de Ciechomski 1994; Rodrigues & Macchi 2010), whereas those for common hake found further north (32-34°S) occur in July and August (Ehrlich & de Ciechomski 1994). Therefore, on the Falkland Shelf, we would expect a peak of abundance for common hake in waters > 100 m depths during May to August.

The main objective of this research cruise was to collect biological data (length, sex, maturity, otoliths), genetic samples, and diet samples for common hake between 41 and 54°S during its peak in abundance on the Falkland Shelf. Many of these data and samples will be used in subsequent analyses to better understand the demography (age and length structure of the population), genetic structure (stock discrimination, contribution of different stocks to Falkland Islands Fisheries), feeding (ontogenetic shifts in diet, extent of feeding grounds for different stocks). Secondary objectives included: (1) collect biological data on other common commercial and bycatch species; (2) conduct an oceanographic survey (pressure, temperature, conductivity, oxygen, fluorescence) of the study area; and (3) carry out trials of the new setup for deploying the Isaac-Kidd plankton net aboard the *F/V Castelo*. We will report only on the main objective and the first two secondary objectives herein.

2.0 Materials and Methods

2.1 Cruise vessel and area surveyed

The hake demography survey was conducted aboard the *F/V Castelo* (ZDLT1), a Falkland Islands registered commercial demersal trawler (Length 67.8 m; GRT 1,321 t) from July 12th to 27th (15 fishing days). The vessel departed FIPASS at 16:00 on July 12th to reach the first station to the north of West Falklands by the following morning. Overall 45 trawl stations (Table 1; Fig 1) were included. These comprised trawl stations repeated from the 2018 demersal survey (stations 3150, 3152, and 3153; see Gras et al. 2018), 2020 demersal survey (stations 3144 – 3147, 3155 – 3171; 3201, 3203; see Randhawa et al. 2020), and 2019 skate biomass survey (stations 3174 – 3176; 3200; see Goyot et al. 2019). Station coordinates for 3179 to 3195 on the High Seas were determined following discussions with the Captain. Stations 3204 to 3222 were adjusted from the 2020 demersal survey (see Randhawa et al. 2020) in order to reduce navigation and make up for lost time on the High Seas. Generally, three or four 60-minute trawls were done each day during daylight hours (Table 1); i.e. the trawl on the seabed during daylight hours. The sunrise and sunset at each station was estimated using the NOAA Sunrise/Sunset Calculator (www.esrl.noaa.gov/gmd/grad/solcalc/sunrise.html). On the final day (July 27th), we performed a single trawl and returned to FIPASS in Stanley at 18:00. No fishing days were lost to bad weather.

2.2 Trawling

The Falkland Islands Government Fisheries Department (FIFD) own bottom trawl net was used, with rockhopper gear, equipped with the *F/V Castelo*'s Thyborøn 23 VF 5.25 m^2 2,700 kg doors. The cod-end had a 90 mm mesh size fitted with a 40 mm cod end liner. The MarPort Net Monitoring System was used to monitor the net geometry successfully on 44 of the 45 trawls. In order to maintain a net opening similar to previous surveys, the bridles measured 114.8 m. Trawl speed ranged from 3.3 to 4.9 knots (mean of 4.2 knots).

2.3 Biological sampling

At each trawl station, the total catch was weighed with an electronic balance (Marel M2200; 80 kg). All species (commercial, non-commercial, benthos) were sorted and weighed individually. All commercial and a selection of common, but non-commercial, species (e.g. *Coelorinchus fasciatus* [GRF], *Schroederichthys bivius* [DGH]) were sampled. For common hake, the sample consisted of 2 x 100 individuals selected randomly from the catch in addition to 10 to 20 individuals selected non-randomly, i.e. targeting small and large individuals. From the random sample, otoliths and stomachs were extracted from the first 35-40 sampled which had not regurgitated and genetic samples were collected from the first 20 of these. From the non-random sample, otoliths and stomachs were extracted from 5-10 of these. For all other species, the sample generally consisted of 100 individuals or all individuals when the total number was less than 100. Biological sampling of finfish included length (total [T_L] or pre-anal; to the lower cm), sex, and maturity (eight-stage scale – see Observer manual). For skates, all individuals were sampled, including disc width (to the lower cm; total length as well in some instances), weight, sex, and maturity (six-stage scale – see Observer manual). For squid, a sample of approximately 100 individuals (if available) were sampled, including dorsal mantle length (to the lower 0.5 cm), sex, and maturity (six-stage scale – see Observer manual). Additionally, 5 *Doryteuthis gahi* and four *Illex argentinus* samples were brought ashore for sampling of statoliths.

Otoliths were extracted for 23 different finfish species. Statolith extraction was undertaken ashore from frozen samples for both *D. gahi* and *I. argentinus*. No skate thorns or vertebrae were collected during this cruise, but *Squalus acanthias* frozen samples were collected from various stations for an age validation study. Length, weight, sex, and maturity information was recorded from each respective individual from which the aforementioned otolith, statolith, spines/vertebrae sample was taken.

Table 1. Trawl stations with station number, date, coordinates, mean depth, and duration.

Station	Date	Latitude (Start, °S)	Longitude (Start, °W)	Latitude (Finish, °S)	Longitude (Finish, °W)	*Mean Depth (m)	Trawl duration (min)
3144	13/07/2020	50.6578	60.3150	50.7235	60.2718	143	60
3146	13/07/2020	50.7753	60.7183	50.7517	60.8197	133	60
3147	13/07/2020	50.6160	61.2055	50.6197	61.3163	149	60
3150	14/07/2020	53.1122	61.7847	53.1148	61.6787	481	60
3152	14/07/2020	53.3315	61.2365	53.2995	61.1420	577	60
3153	14/07/2020	53.3675	60.7998	53.3370	60.7153	723	60
3155	15/07/2020	52.2920	61.7803	52.3557	61.8050	320	60
3156	15/07/2020	52.1352	62.6202	52.1850	62.6902	256	60
3157	15/07/2020	51.9313	63.0862	51.8678	63.0555	213	60
3158	16/07/2020	51.6220	62.2678	51.5497	62.2453	249	61
3159	16/07/2020	51.3445	62.7688	51.3965	62.8455	182	60
3160	16/07/2020	51.1222	63.2495	51.0582	63.1922	154	60
3163	17/07/2020	50.9415	61.9040	50.8738	61.8725	172	60
3165	17/07/2020	50.9053	62.4108	50.8417	62.3597	182	60
3166	17/07/2020	50.5658	62.8245	50.5023	62.7803	147	60
3169	18/07/2020	50.3943	61.3095	50.4235	61.4125	161	60
3170	18/07/2020	50.1218	61.7633	50.0870	61.8568	157	60
3171	18/07/2020	49.8857	62.0798	49.8217	62.0362	146	60
3174	19/07/2020	48.4278	60.6362	48.3637	60.6802	299	60
3175	19/07/2020	48.1542	60.5807	48.0868	60.6143	366	60
3176	19/07/2020	47.9082	60.5965	47.8432	60.6240	406	60
3179	20/07/2020	45.8337	60.4560	45.7690	60.4898	128	60
3180	20/07/2020	45.6557	60.3630	45.5887	60.3383	120	60
3182	20/07/2020	45.4835	60.0983	45.4138	60.0868	153	60
3183	20/07/2020	45.1817	60.0377	45.1095	60.0265	181	60
3185	21/07/2020	42.1067	58.0030	42.0598	57.9337	481	60
3186	21/07/2020	41.9788	57.8842	41.9345	57.8080	429	60
3188	21/07/2020	41.9203	57.8427	41.9587	57.9090	379	61
3189	21/07/2020	42.0765	57.9233	42.0952	57.9493	623	30
3190	22/07/2020	45.9495	60.0250	46.0055	60.0340	618	60
3192	23/07/2020	45.9820	60.1173	46.0402	60.1295	341	60
3193	23/07/2020	46.1948	60.2367	46.2627	60.2632	225	60
3195	23/07/2020	46.5142	60.5748	46.5877	60.6127	153	60
3200	24/07/2020	48.7213	60.4120	48.7940	60.4120	300	60
3201	24/07/2020	48.8493	60.6367	48.9255	60.6033	245	60
3203	24/07/2020	49.1425	60.9812	49.2143	61.0097	173	60
3204	24/07/2020	49.5257	60.9098	49.5788	60.9668	166	60
3207	25/07/2020	49.3825	60.4170	49.4235	60.3272	198	60
3209	25/07/2020	49.3833	59.9965	49.4293	59.9057	281	60
3211	25/07/2020	49.7182	59.7133	49.7618	59.6210	179	60
3212	25/07/2020	49.8372	59.3693	49.8665	59.2677	192	60
3216	26/07/2020	49.9160	58.8892	49.9433	58.7863	253	60
3218	26/07/2020	50.2705	58.2247	50.3040	58.1225	170	60
3219	26/07/2020	50.1815	57.9713	50.2287	57.8828	274	60
3222	27/07/2020	50.4158	57.9805	50.4585	57.8797	140	60

*Calculated as the average depth of when the net hits the bottom and when the net is hauled off the seabed.

Stations were separated into 6 different areas and new otolith and statolith collections were made from each of these. Area 1 was defined as the 4 stations at 42°S (3185 – 3189); Area 2 as the 8 stations at 45-46°S (3179 – 3183, 3190 – 3195); Area 3 as the 6 stations in the FOCZ (3174 – 3176, 3200 – 3203); Area 4 as the 21 stations in the general finfish area to about 52°S, but excluding the FOCZ (3144 – 3147, 3158 – 3171, 3204 – 3222); Area 5 as the 3 stations between 52 and 53°S (3155 – 3157); and Area 6 encompassing the 3 stations south of 53°S (3150 – 3153).

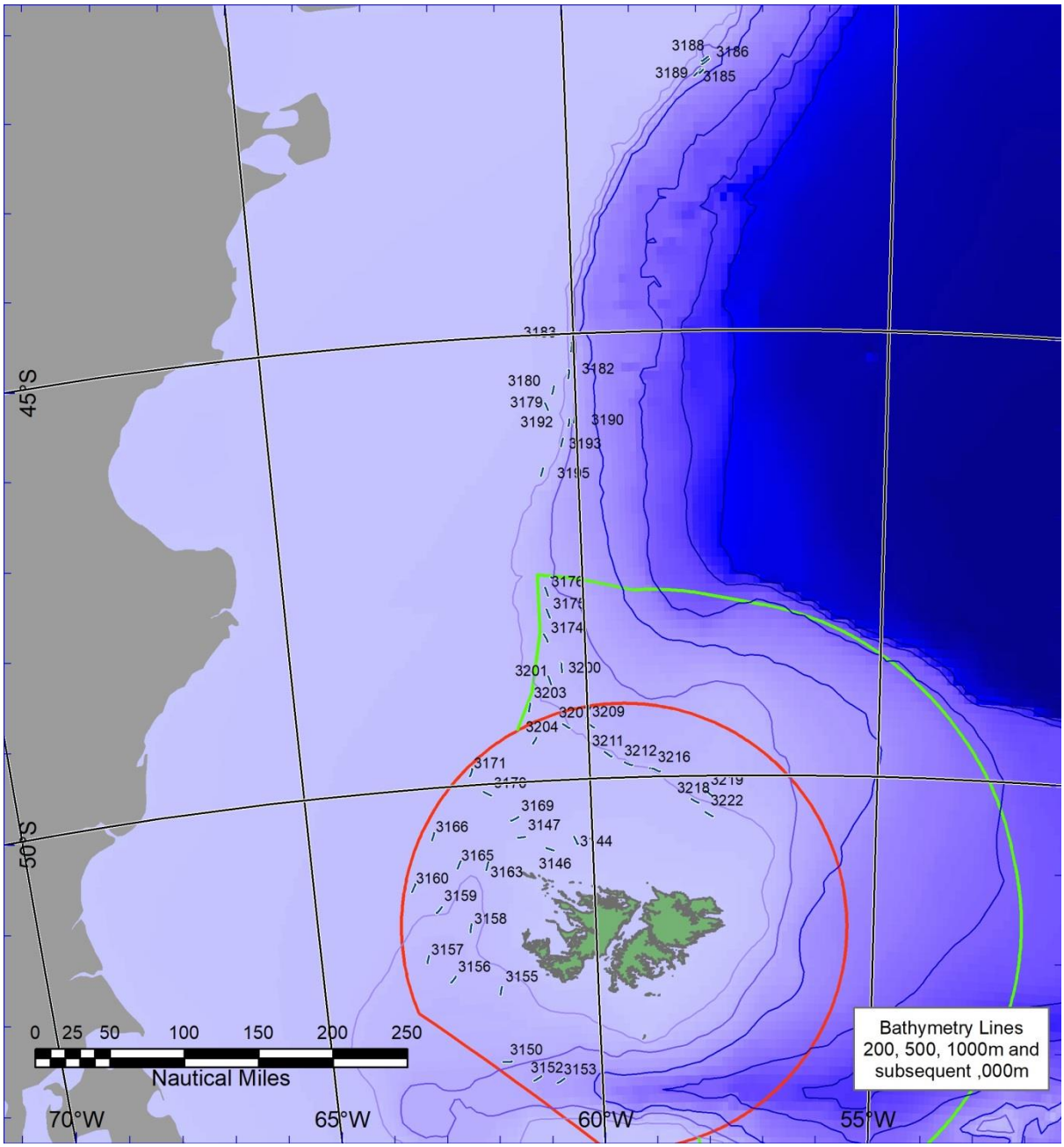

Fig 1. Trawl tracks with station numbers for trawls performed during the 2020 hake demography survey (ZDLT1-07-2020).

2.4 Oceanography

A single CTD (SBE-25, Sea-Bird Electronics Inc., Bellevue, USA) instrument, Serial No 0389, was used to collect oceanographic data in the vicinity of most trawl stations (Fig 2). On the second day, the CTD winch drive motor broke at the deepest station (3154), with the CTD at 701 metres. The CTD remained at this depth for over 1 hour. Eventually a temporary fix was made to enable the CTD to be

recovered. However due to the temporary nature of the repair and the fact that a further breakage of this fix could have resulted in loss of the CTD or delay to the cruise (given the tight time limit available for trawling) the decision was made not to use the CTD winch for the remainder of the cruise. During the third day of the cruise no CTDs were possible, but at the end of the fourth day a system using a cable on the main winch was devised, and tested. This system did not have a depth counter available, so a net sensor was used to relay depth to the vessel during the deployment of the CTD. There was only 500m of cable available on the winch, so the CTDs were not attempted in water where the seabed was deeper than 400 m. Added to this the speed control on the winch was less accurate without the use of a counter, so deployments and recovery generally took longer than normal. As a result of the depth limitation and the loss of the three stations on day 3 there were 32 CTD stations collected from a potential 45.

At all CTD stations the CTD was deployed to a depth of *c.* 10m below surface for a soak time of more than one minute, this allowed the pump to start circulating water and flush the system, following this the CTD was raised to a maximum depth of 5 m below surface. The CTD was then lowered towards the seabed at approximately 1m/sec (but see accuracy issue aforementioned). The CTD collected pressure in dbar, temperature in °C, conductivity in mS/cm (to estimate salinity), Oxygen Voltage, and Fluorescence (measure of productivity or chlorophyll-A concentration in the water column). The raw .hex file was converted and processed using SBE Data Processing Version 7.22.5 using the CON file 0389_2016_06.xmlcon with the instruments calibrated in June 2016. Up-cast data was filtered out. Depth was derived from pressure using the latitude of each station, with dissolved oxygen in mL/L derived at the same time as depth. Practical Salinity (PSU) and Density as sigma-t (σ-t) were derived following derivation of depth. Further derived variables of conservative temperature (°C) and Absolute Salinity (g/kg) were calculated in Ocean Data View version 5.15 (Schlitzer, Ocean Data View, http://odv.awi.de, 2013).

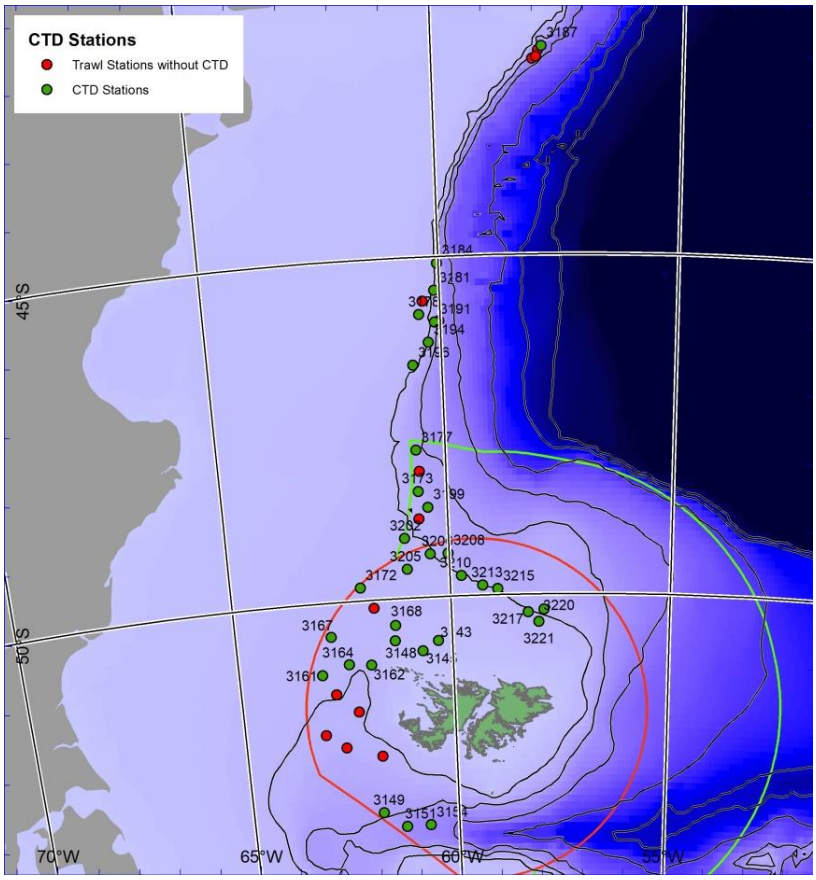

Fig 2. Location and number of CTD stations

2.5 Estimating densities

Densities (kg/km^2) for each species at each station were calculated as per Gras et al. (2018). These were not extrapolated to the entire fishing area.

2.6 Statistical analyses

All statistical analyses were carried out in RStudio version 1.0.153 (R Core Team 2018). Adequacy of Q-Q plots and distribution of residuals for length and abundance were assessed visually and the Shapiro-Wilk test was applied in each instance to confirm the visual result. Data were transformed and the distribution of residuals was re-assessed prior to analyses.

2.6.1 Abundance

The influence of depth and area of collection on the abundance of common hake was assessed using Generalized Linear Mixed Model (GLMM) analyses (Gaussian error distribution with log link function) with multi-model inference approach using the *MuMIn* package v1.43.17 (Barton 2020). Four models were compared:

1) Abundance as a function of depth (fixed effect); in a Generalized Linear Model
2) Abundance as a function of depth (fixed effect) + Area (random effect); in a GLMM
3) Abundance as a function of depth (fixed effect) + Area (random effect) + the interaction between depth and Area; in a GLMM
4) Null model

The models were ranked on the basis of Akaike Information Criterion corrected for small sample size (AIC_c), where the model with the lowest score is deemed to explain most of the variance in the data. The proportion of the variance explained by each predictor in the "best" model was obtained using the function *r2beta* (method = *nsj*) in the package *r2glmm* v 0.1.2 (Jaeger 2017). The *nsj* method corresponds to the Nakagawa & Schielzeth method (extended by Johnson) (see Nakagawa & Schielzeth 2013).

2.6.2 Length

The influence of depth and area of collection on length for common hake was assessed using Linear Mixed Model (LMM) analyses with multi-model inference approach using the *MuMIn* package v1.43.17. Four models were compared (for each sex separately):

1) Length as a function of depth (fixed effect); in a Linear Model
2) Length as a function of depth (fixed effect) + Area (random effect); in a LMM
3) Length as a function of depth (fixed effect) + Area (random effect) + the interaction between depth and Area; in a LMM
4) Null model

The models were ranked on the basis of Akaike Information Criterion (AIC), where the model with the lowest score is deemed to explain most of the variance in the data. The proportion of the variance explained by each predictor in the "best" model was obtained using the function *r2beta* (method = *nsj*) in the package *r2glmm* v 0.1.2.

3.0 Results

3.1 Catch composition

During the survey, a total of 49,989.6 kg of biomass (representing 136 taxa) was caught (Table 2) from a total swept area of 9.33 km^2. The most abundant species by weight was the common hake, followed by the squid *D. gahi* [LOL], and congrid eels [CON] (Table 2). The latter dominated catches at 42°S, was relatively absent from the rest of the survey area, and all were discarded (Table 2). Overall, the total catch of common hake is the only one to have exceeded 10,000 kg, whereas catches for six other species were between 1,000 kg and 9,999 kg (LOL, CON, ridge scale grenadier *Macrourus carinatus* [GRC], red cod *Salilota australis* [BAC], kingclip *Genypterus blacodes* [KIN], and hoki *Macruronus magellanicus* [WHI]). The total catch for 64 individual species was below 1 kg (Table 2). No taxon was caught at all 45 stations, but common hake was caught at 44 (97.8% of stations) and both rock cod *Patagonotothen ramsayi* [PAR] and LOL were caught at 43 (95.6% of stations). Twenty taxa were each caught at a single station (2.2%).

Table 2. Catch composition by weight (with sample weights and discards) of all species caught during the demersal survey (ZDLT1-07-2020).

Species code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. Stations (out of 45)	% of catch
HAK	*Merluccius hubbsi*	22,015.430	4,695.240	-	44	44.04
LOL	*Doryteuthis gahi*	5,740.928	144.258	0.390	43	11.48
CON	Congridae	5,270.140	-	5,270.140	7	10.54
GRC	*Macrourus carinatus*	3,150.640	720.020	230.640	7	6.30
BAC	*Salilota australis*	2,213.806	359.552	43.770	30	4.43
KIN	*Genypterus blacodes*	1,951.420	1,174.960	-	31	3.90
WHI	*Macruronus magellanicus*	1,741.120	304.326	46.940	23	3.48
PYM	*Physiculus marginatus*	934.324	-	934.324	9	1.87
ILL	*Illex argentinus*	933.394	99.184	11.710	28	1.87
PAR	*Patagonotothen ramsayi*	757.072	218.276	654.620	43	1.51
DGH	*Schroederichthys bivius*	729.372	370.552	729.372	27	1.46
GRF	*Coelorinchus fasciatus*	698.612	57.432	698.612	15	1.40
BLU	*Micromesistius australis*	629.609	197.891	623.557	30	1.26
TOO	*Dissostichus eleginoides*	473.436	473.436	-	14	0.95
RFL	*Zearaja chilensis*	373.100	373.100	1.400	30	0.75
DGS	*Squalus acanthias*	332.448	147.680	327.800	6	0.67
RGR	*Bathyraja griseocauda*	316.020	316.020	0.660	17	0.63
ANG	*Anthoptilum grandiflorum*	278.352	-	278.352	6	0.56
RBR	*Bathyraja brachyurops*	204.120	204.120	8.340	25	0.41
BUT	*Stromateus brasiliensis*	150.162	117.442	149.082	13	0.30
STA	*Sterechinus agassizi*	111.971	-	111.971	34	0.22
ALG	Algae	106.033	-	106.033	15	0.21
EEL	*Iluocoetes/Patagolycus* mix	83.288	-	83.288	17	0.17
XXX	Unidentified animals	72.430	-	72.430	7	0.14
RAL	*Bathyraja albomaculata*	69.832	68.912	0.680	20	0.14
SPN	Porifera	64.545	-	64.545	25	0.13
MUN	*Munida* spp.	54.530	-	54.530	7	0.11
CGO	*Cottoperca gobio*	44.024	37.582	44.024	21	0.09
RMU	*Bathyraja multispinis*	39.440	39.440	-	9	0.08
ING	*Moroteuthis ingens*	38.274	19.894	38.274	15	0.08
CIR	*Cirripedia*	38.140	-	38.140	3	0.08
SHT	Mixed invertebrates	29.744	-	29.744	13	0.06
RDO	*Amblyraja doellojuradoi*	27.556	27.280	27.556	14	0.06
SQT	Ascidiacea	23.870	-	23.870	11	0.05
RED	*Sebastes oculatus*	22.560	22.560	5.960	5	0.05
HYD	Hydrozoa	20.864	-	20.864	6	0.04
RMC	*Bathyraja macloviana*	19.460	19.460	19.460	12	0.04

Species code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. Stations (out of 45)	% of catch
COP	*Congiopodus peruvianus*	18.380	0.380	18.380	7	0.04
RSC	*Bathyraja scaphiops*	16.680	16.680	0.060	8	0.03
ANT	Anthozoa	16.289	-	16.289	29	0.03
RBZ	*Bathyraja cousseauae*	14.800	14.800	-	4	0.03
GOC	*Gorgonocephalus chilensis*	14.634	-	14.634	11	0.03
RPX	*Psammobatis* spp.	13.420	13.420	13.420	11	0.03
PAT	*Merluccius australis*	12.120	12.120	-	2	0.02
MUG	*Munida gregaria*	9.683	-	9.677	18	0.02
MAM	*Mancopsetta milfordi*	8.822	7.148	8.822	8	0.02
COT	*Cottunculus granulosus*	8.508	-	8.508	9	0.02
ZYP	*Zygochlamys patagonica*	7.642	-	7.642	18	0.02
OCM	*Enteroctopus megalocyathus*	7.238	1.518	7.238	4	0.01
SEP	*Seriolella porosa*	6.660	6.660	2.660	4	0.01
RTR	*Dipturus trachyderma*	6.380	6.380	-	1	0.01
ANM	Anemone	6.061	-	6.061	24	0.01
RDA	*Zearaja argentinensis*	4.560	4.560	-	2	<0.01
AST	Asteroidea	4.194	-	4.194	29	<0.01
NEM	*Neophyrnichthys marmoratus*	3.900	3.900	3.900	3	<0.01
BAL	*Bathydomus longisetosus*	3.586	-	3.586	10	<0.01
ROC	Rock	3.158	-	3.158	5	<0.01
PAG	*Paralomis granulosa*	2.680	-	2.680	1	<0.01
THO	Thouarellinae	2.608	-	2.608	10	<0.01
CTA	*Ctenodiscus australis*	2.461	-	2.461	31	<0.01
OPV	*Ophiacanta vivipara*	2.190	-	2.190	23	<0.01
MUL	*Eleginops maclovinus*	2.000	2.000	2.000	1	<0.01
MUE	*Muusoctopus eureka*	1.978	-	1.978	2	<0.01
GOR	Alcyonacea	1.872	-	1.872	5	<0.01
CAZ	*Calyptraster* sp.	1.750	-	1.750	22	<0.01
MLA	*Muusoctopus longibrachus akambei*	1.574	-	1.574	3	<0.01
ICA	*Icichthys australis*	1.426	1.426	1.426	1	<0.01
EGG	Egg mass	1.300	-	1.300	21	<0.01
AUC	*Austrocidaris canaliculata*	1.211	-	1.211	18	<0.01
ODM	*Odontocymbiola magellanica*	1.137	-	1.137	14	<0.01
FUM	*Fusitriton m. magellanicus*	1.027	-	1.027	8	<0.01
PRX	*Paragorgia* sp.	1.002	-	1.002	3	<0.01
COL	*Cosmasterias lurida*	0.957	-	0.957	9	<0.01
POA	*Porania antarctica*	0.918	-	0.918	6	<0.01
MAV	*Magellania venosa*	0.903	-	0.903	11	<0.01
GYN	*Gymnoscopelus nicholsi*	0.748	0.066	0.748	11	<0.01
TED	*Terebratella dorsata*	0.724	-	0.724	7	<0.01
COS	*Coryphaenoides subserrulatus*	0.660	-	0.660	1	<0.01
NED	*Neolithodes diomedeae*	0.640	-	0.640	2	<0.01
BRM	*Brucerolis macdonnellae*	0.626	-	0.626	13	<0.01
MYX	*Myxine* spp.	0.580	-	0.580	1	<0.01
THB	*Thymops birsteini*	0.572	-	0.572	5	<0.01
OPL	*Ophiuroglypha lymanii*	0.528	-	0.528	17	<0.01
URB	*Urophycis brasiliensis*	0.500	0.500	0.500	1	<0.01
POX	Empty polychaeta casts	0.489	-	0.489	4	<0.01
BAO	*Bathybiaster loripes*	0.462	-	0.462	10	<0.01
MUU	*Munida subrugosa*	0.456	-	0.456	9	<0.01
OPH	Ophiuroidea	0.449	-	0.449	11	<0.01
ISI	Isididae	0.390	-	0.390	6	<0.01
EUL	*Eurypodius latreillei*	0.383	-	0.383	11	<0.01
CEX	*Ceramaster* sp.	0.363	-	0.363	6	<0.01

Species code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. Stations (out of 45)	% of catch
CAS	*Campylonotus semistriatus*	0.347	-	0.347	8	<0.01
COG	*Patagonotothen guntheri*	0.280	0.260	0.280	2	<0.01
ASA	*Astrotoma agassizii*	0.272	-	0.272	7	<0.01
BRY	Bryozoa	0.259	-	0.259	6	<0.01
SET	Sertulariidae	0.252	-	0.252	11	<0.01
ALC	*Alcyoniina*	0.242	-	0.242	14	<0.01
LIR	*Limopsis marionensis*	0.234	-	0.234	6	<0.01
SUN	*Labidaster radiosus*	0.228	-	0.228	5	<0.01
MED	Medusae	0.220	-	0.220	1	<0.01
MMA	*Mancopsetta maculata*	0.220	-	0.220	1	<0.01
WRM	*Chaetopterus variopedatus*	0.219	-	0.219	10	<0.01
SAR	*Sprattus fuegensis*	0.200	0.200	0.200	1	<0.01
PYX	Pycnogonida	0.196	-	0.196	26	<0.01
HCR	Paguroidea	0.178	-	0.178	7	<0.01
NUD	Nudibranchia	0.157	-	0.157	9	<0.01
BOA	*Borostomias antarcticus*	0.152	-	0.152	3	<0.01
ACS	*Acanthoserolis schythei*	0.144	-	0.144	9	<0.01
GAY	Gastropoda	0.144	-	0.144	4	<0.01
PMB	*Protomyctophum bolini*	0.142	0.022	0.142	5	<0.01
SOR	*Solaster regularis*	0.142	-	0.142	2	<0.01
PSX	Psolidae sp.	0.122	-	0.122	6	<0.01
MAT	*Achiropsetta tricholepis*	0.116	0.116	0.116	1	<0.01
DIA	*Diaulula* spp.	0.112	-	0.112	4	<0.01
UHH	Heart urchin	0.080	-	0.080	4	<0.01
GAF	*Ganaria falklandica*	0.076	-	0.076	1	<0.01
SRP	*Semirossia patagonica*	0.074	-	0.074	4	<0.01
PES	*Peltarion spinosulum*	0.058	-	0.058	2	<0.01
ERR	*Errina* sp.	0.050	-	0.050	3	<0.01
LOS	*Lophaster stellans*	0.050	-	0.050	1	<0.01
CRI	Crinoidea	0.024	-	0.024	4	<0.01
HEO	*Henricia obesa*	0.022	-	0.022	2	<0.01
PRD	Primnoidae	0.022	-	0.022	6	<0.01
TRX	*Trophon* sp.	0.022	-	0.022	2	<0.01
ILF	*Iluocoetes fimbriatus*	0.020	-	0.020	1	<0.01
MXX	Myctophid spp.	0.020	-	0.020	1	<0.01
ISO	Isopoda	0.018	-	0.018	4	<0.01
HOL	Holothuroidea	0.017	-	0.017	5	<0.01
EUO	*Eurypodius longirostris*	0.016	-	0.016	1	<0.01
ASF	*Asternia fimbriata*	0.015	-	0.015	3	<0.01
MAU	*Maurolicus muelleri*	0.014	-	0.014	1	<0.01
ODP	*Odontaster pencillatus*	0.014	-	0.014	2	<0.01
LIA	*Lithodes santolla*	0.012	-	0.012	1	<0.01
BIV	Bivalve	0.008	-	0.008	1	<0.01
POL	Polychaeta	0.008	-	0.008	1	<0.01
BUC	*Falsilunatia carcellesi*	0.005	-	0.005	2	<0.01

3.1.1 Catch composition – Area 1

This area encompasses the four stations at 42°S (Table 1, Fig 1) or 8.9% of the total number of stations. The 0.71 km^2 swept area corresponds to 7.6% of the total for this survey. The 8,247.0 t (55 taxa) caught represent 16.5% of the total catch during this research cruise. The most abundant species by weight was CON (63.2%), followed by common hake (15.3%), and the squid *I. argentinus* [ILL] (10.7%) (Table 3). CON and ILL caught in Area 1 correspond to 98.9% and 94.4% of the total catch for each respective species throughout the entire survey area. Overall, the total catch of common hake is the only one (aside from CON) to have exceeded 1,000 kg, whereas catches for

three other species were between 100 kg and 999 kg (ILL, GRC, and PAR). The total catch for 29 individual species was below 1 kg (Table 3). Seven taxa were caught at all four stations: CON, common hake, ILL, PAR, Eeelpouts *Iluocoetes/Patagolycus* spp. mix [EEL], LOL, and southern blue whiting *Micromesistius australis australis* [BLU] (Table 3).

Table 3. Catch composition by weight (with sample weights and discards) of all species caught in Area 1 at 42°S (trawl stations 3185 – 3189).

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 4)	% catch
CON	Congridae	5,212.740	-	5,212.740	4	63.21
HAK	*Merluccius hubbsi*	1,263.360	432.540	-	4	15.32
ILL	*Illex argentinus*	881.400	69.540	-	4	10.69
GRC	*Macrourus carinatus*	356.280	175.480	199.880	3	4.32
PAR	*Patagonotothen ramsayi*	300.240	14.960	257.100	4	3.64
EEL	*Iluocoetes/Patagolycus* mix	63.170	-	63.170	4	0.77
LOL	*Doryteuthis gahi*	47.840	9.220	-	4	0.58
BLU	*Micromesistius australis*	19.629	19.629	19.629	4	0.24
RBR	*Bathyraja brachyurops*	16.140	16.140	0.000	1	0.20
WHI	*Macruronus magellanicus*	14.460	14.460	14.460	3	0.18
GRF	*Coelorinchus fasciatus*	11.426	6.546	11.426	3	0.14
RFL	*Zearaja chilensis*	10.080	10.080	-	2	0.12
PYM	*Physiculus marginatus*	7.620	-	7.620	2	0.09
KIN	*Genypterus blacodes*	7.540	7.540	-	1	0.09
ING	*Moroteuthis ingens*	4.960	4.960	4.960	3	0.06
RAL	*Bathyraja albomaculata*	4.480	4.480	-	1	0.05
STA	*Sterechinus agassizi*	4.034	-	4.034	3	0.05
RBZ	*Bathyraja cousseauae*	3.520	3.520	-	1	0.04
RSC	*Bathyraja scaphiops*	3.320	3.320	-	1	0.04
ANT	Anthozoa	2.580	-	2.580	1	0.03
TOO	*Dissostichus eleginoides*	1.620	1.620	-	1	0.02
RGR	*Bathyraja griseocauda*	1.460	1.460	0.660	2	0.02
MAM	*Mancopsetta milfordi*	1.240	0.480	1.240	2	0.02
SQT	Ascidiacea	1.224	-	1.224	1	0.01
RMU	*Bathyraja multispinis*	1.100	1.100	-	1	0.01
ANM	Anemone	1.026	-	1.026	2	0.01
PRX	*Paragorgia* sp.	0.902	-	0.902	1	0.01
CTA	*Ctenodiscus australis*	0.568	-	0.568	3	<0.01
THO	Thouarellinae	0.536	-	0.536	1	<0.01
COT	*Cottunculus granulosus*	0.380	-	0.380	1	<0.01
SPN	Porifera	0.370	-	0.370	1	<0.01
RDO	*Amblyraja doellojuradoi*	0.260	-	0.260	1	<0.01
MED	Medusae	0.220	-	0.220	1	<0.01
MMA	*Mancopsetta maculata*	0.220	-	0.220	1	<0.01
SET	Sertulariidae	0.160	-	0.160	2	<0.01
HCR	Paguroidea	0.106	-	0.106	2	<0.01
BAL	*Bathydomus longisetosus*	0.094	-	0.094	1	<0.01
EGG	Egg mass	0.086	-	0.086	1	<0.01
PYX	Pycnogonida	0.082	-	0.082	2	<0.01
AUC	*Austrocidaris canaliculata*	0.076	-	0.076	1	<0.01
CAZ	*Calyptraster* sp.	0.066	-	0.066	1	<0.01
LOS	*Lophaster stellans*	0.050	-	0.050	1	<0.01
AST	Asteroidea	0.040	-	0.040	3	<0.01
GYN	*Gymnoscopelus nicholsi*	0.034	-	0.034	1	<0.01
PSX	Psolidae sp.	0.034	-	0.034	2	<0.01
GAY	Gastropoda	0.030	-	0.030	1	<0.01
GOC	*Gorgonocephalus chilensis*	0.028	-	0.028	1	<0.01
GOR	Alcyonacea	0.028	-	0.028	1	<0.01
ODM	*Odontocymbiola magellanica*	0.024	-	0.024	2	<0.01

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 4)	% catch
MXX	Myctophid spp.	0.020	-	0.020	1	<0.01
PMB	*Protomyctophum bolini*	0.014	0.080	0.014	1	<0.01
ZYP	*Zygochlamys patagonica*	0.010	-	0.010	1	<0.01
ALC	*Alcyoniina*	0.008	-	0.008	1	<0.01
OPL	*Ophiuroglypha lymanii*	0.006	-	0.006	1	<0.01
PRD	Primnoidae	0.004	-	0.004	1	<0.01

3.1.2 Catch composition – Area 2

This area encompasses the eight stations at 45-46°S (Table 1, Fig 1) or 17.8% of the total number of stations. The 1.66 km^2 swept area corresponds to 17.7% of the total for this survey. The 3,798.0 t (72 taxa) caught represent 7.6% of the total catch during this research cruise. The most abundant species by weight was GRC (35.0%), followed by LOL (26.0%), and common hake (22.3%) (Table 4). GRC caught in Area 2 correspond to 42.2% of the total catch for this species throughout the entire survey area, despite only being caught at a single station (Table 4). Overall, the total catch of no other species exceeded 1,000 kg in Area 2, but catches for four other species were between 100 kg and 999 kg (LOL, common hake, PAR, and KIN). The total catch for 25 individual species was below 1 kg (Table 4). Two taxa were caught at all eight stations: common hake and ILL (Table 4).

Table 4. Catch composition by weight (with sample weights and discards) of all species caught in Area 2 at 45-46°S (trawl stations 3179 – 3183, 3190 – 3195).

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 8)	% catch
GRC	*Macrourus carinatus*	1,329.500	64.220	30.760	1	35.01
LOL	*Doryteuthis gahi*	988.073	21.140	-	7	26.02
HAK	*Merluccius hubbsi*	844.940	373.480	-	8	22.25
PAR	*Patagonotothen ramsayi*	127.060	44.020	127.060	7	3.35
KIN	*Genypterus blacodes*	107.440	107.440	-	7	2.83
BUT	*Stromateus brasiliensis*	56.860	43.940	56.860	3	1.50
MUN	*Munida* spp.	53.970	-	53.970	6	1.42
CON	Congridae	51.660	-	51.660	1	1.36
BAC	*Salilota australis*	49.156	49.156	-	4	1.29
ILL	*Illex argentinus*	47.900	26.000	9.120	8	1.26
RFL	*Zearaja chilensis*	22.100	22.100	-	4	0.58
DGH	*Schroederichthys bivius*	20.820	20.820	20.820	6	0.55
RGR	*Bathyraja griseocauda*	16.160	16.160	-	2	0.43
EEL	*Iluocoetes/Patagolycus* mix	10.900	-	10.900	4	0.29
ING	*Moroteuthis ingens*	10.720	10.020	10.720	5	0.28
GRF	*Coelorinchus fasciatus*	10.140	6.440	10.140	1	0.27
RDO	*Amblyraja doellojuradoi*	9.880	9.880	9.880	4	0.26
SPN	Porifera	7.195	-	7.195	3	0.19
WHI	*Macruronus magellanicus*	4.800	4.800	3.040	2	0.13
BLU	*Micromesistius australis*	4.420	4.420	-	2	0.12
TOO	*Dissostichus eleginoides*	4.080	4.080	-	1	0.11
SEP	*Seriolella porosa*	3.560	3.560	0.860	2	0.09
RBZ	*Bathyraja cousseauae*	2.080	2.080	-	1	0.05
RBR	*Bathyraja brachyurops*	1.940	1.940	-	3	0.05
RAL	*Bathyraja albomaculata*	1.808	1.808	-	2	0.05
MAM	*Mancopsetta milfordi*	1.414	1.360	1.414	2	0.04
MUE	*Muusoctopus eureka*	1.388	-	1.388	1	0.04
RSC	*Bathyraja scaphiops*	1.040	1.040	-	1	0.03
PYM	*Physiculus marginatus*	0.940	-	0.940	1	0.02
CGO	*Cottoperca gobio*	0.910	0.460	0.910	3	0.02
ANM	Anemone	0.862	-	0.862	4	0.02

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 8)	% catch
MYX	*Myxine* spp.	0.580	-	0.580	1	0.02
SHT	Mixed invertebrates	0.464	-	0.464	1	0.01
COP	*Congiopodus peruvianus*	0.410	-	0.410	2	0.01
STA	*Sterechinus agassizi*	0.287	-	0.287	5	<0.01
GOC	*Gorgonocephalus chilensis*	0.262	-	0.262	2	<0.01
RPX	*Psammobatis* spp.	0.220	0.220	0.220	1	<0.01
MUG	*Munida gregaria*	0.194	-	0.194	2	<0.01
OPV	*Ophiacanta vivipara*	0.184	-	0.184	5	<0.01
ODM	*Odontocymbiola magellanica*	0.161	-	0.161	2	<0.01
COL	*Cosmasterias lurida*	0.161	-	0.161	3	<0.01
GYN	*Gymnoscopelus nicholsi*	0.154	0.050	0.154	3	<0.01
AST	Asteroidea	0.128	-	0.128	4	<0.01
CAZ	*Calyptraster* sp.	0.123	-	0.123	4	<0.01
PMB	*Protomyctophum bolini*	0.108	0.008	0.108	2	<0.01
GAY	Gastropoda	0.100	-	0.100	1	<0.01
NED	*Neolithodes diomedeae*	0.100	-	0.100	1	<0.01
XXX	Unidentified animals	0.092	-	0.092	1	<0.01
ZYP	*Zygochlamys patagonica*	0.084	-	0.084	5	<0.01
NUD	Nudibranchia	0.061	-	0.061	2	<0.01
ANT	Anthozoa	0.051	-	0.051	4	<0.01
DIA	*Diaulula* spp.	0.048	-	0.048	1	<0.01
SET	Sertulariidae	0.047	-	0.047	3	<0.01
BAO	*Bathybiaster loripes*	0.040	-	0.040	1	<0.01
ALC	*Alcyoniina*	0.030	-	0.030	2	<0.01
WRM	*Chaetopterus variopedatus*	0.028	-	0.028	2	<0.01
GOR	Alcyonacea	0.022	-	0.022	2	<0.01
ILF	*Iluocoetes fimbriatus*	0.020	-	0.020	1	<0.01
FUM	*Fusitriton m. magellanicus*	0.019	-	0.019	1	<0.01
HOL	Holothuroidea	0.015	-	0.015	4	<0.01
AUC	*Austrocidaris canaliculata*	0.012	-	0.012	1	<0.01
CAS	*Campylonotus semistriatus*	0.010	-	0.010	1	<0.01
ASA	*Astrotoma agassizii*	0.008	-	0.008	1	<0.01
PYX	Pycnogonida	0.008	-	0.008	4	<0.01
ASF	*Asternia fimbriata*	0.007	-	0.007	2	<0.01
CTA	*Ctenodiscus australis*	0.006	-	0.006	1	<0.01
ACS	*Acanthoserolis schythei*	0.006	-	0.006	5	<0.01
EGG	Egg mass	0.003	-	0.003	2	<0.01
OPL	*Ophiuroglypha lymanii*	0.002	-	0.002	1	<0.01
POX	Empty polychaeta casts	0.002	-	0.002	1	<0.01
ALG	Algae	0.001	-	0.001	1	<0.01
BUC	*Falsilunatia carcellesi*	0.001	-	0.001	1	<0.01

3.1.3 Catch composition – Area 3

This area encompasses the six stations in the FOCZ (Table 1, Fig 1) or 13.3% of the total number of stations. The 1.34 km^2 swept area corresponds to 14.4% of the total for this survey. The 5,565.1 t (75 taxa) caught represent 11.1% of the total catch during this research cruise. The most abundant species by weight was common hake (46.5%), followed by LOL (37.2%) (Table 5). Overall, the total catch of no other species exceeded 1,000 kg in Area 3, but catches for two other species were between 100 kg and 999 kg (grey-tail skate *Bathyraja griseocauda* [RGR] and yellow-nose skate *Zearaja chilensis* [RFL]). The total catch for 40 individual species was below 1 kg (Table 5). Five taxa were caught at all six stations: common hake, LOL, PAR, BLU, and corals Anthozoa [ANT] (Table 5).

Table 5. Catch composition by weight (with sample weights and discards) of all species caught in Area 3 in the FOCZ (trawl stations 3174 – 3176, 3200 – 3203).

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 6)	% catch
HAK	*Merluccius hubbsi*	2,586.760	956.740	-	6	46.48
LOL	*Doryteuthis gahi*	2,072.540	28.040	-	6	37.24
RGR	*Bathyraja griseocauda*	149.420	149.420	-	5	2.68
RFL	*Zearaja chilensis*	109.160	109.160	-	5	1.96
RBR	*Bathyraja brachyurops*	96.620	96.620	-	5	1.74
PAR	*Patagonotothen ramsayi*	93.680	36.3760	76.120	6	1.68
STA	*Sterechinus agassizi*	75.226	-	75.226	5	1.35
TOO	*Dissostichus eleginoides*	67.680	67.680	-	3	1.22
KIN	*Genypterus blacodes*	61.200	61.200	-	4	1.10
ALG	Algae	48.361	-	48.361	2	0.87
RAL	*Bathyraja albomaculata*	33.804	33.804	-	5	0.61
RMU	*Bathyraja multispinis*	23.800	23.800	-	4	0.43
BAC	*Salilota australis*	20.220	20.220	0.820	4	0.36
WHI	*Macruronus magellanicus*	18.300	18.300	17.500	5	0.33
RDO	*Amblyraja doellojuradoi*	9.940	9.940	9.940	3	0.18
DGH	*Schroederichthys bivius*	9.812	9.812	9.812	2	0.18
SPN	Porifera	9.286	-	9.286	3	0.17
MUG	*Munida gregaria*	7.468	-	7.468	5	0.13
RBZ	*Bathyraja cousseauae*	7.400	7.400	-	1	0.13
RSC	*Bathyraja scaphiops*	6.260	6.260	-	4	0.11
CON	Congridae	5.740	-	5.740	2	0.10
COT	*Cottunculus granulosus*	5.220	-	5.220	3	0.09
RMC	*Bathyraja macloviana*	5.160	5.160	5.160	2	0.09
BLU	*Micromesistius australis*	5.000	3.900	3.540	6	0.09
DGS	*Squalus acanthias*	4.648	-	-	1	0.08
RDA	*Zearaja argentinensis*	4.560	4.560	-	2	0.08
BUT	*Stromateus brasiliensis*	4.480	4.480	4.480	1	0.08
EEL	*Iluocoetes/Patagolycus* mix	4.140	-	4.140	3	0.07
ANT	Anthozoa	3.854	-	3.854	6	0.07
ILL	*Illex argentinus*	2.606	2.544	1.322	5	0.05
SHT	Mixed invertebrates	1.728	-	1.728	3	0.03
AST	Asteroidea	1.700	-	1.700	5	0.03
ANM	Anemone	1.238	-	1.238	5	0.02
GRF	*Coelorinchus fasciatus*	1.140	1.140	1.140	3	0.02
ING	*Moroteuthis ingens*	1.100	1.100	1.100	1	0.02
BAL	*Bathydomus longisetosus*	0.806	-	0.806	2	0.01
MUE	*Muusoctopus eureka*	0.590	-	0.590	1	0.01
MUN	*Munida* spp.	0.560	-	0.560	1	0.01
ROC	Rock	0.482	-	0.482	1	<0.01
COP	*Congiopodus peruvianus*	0.440	-	0.440	1	<0.01
ISI	Isididae	0.389	-	0.389	5	<0.01
BRM	*Brucerolis macdonnellae*	0.370	-	0.370	5	<0.01
MAM	*Mancopsetta milfordi*	0.328	0.328	0.328	1	<0.01

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 6)	% catch
AUC	*Austrocidaris canaliculata*	0.280	-	0.280	3	<0.01
GYN	*Gymnoscopelus nicholsi*	0.274	0.008	0.274	4	<0.01
COL	*Cosmasterias lurida*	0.268	-	0.268	4	<0.01
CTA	*Ctenodiscus australis*	0.178	-	0.178	5	<0.01
MAT	*Achiropsetta tricholepis*	0.116	0.116	0.116	1	<0.01
OPH	Ophiuroidea	0.115	-	0.115	3	<0.01
PSX	Psolidae sp.	0.080	-	0.080	3	<0.01
BAO	*Bathybiaster loripes*	0.070	-	0.070	1	<0.01
CAS	*Campylonotus semistriatus*	0.056	-	0.056	2	<0.01
SRP	*Semirossia patagonica*	0.046	-	0.046	1	<0.01
LIR	*Limopsis marionensis*	0.044	-	0.044	1	<0.01
PYX	Pycnogonida	0.042	-	0.042	3	<0.01
ALC	*Alcyoniina*	0.040	-	0.040	3	<0.01
ACS	*Acanthoserolis schythei*	0.030	-	0.030	1	<0.01
CAZ	*Calyptraster* sp.	0.023	-	0.023	2	<0.01
CRI	Crinoidea	0.021	-	0.021	3	<0.01
EGG	Egg mass	0.020	-	0.020	1	<0.01
PMB	*Protomyctophum bolini*	0.020	0.006	0.020	2	<0.01
THB	*Thymops birsteini*	0.020	-	0.020	1	<0.01
SET	Sertulariidae	0.018	-	0.018	3	<0.01
SQT	Ascidiacea	0.018	-	0.018	1	<0.01
OPL	*Ophiuroglypha lymanii*	0.012	-	0.012	1	<0.01
UHH	Heart urchin	0.012	-	0.012	1	<0.01
TRX	*Trophon* sp.	0.010	-	0.010	1	<0.01
GAY	Gastropoda	0.008	-	0.008	1	<0.01
ODP	*Odontaster pencillatus*	0.006	-	0.006	1	<0.01
OPV	*Ophiacanta vivipara*	0.006	-	0.006	1	<0.01
WRM	*Chaetopterus variopedatus*	0.006	-	0.006	1	<0.01
HYD	Hydrozoa	0.004	-	0.004	1	<0.01
PRD	Primnoidae	0.002	-	0.002	2	<0.01
ISO	Isopoda	0.001	-	0.001	1	<0.01
MAV	*Magellania venosa*	0.001	-	0.001	1	<0.01

3.1.4 Catch composition – Area 4

This area encompasses the 21 stations in the finfish area north of 52°S, but excluding the FOCZ (Table 1, Fig 1) or 46.7% of the total number of stations. The 4.60 km^2 swept area corresponds to 49.4% of the total for this survey. The 23,711.4 t (115 taxa) caught represent 47.4% of the total catch during this research cruise. The most abundant species by weight was common hake (66.7%), followed by LOL (9.5%) and BAC (8.4%) (Table 6). Only the total catch of KIN exceeded also 1,000 kg in Area 4, but catches for four other species were between 100 kg and 999 kg (narrowmouth catshark *Schroederichthys bivius* [DGH], spurdog *Squalus acanthias* [DGS], PAR, and RFL). The total catch for 60 individual taxa was below 1 kg (Table 6). Three taxa were caught at all 21 stations: common hake, LOL, and PAR (Table 6).

Table 6. Catch composition by weight (with sample weights and discards) of all species caught in Area 4 in the FOCZ (trawl stations 3144 – 3147, 3158 – 3171, 3204 – 3222).

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 21)	% catch
HAK	*Merluccius hubbsi*	15,810.031	2,405.960	-	21	66.68
LOL	*Doryteuthis gahi*	2,261.810	64.282	0.390	21	9.54
BAC	*Salilota australis*	1,985.630	221.890	42.950	19	8.37
KIN	*Genypterus blacodes*	1,547.200	860.00	-	16	6.53
DGH	*Schroederichthys bivius*	690.500	331.680	690.500	17	2.91
DGS	*Squalus acanthias*	327.800	147.680	327.800	5	1.38

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 21)	% catch
PAR	*Patagonotothen ramsayi*	211.390	100.160	171.580	21	0.89
RFL	*Zearaja chilensis*	145.120	145.120	1.400	15	0.61
BUT	*Stromateus brasiliensis*	88.822	69.022	87.742	9	0.37
RBR	*Bathyraja brachyurops*	65.420	65.420	8.340	14	0.28
WHI	*Macruronus magellanicus*	61.100	61.100	11.940	7	0.26
ALG	Algae	57.327	-	57.327	11	0.24
RGR	*Bathyraja griseocauda*	42.540	42.540	-	5	0.18
CGO	*Cottoperca gobio*	39.152	33.160	39.152	15	0.17
CIR	*Cirripedia*	38.140	-	38.140	3	0.16
SPN	Porifera	36.741	-	36.741	14	0.15
STA	*Sterechinus agassizi*	28.082	-	28.082	17	0.12
RED	*Sebastes oculatus*	22.560	22.560	5.960	5	0.10
SQT	Ascidiacea	22.228	-	22.228	8	0.09
HYD	Hydrozoa	20.860	-	20.860	5	0.09
SHT	Mixed invertebrates	18.842	-	18.842	7	0.08
COP	*Congiopodus peruvianus*	17.530	0.380	17.530	4	0.07
RMC	*Bathyraja macloviana*	14.300	14.300	14.300	10	0.06
RPX	*Psammobatis* spp.	13.200	13.200	13.200	10	0.06
RAL	*Bathyraja albomaculata*	12.600	11.680	0.580	7	0.05
RMU	*Bathyraja multispinis*	11.220	11.220	-	3	0.05
GOC	*Gorgonocephalus chilensis*	11.026	-	11.026	6	0.05
BLU	*Micromesistius australis*	8.386	8.148	8.214	12	0.04
TOO	*Dissostichus eleginoides*	8.320	8.320	-	3	0.04
ZYP	*Zygochlamys patagonica*	7.436	-	7.436	11	0.03
OCM	*Enteroctopus megalocyathus*	7.238	1.518	7.238	4	0.03
RDO	*Amblyraja doellojuradoi*	6.320	6.320	6.320	3	0.03
RSC	*Bathyraja scaphiops*	6.000	6.000	-	1	0.03
GRF	*Coelorinchus fasciatus*	5.658	5.538	5.658	2	0.02
EEL	*Iluocoetes/Patagolycus* mix	4.924	-	4.924	4	0.02
SEP	*Seriolella porosa*	3.100	3.100	1.800	2	0.01
NEM	*Neophyrnichthys marmoratus*	2.720	2.720	2.720	2	0.01
BAL	*Bathydomus longisetosus*	2.686	-	2.686	7	0.01
PAG	*Paralomis granulosa*	2.680	-	2.680	1	0.01
ROC	Rock	2.676	-	2.676	4	0.01
ING	*Moroteuthis ingens*	2.594	2.594	2.594	4	0.01
ANM	Anemone	2.447	-	2.447	9	0.01
MUG	*Munida gregaria*	2.021	-	2.015	11	<0.01
ANT	Anthozoa	2.018	-	2.018	12	<0.01
MUL	*Eleginops maclovinus*	2.000	2.000	2.000	1	<0.01
OPV	*Ophiacanta vivipara*	1.964	-	1.964	15	<0.01
COT	*Cottunculus granulosus*	1.900	-	1.900	1	<0.01
GOR	Alcyonacea	1.822	-	1.822	2	<0.01
THO	Thouarellinae	1.654	-	1.654	5	<0.01
MLA	*Muusoctopus longibrachus akambei*	1.574	-	1.574	3	<0.01
ILL	*Illex argentinus*	1.488	1.100	1.268	11	<0.01
CTA	*Ctenodiscus australis*	1.484	-	1.484	16	<0.01
AST	Asteroidea	1.216	-	1.216	11	<0.01
EGG	Egg mass	1.120	-	1.120	14	<0.01
POA	*Porania antarctica*	0.918	-	0.918	6	<0.01
MAV	*Magellania venosa*	0.838	-	0.838	8	<0.01
FUM	*Fusitriton m. magellanicus*	0.822	-	0.822	5	<0.01
NED	*Neolithodes diomedeae*	0.540	-	0.540	1	<0.01
COL	*Cosmasterias lurida*	0.528	-	0.528	2	<0.01
URB	*Urophycis brasiliensis*	0.500	-	0.500	1	<0.01
POX	Empty polychaeta casts	0.487		0.487	3	<0.01
CAZ	*Calyptraster* sp.	0.484	-	0.484	11	<0.01

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 21)	% catch
AUC	*Austrocidaris canaliculata*	0.435	-	0.435	8	<0.01
MUU	*Munida subrugosa*	0.432	-	0.432	8	<0.01
ODM	*Odontocymbiola magellanica*	0.406	-	0.406	6	<0.01
CEX	*Ceramaster* sp.	0.363	-	0.363	6	<0.01
BAO	*Bathybiaster loripes*	0.352	-	0.352	8	<0.01
OPL	*Ophiuroglypha lymanii*	0.320	-	0.320	11	<0.01
COG	*Patagonotothen guntheri*	0.280	-	0.280	2	<0.01
BRY	Bryozoa	0.259	-	0.259	6	<0.01
GYN	*Gymnoscopelus nicholsi*	0.240	-	0.240	1	<0.01
XXX	Unidentified animals	0.204	-	0.204	2	<0.01
SAR	*Sprattus fuegensis*	0.200	0.200	0.200	1	<0.01
ASA	*Astrotoma agassizii*	0.189	-	0.189	4	<0.01
EUL	*Eurypodius latreillei*	0.189	-	0.189	9	<0.01
ALC	*Alcyoniina*	0.154	-	0.154	7	<0.01
SUN	*Labidaster radiosus*	0.148	-	0.148	4	<0.01
SOR	*Solaster regularis*	0.142	-	0.142	2	<0.01
ACS	*Acanthoserolis schythei*	0.108	-	0.108	3	<0.01
BRM	*Brucerolis macdonnellae*	0.104	-	0.104	5	<0.01
PRX	*Paragorgia* sp.	0.100	-	0.100	2	<0.01
BOA	*Borostomias antarcticus*	0.096	-	0.096	2	<0.01
LIR	*Limopsis marionensis*	0.080	-	0.080	3	<0.01
GAF	*Ganaria falklandica*	0.076	-	0.076	1	<0.01
HCR	Paguroidea	0.072	-	0.072	5	<0.01
NUD	Nudibranchia	0.068	-	0.068	5	<0.01
UHH	Heart urchin	0.068	-	0.068	3	<0.01
TED	*Terebratella dorsata*	0.066	-	0.066	4	<0.01
CAS	*Campylonotus semistriatus*	0.060	-	0.060	2	<0.01
WRM	*Chaetopterus variopedatus*	0.057	-	0.057	5	<0.01
ERR	*Errina* sp.	0.050	-	0.050	3	<0.01
THB	*Thymops birsteini*	0.050	-	0.050	1	<0.01
DIA	*Diaulula* spp.	0.042	-	0.042	2	<0.01
PES	*Peltarion spinosulum*	0.034	-	0.034	1	<0.01
OPH	Ophiuroidea	0.030	-	0.030	5	<0.01
SRP	*Semirossia patagonica*	0.028	-	0.028	3	<0.01
SET	Sertulariidae	0.027	-	0.027	3	<0.01
PYX	Pycnogonida	0.024	-	0.024	13	<0.01
HEO	*Henricia obesa*	0.022	-	0.022	2	<0.01
ISO	Isopoda	0.017	-	0.017	3	<0.01
EUO	*Eurypodius longirostris*	0.016	-	0.016	1	<0.01
MAU	*Maurolicus muelleri*	0.014	-	0.014	1	<0.01
LIA	*Lithodes santolla*	0.012	-	0.012	1	<0.01
PYM	*Physiculus marginatus*	0.012	-	0.012	1	<0.01
TRX	*Trophon* sp.	0.012	-	0.012	1	<0.01
ASF	*Asternia fimbriata*	0.008	-	0.008	1	<0.01
BIV	Bivalve	0.008	-	0.008	1	<0.01
ODP	*Odontaster pencillatus*	0.008	-	0.008	1	<0.01
POL	Polychaeta	0.008	-	0.008	1	<0.01
PSX	Psolidae sp.	0.008	-	0.008	1	<0.01
GAY	Gastropoda	0.006	-	0.006	1	<0.01
BUC	*Falsilunatia carcellesi*	0.004	-	0.004	1	<0.01
CRI	Crinoidea	0.003	-	0.003	1	<0.01
HOL	Holothuroidea	0.002	-	0.002	1	<0.01
PRD	Primnoidae	0.001	-	0.001	1	<0.01

3.1.5 Catch composition – Area 5

This area encompasses the three stations in the finfish area between 52 and 53°S (Table 1, Fig 1) or 6.7% of the total number of stations. The 0.61 km^2 swept area corresponds to 6.6% of the total for this survey. The 3,306.7 t (59 taxa) caught represent 6.6% of the total catch during this research cruise. The most abundant species by weight was common hake (39.9%), followed by WHI (26.6%) and LOL (9.6%) (Table 7). Only the total catch of common hake exceeded 1,000 kg in Area 5, but catches for five species were between 100 kg and 999 kg (WHI, LOL, KIN, the Banded whiptail grenadier *Coelorinchus fasciatus* [GRF], and BAC). The total catch for 39 individual species was below 1 kg (Table 7). Twenty-one taxa were caught at all three stations (see Table 7).

Table 7. Catch composition by weight (with sample weights and discards) of all species caught in Area 5 between 52 and 53°S (trawl stations 3155 - 3157).

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 3)	% catch
HAK	*Merluccius hubbsi*	1,318.240	334.700	-	3	39.87
WHI	*Macruronus magellanicus*	880.140	77.826	-	3	26.62
LOL	*Doryteuthis gahi*	318.760	10.696	-	3	9.64
KIN	*Genypterus blacodes*	228.040	138.780	-	3	6.90
GRF	*Coelorinchus fasciatus*	199.608	10.128	199.608	3	6.04
BAC	*Salilota australis*	158.860	68.346	-	3	4.80
RFL	*Zearaja chilensis*	65.220	65.220	-	3	1.97
TOO	*Dissostichus eleginoides*	34.980	34.980	-	3	1.06
RBR	*Bathyraja brachyurops*	24.000	24.000	-	2	0.73
PAR	*Patagonotothen ramsayi*	14.760	14.760	14.760	3	0.45
RAL	*Bathyraja albomaculata*	10.620	10.620	0.100	3	0.32
SPN	Porifera	10.459	-	10.459	2	0.32
SHT	Mixed invertebrates	8.710	-	8.710	2	0.26
DGH	*Schroederichthys bivius*	8.240	8.240	8.240	2	0.25
BLU	*Micromesistius australis*	5.014	5.014	5.014	3	0.15
STA	*Sterechinus agassizi*	4.216	-	4.216	3	0.13
CGO	*Cottoperca gobio*	3.962	3.962	3.962	3	0.12
GOC	*Gorgonocephalus chilensis*	3.318	-	3.318	2	0.10
RBZ	*Bathyraja cousseauae*	1.800	1.800	-	1	0.05
NEM	*Neophyrnichthys marmoratus*	1.180	1.180	1.180	1	0.04
CAZ	*Calyptraster* sp.	0.884	-	0.884	3	0.03
ANT	Anthozoa	0.870	-	0.870	3	0.03
AST	Asteroidea	0.854	-	0.854	3	0.03
TED	*Terebratella dorsata*	0.658	-	0.658	3	0.02
SQT	Ascidiacea	0.400	-	0.400	1	0.01
ALG	Algae	0.344	-	0.344	1	0.01
AUC	*Austrocidaris canaliculata*	0.228	-	0.228	2	<0.01
PYM	*Physiculus marginatus*	0.200	-	0.200	2	<0.01
EUL	*Eurypodius latreillei*	0.194	-	0.194	2	<0.01
OPL	*Ophiuroglypha lymanii*	0.188	-	0.188	3	<0.01
FUM	*Fusitriton m. magellanicus*	0.186	-	0.186	2	<0.01
ODM	*Odontocymbiola magellanica*	0.176	-	0.176	2	<0.01
RDO	*Amblyraja doellojuradoi*	0.140	0.140	0.140	1	<0.01
BRM	*Brucerolis macdonnellae*	0.130	-	0.130	1	<0.01
THO	Thouarellinae	0.122	-	0.122	2	<0.01
ANG	*Anthoptilum grandiflorum*	0.118	-	0.118	3	<0.01
ZYP	*Zygochlamys patagonica*	0.112	-	0.112	1	<0.01
LIR	*Limopsis marionensis*	0.110	-	0.110	2	<0.01
XXX	Unidentified animals	0.100	-	0.100	1	<0.01
SUN	*Labidaster radiosus*	0.080	-	0.080	1	<0.01
MAV	*Magellania venosa*	0.064	-	0.064	2	<0.01
CTA	*Ctenodiscus australis*	0.060	-	0.060	3	<0.01
RSC	*Bathyraja scaphiops*	0.060	0.060	0.060	1	<0.01

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 3)	% catch
COT	*Cottunculus granulosus*	0.044	-	0.044	2	<0.01
PYX	Pycnogonida	0.039	-	0.039	3	<0.01
OPV	*Ophiacanta vivipara*	0.036	-	0.036	2	<0.01
ANM	Anemone	0.030	-	0.030	2	<0.01
NUD	Nudibranchia	0.028	-	0.028	2	<0.01
MUU	*Munida subrugosa*	0.024	-	0.024	1	<0.01
PES	*Peltarion spinosulum*	0.024	-	0.024	1	<0.01
DIA	*Diaulula* spp.	0.022	-	0.022	1	<0.01
CAS	*Campylonotus semistriatus*	0.020	-	0.020	1	<0.01
PRD	Primnoidae	0.014	-	0.014	1	<0.01
WRM	*Chaetopterus variopedatus*	0.014	-	0.014	1	<0.01
ALC	*Alcyoniina*	0.010	-	0.010	1	<0.01
ASA	*Astrotoma agassizii*	0.010	-	0.010	1	<0.01
THB	*Thymops birsteini*	0.010	-	0.010	1	<0.01
EGG	Egg mass	0.004	-	0.004	1	<0.01
OPH	Ophiuroidea	0.002	-	0.002	1	<0.01

3.1.6 Catch composition – Area 6

This area encompasses the three stations in the finfish area south of 53°S (Table 1, Fig 1) or 6.7% of the total number of stations. The 0.59 km^2 swept area corresponds to 6.3% of the total for this survey. The 5,367.2 t (46 taxa) caught represent 10.7% of the total catch during this research cruise. The most abundant species by weight was GRC (27.3%), followed by the Dwarf codling *Notophycis marginata* [PYM] (17.2%), and WHI (14.2%) (Table 8). Only the total catch of GRC exceeded 1,000 kg in Area 6, but catches for eigth species were between 100 kg and 999 kg (PYM, WHI, BLU, GRF, Patagonian toothfish *Dissostichus eleginoides* [TOO], Slimy sea pen *Anthoptilum grandiflorum* [ANG], common hake, and RGR). The total catch for 24 individual species was below 1 kg (Table 8). Fourteen taxa were caught at all three stations (see Table 8). Of interest, common hake was only caught at two stations and made up 3.6% of the total catch in Area 6 (Table 8).

Table 8. Catch composition by weight (with sample weights and discards) of all species caught in Area 6 south of 53°S (trawl stations 3150 - 3153).

Species Code	Latin name	Total catch (kg)	Total sampled (kg)	Total discarded (kg)	No. stations (out of 3)	% catch
GRC	*Macrourus carinatus*	1464.860	480.32	0.000	3	27.29
PYM	*Physiculus marginatus*	925.552	0	925.552	3	17.24
WHI	*Macruronus magellanicus*	762.320	127.84	0.000	3	14.20
BLU	*Micromesistius australis*	587.160	156.78	587.160	3	10.94
GRF	*Coelorinchus fasciatus*	470.640	27.64	470.640	3	8.77
TOO	*Dissostichus eleginoides*	356.756	356.756	0.000	3	6.65
ANG	*Anthoptilum grandiflorum*	278.234	0	278.234	3	5.18
HAK	*Merluccius hubbsi*	191.820	191.82	0.000	2	3.57
RGR	*Bathyraja griseocauda*	106.440	106.44	0.000	3	1.98
XXX	Unidentified animals	72.034	0	72.034	3	1.34
LOL	*Doryteuthis gahi*	51.905	10.88	0.000	2	0.97
RFL	*Zearaja chilensis*	21.420	21.42	0.000	1	0.40
ING	*Moroteuthis ingens*	18.900	1.22	18.900	2	0.35
PAT	*Merluccius australis*	12.120	12.12	0.000	2	0.23
PAR	*Patagonotothen ramsayi*	9.942	8	8.000	2	0.19
ANT	Anthozoa	6.916	0	6.916	3	0.13
RAL	*Bathyraja albomaculata*	6.520	6.52	0.000	2	0.12
RTR	*Dipturus trachyderma*	6.380	0	6.380	1	0.12
MAM	*Mancopsetta milfordi*	5.840	4.98	5.840	3	0.11
RMU	*Bathyraja multispinis*	3.320	3.32	0.000	1	0.06
ICA	*Icichthys australis*	1.426	1.426	1.426	1	0.03
RDO	*Amblyraja doellojuradoi*	1.016	1	1.016	2	0.02
COT	*Cottunculus granulosus*	0.964	0	0.964	2	0.02
COS	*Coryphaenoides subserrulatus*	0.660	0	0.660	1	0.01
SPN	Porifera	0.494	0	0.494	2	0.01
THB	*Thymops birsteini*	0.492	0	0.492	2	0.01
ANM	Anemone	0.458	0	0.458	2	0.01
ODM	*Odontocymbiola magellanica*	0.370	0	0.370	2	0.01
OPH	Ophiuroidea	0.302	0	0.302	2	0.01
THO	Thouarellinae	0.296	0	0.296	2	0.01
AST	Asteroidea	0.256	0	0.256	3	0.00
CAS	*Campylonotus semistriatus*	0.201	0	0.201	2	0.00
AUC	*Austrocidaris canaliculata*	0.180	0	0.180	3	0.00
CAZ	*Calyptraster* sp.	0.170	0	0.170	1	0.00
CTA	*Ctenodiscus australis*	0.165	0	0.165	3	0.00
EEL	*Iluocoetes/Patagolycus* mix	0.154	0	0.154	2	0.00
STA	*Sterechinus agassizi*	0.126	0	0.126	1	0.00
WRM	*Chaetopterus variopedatus*	0.114	0	0.114	1	0.00
BRM	*Brucerolis macdonnellae*	0.072	0	0.072	2	0.00
EGG	Egg mass	0.067	0	0.067	2	0.00
ASA	*Astrotoma agassizii*	0.065	0	0.065	1	0.00
BOA	*Borostomias antarcticus*	0.056	0	0.056	1	0.00
GYN	*Gymnoscopelus nicholsi*	0.046	0	0.046	2	0.00
ISI	Isididae	0.001	0	0.001	1	0.00
PRD	Primnoidae	0.001	0	0.001	1	0.00
PYX	Pycnogonida	0.001	0	0.001	1	0.00

3.2 *Merluccius hubbsi* – Common hake (HAK)

The total catch of *M. hubbsi* was 22,015 kg (Table 2). It was caught at 44 of the 45 stations sampled during this cruise (97.8%). Catches ranged from 4.00 to 3,676.82 kg (Fig 3a) and densities from 17 to 18,771 kg/km^2 (Fig 3a). Of the 44 stations where *M. hubbsi* was caught, 40 stations yielded > 100 kg/km^2 (90.9%), 33 stations > 500 kg/km^2 (75.0%), 27 stations > 1,000 kg/km^2 (61.4%), four stations > 5,000 kg/km^2 (9.1%), and two stations > 10,000 kg/km^2 (4.5%). Catches of *M. hubbsi* occurred throughout the survey area, but primarily within the FICZ in Areas 3 and 4 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 1,710 (range = 3 to 51 per station) (Fig 3b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 1,303 females (T_L = 20 to 80 cm), 406 males (T_L = 19 to 56 cm), and one unsexed individual (T_L = 46 cm) (Fig 4). The number of fish sampled for length frequency was 7,407 (5,514 females and 1,893 males). Female T_L ranged from 20 to 81 cm (mean of 45.47 cm) (Fig 5a), whereas males measured between 19 and 56 cm (mean of 38.50 cm) (Fig 5b). The histograms show a single mode at 43 to 45 cm for females and two modes at 26 cm and 38 to 40 cm for males (Fig 5). Females were observed Stage I (0.1%), Stage II (63.7%), Stage III (22.9%), Stage IV (0.3%), Stage V (< 0.1%), Stage VII (0.3%), and Stage VIII (12.7%) (Fig 5a). Males were observed Stage I (2.1%), Stage II (34.8%), Stage III (51.8%), Stage IV (6.9%), Stage V (1.8%), Stage VII (1.2%), and Stage VIII (1.5%) (Fig 5b).

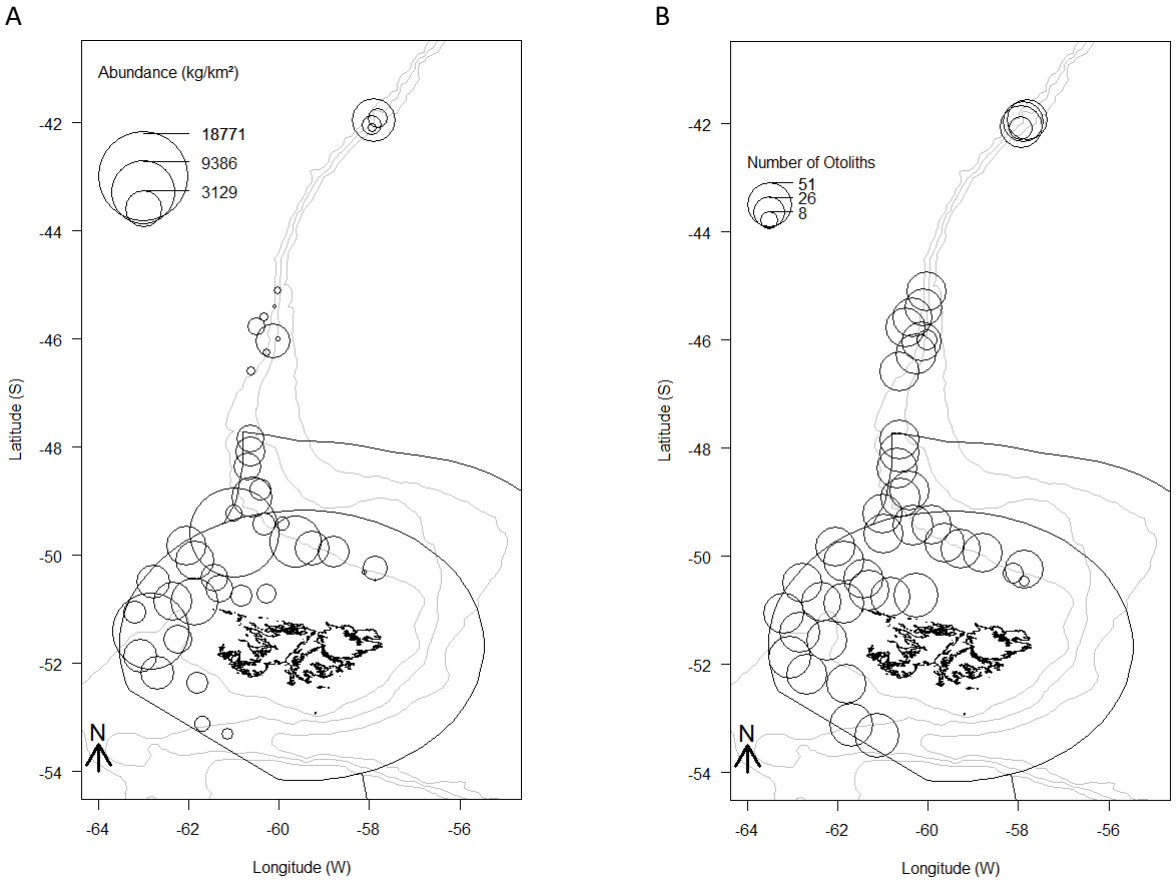

Fig 3. Distribution of (A) densities and (B) otolith samples (N = 1,710) of *Merluccius hubbsi*.

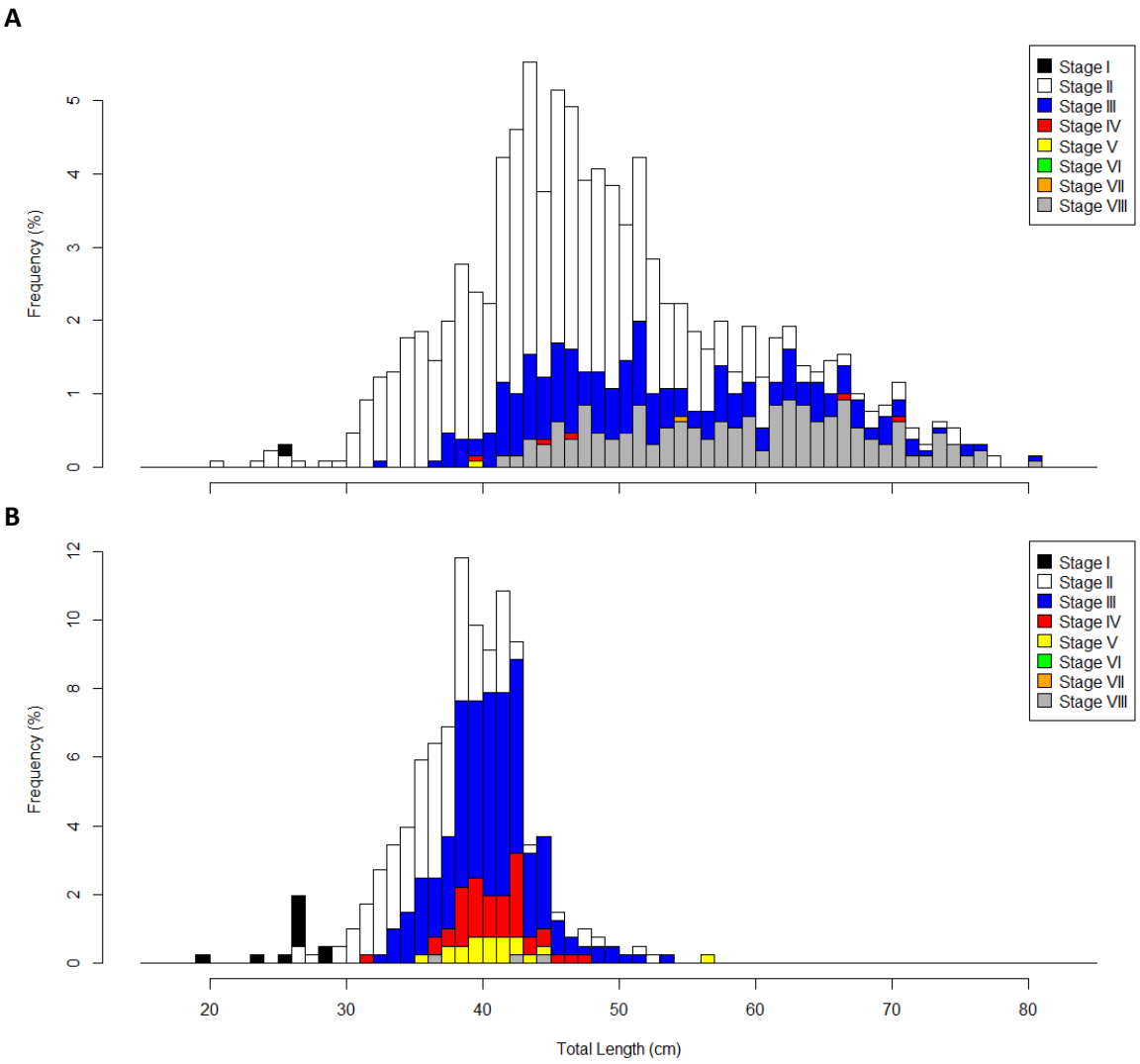

Fig 4. Length frequency (percentage of the total sample collected) of *Merluccius hubbsi* individuals sampled from all stations for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 1,303) and (B) males (N = 406).

Variation in common **hake density** was best explained by the "Null" model (AIC_c = 163.09). Consequently, none of the predictor variables included in our model approach could adequately explain the variation observed in densities throughout the survey area or the number of stations was too small, thus the analytical power of the analysis was too low. Regardless, 5.3% of the variance was explained by **Area**, 3.0% by the **interaction between Area and depth**, and 0.9% by **depth** (Table 9).

Variation in **female common hake length** was best explained by the model including all three predictors (AIC = 37,450.63). The analysis revealed that 15.0% of the variance was explained by **depth**, 7.4% by **Area**, and 5.6% by the **interaction between Area and depth**. Approximately 70% of the variance in the data remained unexplained.

Variation in **male common hake length** was best explained by the model including all three predictors (AIC = 10,248.89). The analysis reveals that 16.2% of the variance was explained by **depth**, 12.4% by **Area**, and 4.3% by the **interaction between Area and depth**. Approximately 65% of the variance in the data remained unexplained.

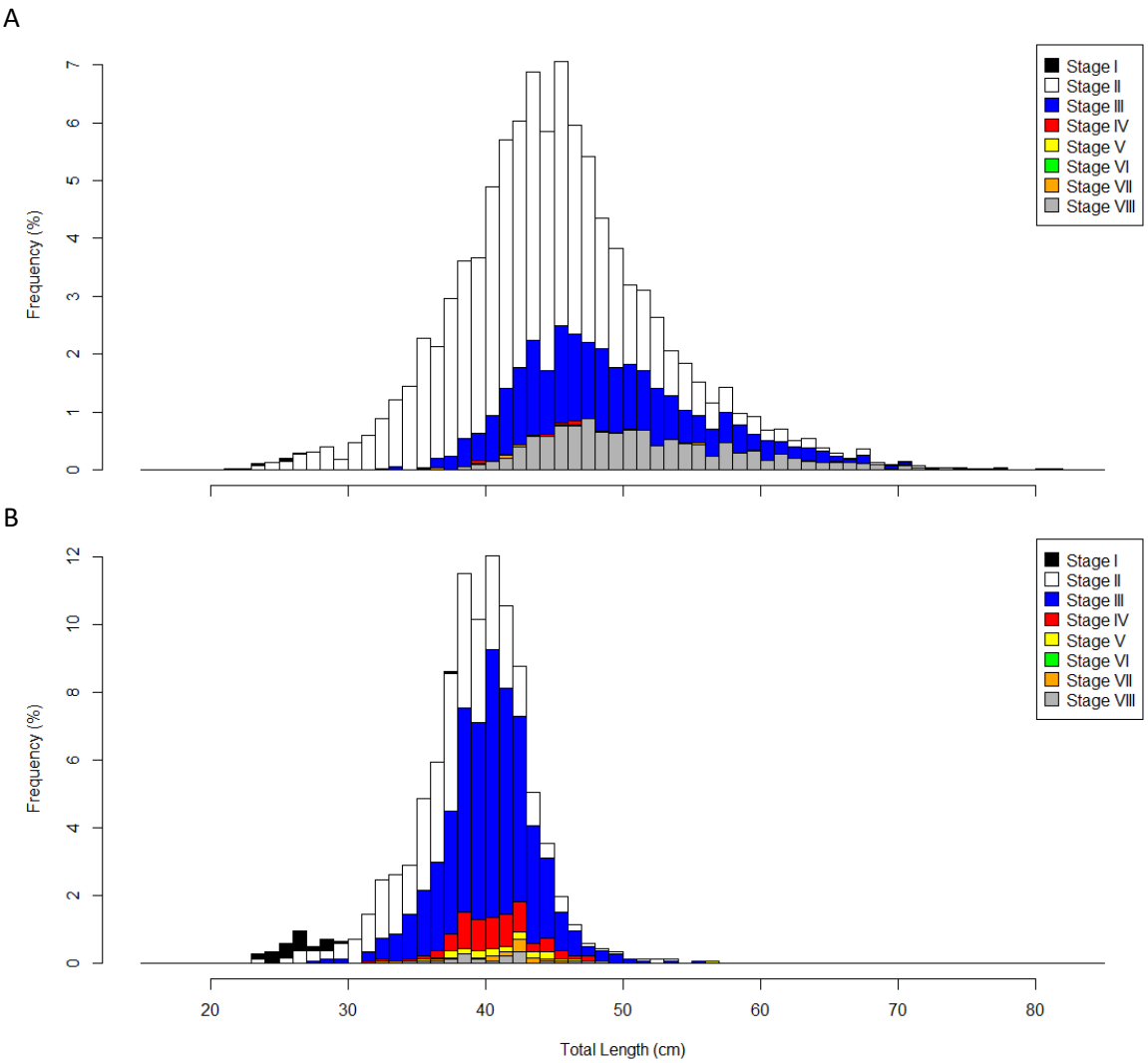

Fig 5. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population (from all stations) of *Merluccius hubbsi* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 5,514) and (B) males (N = 1,893).

3.2.1 *Merluccius hubbsi* – Common hake – Area 1

The total catch of *M. hubbsi* in Area 1 was 1,790 kg (Table 3) and the total density was 2,360 kg/km^2. It was caught at all four stations in Area 1 sampled during this cruise. Catches ranged from 15.56 to 855.28 kg (Fig 3a) and densities from 199 to 4,428 kg/km^2 (Fig 3a). Of the four stations where *M. hubbsi* was caught, all four stations yielded > 100 kg/km^2, three stations > 500 kg/km^2 (75.0%), and a single station > 1,000 kg/km^2 (25.0%). The number of *M. hubbsi* sampled for otoliths was 144 (range = 14 to 46 per station) (Fig 3b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 121 females (T_L = 33 to 70 cm) and 22 males (T_L = 33 to 56 cm). The number of fish sampled for length frequency was 634 (511 females and 123 males). Female T_L ranged from 33 to 70 cm (mean of 46.59 cm) (Fig 6a), whereas males measured between 29 and 56 cm (mean of 39.66 cm) (Fig 7a). The histograms show a weak mode at 42 cm for females and two modes at 37 cm and 42 cm for males (Figs 6a, 7a, respectively). Females were observed Stage II (57.7%), Stage III (21.5%), and Stage VIII (20.7%) (Fig 6a). Males were observed Stage II (39.8%), Stage III (40.7%), Stage IV (13.8%), Stage V (2.4%), Stage VII (0.8%), and Stage VIII (2.4%) (Fig 7a).

3.2.2 *Merluccius hubbsi* – Common hake – Area 2

The total catch of *M. hubbsi* in Area 2 was 844.94 kg (Table 4) and the total density was 510 kg/km^2. It was caught at all eight stations in Area 2 sampled during this cruise. Catches ranged from 9.58 to 511.00 kg (Fig 3a) and densities from 45 to 2,864 kg/km^2 (Fig 3a). Of the eight stations where *M. hubbsi* was caught, six stations yielded > 100 kg/km^2 (75.0%), two stations > 500 kg/km^2 (25.0%), and a single station > 1,000 kg/km^2 (12.5%). The number of *M. hubbsi* sampled for otoliths was 291 (range = 11 to 42 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 184 females (T_L = 20 to 76 cm) and 106 males (T_L = 19 to 53 cm). The number of fish sampled for length frequency was 880 (554 females and 326 males). Female T_L ranged from 20 to 76 cm (mean of 39.81 cm) (Fig 6b), whereas males measured between 19 and 53 cm (mean of 33.77 cm) (Fig 7b). The histograms show a dominant mode at 32 and 33 cm for females and two modes at 26 cm and 32 cm for males (Figs 6b, 7b, respectively). Females were observed Stage I (1.3%), Stage II (74.5%), Stage III (17.1%), Stage IV (0.2%), and Stage VIII (6.9%) (Fig 6b). Males were observed Stage I (12.0%), Stage II (44.8%), Stage III (35.6%), Stage IV (3.7%), Stage V (3.4%), and Stage VII (0.6%) (Fig 7b).

3.2.3 *Merluccius hubbsi* – Common hake – Area 3

The total catch of *M. hubbsi* in Area 3 was 2,586.76 kg (Table 5) and the total density was 1,929 kg/km^2. It was caught at all six stations in Area 3 sampled during this cruise. Catches ranged from 159.64 to 938.88 kg (Fig 3a) and densities from 674 to 3,946 kg/km^2 (Fig 3a). Of the six stations where *M. hubbsi* was caught, all stations yielded > 500 kg/km^2, five stations > 1,000 kg/km^2 (83.3%), two stations > 2,000 kg/km^2 (33.3%), and a single station > 3,000 kg/km^2 (16.7%). The number of *M. hubbsi* sampled for otoliths was 291 (range = 11 to 42 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 218 females (T_L = 31 to 73 cm) and 27 males (T_L = 31 to 52 cm). The number of fish sampled for length frequency was 1,220 (1,087 females and 133 males). Female T_L ranged from 31 to 73 cm (mean of 48.12 cm) (Fig 6c), whereas males measured between 31 and 55 cm (mean of 39.74 cm) (Fig 7c). The histograms show a single mode at 46 to 48 cm for females and a mode between 37 cm and 41 cm for males (Figs 6c, 7c, respectively). Females were observed Stage II (51.7%), Stage III (42.0%), Stage IV (0.2%), Stage VII (0.6%), and Stage VIII (5.5%) (Fig 6c). Males were observed Stage II (39.1%), Stage III (52.6%), Stage IV (7.5%), and Stage V (0.8%) (Fig 7c).

3.2.4 *Merluccius hubbsi* – Common hake – Area 4

The total catch of *M. hubbsi* in Area 4 was 15,810.03 kg (Table 6) and the total density was 3,434 kg/km^2. It was caught at all 21 stations in Area 4 sampled during this cruise. Catches ranged from 4.00 to 3,676.82 kg (Fig 3a) and densities from 17 to 18,771 kg/km^2 (Fig 3a). Of the 21 stations where *M. hubbsi* was caught, 19 stations yielded > 100 kg/km^2 (90.5%), 18 stations yielded > 500 kg/km^2 (85.7%), 17 stations > 1,000 kg/km^2 (81.0%), four stations > 5,000 kg/km^2 (19.0%), and two stations > 10,000 kg/km^2 (9.5%). The number of *M. hubbsi* sampled for otoliths was 804 (range = 3 to 51 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 587 females (T_L = 30 to 80 cm) and 217 males (T_L = 30 to 51 cm). The number of fish sampled for length frequency was 3,861 (2,694 females and 1,167 males). Female T_L ranged from 26 to 81 cm (mean of 45.19 cm) (Fig 6d), whereas males measured between 30 and 52 cm (mean of 39.47 cm) (Fig 7d). The histograms show a single mode at 43 to 45 cm for females and a mode between 38 cm and 40 cm for males (Figs 6d, 7d, respectively). Females were observed Stage II (62.3%), Stage III (19.2%), Stage IV (0.4%), Stage V (< 0.1%), Stage VII (0.3%), and Stage VIII (17.8%) (Fig 6d). Males were observed Stage II (30.4%), Stage III (58.4%), Stage IV (6.3%), Stage V (1.5 %), Stage VII (1.4%), and Stage VIII (2.1%) (Fig 7d).

3.2.5 *Merluccius hubbsi* – Common hake – Area 5

The total catch of *M. hubbsi* in Area 5 was 1,318.24 kg (Table 7) and the total density was 2,147 kg/km^2. It was caught at all three stations in Area 5 sampled during this cruise. Catches ranged from 236.78 to 542.06 kg (Fig 3a) and densities from 1,146 to 2,724 kg/km^2 (Fig 3a). Of the three stations where *M. hubbsi* was caught, all stations yielded > 1,000 kg/km^2 and two stations > 2,000 kg/km^2 (66.7%). The number of *M. hubbsi* sampled for otoliths was 129 (range = 41 to 46 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 95 females (T_L = 36 to 73 cm) and 34 males (T_L = 35 to 48 cm). The number of fish sampled for length frequency was 606 (463 females and 143 males). Female T_L ranged from 34 to 73 cm (mean of 43.46 cm) (Fig 6e), whereas males measured between 32 and 48 cm (mean of 39.10 cm) (Fig 7e). The histograms show a single mode at 41 and 42 cm for females and a mode at 38 to 40 cm for males (Figs 6e, 7e, respectively). Females were observed Stage II (85.3%), Stage III (13.2%), Stage IV (0.4%), Stage VII (0.2%), and Stage VIII (0.9%) (Fig 6e). Males were observed Stage I (0.7%), Stage II (39.2%), Stage III (44.1%), Stage IV (11.9%), Stage V (1.4%), Stage VII (2.1%), and Stage VIII (0.7%) (Fig 7e).

3.2.6 *Merluccius hubbsi* – Common hake – Area 6

The total catch of *M. hubbsi* in Area 6 was 191.82 kg (Table 8) and the total density was 326 kg/km^2. It was caught at two of the three stations in Area 6 sampled during this cruise (66.7%). Catches were 68.98 kg at station 3152 and 122.84 kg at station 3150 (Fig 3a) and densities were 334 and 609 kg/km^2, respectively (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 99 (49 and 50 per station, respectively) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 98 females (T_L = 41 to 77 cm) and a single unsexed individual (T_L = 48 cm). The number of fish sampled for length frequency was 206 (205 females and 1 male). Female T_L ranged from 40 to 77 cm (mean of 52.15 cm) (Fig 6f), whereas the single male measured 45 cm (Fig 7f). The histograms show a single mode at 52 cm for females (Figs 6f). Females were observed Stage II (81.5%), Stage III (11.2%), and Stage VIII (7.3%) (Fig 6f). The lone male was observed Stage III (Fig 7f).

3.2.7 *Merluccius hubbsi* – Common hake – Depth 100 to 149 m

The total catch of *M. hubbsi* at depth shallower than 150 m was 2,001.14 kg and the total density was 1,319 kg/km^2. It was caught at all seven stations of depths shallower than 150 m sampled during this cruise. Catches ranged from 4.00 to 776.10 kg and densities ranged from 17 to 3,739 kg/km^2 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 256 (range = 3 to 51 per station) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 1,187 (704 females and 483 males). Female T_L ranged from 20 to 74 cm (mean of 40.49 cm) (Fig 8a), whereas males measured between 19 and 51 cm (mean of 36.91 cm) (Fig 9a). The histograms show a single mode at 43 cm for females and a mode at 38 cm for males (Figs 8a, 9a, respectively). Females were observed Stage I (0.9%), Stage II (75.7%), Stage III (18.5%), Stage IV (0.3%), Stage V (0.1%), Stage VII (0.6%), and Stage VIII (4.0%) (Fig 8a). Males were observed Stage I (5.8%), Stage II (41.2%), Stage III (43.3%), Stage IV (4.1%), Stage V (2.1%), Stage VII (1.2%), and Stage VIII (2.3%) (Fig 9a).

3.2.8 *Merluccius hubbsi* – Common hake – Depth 150 to 199 m

The total catch of *M. hubbsi* at depth shallower than 150 m was 12,891.33 kg and the total density was 3,668 kg/km^2. It was caught at all 16 stations of depths between 150 and 199 m sampled during this cruise. Catches ranged from 9.58 to 3,676.82 kg and densities ranged from 45 to 18,771 kg/km^2 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 625 (range = 11 to 43 per station) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 2,755 (1,803 females and 952 males). Female T_L ranged from 25 to 81 cm (mean of 43.78 cm) (Fig 8b), whereas males measured between 23 and 55 cm (mean of 38.69 cm) (Fig 9b). The histograms show two modes at 42 and 46 cm for females and a mode at 41

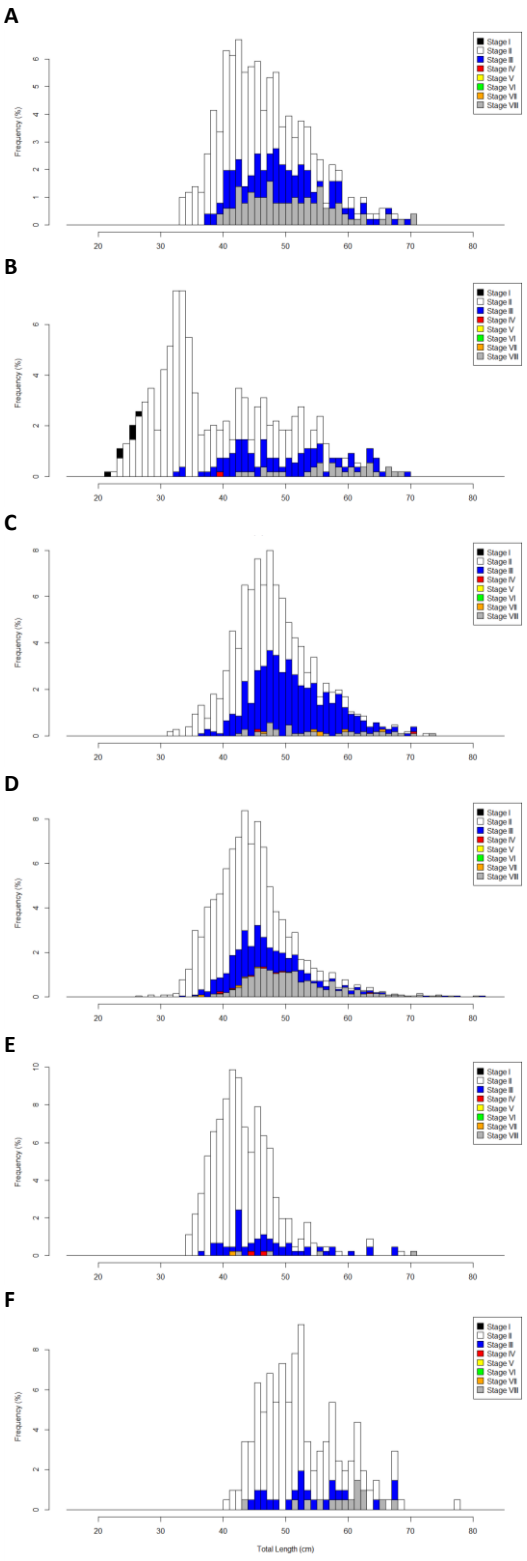

Fig 6. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Merluccius hubbsi* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 511), **(B)** Area 2 (N = 554), **(C)** Area 3 (N = 1,087), **(D)** Area 4 (N = 2,694), **(E)** Area 5 (N = 463), and **(F)** Area 6 (N = 205).

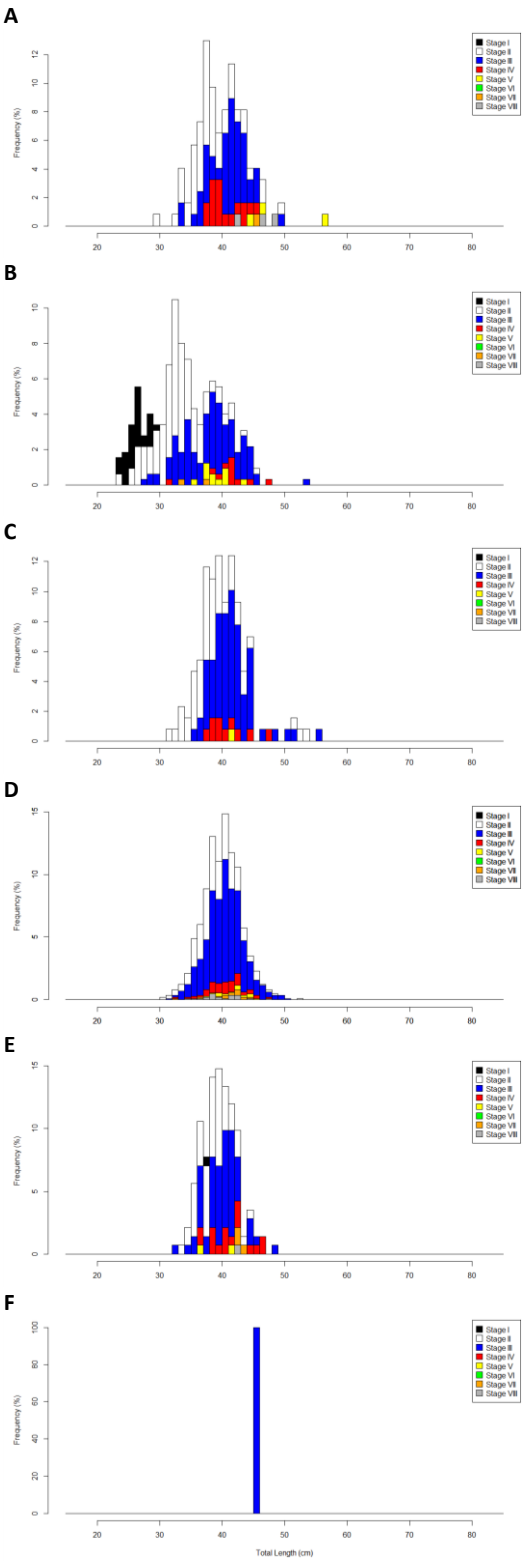

Fig 7. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Merluccius hubbsi* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 123), **(B)** Area 2 (N = 326), **(C)** Area 3 (N = 133), **(D)** Area 4 (N = 1,167), **(E)** Area 5 (N = 143), and **(F)** Area 6 (N = 1).

cm for males (Figs 8b, 9b, respectively). Females were observed Stage I (< 0.1%), Stage II (69.2%), Stage III (17.8%), Stage IV (0.5%), Stage VII (0.2%), and Stage VIII (12.3%) (Fig 8b). Males were observed Stage I (1.2%), Stage II (32.9%), Stage III (54.9%), Stage IV (6.7%), Stage V (1.7%), Stage VII (1.3%), and Stage VIII (1.4%) (Fig 9b).

3.2.9 *Merluccius hubbsi* – Common hake – Depth 200 to 249 m

The total catch of *M. hubbsi* at depth of between 200 and 249 m was 1,938.38 kg and the total density was 2,196 kg/km^2. It was caught at all four stations of depths between 200 and 249 m sampled during this cruise. Catches ranged from 31.70 to 938.88 kg and densities ranged from 150 to 3,946 kg/km^2 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 171 (range = 41 to 46 per station) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 661 (527 females and 134 males). Female T_L ranged from 31 to 75 cm (mean of 44.53 cm) (Fig 8c), whereas males measured between 31 and 53 cm (mean of 39.16 cm) (Fig 9c). The histograms show an undistinctive mode between 42 and 46 cm for females and a mode at 38 cm for males (Figs 8c, 9c, respectively). Additionally, the length frequency is truncated at 45 cm for females (Fig 8c). Females were observed Stage II (71.2%), Stage III (22.0%), Stage IV (0.6%), Stage VII (0.2%), and Stage VIII (6.1%) (Fig 8c). Males were observed Stage II (32.1%), Stage III (58.2%), Stage IV (6.7%), Stage VII (2.2%), and Stage VIII (0.7%) (Fig 9c).

3.2.10 *Merluccius hubbsi* – Common hake – Depth 250 to 299 m

The total catch of *M. hubbsi* at depth of between 250 and 299 m was 1,729.26 kg and the total density was 1,572 kg/km^2. It was caught at all five stations of depths between 250 and 299 m sampled during this cruise. Catches ranged from 99.46 to 542.06 kg and densities ranged from 433 to 2,624 kg/km^2 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 203 (range = 39 to 42 per station) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 938 (823 females and 115 males). Female T_L ranged from 31 to 77 cm (mean of 47.86 cm) (Fig 8d), whereas males measured between 32 and 48 cm (mean of 39.83 cm) (Fig 9d). The histograms show a single mode between 45 cm for females and a mode at 40 cm for males (Figs 8d, 9d, respectively). Females were observed Stage II (46.3%), Stage III (22.0%), Stage IV (0.1%), and Stage VIII (31.6%) (Fig 8d). Males were observed Stage I (0.9%), Stage II (33.0%), Stage III (55.7%), Stage IV (8.7%), and Stage V (1.7%) (Fig 9d).

3.2.11 *Merluccius hubbsi* – Common hake – Depth 300 to 349 m

The total catch of *M. hubbsi* at depth of between 300 and 349 m was 1,153.64 kg and the total density was 1,908 kg/km^2. It was caught at all three stations of depths between 300 and 349 m sampled during this cruise. Catches ranged from 236.78 to 511.00 kg and densities ranged from 1,146 to 2,864 kg/km^2 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 123 (range = 40 to 42 per station) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 612 (539 females and 73 males). Female T_L ranged from 33 to 76 cm (mean of 47.39 cm) (Fig 8e), whereas males measured between 26 and 47 cm (mean of 40.12 cm) (Fig 9e). The histograms show a single mode at 46 cm for females and no distinct mode for males (Figs 8e, 9e, respectively). Females were observed Stage II (72.2%), Stage III (24.3%), and Stage VIII (3.5%) (Fig 8e). Males were observed Stage II (17.8%), Stage III (65.8%), Stage IV (13.7%), and Stage V (2.7%) (Fig 9e).

3.2.12 *Merluccius hubbsi* – Common hake – Depth 350 to 399 m

The total catch of *M. hubbsi* at depth of between 350 and 399 m was 1,305.06 kg and the total density was 3,145 kg/km^2. It was caught at both stations of depths between 350 and 399 m sampled during this cruise. Catches were 449.78 at station 3175 and 855.28 at station 3188 and respective densities were 2,028 and 4,428 kg/km^2 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 82 (40 and 42 per station, respectively) and covered the entire length frequency for both males and

females. The number of fish sampled for length frequency at those depths was 422 (336 females and 86 males). Female T_L ranged from 33 to 72 cm (mean of 46.58 cm) (Fig 8f), whereas males measured between 29 and 53 cm (mean of 39.13 cm) (Fig 9f). The histograms show a single mode at 43 cm for females and a single mode at 37 cm for males (Figs 8f, 9f, respectively). Females were observed Stage II (53.6%), Stage III (37.5%), Stage VII (0.6%), and Stage VIII (8.3%) (Fig 8f). Males were observed Stage II (41.9%), Stage III (43.0%), Stage IV (10.5%), Stage V (2.3%), and Stage VIII (2.3%) (Fig 9f).

3.2.13 *Merluccius hubbsi* – Common hake – Depth 400 to 449 m

The total catch of *M. hubbsi* at depth of between 400 and 449 m was 589.06 kg and the total density was 1,371 kg/km^2. It was caught at both stations of depths between 400 and 449 m sampled during this cruise. Catches were 203.88 kg at station 3186 and 385.18 kg at station 3176 and densities were 924 and 1,844 kg/km^2, respectively (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 82 (40 and 42 per station, respectively) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 393 (359 females and 34 males). Female T_L ranged from 33 to 70 cm (mean of 48.65 cm) (Fig 8g), whereas males measured between 33 and 49 cm (mean of 41.65 cm) (Fig 9g). The histograms show two modes at 47 and 58 cm for females and a distinct mode at 41 cm for males (Figs 8g, 9g, respectively). Females were observed Stage II (38.4%), Stage III (47.6%), Stage IV (0.3%), Stage VII (1.1%), and Stage VIII (12.5%) (Fig 8g). Males were observed Stage II (26.5%), Stage III (47.1%), Stage IV (20.6%), Stage VII (2.1%), and Stage VIII (2.1%) (Fig 9g).

3.2.14 *Merluccius hubbsi* – Common hake – Depth 450 to 499 m

The total catch of *M. hubbsi* at depth of between 450 and 499 m was 311.48 kg and the total density was 750 kg/km^2. It was caught at both stations of depths between 450 and 499 m sampled during this cruise. Catches were 122.84 kg at station 3150 and 188.64 kg at station 3185 and densities were 609 and 883 kg/km^2, respectively (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 95 (46 and 49 per station, respectively) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 328 (326 females and 2 males). Female T_L ranged from 34 to 77 cm (mean of 50.84 cm) (Fig 8h), whereas both males measured 37 and 38 cm, respectively (Fig 9h). The histogram shows a single mode at 52 cm for females (Figs 8h). Females were observed Stage II (58.9%), Stage III (23.6%), and Stage VIII (17.5%) (Fig 8h). Males were observed Stage II (50.0%) and Stage III (50.0%) (Fig 9h).

3.2.15 *Merluccius hubbsi* – Common hake – Depth greater than 500 m

The total catch of *M. hubbsi* at depths greater than 500 m was 96.08 kg and the total density was 152 kg/km^2. It was caught at three of four stations of depths greater than 500 m sampled during this cruise. Catches ranged from 0.00 to 68.98 kg and densities ranged from 0 to 334 kg/km^2 (Fig 3a). The number of *M. hubbsi* sampled for otoliths was 75 (range = 0 to 50 per station) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency at those depths was 97 (97 females and no males). Female T_L ranged from 37 to 70 cm (mean of 53.48 cm) (Fig 8i). The histogram shows a single mode at 52 cm for females (Figs 8i). Females were observed Stage II (77.3%), Stage III (10.3%), and Stage VIII (12.4%) (Fig 8i).

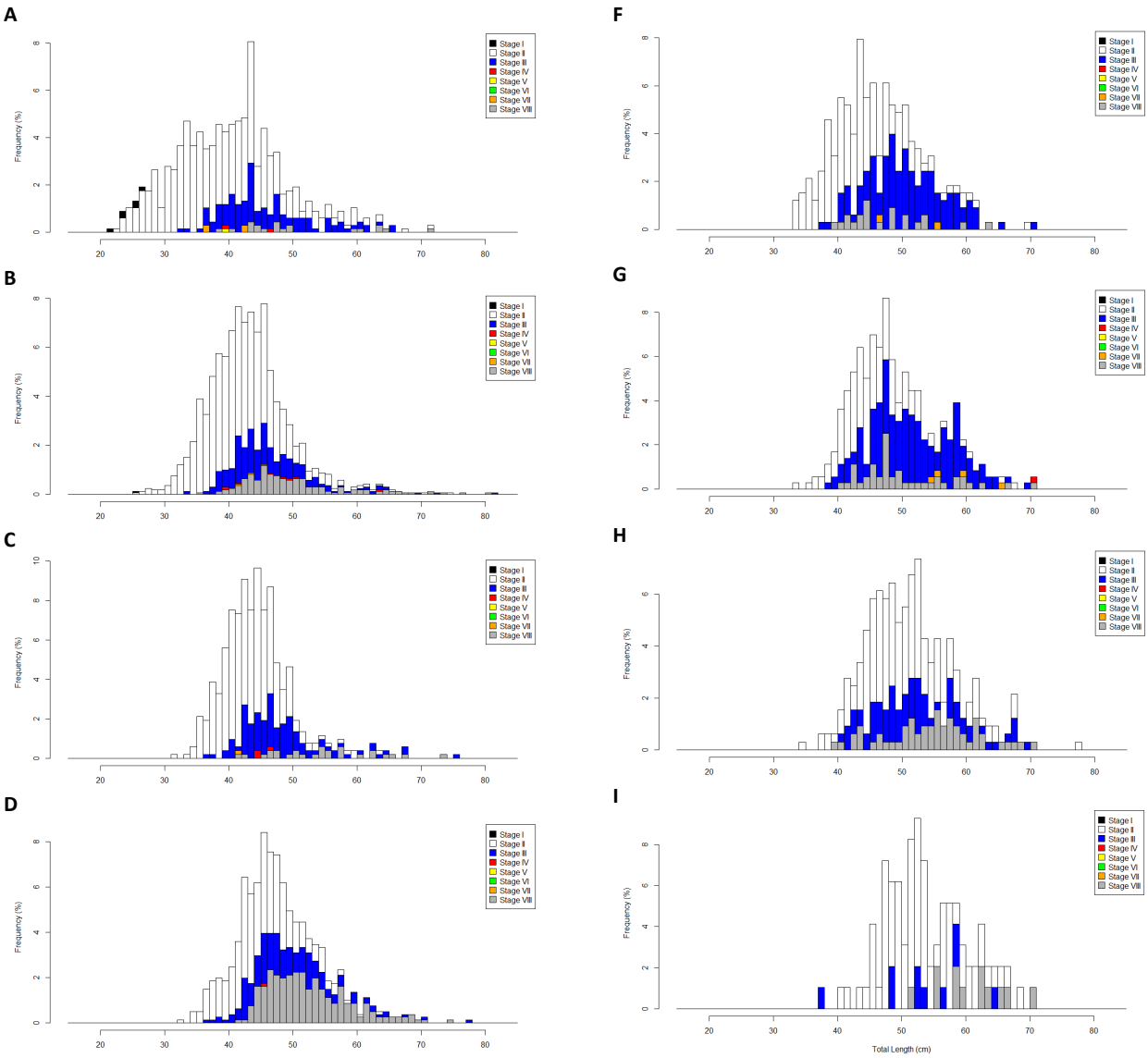

Fig 8. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Merluccius hubbsi* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** depth of 100 to 149 m (N = 704), **(B)** depth 150 to 199 m (N = 1,803), **(C)** depth 200 to 249 m (N = 527), **(D)** depth 250 to 299 m (N = 823), **(E)** depth 300 to 349 m (N = 539), **(F)** depth 350 to 399 m (N = 336), **(G)** depth 400 to 449 m (N = 359), **(H)** depth 450 to 499 m (N = 326), and **(I)** depth > 500 m (N = 97).

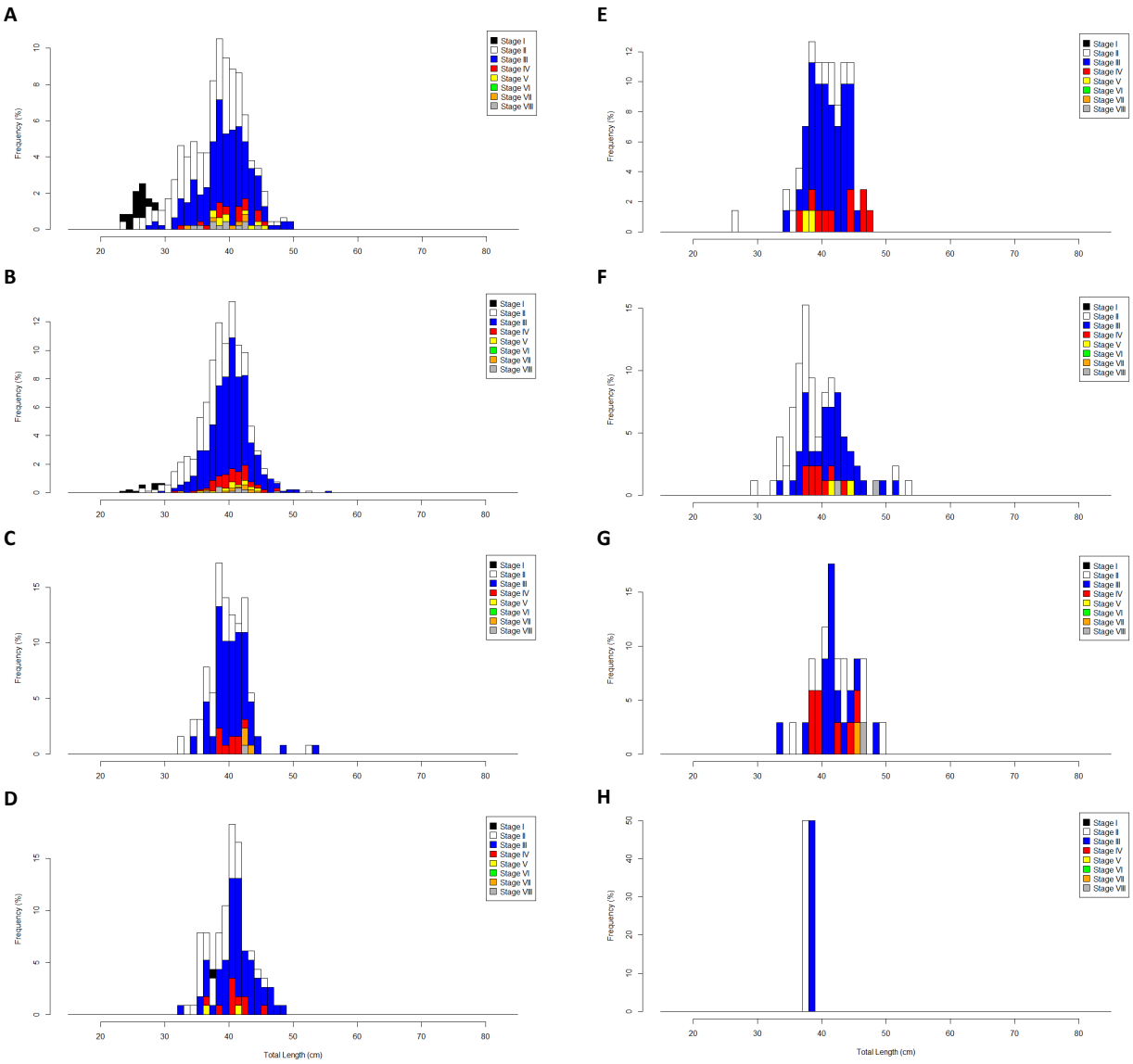

Fig 9. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Merluccius hubbsi* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** depth of 100 to 149 m (N = 483), **(B)** depth 150 to 199 m (N = 952), **(C)** depth 200 to 249 m (N = 134), **(D)** depth 250 to 299 m (N = 115), **(E)** depth 300 to 349 m (N = 73), **(F)** depth 350 to 399 m (N = 86), **(G)** depth 400 to 449 m (N = 34), **(H)** and depth 450 to 499 m (N = 2).

Consistent with the February demersal survey (Randhawa et al. 2020), both male and female *M. hubbsi* size increased with depth (Figs 8; 9). For instance, all individual females and > 95% of males under 30 cm T_L were collected from waters shallower than 200 m and a greater proportion of female individuals > 60 cm T_L were sampled at depths greater than 350 m. Furthermore, > 95% of immature individuals of both sexes (maturity Stage I) were sampled in waters shallower than 150 m at 45-46°S (Figs 6; 7; 8; 9).

3.3 *Salilota australis* – Red cod (BAC)

The total catch of *S. australis* was 2,213.806 kg (Table 2). It was caught at 30 of the 45 stations sampled during this cruise (66.7%). Catches ranged from 0.06 to 1,764.80 kg and densities from 0.3 to 8,435.3 kg/km^2 (Fig 10a). Of the 30 stations where *S. australis* was caught, 27 stations yielded > 1 kg/km^2 (90.0%), 20 stations yielded > 10 kg/km^2 (66.7%), eight stations yielded > 100 kg/km^2 (26.7%), two stations > 500 kg/km^2 (6.7%), and one station > 1,000 kg/km^2 (3.3%). Catches of *S. australis* occurred only in Areas 2 (abundance = 29.7 kg/km^2), 3 (abundance = 15.1 kg/km^2), 4 (abundance = 431.2 kg/km^2), and 5 (abundance = 258.7 kg/km^2), primarily within the FICZ in Areas 4 and 5 (Fig 10a). The number of *S. australis* sampled for otoliths was 220 (range = 0 to 50 per station) (Fig 10b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 134 females (T_L = 19 to 74 cm), 85 males (T_L = 18 to 66 cm), and one juvenile individual (T_L = 11 cm) (Fig 11). The number of fish sampled for length frequency was 1,033 (588 females and 445 males). Female T_L ranged from 11 to 74 cm (mean of 30.84 cm) (Fig 12a), whereas males measured between 18 and 66 cm (mean of 27.53 cm) (Fig 12b). The histograms show a single mode at 21 and 22 cm for females and a single mode at 21 and 22 cm for males as well (Fig 12). Females were observed Stage I (7.0%), Stage II (83.8%), Stage III (4.6%), Stage IV (3.1%), Stage V (0.3%), Stage VII (0.2%), and Stage VIII (1.0%) (Fig 12a). Males were observed Stage I (15.1%), Stage II (64.3%), Stage III (19.6%), and Stage IV (1.1%) (Fig 12b).

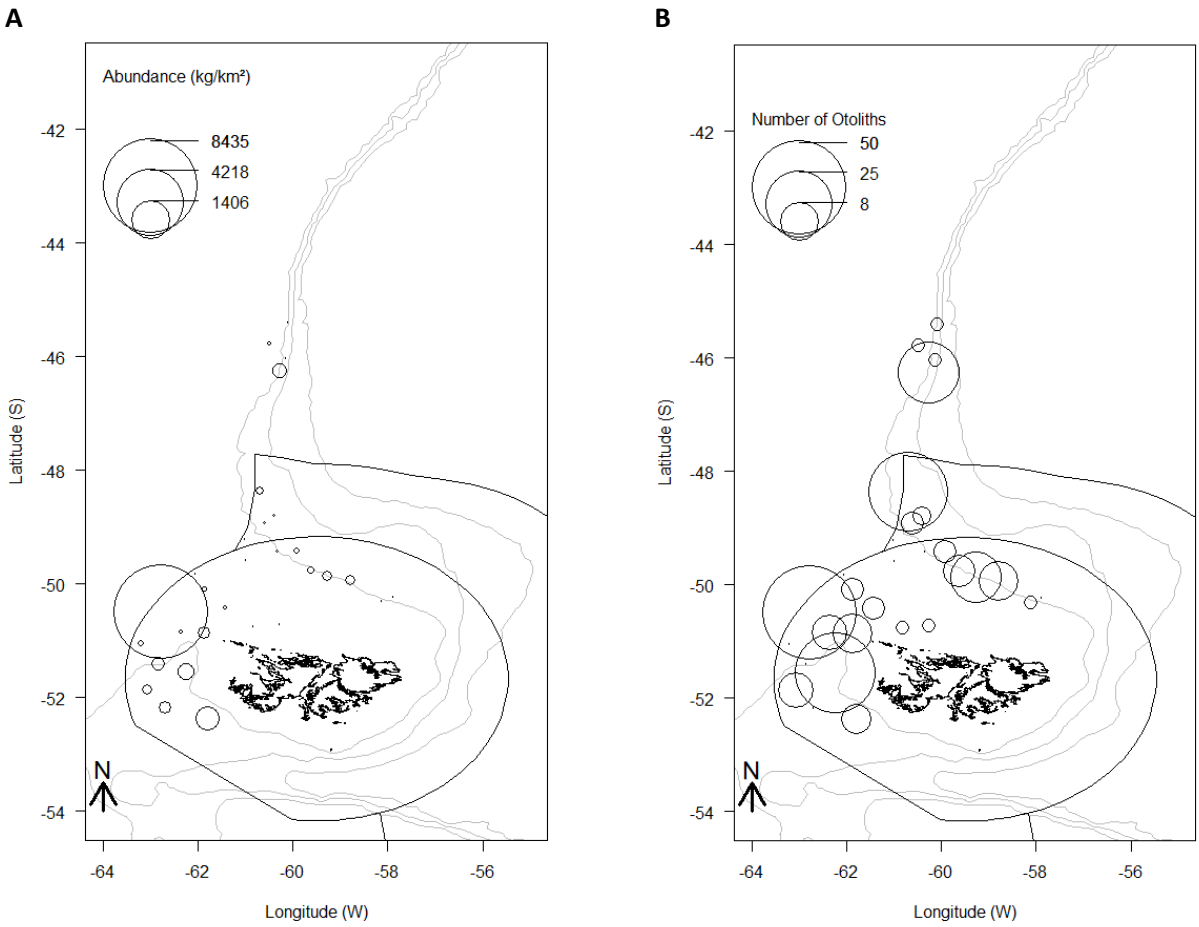

Fig 10. Distribution of (A) densities and (B) otolith samples (N = 220) of *Salilota australis*.

The largest proportions of individuals smaller than the median T_L of 27 cm for females and 24 cm for males was observed in deeper waters. In waters shallower than 200 m, 45.9% of the 255 female individuals and 43.0% of the 200 male individuals were smaller than median T_L. In waters of between 200 and 300 m depths, 61.8% of the 267 female individuals and 63.4% of the 191 male individuals were smaller than median T_L. In waters deeper than 300 m depths, 59.1% of the 66 female individuals and 48.1% of the 54 male individuals were smaller than median T_L. The larger *S. australis* individuals were aggregating in shallower waters as they prepare to spawn.

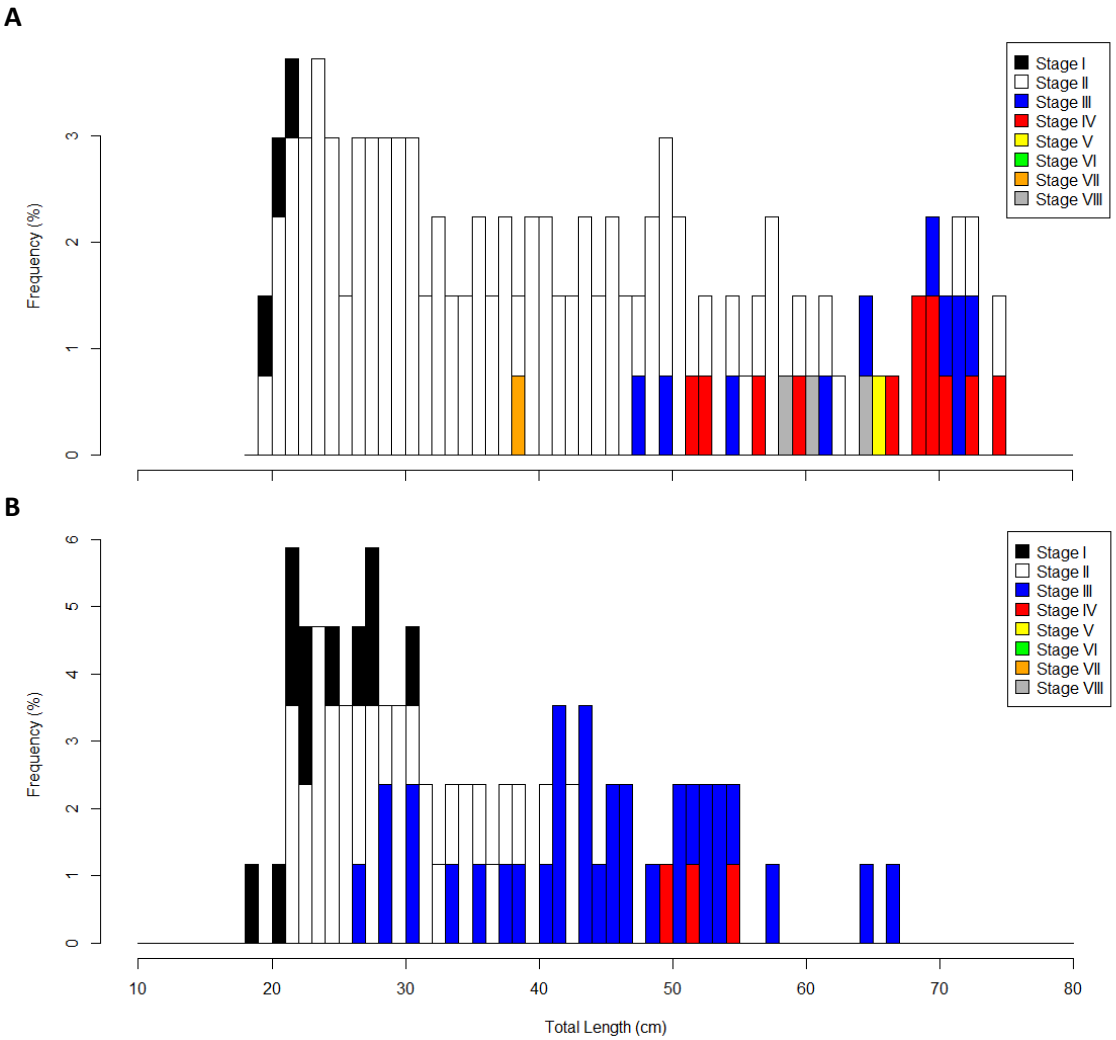

Fig 11. Length frequency (percentage of the total sample collected) of *Salilota australis* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 134) and (B) males (N = 85).

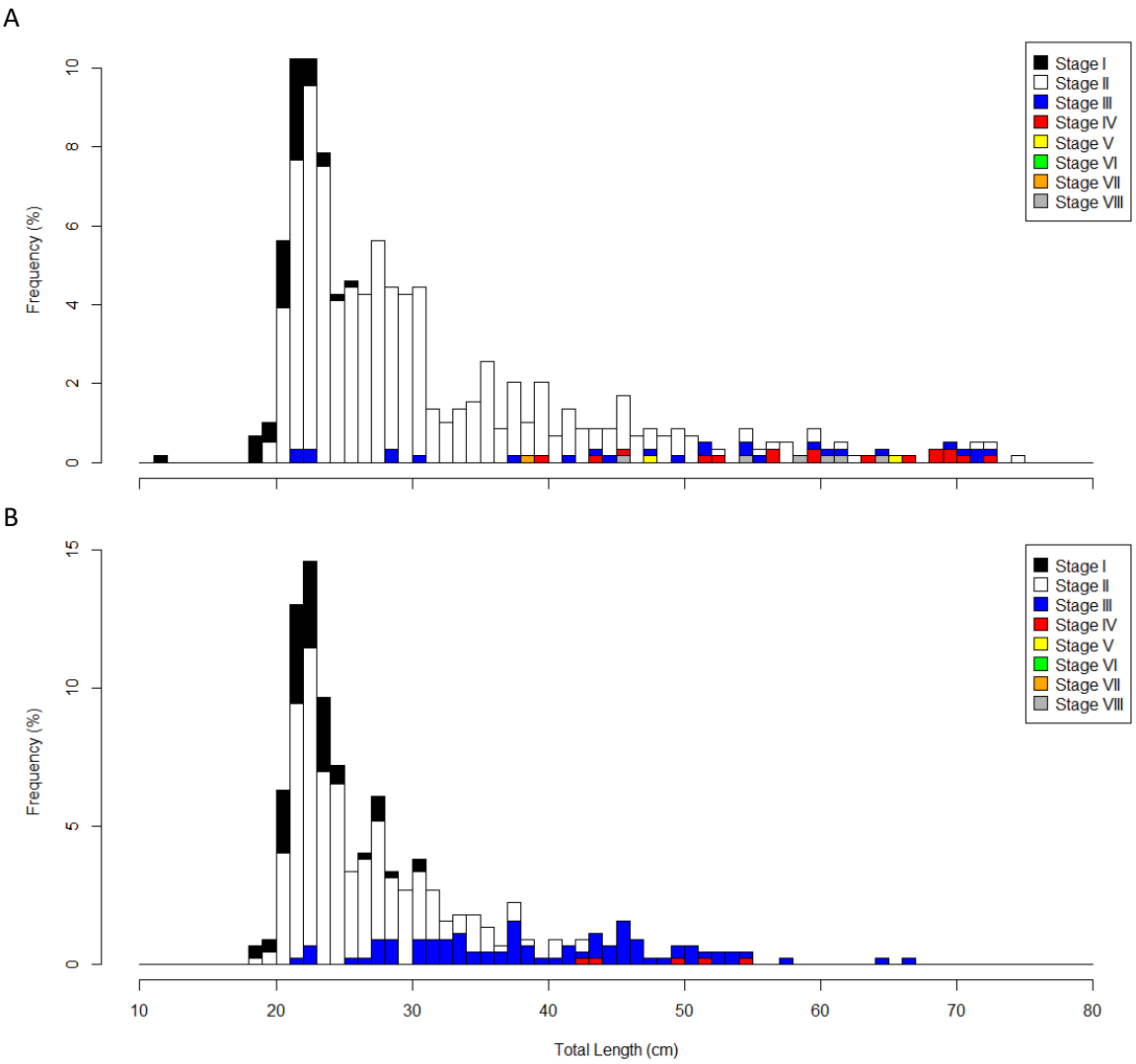

Fig 12. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Salilota australis* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 588) and (B) males (N = 445).

3.3.1 *Salilota australis* – Red cod – Area 1

No *S. australis* was caught in Area 1.

3.3.2 *Salilota australis* – Red cod – Area 2

The total catch of *S. australis* in Area 2 was 49.156 kg (Table 4) and the total density was 29.7 kg/km^2. It was caught at four of the eight stations sampled in Area 2 during this cruise (50.0%). Catches ranged from 0.08 to 44.48 kg and densities from 0.4 to 210.1 kg/km^2 (Fig 10a). Of the four stations where *S. australis* was caught in Area 2, three stations yielded > 1 kg/km^2 (75.0%), two stations yielded > 10 kg/km^2 (50.0%), and a single station yielded > 100 kg/km^2 (25.0%). The number of *S. australis* sampled for otoliths was 24 (range = 1 to 21 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 21 females (T_L = 20 to 72 cm) and three males (T_L = 52 to 66 cm). The number of fish sampled for length frequency was 24 (21 females and three males). Female T_L ranged from 20 to 72 cm (mean of 55.81 cm) (Fig 13a), whereas males measured between 52 and 66 cm (mean of 60.67 cm) (Fig 14a). Females were observed Stage I (4.8%), Stage II (52.4%), Stage III (14.3%), Stage IV (23.8%), and Stage VIII (4.8%) (Fig

13a). All three males were observed Stage III (Fig 14a). In Area 2, 19 of 21 females sampled (90.5%) and all three males were larger than the median T_L of 27 and 24 cm, respectively.

3.3.3 *Salilota australis* – Red cod – Area 3

The total catch of *S. australis* in Area 3 was 20.22 kg (Table 5) and the total density was 15.1 kg/km^2. It was caught at four of the six stations sampled in Area 3 during this cruise (66.7%). Catches ranged from 0.82 to 14.36 kg and densities from 3.5 to 65.4 kg/km^2 (Fig 10a). Of the four stations where *S. australis* was caught in Area 3, all four stations yielded > 1 kg/km^2, two stations yielded > 10 kg/km^2 (50.0%), and no station yielded > 100 kg/km^2. The number of *S. australis* sampled for otoliths was 40 (range = 0 to 35 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 22 females (T_L = 21 to 71 cm) and 18 males (T_L = 21 to 30 cm). The number of fish sampled for length frequency was 93 (58 females and 35 males). Female T_L ranged from 21 to 71 cm (mean of 26.95 cm) (Fig 13b), whereas males measured between 20 and 32 cm (mean of 24.57 cm) (Fig 14b). Females were observed Stage II (98.3%) and Stage III (1.7%) (Fig 13b). Males were observed Stage I (14.3%), Stage II (71.4%) and Stage III (14.3%) (Fig 14b). In Area 3, 34 of 58 females sampled (58.6%) and 21 of 35 males (60.0%) were smaller or equal to the median T_L of 27 and 24 cm, respectively.

3.3.4 *Salilota australis* – Red cod – Area 4

The total catch of *S. australis* in Area 4 was 1,985.63 kg (Table 6) and the total density was 431.2 kg/km^2. It was caught at 19 of the 21 stations sampled in Area 4 during this cruise (90.5%). Catches ranged from 0.06 to 1,764.80 kg and densities from 0.3 to 8,435.3 kg/km^2 (Fig 10a). Of the 19 stations where *S. australis* was caught in Area 4, 17 stations yielded > 1 kg/km^2 (89.5%), 13 stations yielded > 10 kg/km^2 (68.4%), five stations yielded > 100 kg/km^2 (26.3%), and a single station yielded > 1,000 kg/km^2 (5.3%). The number of *S. australis* sampled for otoliths was 144 (range = 0 to 50 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 80 females (T_L = 19 to 74 cm), 63 males (T_L = 18 to 57 cm), and a single juvenile individual (T_L = 11 cm). The number of fish sampled for length frequency was 638 (374 females and 264 males). Female T_L ranged from 11 to 74 cm (mean of 30.88 cm) (Fig 13c), whereas males measured between 18 and 57 cm (mean of 28.82 cm) (Fig 14c). Females were observed Stage I (8.8%), Stage II (82.4%), Stage III (4.5%), Stage IV (2.7%), Stage V (0.5%), Stage VII (0.3%), and Stage VIII (0.8%) (Fig 13c). Males were observed Stage I (16.7%), Stage II (59.1%), Stage III (22.3%), and Stage IV (1.9%) (Fig 14c). In Area 4, 197 of 374 females sampled (52.7%) and 122 of 264 males (46.2%) were smaller or equal to the median T_L of 27 and 24 cm, respectively.

3.3.5 *Salilota australis* – Red cod – Area 5

The total catch of *S. australis* in Area 5 was 158.86 kg (Table 7) and the total density was 258.7 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 19.76 to 108.32 kg and densities from 94.8 to 524.3 kg/km^2 (Fig 10a). Of the three stations where *S. australis* was caught in Area 5, all three stations yielded > 1 kg/km^2 and > 10 kg/km^2, two stations yielded > 100 kg/km^2 (66.7%), and no station yielded > 1,000 kg/km^2. The number of *S. australis* sampled for otoliths was 12 (range = 0 to 7 per station) and did not covered the entire length frequency for both males and females. Overall, otoliths were collected from 13 females (T_L = 19 to 74 cm) and a single male (T_L = 43 cm). The number of fish sampled for length frequency was 278 (135 females and 143 males). Female T_L ranged from 18 to 74 cm (mean of 28.51 cm) (Fig 13d), whereas males measured between 19 and 49 cm (mean of 25.18 cm) (Fig 14d). Females were observed Stage I (5.2%), Stage II (86.7%), Stage III (4.4%), Stage IV (2.2%), and Stage VIII (1.5%) (Fig 13d). Males were observed Stage I (12.6%), Stage II (73.4%), and Stage III (14.0%) (Fig 14d). In Area 5, 88 of 135 females sampled (65.2%) and 90 of 143 males (62.9%) were smaller or equal to the median T_L of 27 and 24 cm, respectively.

3.3.6 *Salilota australis* – Red cod – Area 6

No *S. australis* was caught in Area 6.

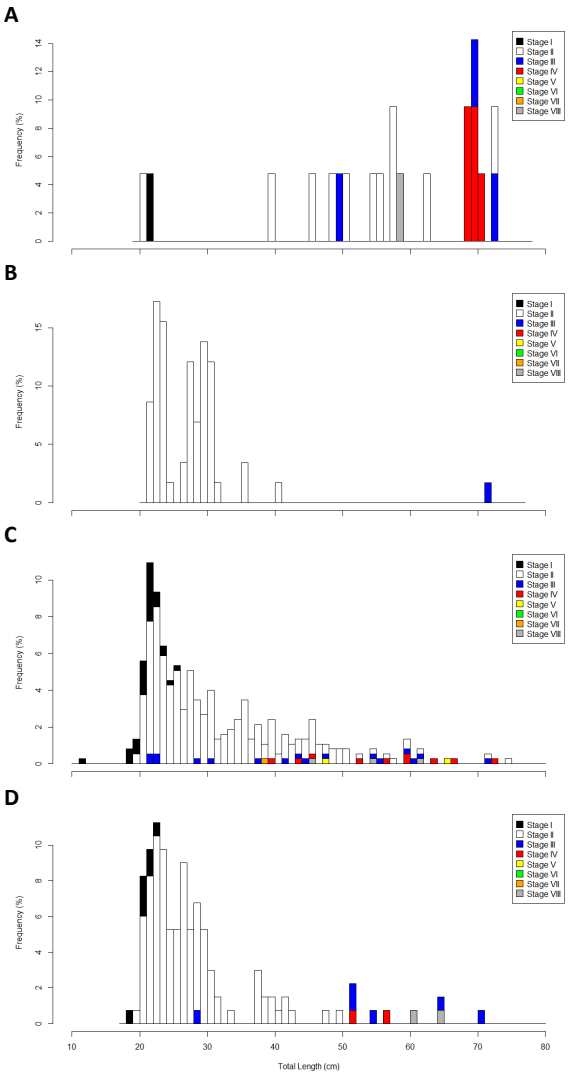

Fig 13. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Salilota australis* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 2 (N = 21), **(B)** Area 3 (N = 58), **(C)** Area 4 (N = 374), **(D)** Area 5 (N = 135).

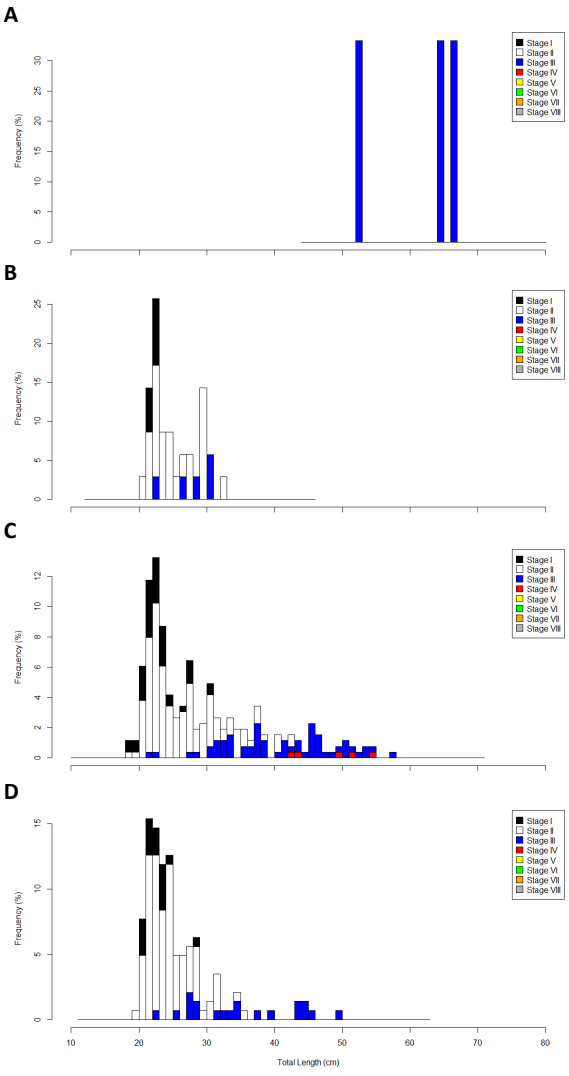

Fig 14. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Salilota australis* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 2 (N = 3), **(B)** Area 3 (N = 35), **(C)** Area 4 (N = 264), **(D)** Area 5 (N = 143).

3.4 *Micromesistius australis australis* – Southern blue whiting (BLU)

The total catch of *M. a. australis* was 629.609 kg (Table 2). It was caught at 30 of the 45 stations sampled during this cruise (66.7%). Catches ranged from 0.01 to 258.34 kg and densities from 0.05 to 1,291.44 kg/km^2 (Fig 15a). Of the 30 stations where *M. a. australis* was caught, 18 stations yielded > 1 kg/km^2 (60.0%), nine stations yielded > 10 kg/km^2 (30.0%), three stations yielded > 100 kg/km^2 (10.0%), and two stations > 1,000 kg/km^2 (6.7%). Catches of *M. a. australis* occurred in all six areas: Area 1 (abundance = 27.8 kg/km^2), Area 2 (abundance = 2.7 kg/km^2), Area 3 (abundance = 3.7 kg/km^2), Area 4 (abundance = 1.8 kg/km^2), Area 5 (abundance = 8.2 kg/km^2), and Area 6 (abundance = 999.0 kg/km^2), primarily in the southwest of the FICZ in Area 6 (Fig 15a). The number of *M. a. australis* sampled for otoliths was 158 (range = 0 to 39 per station) (Fig 15b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 72 females (T_L = 14 to 63 cm) and 86 males (T_L = 14 to 58 cm) (Fig 16). The number of fish sampled for length frequency was 699 (164 females, 329 males, and 206 juveniles). Female T_L ranged from 14 to 63 cm (mean of 36.57 cm) (Fig 17a), whereas males measured between 14 and 59 cm (mean of 34.90 cm) (Fig 17b), and juveniles measured between 14 and 19 cm (mean of 16.29 cm). The histograms show two distinct modes at 15 and 41 cm, respectively, for females and two distinct modes at 17 and 39 cm, respectively, for males (Fig 17). Females were observed Stage I (29.9%), Stage II (11.0%), Stage III (40.9%), Stage IV (17.1%), and Stage VIII (1.2%) (Fig 17a). Males were observed Stage I (26.1%), Stage II (7.3%), Stage III (60.2%), and Stage IV (6.4%) (Fig 17b).

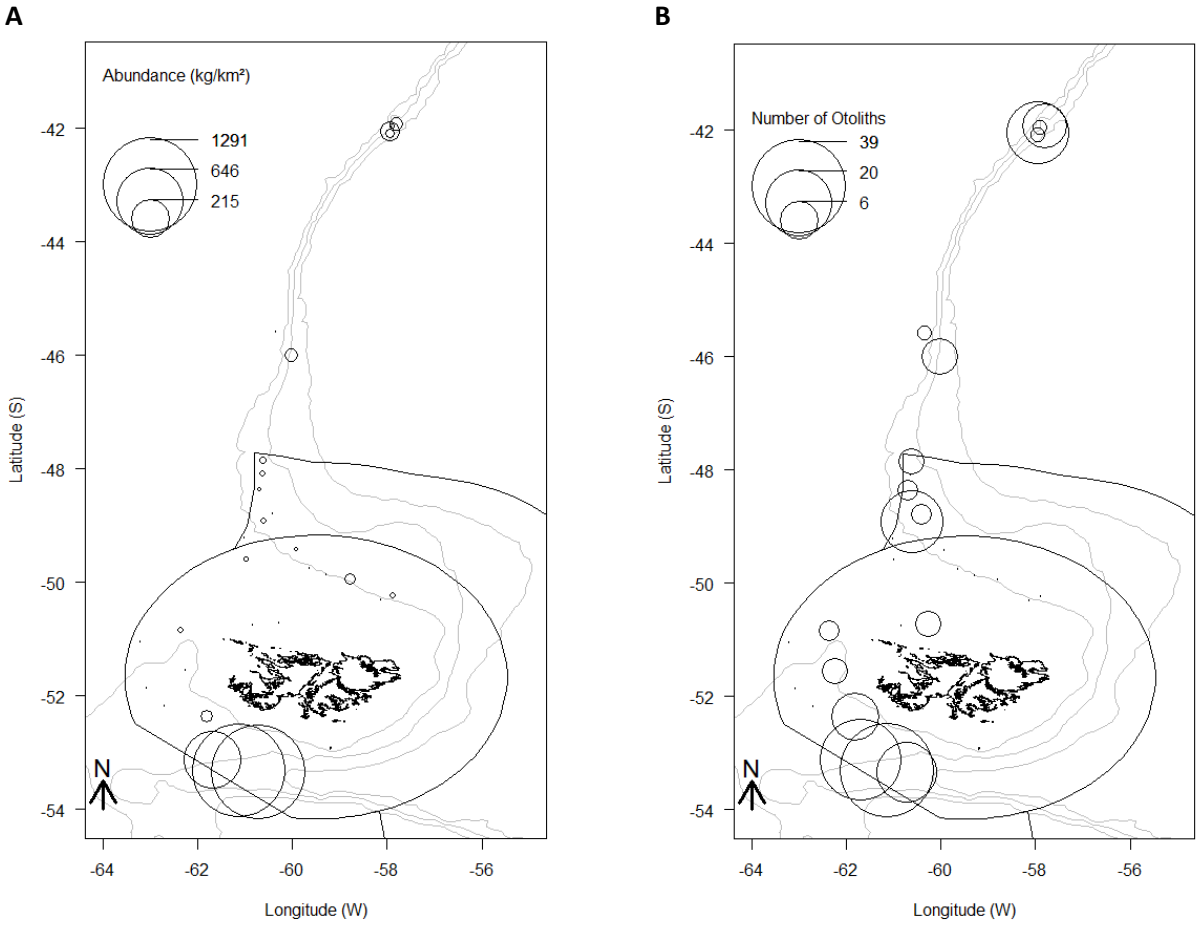

Fig 15. Distribution of (A) densities and (B) otolith samples (N = 158) of *Micromesistius australis australis*.

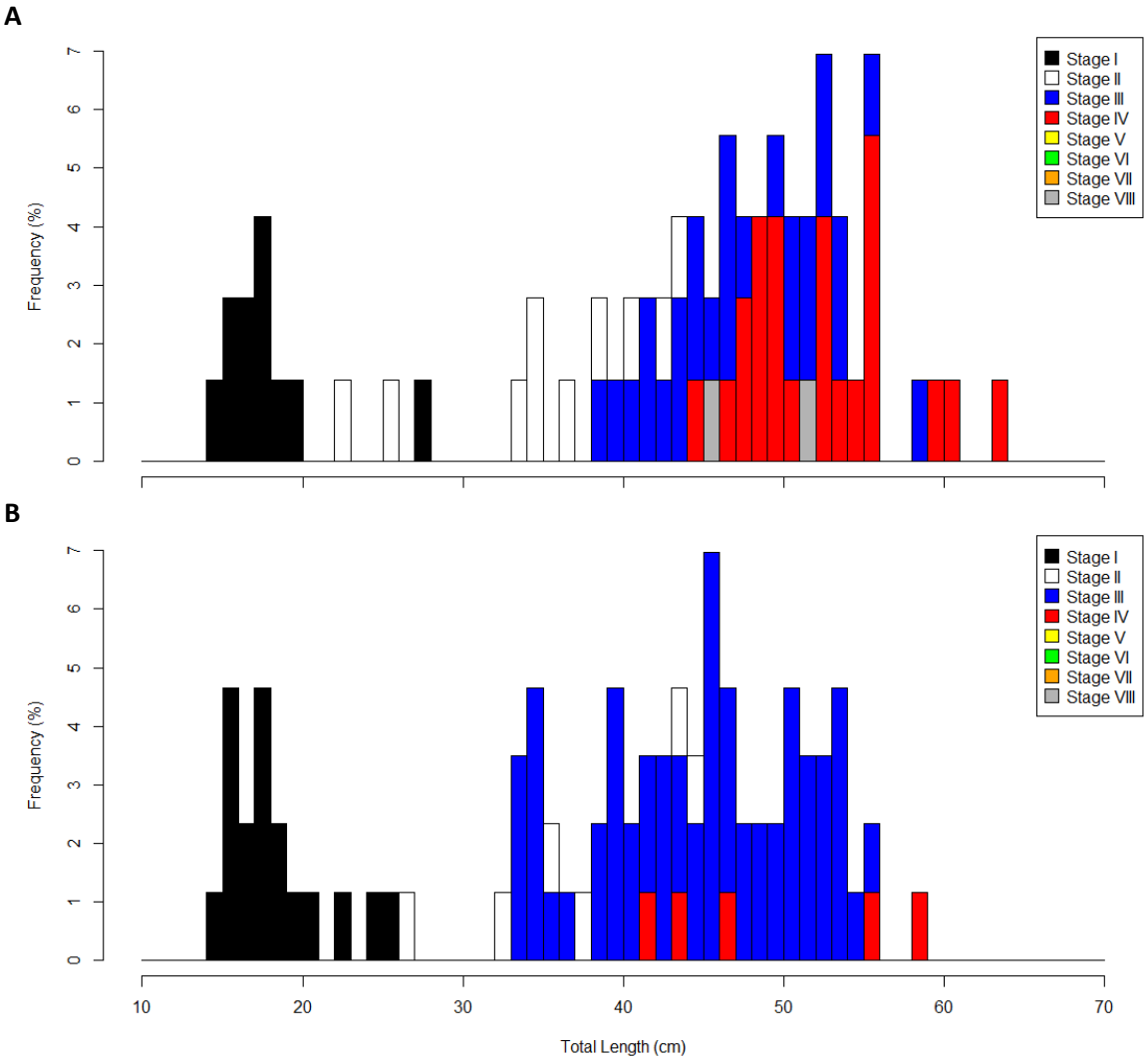

Fig 16. Length frequency (percentage of the total sample collected) of *Micromesistius australis australis* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 72) and (B) males (N = 86).

The greater proportions of individuals smaller than the median T_L of 41 cm for females and 39 cm for males was observed in shallower waters. In waters shallower than 200 m, the lone female individual sampled was larger than the median size and 80.0% of the 5 male individuals were smaller than the median T_L. In waters of between 200 and 300 m depths, all of the 46 female individuals and 79 male individuals were smaller than median T_L. In waters deeper than 300 m depths, 31.6% of the 117 female individuals and 43.3% of the 245 male individuals were smaller than median T_L. All juveniles were observed in waters shallower than 300 m.

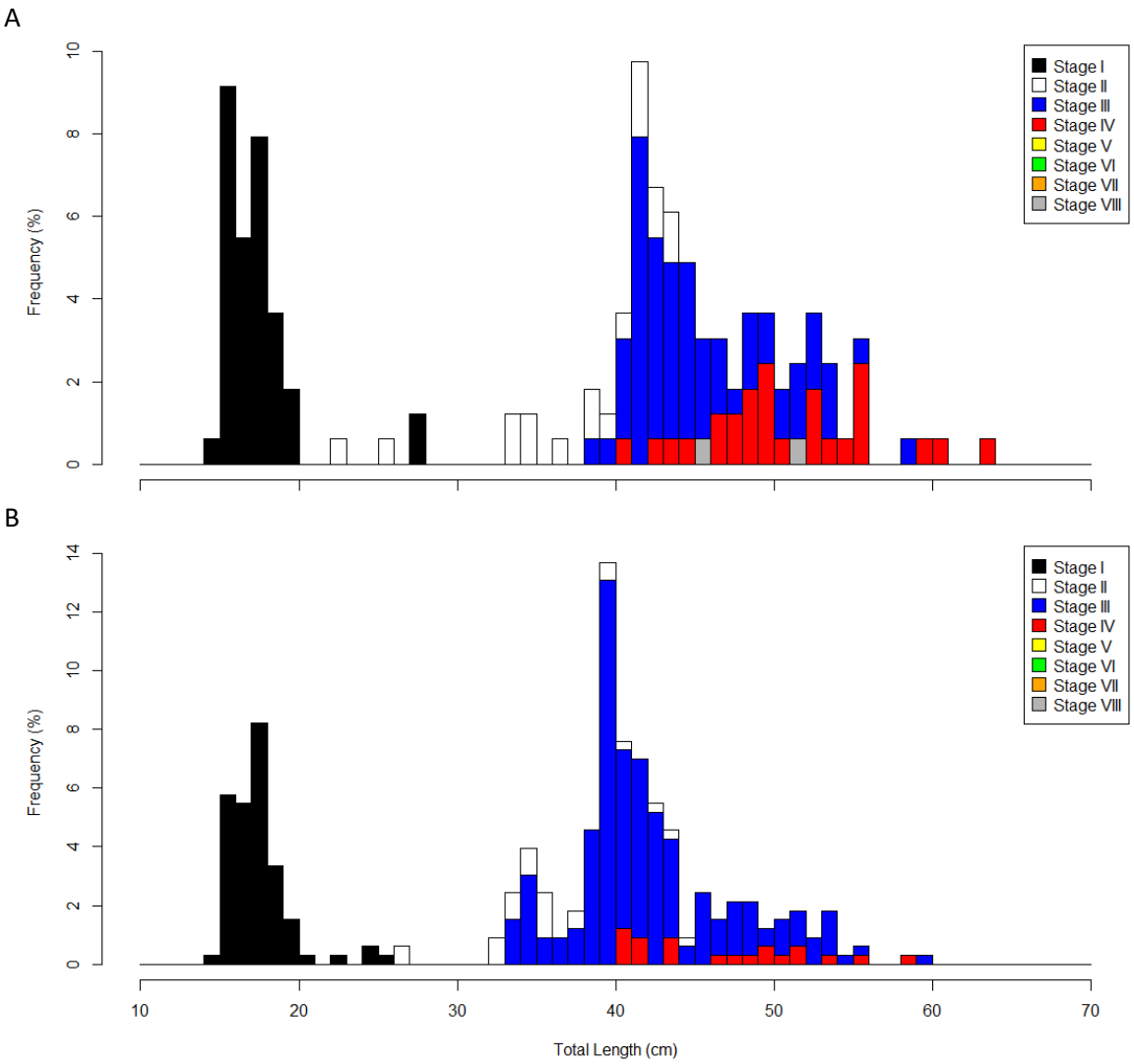

Fig 17. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Micromesistius australis australis* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 164) and (B) males (N = 329).

3.4.1 *Micromesistius australis australis* – Southern blue whiting – Area 1

The total catch of *M. a. australis* in Area 1 was 19.629 kg (Table 3) and the total density was 27.8 kg/km^2. It was caught at all four stations sampled in Area 1 during this cruise. Catches ranged from 0.68 to 11.59 kg and densities from 3.5 to 54.3 kg/km^2 (Fig 10a). Of the four stations where *M. a. australis* was caught in Area 1, all four stations yielded > 1 kg/km^2, three stations yielded > 10 kg/km^2 (75.0%), and no station yielded > 100 kg/km^2. The number of *M. a. australis* sampled for otoliths was 28 (range = 1 to 17 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from nine females (T_L = 44 to 55 cm) and 19 males (T_L = 22 to 53 cm). The number of fish sampled for length frequency was 28 (nine females and 19 males). Female T_L ranged from 44 to 55 cm (mean of 49.44 cm) (Fig 18a), whereas males measured between 22 and 53 cm (mean of 46.79 cm) (Fig 19a). Females were observed Stage III (44.4%) and Stage IV (55.6%) (Fig 18a). Males were observed Stage I (5.3%), Stage II (5.3%), and Stage III (89.5%) (Fig 19a). In Area 1, none of the 9 females sampled and 2 of 19 males (10.5%) were smaller or equal to the median T_L of 41 and 39 cm, respectively.

3.4.2 *Micromesistius australis australis* – Southern blue whiting – Area 2

The total catch of *M. a. australis* in Area 2 was 4.420 kg (Table 4) and the total density was 2.7 kg/km^2. It was caught at two of the eight stations sampled in Area 2 during this cruise (25.0%). Catches were 0.02 at station 3180 and 4.40 kg at station 3190, with respective densities of < 0.1 and 26.5 kg/km^2 (Fig 15a). The number of *M. a. australis* sampled for otoliths was seven (one or six per station). Overall, otoliths were collected from three females (T_L = 43 to 50 cm) and four males (T_L = 15 to 50 cm). The number of fish sampled for length frequency was seven (three females and four males). Female T_L ranged from 43 to 50 cm (mean of 47.33 cm) (Fig 18b), whereas males measured between 15 and 50 cm (mean of 38.50 cm) (Fig 19b). Females were observed Stage II (33.3%) and Stage IV (66.7%) (Fig 18b). Males were observed Stage I (25.0%), Stage II (25.0%), and Stage III (50.0%) (Fig 19b). In Area 2, none of the 3 females and 1 of the 4 males (25.0%) sampled were smaller or equal to the median T_L of 41 and 39 cm, respectively.

3.4.3 *Micromesistius australis australis* – Southern blue whiting – Area 3

The total catch of *M. a. australis* in Area 3 was 5.00 kg (Table 5) and the total density was 3.7 kg/km^2. It was caught at all six stations sampled in Area 3 during this cruise. Catches ranged from 0.08 to 1.74 kg and densities from 0.3 to 8.3 kg/km^2 (Fig 15a). Of the six stations where *M. a. australis* was caught in Area 3, four stations yielded > 1 kg/km^2 (66.7%) and no stations yielded > 10 kg/km^2. The number of *M. a. australis* sampled for otoliths was 24 (range = 0 to 17 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from ten females (T_L = 14 to 25 cm) and 14 males (T_L = 14 to 58 cm). The number of fish sampled for length frequency was 80 (26 females and 54 males). Female T_L ranged from 14 to 25 cm (mean of 16.23 cm) (Fig 18c), whereas males measured between 14 and 58 cm (mean of 17.61 cm) (Fig 19c). Females were observed Stage I (92.3%) and Stage II (7.7%) (Fig 18c). Males were observed Stage I (94.4%), Stage II (1.9%), Stage III (1.9%), and Stage IV (1.9%) (Fig 19c). In Area 3, all 26 females sampled and 52 of 53 males (98.1%) were smaller or equal to the median T_L of 41 and 39 cm, respectively.

3.4.4 *Micromesistius australis australis* – Southern blue whiting – Area 4

The total catch of *M. a. australis* in Area 4 was 8.39 kg (Table 6) and the total density was 1.8 kg/km^2. It was caught at 12 of the 21 stations sampled in Area 4 during this cruise (57.1%). Catches ranged from 0.01 to 4.02 kg and densities from < 0.1 to 17.9 kg/km^2 (Fig 15a). Of the 12 stations where *M. a. australis* was caught in Area 4, five stations yielded > 1 kg/km^2 (41.7%), a single station yielded > 10 kg/km^2 (8.3%), and no station yielded > 100 kg/km^2. The number of *M. a. australis* sampled for otoliths was five (2 or 3 per station). Overall, otoliths were collected from two females (T_L = 18 and 52 cm) and three males (T_L range = 17 to 19 cm). The number of fish sampled for length frequency was 50 (21 females and 29 males). Female T_L ranged from 15 to 52 cm (mean of 18.57 cm) (Fig 18d), whereas males measured between 15 and 45 cm (mean of 18.69 cm) (Fig 19d). Females were observed Stage I (95.2%) and Stage IV (4.8%) (Fig 18d). Males were observed Stage I (96.6%) and Stage III (3.4%) (Fig 19d). In Area 4, 20 of 21 females sampled (95.2%) and 28 of 29 males (96.6%) were smaller or equal to the median T_L of 41 and 39 cm, respectively. Additionally, all 206 juvenile *M. a. australis* sampled during the cruise were collected from Area 4.

3.4.5 *Micromesistius australis australis* – Southern blue whiting – Area 5

The total catch of *M. a. australis* in Area 5 was 5.01 kg (Table 7) and the total density was 8.2 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 0.02 to 4.82 kg and densities from 0.1 to 23.3 kg/km^2 (Fig 15a). Of the three stations where *M. a. australis* was caught in Area 5, a single one yielded > 1 kg/km^2 (33.3%) and > 10 kg/km^2 (33.3%), and no station yielded > 100 kg/km^2. The number of *M. a. australis* sampled for otoliths was ten (all from a single station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from two females (T_L = 19 and 51 cm) and eight males (T_L = 18 to 54 cm). The number of fish sampled for length frequency was 15 (four females and 11 males). Female T_L ranged from 18 to 51 cm (mean of 26.75 cm) (Fig 18e), whereas males measured between 15 and 54 cm (mean of 32.55 cm) (Fig 19e). Females were observed Stage I (75.0%) and Stage III (25.0%) (Fig 18e). Males were observed Stage I (45.5%) and Stage III (54.5%) (Fig 19e). In Area 5, 3 of 4 females sampled (75.0%) and 6 of 11 males (54.5%) were smaller or equal to the median T_L of 41 and 39 cm, respectively.

3.4.6 *Micromesistius australis australis* – Southern blue whiting – Area 6

The total catch of *M. a. australis* in Area 6 was 587.16 kg (Table 8) and the total density was 999.0 kg/km^2. It was caught at all three stations sampled in Area 6 during this cruise. Catches ranged from 96.90 to 258.34 kg and densities from 480.1 to 1,291.4 kg/km^2 (Fig 15a). Of the three stations where *M. a. australis* was caught in Area 6, all three yielded > 1 kg/km^2, all three > 10 kg/km^2, all three > 100 kg/km^2, and two station yielded > 1,000 kg/km^2 (66.7%). The number of *M. a. australis* sampled for otoliths was 84 (range = 16 to 39 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 46 females (T_L = 27 and 63 cm) and 38 males (T_L = 32 to 55 cm). The number of fish sampled for length frequency was 313 (101 females and 212 males). Female T_L ranged from 27 to 63 cm (mean of 44.47 cm) (Fig 18f), whereas males measured between 26 and 59 cm (mean of 40.50 cm) (Fig 19f). Females were observed Stage I (2.0%), Stage II (14.9%), Stage III (61.4%), Stage IV (19.8%), and Stage VIII (2.0%) (Fig 18f). Males were observed Stage II (9.9%), Stage III (80.7%), and Stage IV (9.4%) (Fig 19f). In Area 6, 34 of 101 females sampled (33.7%) and 99 of 212 males (46.7%) were smaller or equal to the median T_L of 41 and 39 cm, respectively.

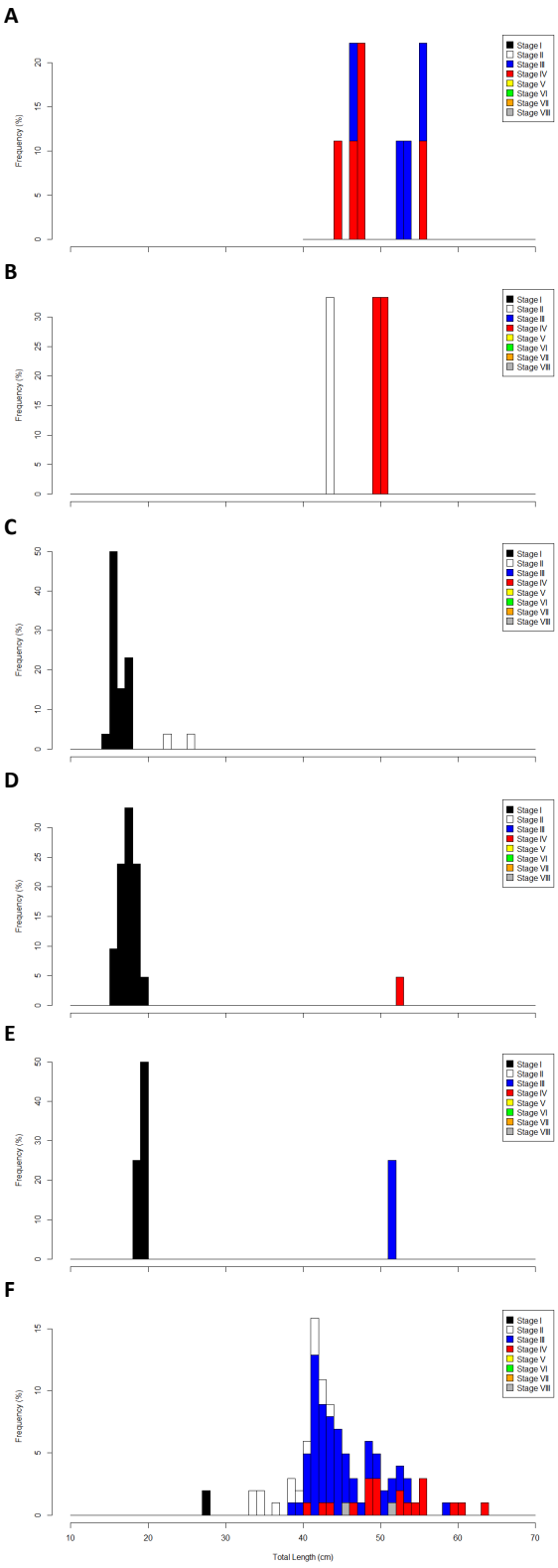

Fig 18. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Micromesistius australis australis* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 9), **(B)** Area 2 (N = 3), **(C)** Area 3 (N = 26), **(D)** Area 4 (N = 21), **(E)** Area 5 (N = 4), **(F)** (Area 6 (N = 101).

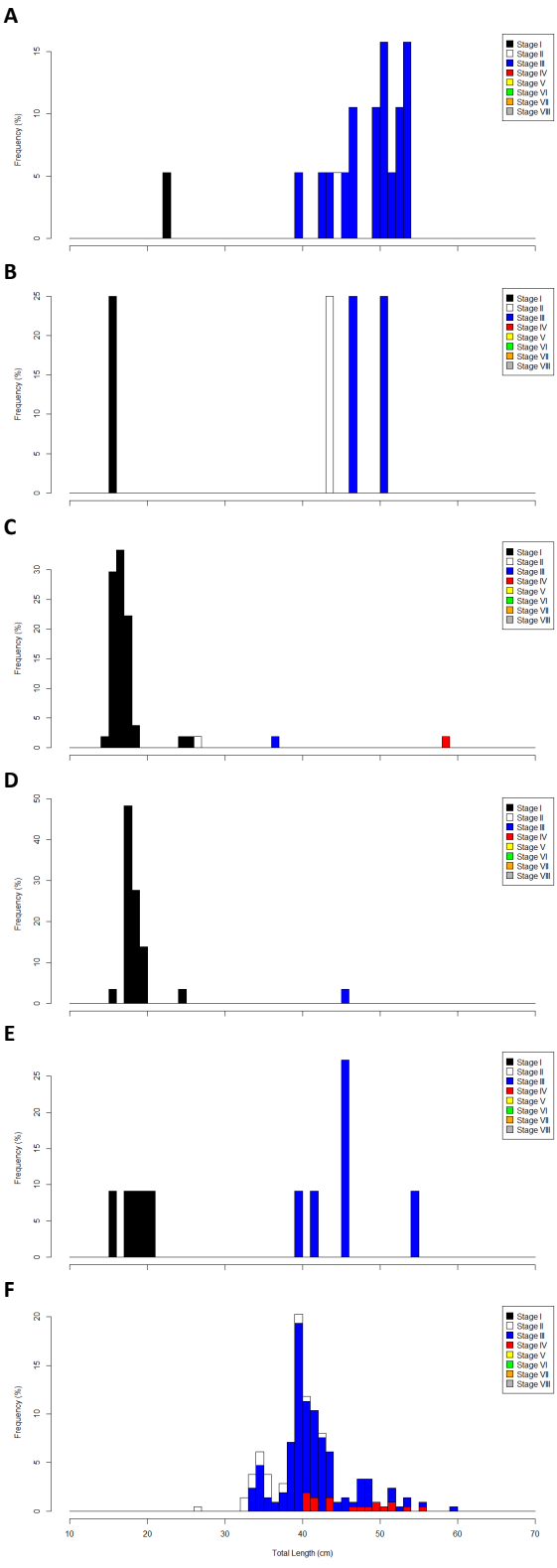

Fig 19. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Micromesistius australis australis* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 19), **(B)** Area 2 (N = 4), **(C)** Area 3 (N = 54), **(D)** Area 4 (N = 29), **(E)** Area 5 (N = 11), **(F)** (Area 6 (N = 212).

3.5 *Stromateus brasiliensis* – Butterfish (BUT)

The total catch of *S. brasiliensis* was 150.162 kg (Table 2). It was caught at 13 of the 45 stations sampled during this cruise (28.9%). Catches ranged from 0.18 to 65.08 kg and densities from 0.9 to 311.1 kg/km^2 (Fig 20a). Of the 13 stations where *S. brasiliensis* was caught, 12 stations yielded > 1 kg/km^2 (92.3%), seven stations yielded > 10 kg/km^2 (53.8%), two stations yielded > 100 kg/km^2 (15.4%), and no station > 1,000 kg/km^2. Catches of *S. brasiliensis* occurred in three of six areas: Area 2 (abundance = 34.4 kg/km^2), Area 3 (abundance = 3.3 kg/km^2), and Area 4 (abundance = 19.3 kg/km^2) (Fig 20a). The number of *S. brasiliensis* sampled for otoliths was 83 (range = 0 to 25 per station) (Fig 20b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 68 females (T_L = 22 to 38 cm) and 15 males (T_L = 24 to 35 cm) (Fig 21). The number of fish sampled for length frequency was 315 (277 females and 38 males). Female T_L ranged from 22 to 39 cm (mean of 30.16 cm) (Fig 22a), whereas males measured between 23 and 37 cm (mean of 28.43 cm) (Fig 22b). The histograms show two distinct modes at 27 to 28 and 33 cm, respectively, for females and one distinct mode at 31 cm, for males (Fig 22). Females were observed Stage II (9.7%), Stage III (44.8%), Stage IV (44.4%), and Stage V (1.8%) (Fig 22a). Males were observed Stage I (2.6%), Stage II (13.2%), Stage III (71.1%), and Stage VIII (13.2%) (Fig 22b). All *S. brasiliensis* sampled were collected from waters shallower than 200 m.

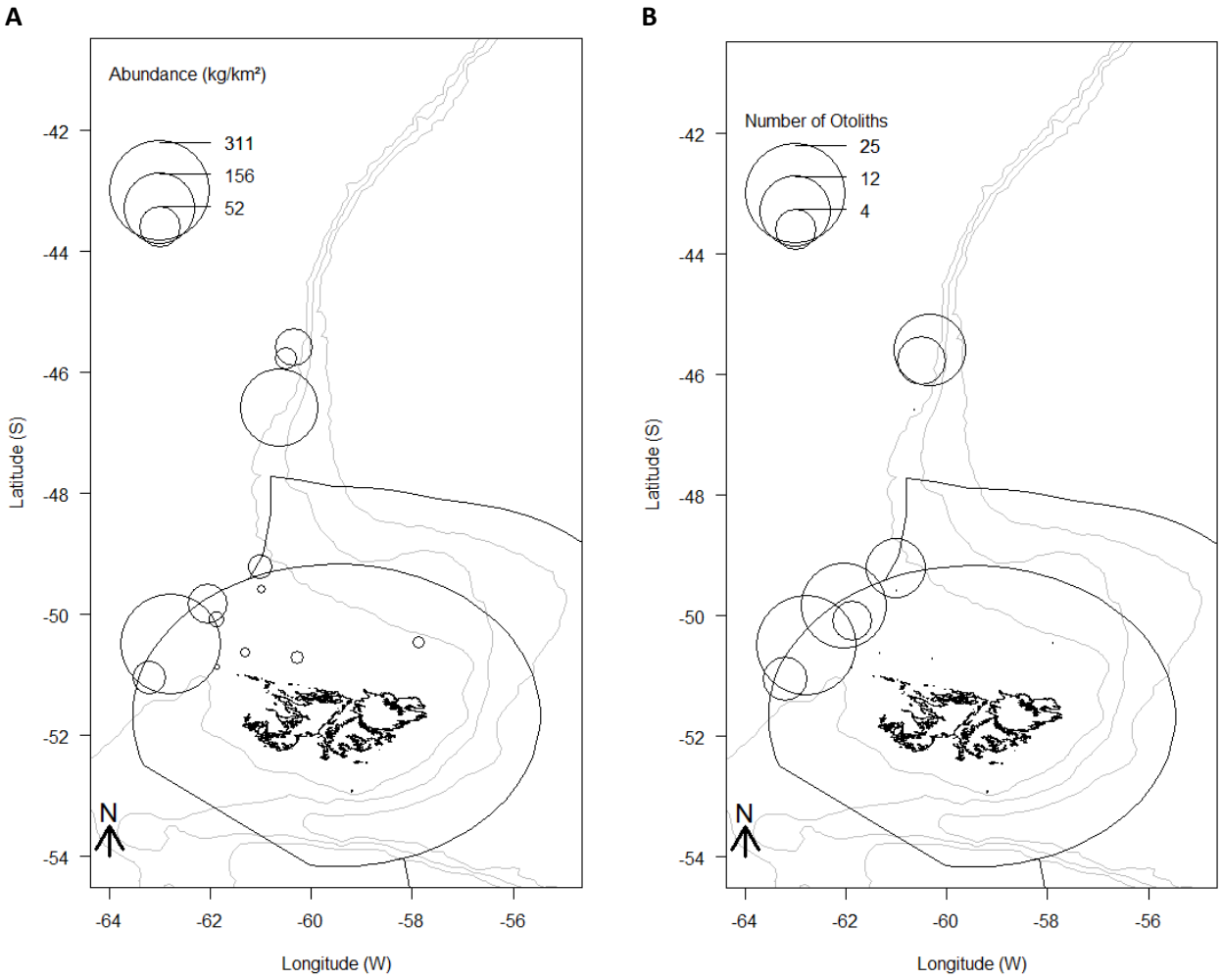

Fig 20. Distribution of (A) densities and (B) otolith samples (N = 83) of *Stromateus brasiliensis*.

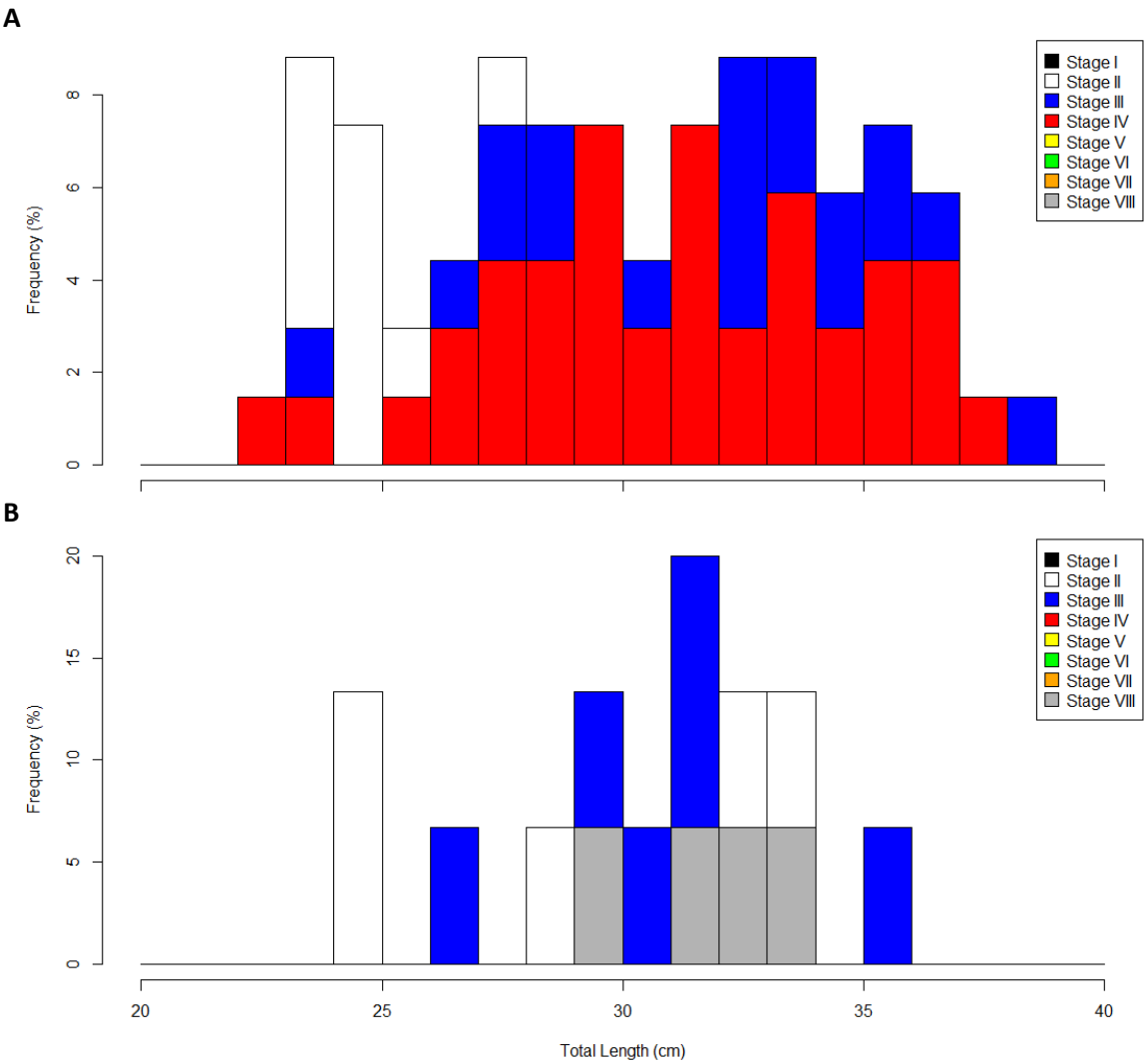

Fig 21. Length frequency (percentage of the total sample collected) of *Stromateus brasiliensis* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 68) and (B) males (N = 15).

3.5.1 *Stromateus brasiliensis* – Butterfish – Area 1

No *S. brasiliensis* was caught in Area 1.

3.5.2 *Stromateus brasiliensis* – Butterfish – Area 2

The total catch of *S. brasiliensis* in Area 2 was 56.86 kg (Table 4) and the total density was 34.4 kg/km^2. It was caught at three of the eight stations sampled in Area 2 during this cruise (37.5%). Catches ranged from 3.00 to 44.08 kg per station, with densities ranging between 14.6 and 185.6 kg/km^2 (Fig 20a). Of the three stations where *S. brasiliensis* was caught, all three stations yielded > 1 kg/km^2 and > 10 kg/km^2 and a single station yielded > 100 kg/km^2 (33.3%). The number of *S. brasiliensis* sampled for otoliths was 19 (0 to 13 per station). Overall, otoliths were collected from 16 females (T_L = 23 to 36 cm) and three males (T_L = 29 to 33 cm) and covered the entire length frequency for both sexes. The number of fish sampled for length frequency was 136 (117 females and 19 males). Female T_L ranged from 23 to 37 cm (mean of 28.43 cm) (Fig 23a), whereas males measured between 24 and 33 cm (mean of 27.84 cm) (Fig 24a). Females were observed Stage II

(13.7%), Stage III (41.9%), Stage IV (42.7%), and Stage V (1.7%) (Fig 23a). Males were observed Stage I (5.3%), Stage II (5.3%), Stage III (73.7%), and Stage VIII (15.8%) (Fig 24a).

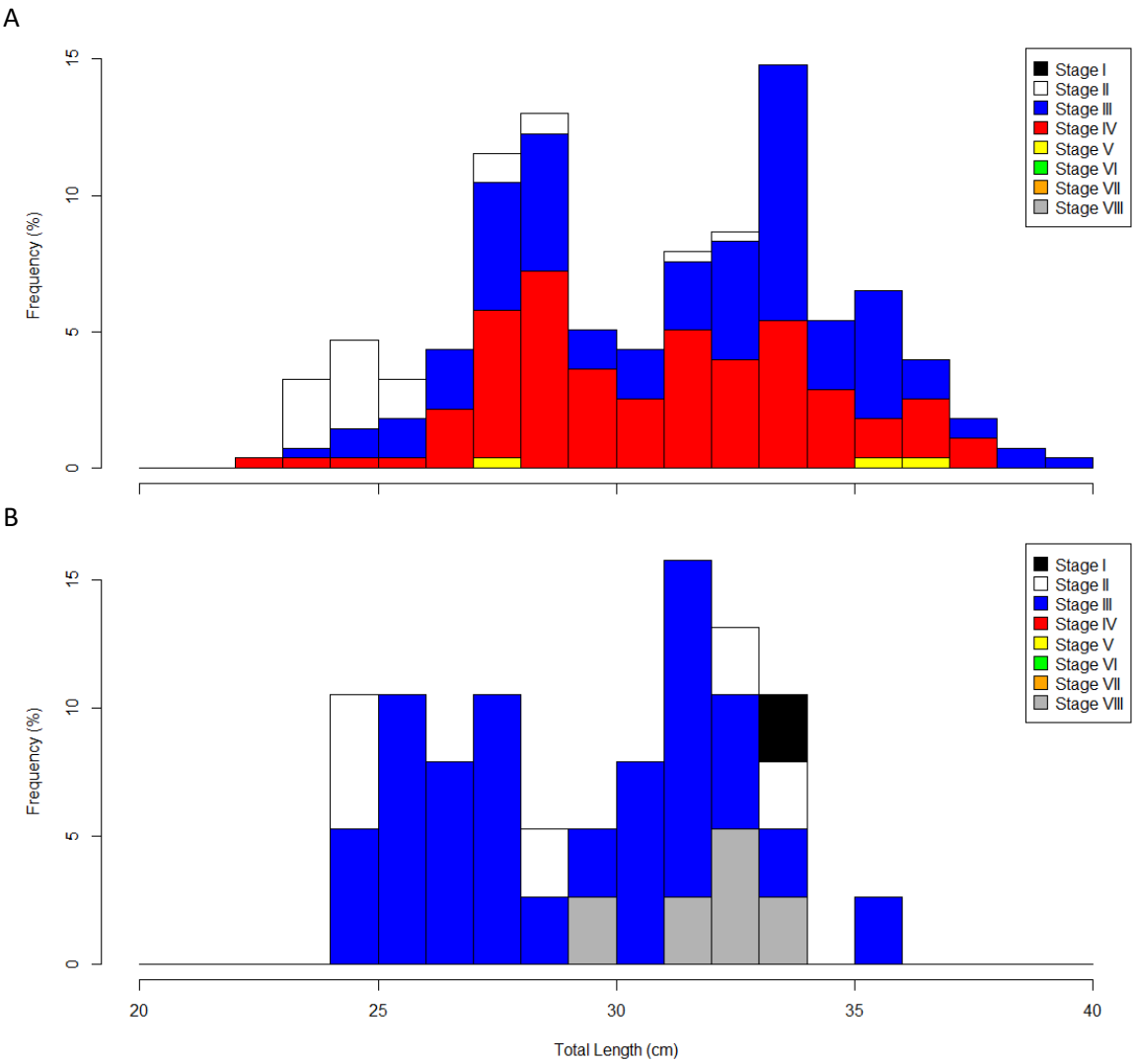

Fig 22. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Stromateus brasiliensis* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 277) and (B) males (N = 38).

3.5.3 *Stromateus brasiliensis* – Butterfish – Area 3

The total catch of *S. brasiliensis* in Area 3 was 4.48 kg (Table 5) and the total density was 3.3 kg/km^2. It was caught at a single station sampled in Area 3 during this cruise (16.7%). The number of *S. brasiliensis* sampled for otoliths was nine and covered the entire length frequency for both males and females. Overall, otoliths were collected from six females (T_L = 23 to 36 cm) and 3 males (T_L = 26 to 32 cm). The number of fish sampled for length frequency was 15 (12 females and three males). Female T_L ranged from 23 to 36 cm (mean of 26.17 cm) (Fig 23b), whereas males measured between 26 and 32 cm (mean of 29.0 cm) (Fig 24b). Females were observed Stage II (33.3%), Stage III (25.0%), Stage IV (33.3%), and Stage V (8.3%) (Fig 23b). Males were observed Stage III (66.7%) and Stage VIII (33.3%) (Fig 24b).

3.5.4 *Stromateus brasiliensis* – Butterfish – Area 4

The total catch of *S. brasiliensis* in Area 4 was 88.822 kg (Table 6) and the total density was 19.3 kg/km^2. It was caught at nine of the 21 stations sampled in Area 4 during this cruise (42.9%). Catches ranged from 0.18 to 65.08 kg and densities from 0.9 to 311.1 kg/km^2 (Fig 20a). Of the nine stations where *S. brasiliensis* was caught in Area 4, eight stations yielded > 1 kg/km^2 (88.9%), three stations yielded > 10 kg/km^2 (33.3%), and a single station yielded > 100 kg/km^2 (11.1%). The number of *S. brasiliensis* sampled for otoliths was 55 (0 to 25 per station). Overall, otoliths were collected from 46 females (T_L = 22 to 38 cm) and nine males (T_L range = 24 to 35 cm). The number of fish sampled for length frequency was 164 (148 females and 16 males). Female T_L ranged from 22 to 39 cm (mean of 31.86 cm) (Fig 23c), whereas males measured between 24 and 35 cm (mean of 30.19 cm) (Fig 24c). Females were observed Stage II (4.7%), Stage III (48.6%), and Stage IV (46.6%) (Fig 23c). Males were observed Stage II (25.0%), Stage III (68.8%), and Stage VIII (6.3%) (Fig 24c).

3.5.5 *Stromateus brasiliensis* – Butterfish – Area 5

No *S. brasiliensis* was caught in Area 5.

3.5.6 *Stromateus brasiliensis* – Butterfish – Area 6

No *S. brasiliensis* was caught in Area 6.

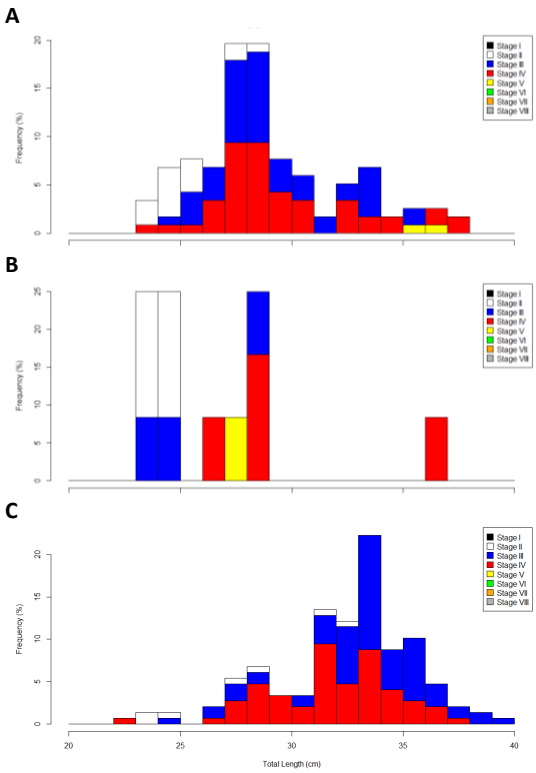

Fig 23. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Stromateus brasiliensis* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 2 (N = 117), **(B)** Area 3 (N = 12), **(C)** Area 4 (N = 148).

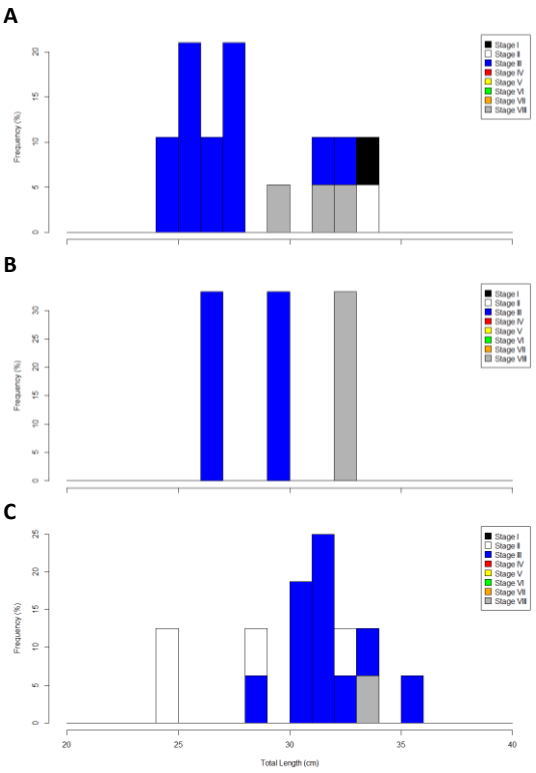

Fig 24. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Stromateus brasiliensis* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 2 (N = 19), **(B)** Area 3 (N = 3), **(C)** Area 4 (N = 16).

3.6 *Cottoperca gobio* – Frogmouth (CGO)

The total catch of *C. gobio* was 44.024 kg (Table 2). It was caught at 21 of the 45 stations sampled during this cruise (46.7%). Catches ranged from 0.08 to 17.36 kg and densities from 0.36 to 84.50 kg/km^2 (Fig 25a). Of the 21 stations where *C. gobio* was caught, 19 stations yielded > 1 kg/km^2 (90.5%), six stations yielded > 10 kg/km^2 (28.6%), and none yielded > 100 kg/km^2. Catches of *C. gobio* occurred in three areas: Area 2 (abundance = 0.55 kg/km^2), Area 4 (abundance = 8.50 kg/km^2), and Area 5 (abundance = 6.45 kg/km^2) (Fig 25a). The number of *C. gobio* sampled for otoliths was 15 (range = 0 to 4 per station) (Fig 25b). Overall, otoliths were collected from seven females (T_L = 14 to 41 cm) and eight males (T_L = 26 to 55 cm). The number of fish sampled for length frequency was 104 (50 females and 54 males). Female T_L ranged from 13 to 41 cm (mean of 27.79 cm) (Fig 26a), whereas males measured between 16 and 62 cm (mean of 31.52 cm) (Fig 26b). Females were observed Stage I (2.0%), Stage II (50.0%), Stage III (20.0%), Stage IV (16.0%), Stage V (2.0%), and Stage VII (10.0%) (Fig 26a). Males were observed Stage I (9.3%), Stage II (77.8%), Stage III (7.4%), and Stage IV (5.6%) (Fig 26b).

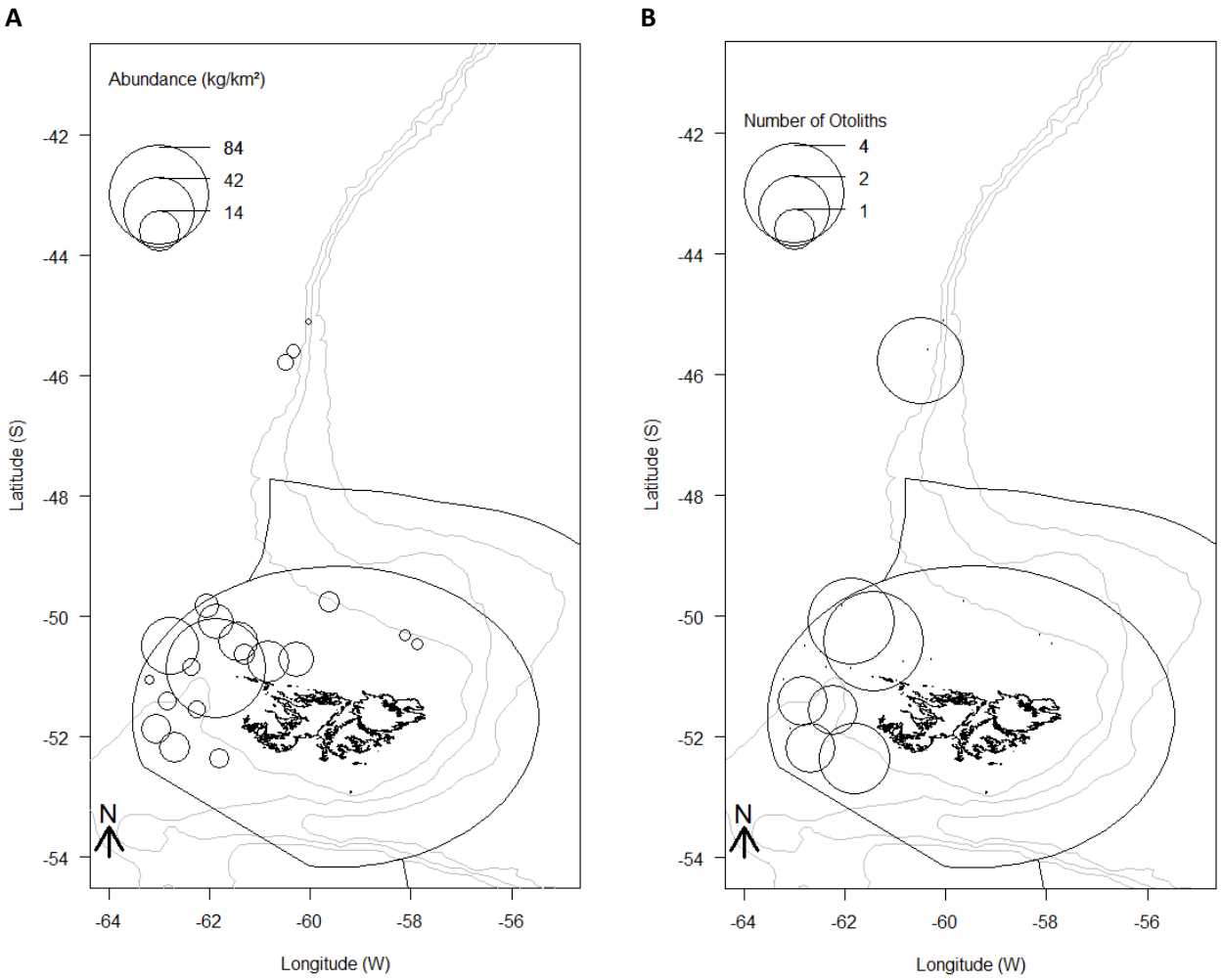

Fig 25. Distribution of (A) densities and (B) otolith samples (N = 15) of *Cottoperca gobio*.

Cottoperca gobio were more abundant at shallower depths with 93 of the 104 individuals sampled collected from waters shallower than 200 m. The greater proportions of individuals smaller or equal to the median T_L of 28 cm for females and 30 cm for males was observed in shallower waters. In waters shallower than 200 m, 26 of the 42 female individuals sampled (61.9%) was smaller or equal to the median T_L and 27 of 51 male individuals (52.9%) were smaller or equal to the median T_L. In waters of between 200 and 300 m depths, none of the 7 female individuals and both male individuals were smaller than median T_L. In waters deeper than 300 m depths, the lone female individual was smaller than the median T_L whereas the lone male individual was larger than the median T_L.

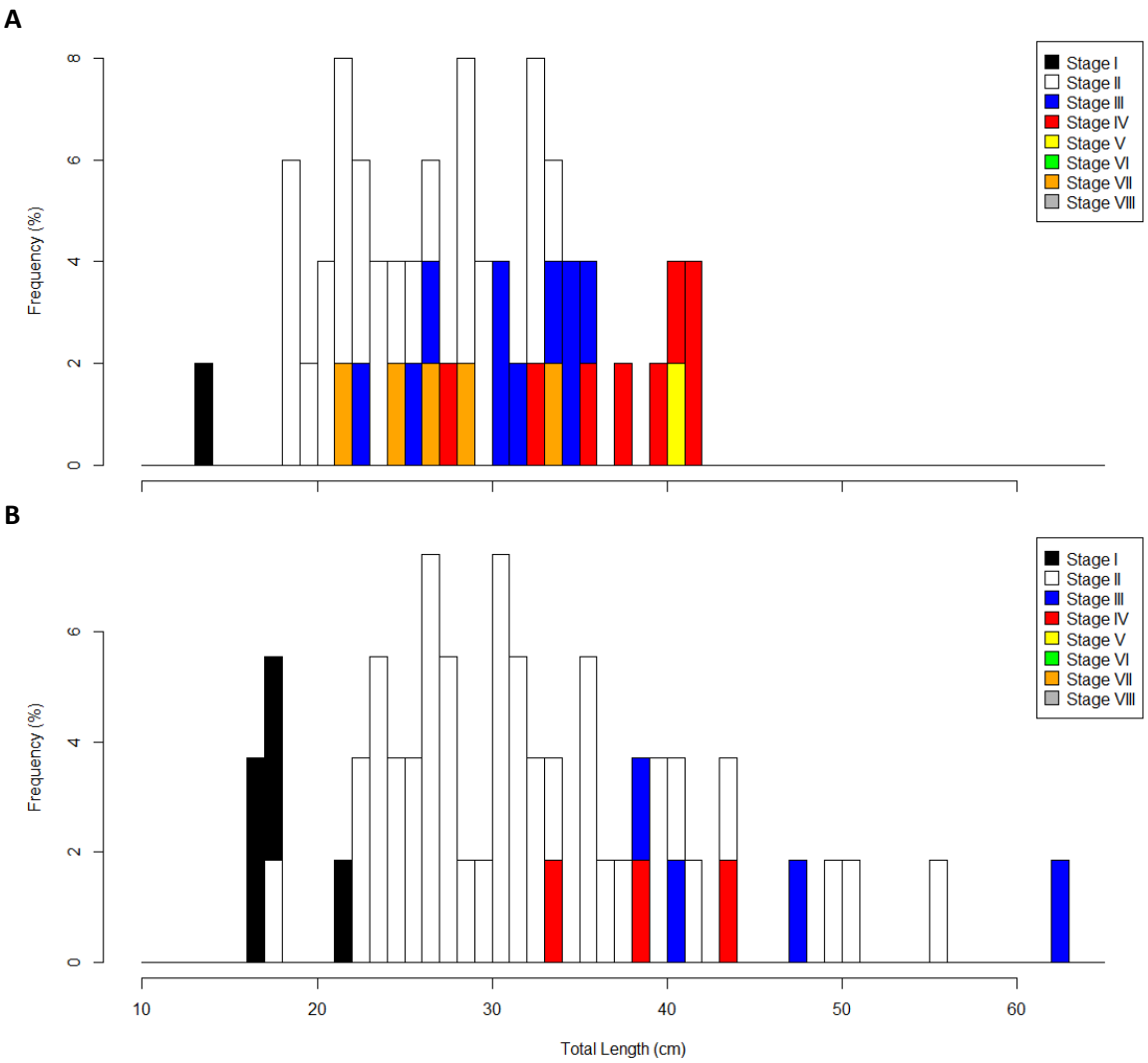

Fig 26. Length frequency (percentage of the total sample collected) of *Cottoperca gobio* individuals sampled with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 50) and (B) males (N = 54).

3.7 *Schroederichthys bivius* – Narrowmouth catshark (DGH)

The total catch of *S. bivius* was 729.372 kg (Table 2). It was caught at 27 of the 45 stations sampled during this cruise (60.0%). Catches ranged from 0.112 to 254.220 kg and densities from 0.51 to 1,215.11 kg/km^2 (Fig 27). Of the 27 stations where *S. bivius* was caught, 26 stations yielded > 1 kg/km^2 (96.3%), 21 stations yielded > 10 kg/km^2 (77.8%), seven yielded > 100 kg/km^2 (25.9%), and a single station > 1,000 kg/km^2 (3.7%) Catches of *S. bivius* occurred in four areas: Area 2 (abundance = 12.6 kg/km^2), Area 3 (abundance = 7.3 kg/km^2), Area 4 (abundance = 146.0 kg/km^2), and Area 5 (abundance = 13.4 kg/km^2) (Fig 27). The number of sharks sampled for length frequency was 961 (456 females and 505 males). Female T_L ranged from 19 to 61 cm (mean of 46.15 cm) (Fig 28a), whereas males measured between 25 and 79 cm (mean of 57.09 cm) (Fig 28b). Females were observed Stage I (16.4%), Stage II (36.4%), Stage III (14.7%), Stage IV (19.7%), Stage V (5.0%), and Stage VI (7.7%) (Fig 28a). Males were observed Stage I (15.0%), Stage II (17.8%), Stage III (23.6%), Stage IV (42.6%), and Stage V (1.0%) (Fig 28b).

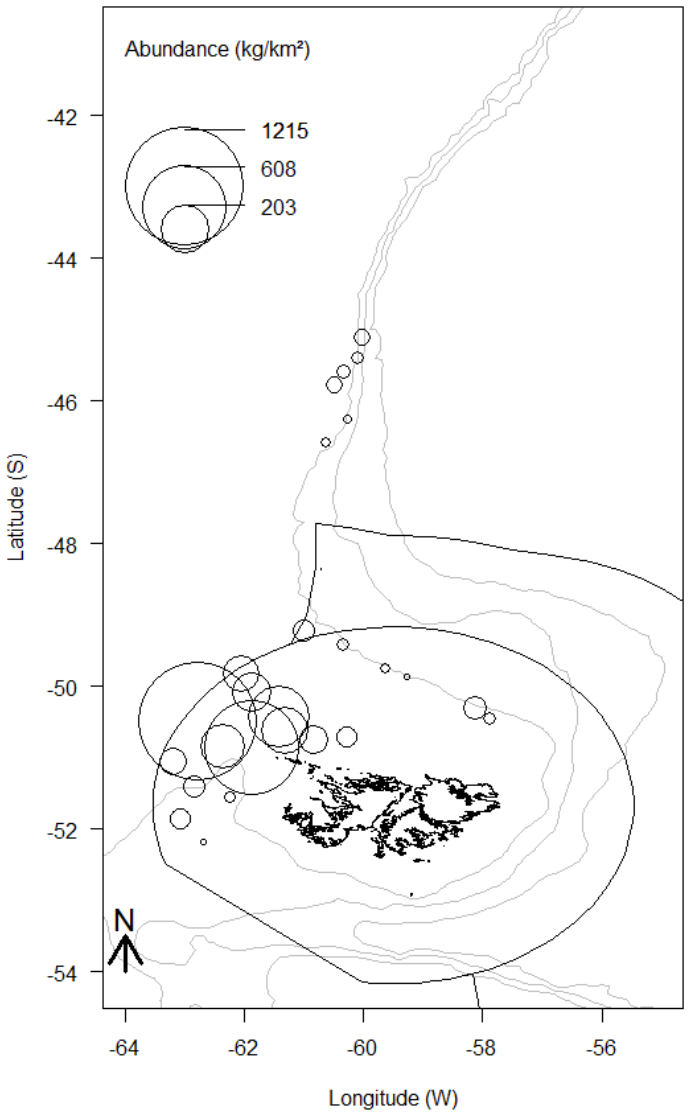

Fig 27. Distribution of densities of *Schroederichthys bivius*.

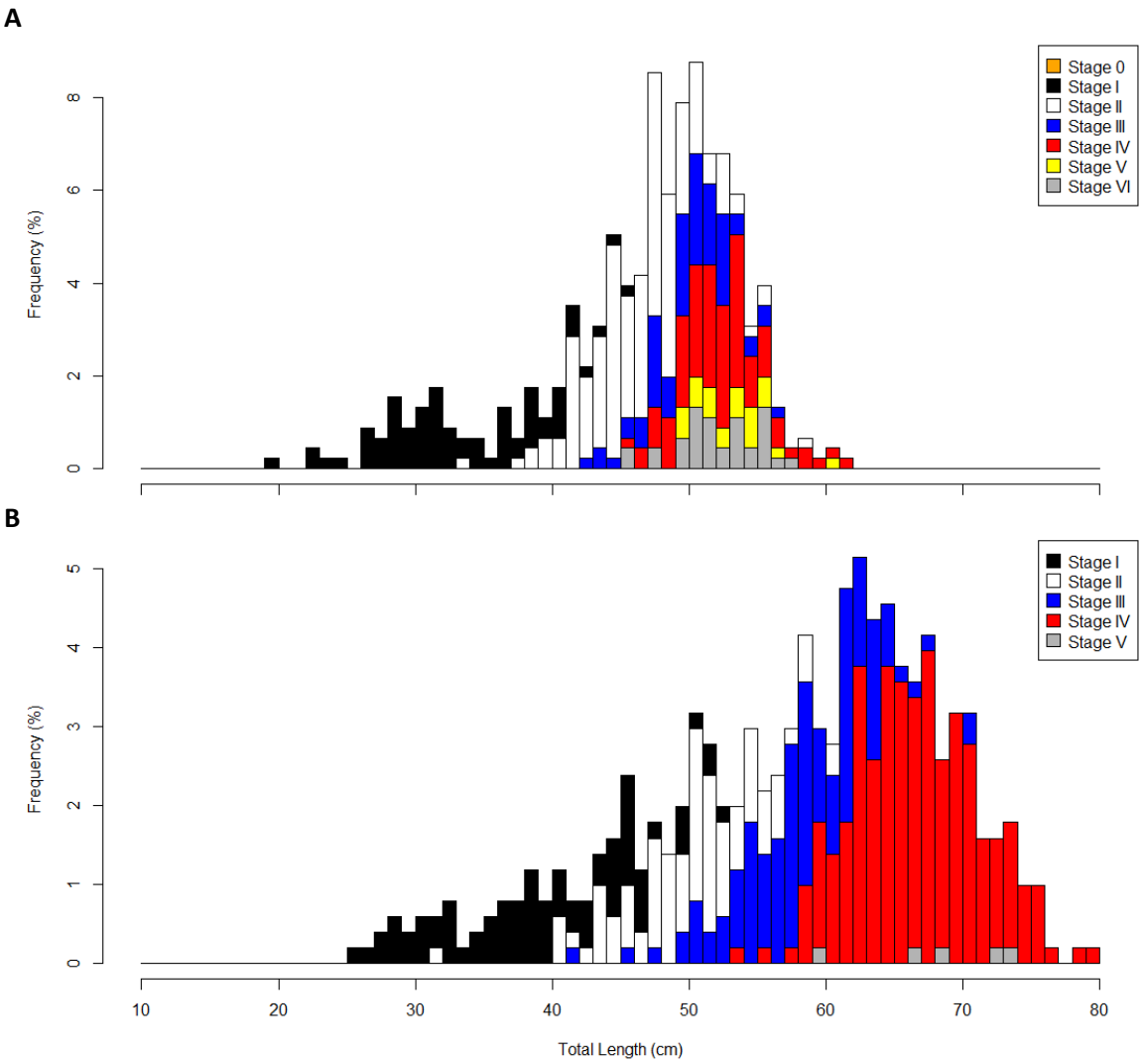

Fig 28. Length frequency (percentage of the total sample collected) of *Schroederichthys bivius* individuals sampled with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for (A) females (N = 456) and (B) males (N = 505).

The greater proportions of individuals smaller than the median T_L of 48 cm for females and 59 cm for males was observed in shallower waters. In waters shallower than 200 m, 56.2% of the 425 female individuals and 50.7% of the 495 male individuals were smaller than median T_L. In waters deeper than 200 m depths, 16.1% of the 31 female individuals and 40.0% of the 10 male individuals were smaller than median T_L. No individuals were caught in waters deeper than 294 m.

3.7.1 *Schroederichthys bivius* – Narrowmouth catshark – Area 1

No *S. bivius* was caught in Area 1.

3.7.2 *Schroederichthys bivius* – Narrowmouth catshark – Area 2

The total catch of *S. bivius* in Area 2 was 20.82 kg (Table 4) and the total density was 12.58 kg/km^2. It was caught at six of the eight stations sampled in Area 2 during this cruise (75.0%). Catches ranged from 1.42 to 5.34 kg per station, with densities ranging between 6.71 and 24.87 kg/km^2 (Fig 27). Of the six stations where *S. bivius* was caught, all six stations yielded > 1 kg/km^2, four yielded > 10 kg/km^2 (66.7%), and none yielded > 100 kg/km^2. The number of sharks sampled for length frequency was 57 (45 females and 12 males). Female T_L ranged from 33 to 57 cm (mean of 50.07 cm) (Fig 29a), whereas males measured between 45 and 72 cm (mean of 57.58 cm) (Fig 30a). Females were observed Stage I (2.2%), Stage II (17.8%), Stage III (15.6%), Stage IV (46.7%), Stage V (2.2%), and Stage VI (15.6%) (Fig 29a). Males were observed Stage I (16.7%), Stage II (25.0%), Stage III (41.7%), and Stage IV (16.7%) (Fig 30a). In Area 2, 13 of 45 females sampled (28.9%) and 6 of 12 males (50.0%) were smaller or equal to the median T_L of 48 and 59 cm, respectively.

3.7.3 *Schroederichthys bivius* – Narrowmouth catshark – Area 3

The total catch of *S. bivius* in Area 3 was 9.812kg (Table 5) and the total density was 7.32 kg/km^2. It was caught at two of the six station sampled in Area 3 during this cruise (33.3%). Of the two stations where *S. bivius* was caught, one yielded 0.51 kg/km^2 and the second yielded 40.96 kg/km^2. The number of sharks sampled for length frequency was 26 (17 females and nine males). Female T_L ranged from 22 to 54 cm (mean of 48.00 cm) (Fig 29b), whereas males measured between 49 and 69 cm (mean of 59.0 cm) (Fig 30b). Females were observed Stage I (5.9%), Stage II (5.9%), Stage III (17.6%), Stage IV (11.8%), and Stage V (58.8%) (Fig 29b). Males were observed Stage II (11.1%), Stage III (44.4%) and Stage IV (44.4%) (Fig 30b). In Area 3, 6 of 17 females sampled (35.3%) and 6 of 9 males (66.7%) were smaller or equal to the median T_L of 48 and 59 cm, respectively.

3.7.4 *Schroederichthys bivius* – Narrowmouth shark – Area 4

The total catch of *S. bivius* in Area 4 was 690.50 kg (Table 6) and the total density was 146.0 kg/km^2. It was caught at 17 of the 21 stations sampled in Area 4 during this cruise (81.0%). Catches ranged from 0.86 to 254.22 kg and densities from 3.9 to 1,215.1 kg/km^2 (Fig 27). Of the 17 stations where *S. bivius* was caught in Area 4, all stations yielded > 1 kg/km^2, 15 stations yielded > 10 kg/km^2 (88.2%), seven stations yielded > 100 kg/km^2 (41.2%), and a single stations yielded > 1,000 kg/km^2 (5.9%). The number of sharks sampled for length frequency was 855 (376 females and 479 males). Female T_L ranged from 19 to 61 cm (mean of 45.33 cm) (Fig 29c), whereas males measured between 25 and 79 cm (mean of 57.04 cm) (Fig 30c). Females were observed Stage I (19.4%), Stage II (41.5%), Stage III (14.3%), Stage IV (16.8%), Stage V (4.3%), and Stage VI (3.7%) (Fig 29c). Males were observed Stage I (15.2%), Stage II (17.7%), Stage III (22.8%), Stage IV (43.2%), and Stage V (1.0%) (Fig 30c). In Area 4, 223 of 376 females sampled (59.3%) and 240 of 479 males (50.1%) were smaller or equal to the median T_L of 48 and 59 cm, respectively.

3.7.5 *Schroederichthys bivius* – Narrowmouth shark – Area 5

The total catch of *S. bivius* in Area 5 was 8.24 kg (Table 7) and the total density was 13.42 kg/km^2. It was caught at two of the three stations sampled in Area 5 during this cruise (66.7%). Catches were 0.64 at station 3156 and 7.60 kg at station 3157, with respective densities 3.2 and 36.5 kg/km^2 (Fig 27). The number of sharks sampled for length frequency was 23 (18 females and five males). Female T_L ranged from 47 to 57 cm (mean of 51.78 cm) (Fig 29d), whereas males measured between 46 and 70 cm (mean of 57.40 cm) (Fig 30d). Females were observed Stage II (5.6%), Stage III (16.7%), Stage IV (22.2%), Stage V (33.3%), and Stage VI (22.2%) (Fig 29d). Males were observed Stage I (20.0%), Stage II (20.0%), Stage III (20.0%), Stage IV (20.0%), and Stage V (40.0%) (Fig 30d). In Area 5, 2 of 18 females sampled (11.1%) and 3 of 5 males (60.0%) were smaller or equal to the median T_L of 48 and 59 cm, respectively.

3.7.6 *Schroederichthys bivius* – Narrowmouth shark – Area 6

No *S. bivius* was caught in Area 6.

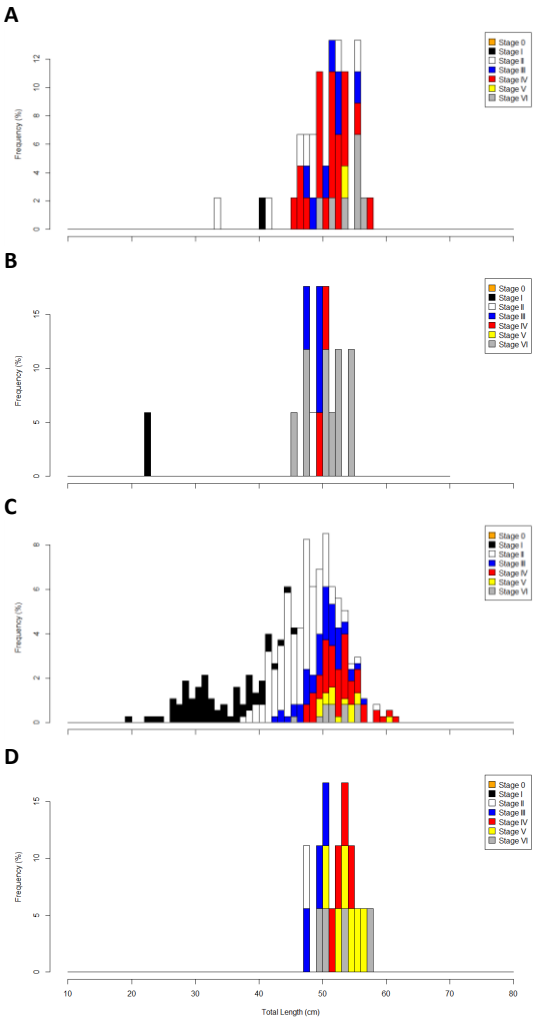

Fig 29. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Schroederichthys bivius* (females) with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for **(A)** Area 2 (N = 45), **(B)** Area 3 (N = 17), **(C)** Area 4 (N = 376) **(D)** Area 5 (N = 18).

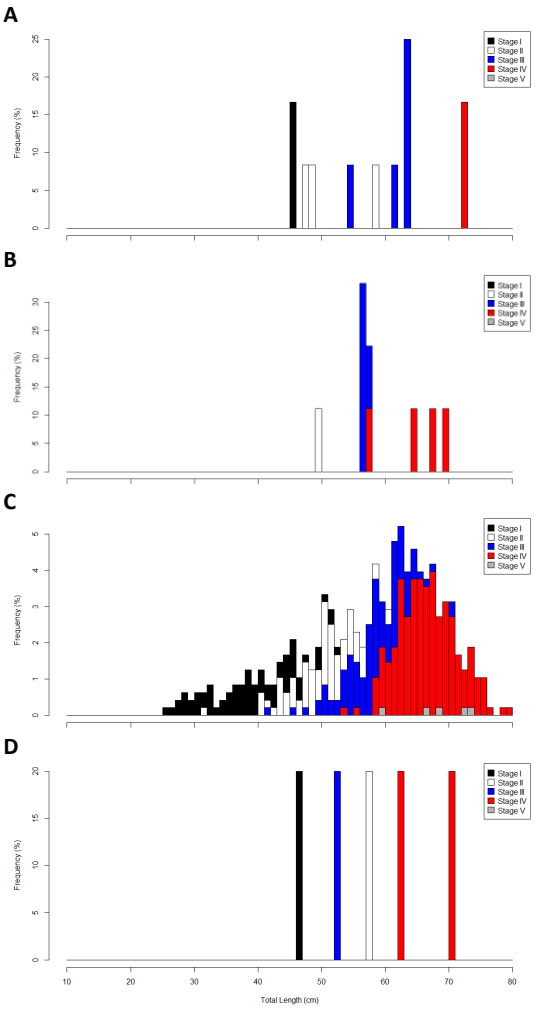

Fig 30. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Schroederichthys bivius* (males) with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for **(A)** Area 2 (N = 12), **(B)** Area 3 (N = 9), **(C)** Area 4 (N = 479) **(D)** Area 5 (N = 5).

3.8 *Squalus acanthias* – Spurdog (DGS)

The total catch of *S. acanthias* was 332.448 kg (Table 2). It was caught at six of the 45 stations sampled during this cruise (13.3%). Catches ranged from 1.34 to 317.38 kg and densities from 6.46 to 1,517.00 kg/km^2 (Fig 31). Of the six stations where *S. acanthias* was caught, all stations yielded > 1 kg/km^2, four stations yielded > 10 kg/km^2 (66.7%), one yielded > 100 kg/km^2 (16.7%), and a single station > 1,000 kg/km^2 (16.7%) Catches of *S. acanthias* occurred in two areas: Area 3 (abundance = 3.5 kg/km^2) and Area 4 (abundance = 71.2 kg/km^2). The number of sharks sampled for length frequency was 135 (120 females and 15 males); all from Area 4. Female T_L ranged from 50 to 89 cm (mean of 64.85 cm) (Fig 32a), whereas males measured between 59 and 71 cm (mean of 63.40 cm) (Fig 32b). Females were observed Stage I (1.7%), Stage II (14.2%), Stage III (40.8%), Stage IV (36.7%), Stage V (5.0%), and Stage VI (1.7%) (Fig 32a). Males were observed Stage III (20.0%), Stage IV (73.3%), and Stage V (6.7%) (Fig 32b).

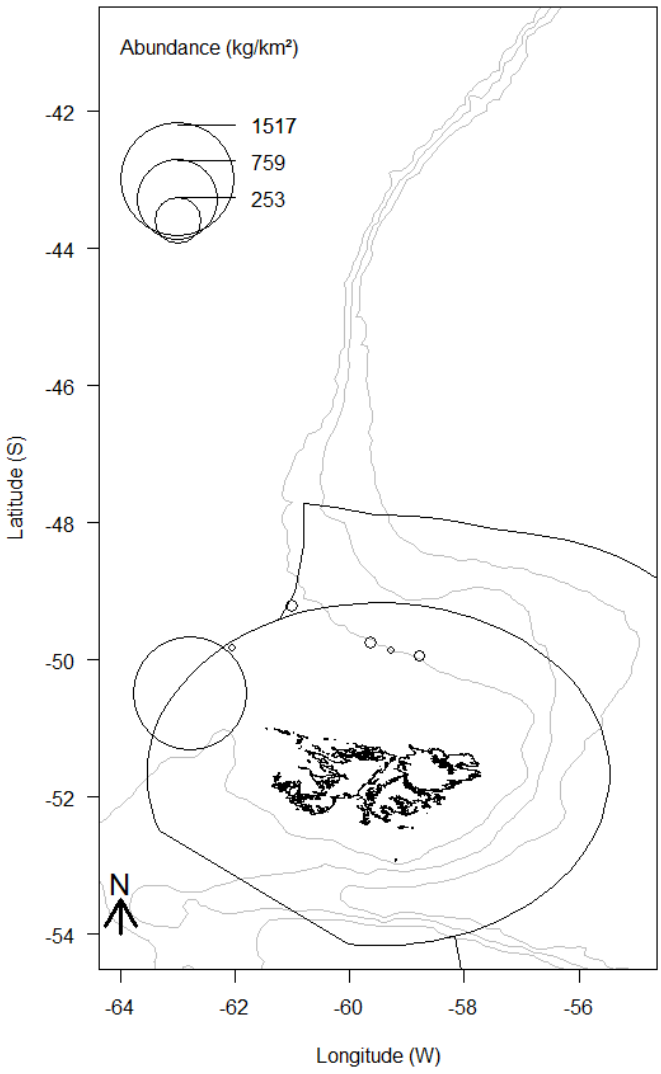

Fig 31. Distribution of densities of *Squalus acanthias*.

The greater proportions of individuals smaller than the median T_L of 63 cm for females and 64 cm for males was observed in shallower waters. In waters shallower than 200 m, 50.8% of the 118 female individuals and 60.0% of the 15 male individuals were smaller than median T_L. In waters deeper than 200 m depths, both female individuals were larger than median T_L. No male individuals were caught in waters deeper than 200 m. Over 95% of *S. acanthias* were caught in waters shallower than 150 m. All *S. acanthias* caught in waters deeper than 150 m were larger than the median T_L.

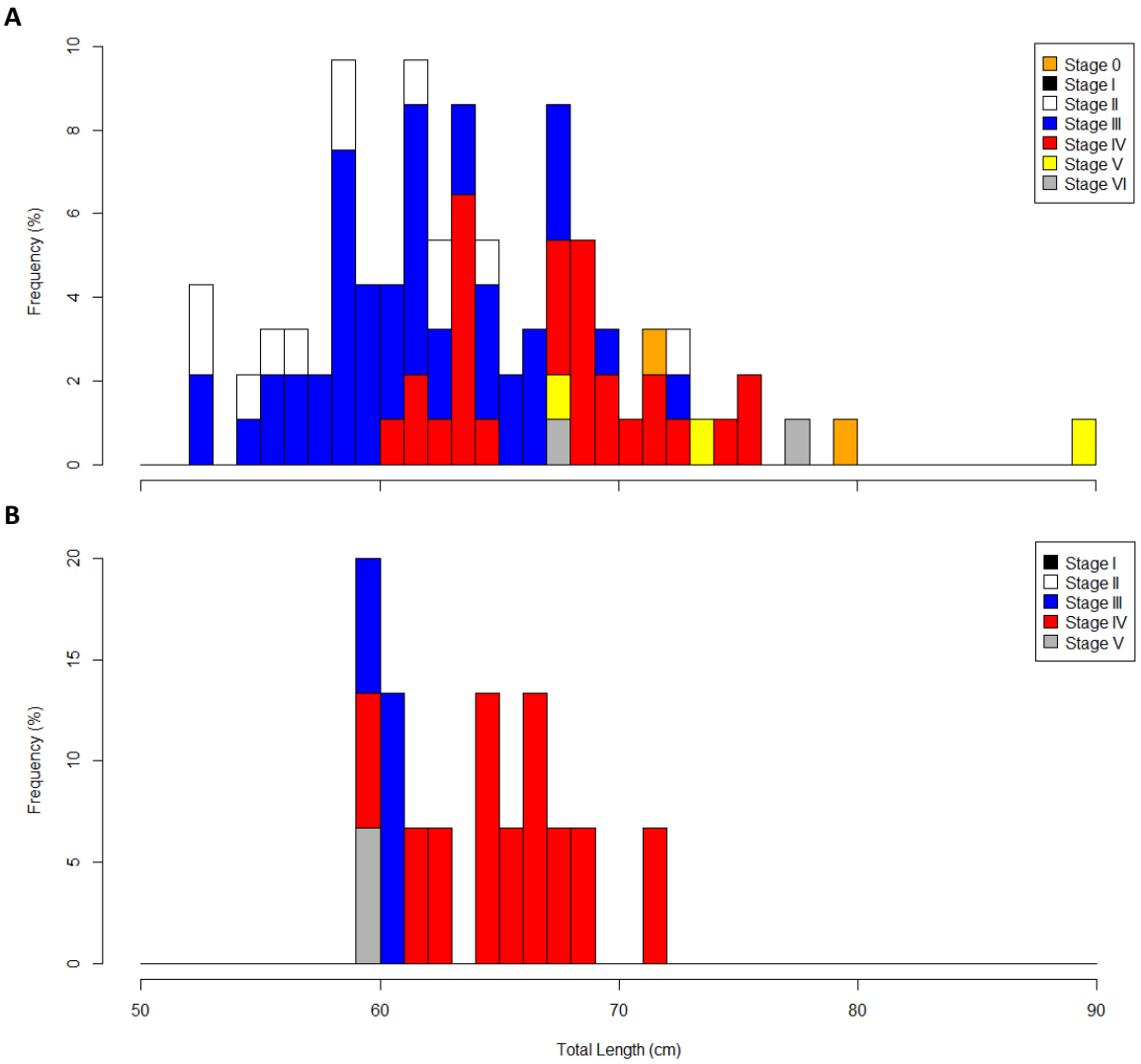

Fig 32. Length frequency (percentage of the total sample collected) of *Squalus acanthias* individuals sampled with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for (A) females (N = 120) and (B) males (N = 15).

3.9 *Macrourus carinatus*– Ridged scale grenadier (GRC)

The total catch of *M. carinatus* was 3,150.640 kg (Table 2). It was caught at seven of the 45 stations sampled during this cruise (15.6%). Catches ranged from 1.36 to 1,329.50 kg and densities from 6.2 to 8,007.1 kg/km^2 (Fig 33a). Of the seven stations where *M. carinatus* was caught, all stations yielded > 1 kg/km^2, six stations yielded > 10 kg/km^2 (85.7%), six stations yielded > 100 kg/km^2 (85.7%), and four stations > 1,000 kg/km^2 (57.1%). Catches of *M. carinatus* occurred in three of six areas: Area 1 (abundance = 504.9 kg/km^2), Area 2 (abundance = 803.2 kg/km^2), and Area 6 (abundance = 2,492.3 kg/km^2) (Fig 33a). The number of *M. carinatus* sampled for otoliths was 264 (range = 3 to 77 per station) (Fig 33b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 177 females (PA_L = 8 to 34 cm) and 87 males (PA_L = 5 to 23 cm) (Fig 34). The number of fish sampled for length frequency was 763 (497 females and 266 males). Female PA_L ranged from 8 to 34 cm (mean of 20.32 cm) (Fig 35a), whereas males measured between 5 and 23 cm (mean of 15.67 cm) (Fig 35b). The histograms show two distinct modes at 15 to 19 and 26 cm, respectively, for females and one distinct mode at 17 to 18 cm, for males (Fig 35). Females were observed Stage I (3.8%), Stage II (47.1%), Stage III (12.7%), Stage IV (19.9%), Stage V (5.4%), Stage VII (7.5%), and Stage VIII (6.4%) (Fig 35a). Males were observed Stage I (15.4%), Stage II (67.3%), Stage III (12.0%), and Stage IV (5.3%) (Fig 35b).

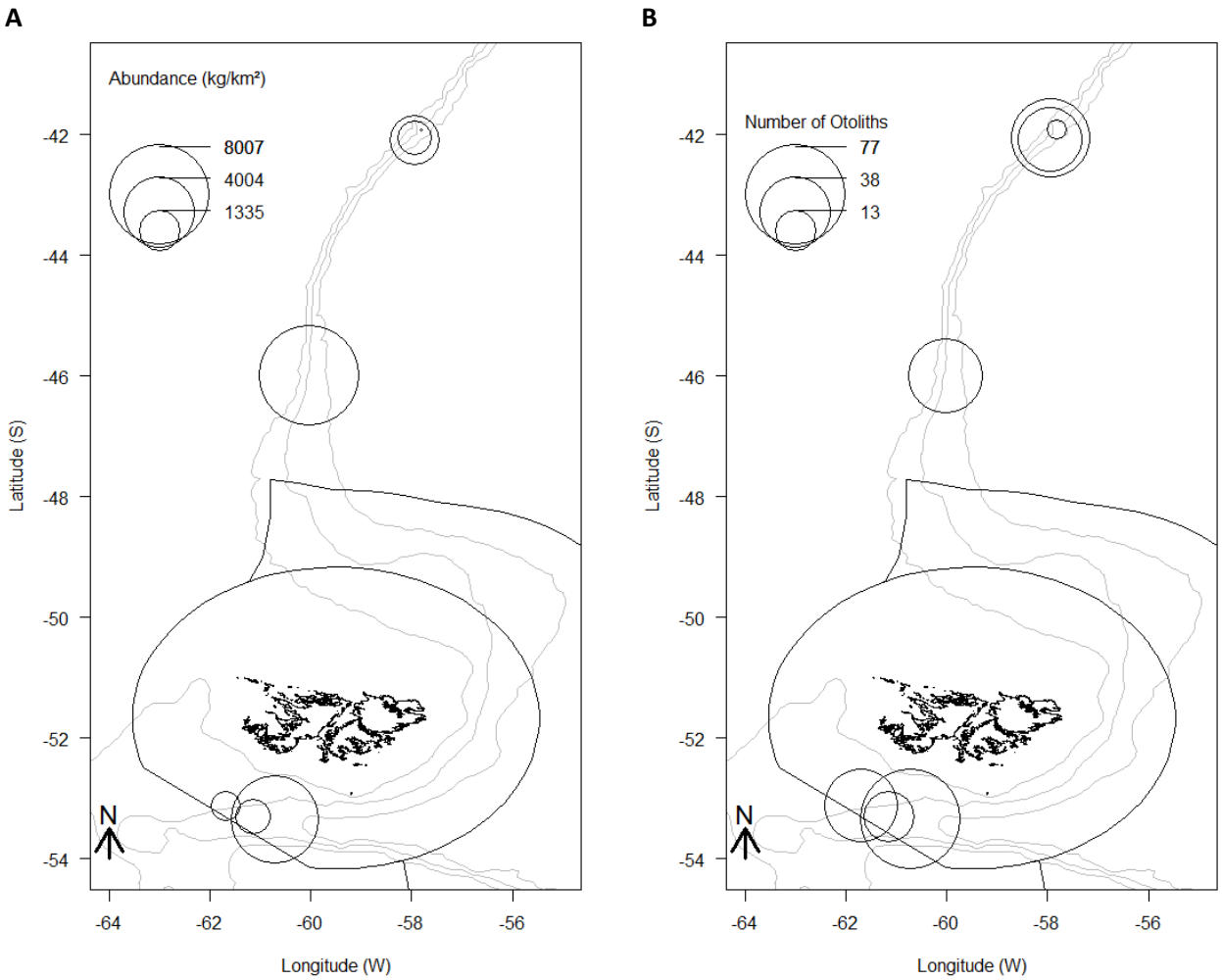

Fig 33. Distribution of (A) densities and (B) otolith samples (N = 264) of *Macrourus carinatus*.

The greater proportions of individuals smaller than the median PA_L of 20 cm for females and 16 cm for males was observed in shallower waters. In waters shallower than 500 m, 67.9% of the 190 female individuals and 74.5% of the 102 male individuals were smaller than median PA_L. In waters deeper than 500 m depths, 44.0% of the 307 female individuals and 47.6% of the 164 male individuals were smaller than median PA_L. No individuals were caught in waters shallower than 425 m.

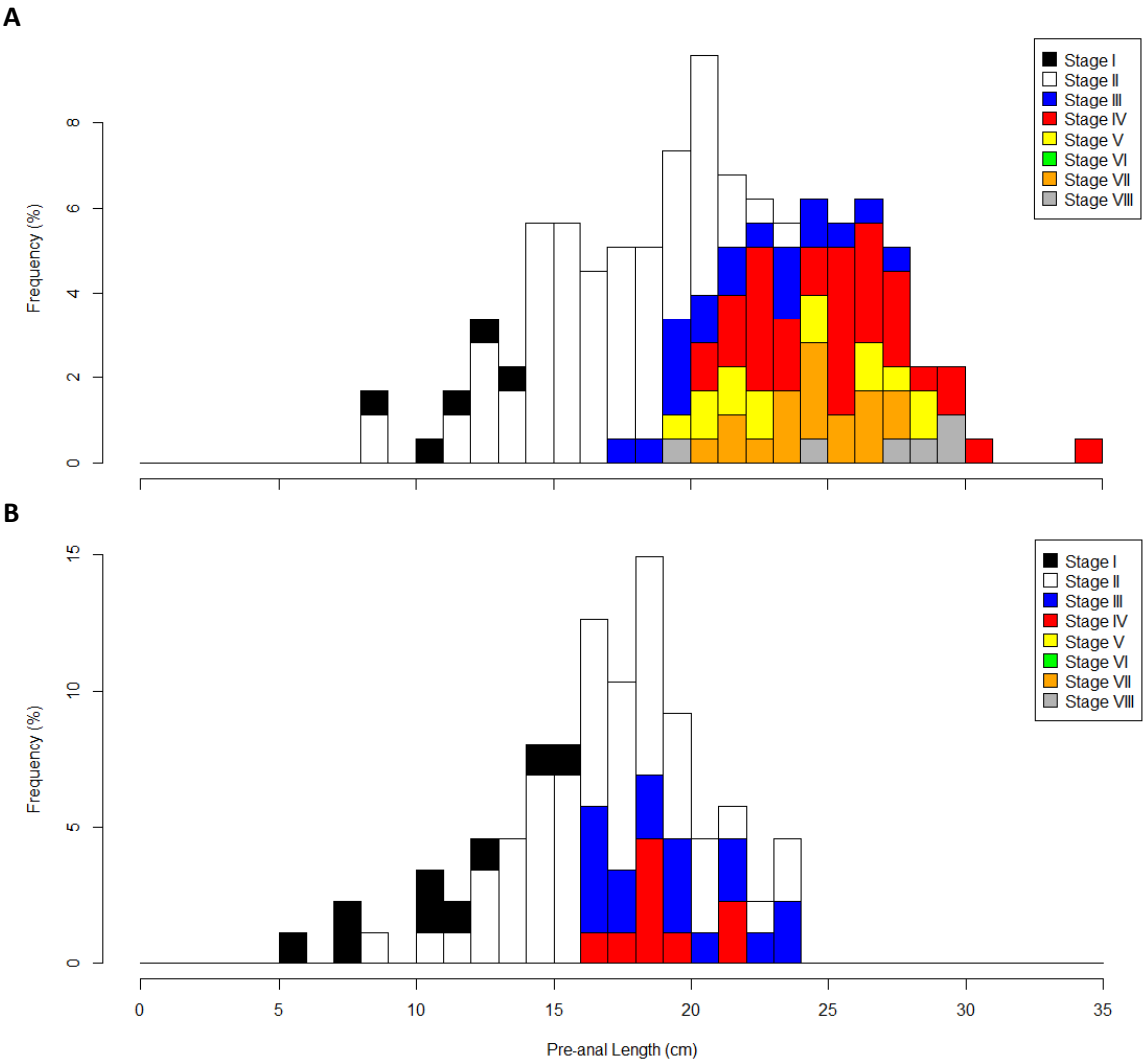

Fig 34. Length frequency (percentage of the total sample collected) of *Macrourus carinatus* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 177) and (B) males (N = 87).

3.9.1 *Macrourus carinatus* – Ridged scale grenadier – Area 1

The total catch of *M. carinatus* in Area 1 was 356.28 kg (Table 3) and the total density was 504.9 kg/km^2. It was caught at three of the four stations sampled in Area 1 during this cruise (75.0%). Catches ranged from 1.36 to 198.52 kg per station, with densities ranging between 6.2 and 1,999.6 kg/km^2 (Fig 33a). Of the three stations where *M. carinatus* was caught, all three stations yielded > 1 kg/km^2, two stations yielded > 10 kg/km^2 and > 100 kg/km^2 (66.7%), and one station > 1,000 kg/km^2 (33.3%). The number of *M. carinatus* sampled for otoliths was 83 (3 to 48 per station). Overall, otoliths were collected from 43 females (PA_L = 8 to 21 cm) and 40 males (PA_L = 5 to 21 cm) and covered the entire length frequency for both sexes. The number of fish sampled for length frequency was 335 (154 females and 181 males). Female PA_L ranged from 8 to 22 cm (mean of 15.64 cm) (Fig 36a), whereas males measured between 5 and 21 cm (mean of 14.92 cm) (Fig 37a). Females were observed Stage I (11.0%), Stage II (79.9%), Stage III (7.8%), and Stage IV (1.3%) (Fig 36a). Males were observed Stage I (21.0%), Stage II (65.2%), Stage III (11.0%), and Stage IV (2.8%) (Fig 37a). In Area 1, 148 of 154 females sampled (96.1%) and 125 of 181 males (69.1%) were smaller or equal to the median PA_L of 20 and 16 cm, respectively.

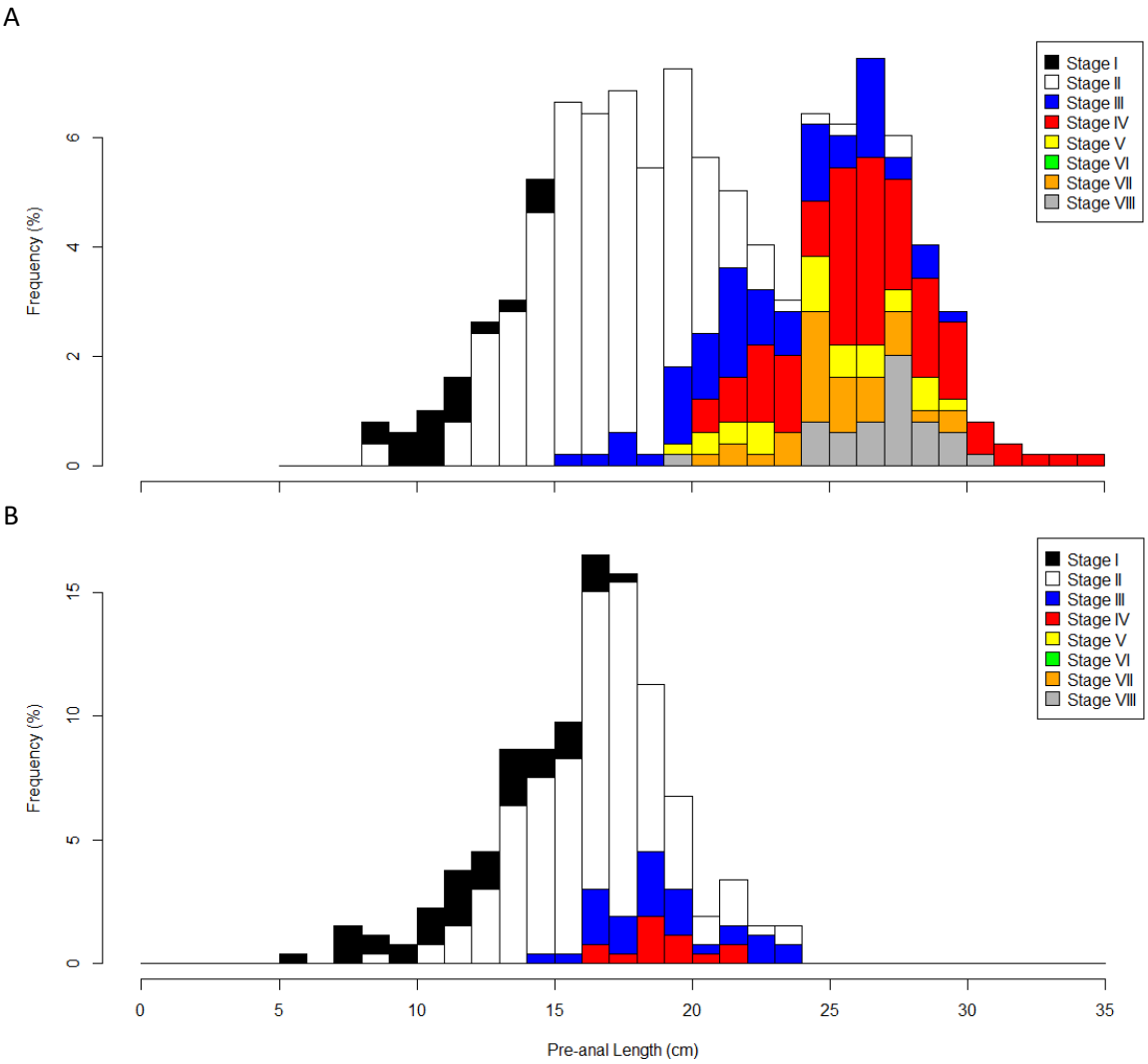

Fig 35. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Macrourus carinatus* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 497) and (B) males (N = 266).

3.9.2 *Macrourus carinatus* – Ridged scale grenadier – Area 2

The total catch of *M. carinatus* in Area 2 was 1,329.50 kg (Table 4) and the total density was 803.2 kg/km^2. It was caught at a single of the eight stations sampled in Area 2 during this cruise (12.5%). Overall, otoliths were collected from 21 females (PA_L = 10 to 21 cm) and 22 males (PA_L = 10 to 23 cm) and covered the entire length frequency for both sexes. The number of fish sampled for length frequency was 100 (49 females and 51 males). Female PA_L ranged from 10 to 21 cm (mean of 16.78 cm) (Fig 36b), whereas males measured between 10 and 23 cm (mean of 16.73 cm) (Fig 37b). Females were observed Stage I (2.0%) and Stage II (98.0%) (Fig 36b). Males were observed Stage I (3.9%), Stage II (94.1%), and Stage III (2.0%) (Fig 37b). In Area 2, 47 of 49 females sampled (95.9%) and 18 of 51 males (35.3%) were smaller or equal to the median PA_L of 20 and 16 cm, respectively.

3.9.3 *Macrourus carinatus* – Ridged scale grenadier – Area 3

No *M. carinatus* was caught in Area 3.

3.9.4 *Macrourus carinatus* – Ridged scale grenadier – Area 4

No *M. carinatus* was caught in Area 4.

3.9.5 *Macrourus carinatus* – Ridged scale grenadier – Area 5

No *M. carinatus* was caught in Area 5.

3.9.6 *Macrourus carinatus* – Ridged scale grenadier – Area 6

The total catch of *M. carinatus* in Area 6 was 1,464.86 kg (Table 8) and the total density was 2,492.3 kg/km^2. It was caught at all three stations sampled in Area 6 during this cruise. Catches ranged from 146.16 to 1,107.68 kg per station, with densities ranging between 724.3 and 6,168.1 kg/km^2 (Fig 33a). Of the three stations where *M. carinatus* was caught, all three stations yielded > 1 kg/km^2, > 10 kg/km^2, and > 100 kg/km^2, and two stations > 1,000 kg/km^2 (66.7%).The number of *M. carinatus* sampled for otoliths was 138 (range = 20 to 77) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 113 females (PA_L = 14 to 34 cm) and 25 males (PA_L = 14 to 23 cm). The number of fish sampled for length frequency was 328 (294 females and 34 males). Female PA_L ranged from 12 to 34 cm (mean of 23.36 cm) (Fig 36c), whereas males measured between 13 and 23 cm (mean of 18.09 cm) (Fig 37c). Females were observed Stage I (0.3%), Stage II (21.4%), Stage III (17.3%), Stage IV (31.0%), Stage V (8.5%), Stage VII (11.2%), and Stage VIII (10.2%) (Fig 36c). Males were observed Stage I (2.9%), Stage II (38.2%), Stage III (32.4%) and Stage IV (26.5%) (Fig 37c). In Area 6, 69 of 294 females sampled (23.5%) and 11 of 34 males (32.4%) were smaller or equal to the median PA_L of 20 and 16 cm, respectively.

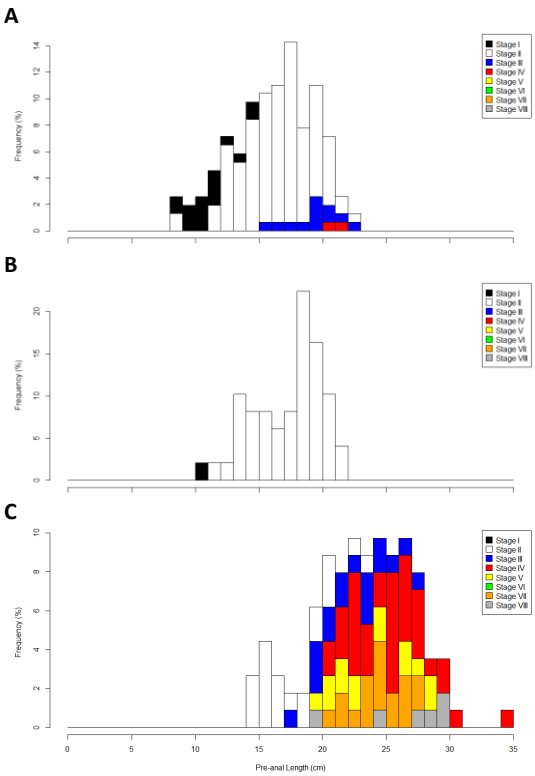

Fig 36. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Macrourus carinatus* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 154), **(B)** Area 2 (N = 49), **(C)** Area 6 (N = 294).

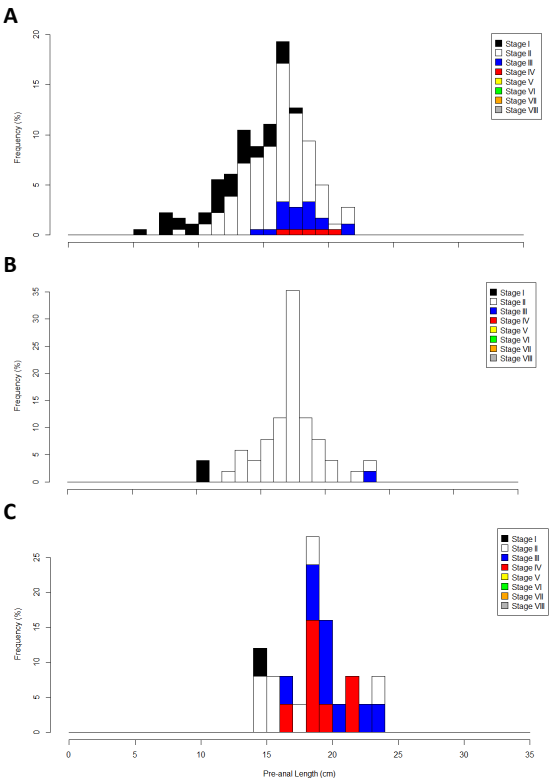

Fig 37. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Macrourus carinatus* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 181), **(B)** Area 2 (N = 51), **(C)** Area 6 (N = 34).

3.10 *Coelorinchus fasciatus*– Banded whiptail grenadier (GRF)

The total catch of *C. fasciatus* was 698.612 kg (Table 2). It was caught at 15 of the 45 stations sampled during this cruise (33.3%). Catches ranged from 0.02 to 330.28 kg and densities from < 0.1 to 1,636.6 kg/km^2 (Fig 38a). Of the 15 stations where *C. fasciatus* was caught, nine stations yielded > 1 kg/km^2 (60.0%), seven stations yielded > 10 kg/km^2 (46.7%), three stations yielded > 100 kg/km^2 (20.0%), and one station > 1,000 kg/km^2 (6.7%). Catches of *C. fasciatus* occurred in all six areas: Area 1 (abundance = 16.2 kg/km^2), Area 2 (abundance = 6.1 kg/km^2), Area 3 (abundance = 0.9 kg/km^2), Area 4 (abundance = 1.2 kg/km^2), Area 5 (abundance = 325.1 kg/km^2), and Area 6 (abundance = 800.7 kg/km^2) (Fig 38a). The number of *C. fasciatus* sampled for otoliths was 123 (range = 0 to 46 per station) (Fig 38b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 64 females (PA_L = 4 to 14 cm), 56 males (PA_L = 4 to 16 cm), a single juvenile individual (PA_L = 4 cm), and two unsexed individuals (PA_L = 9 and 11 cm, respectively) (Fig 39). The number of fish sampled for length frequency was 550 (367 females and 183 males). Female PA_L ranged from 4 to 14 cm (mean of 8.36 cm) (Fig 40a), whereas males measured between 4 and 16 cm (mean of 7.56 cm) (Fig 40b). The histograms show two distinct modes at 7 and 10 cm, respectively, for females and one distinct mode at 7 cm, for males (Fig 40). Females were observed Stage I (3.3%), Stage II (56.1%), Stage III (6.5%), Stage IV (17.7%), Stage V (3.0%), Stage VII (13.1%), and Stage VIII (0.3%) (Fig 40a). Males were observed Stage I (9.8%), Stage II (73.2%), Stage III (15.8%), and Stage IV (1.1%) (Fig 40b).

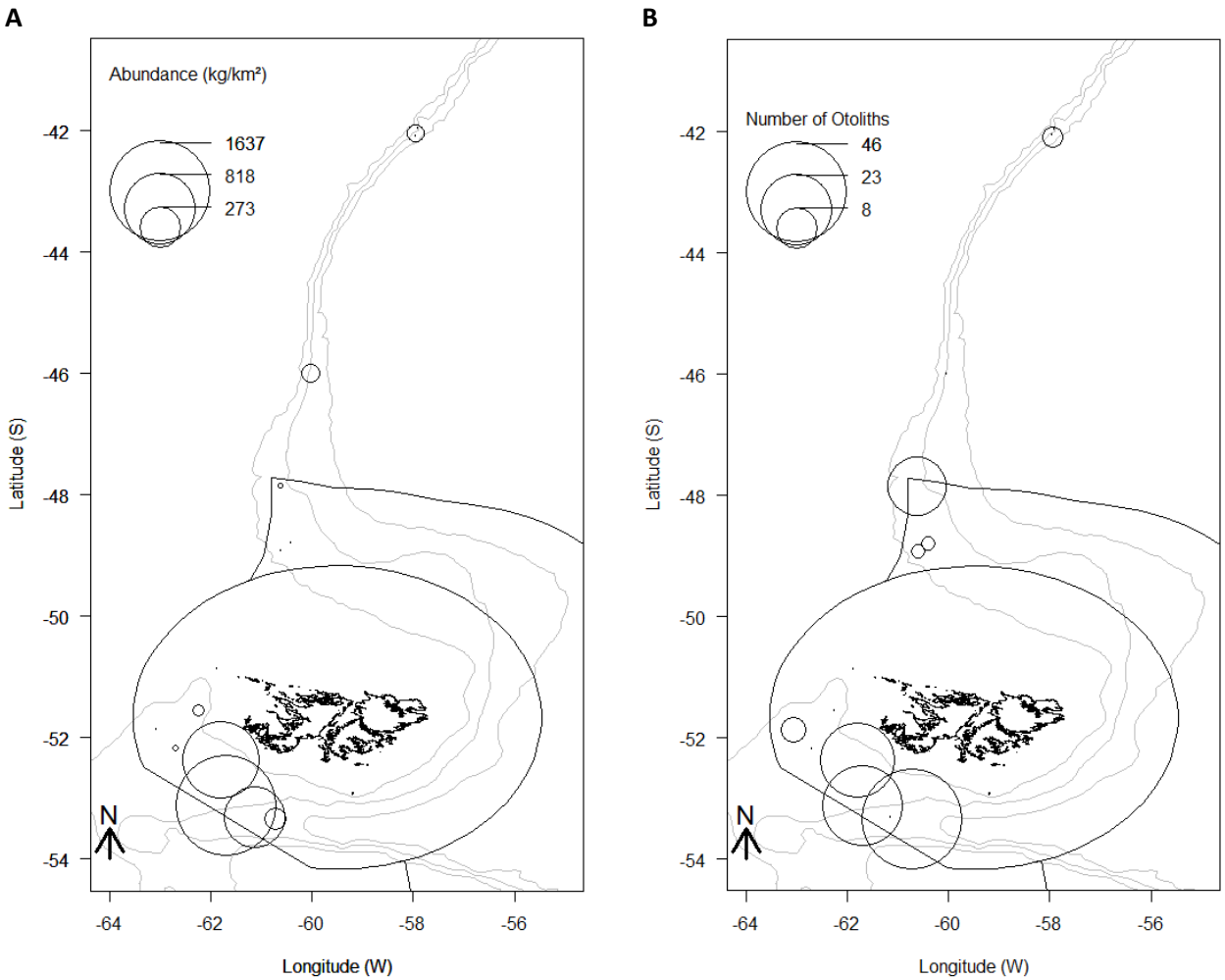

Fig 38. Distribution of (A) densities and (B) otolith samples (N = 123) of *Coelorinchus fasciatus*.

The greater proportions of individuals smaller than the median PA_L of 8 cm for females and 7 cm for males was observed in deeper waters for females and shallower waters for males. In waters shallower than 300 m, 48.9% of the 45 female individuals and 70.0% of the 10 male individuals were smaller than median PA_L. In waters between 300 and 500 m depths, 55.3% of the 208 female individuals and 65.0% of the 117 male individuals were smaller than median PA_L. In waters deeper than 500 m depths, 54.4% of the 114 female individuals and 46.4% of the 56 male individuals were smaller than median PA_L. The depth range for this species during the survey was 176 to 728 m.

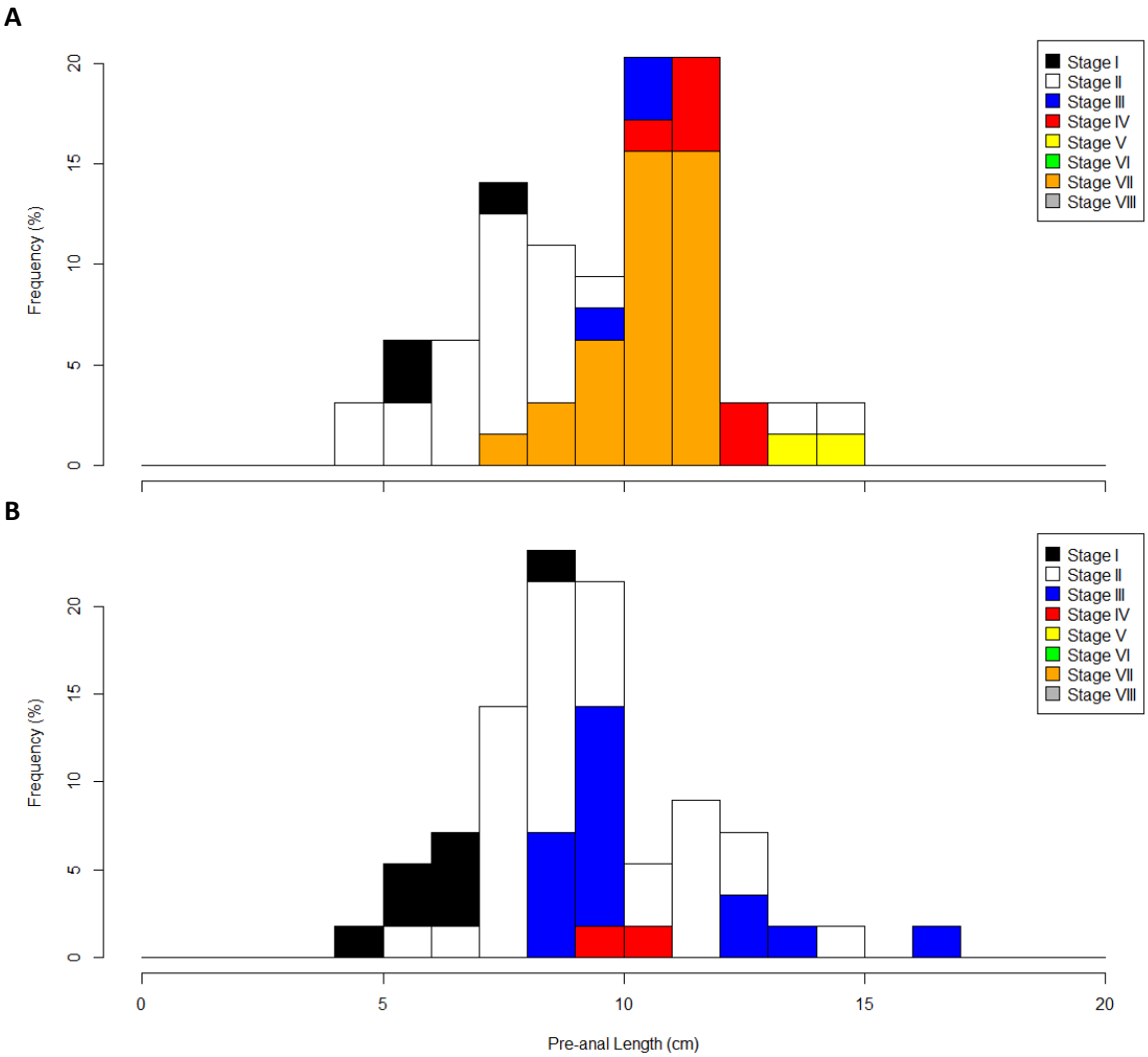

Fig 39. Length frequency (percentage of the total sample collected) of *Coelorinchus fasciatus* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 64) and (B) males (N = 56).

3.10.1 *Coelorinchus fasciatus* – Banded whiptail grenadier – Area 1

The total catch of *C. fasciatus* in Area 1 was 11.426 kg (Table 3) and the total density was 16.2 kg/km^2. It was caught at three of the four stations sampled in Area 1 during this cruise (75.0%). Catches ranged from 0.066 to 11.220 kg per station, with densities ranging between 0.7 and 52.5 kg/km^2 (Fig 38a). Of the three stations where *C. fasciatus* was caught, only one yielded > 1 kg/km^2 (33.3%), one station yielded > 10 kg/km^2 (33.3%), and no station yielded > 100 kg/km^2. The number of *C. fasciatus* sampled for otoliths was two (0 to 2 per station). Overall, otoliths were collected from a single female (PA_L = 7 cm) and one juvenile individual (PA_L = 4 cm). The number of fish sampled for length frequency was 98 (53 females and 45 males). Female PA_L ranged from 5 to 10 cm (mean of 7.26 cm) (Fig 41a), whereas males measured between 5 and 8 cm (mean of 6.93 cm) (Fig 42a). All females were observed Stage II (Fig 41a). Males were observed Stage I (4.4%) and Stage II (95.6%) (Fig 42a). In Area 1, 49 of 53 females sampled (92.5%) and 40 of 45 males (88.9%) were smaller or equal to the median PA_L of 8 and 7 cm, respectively.

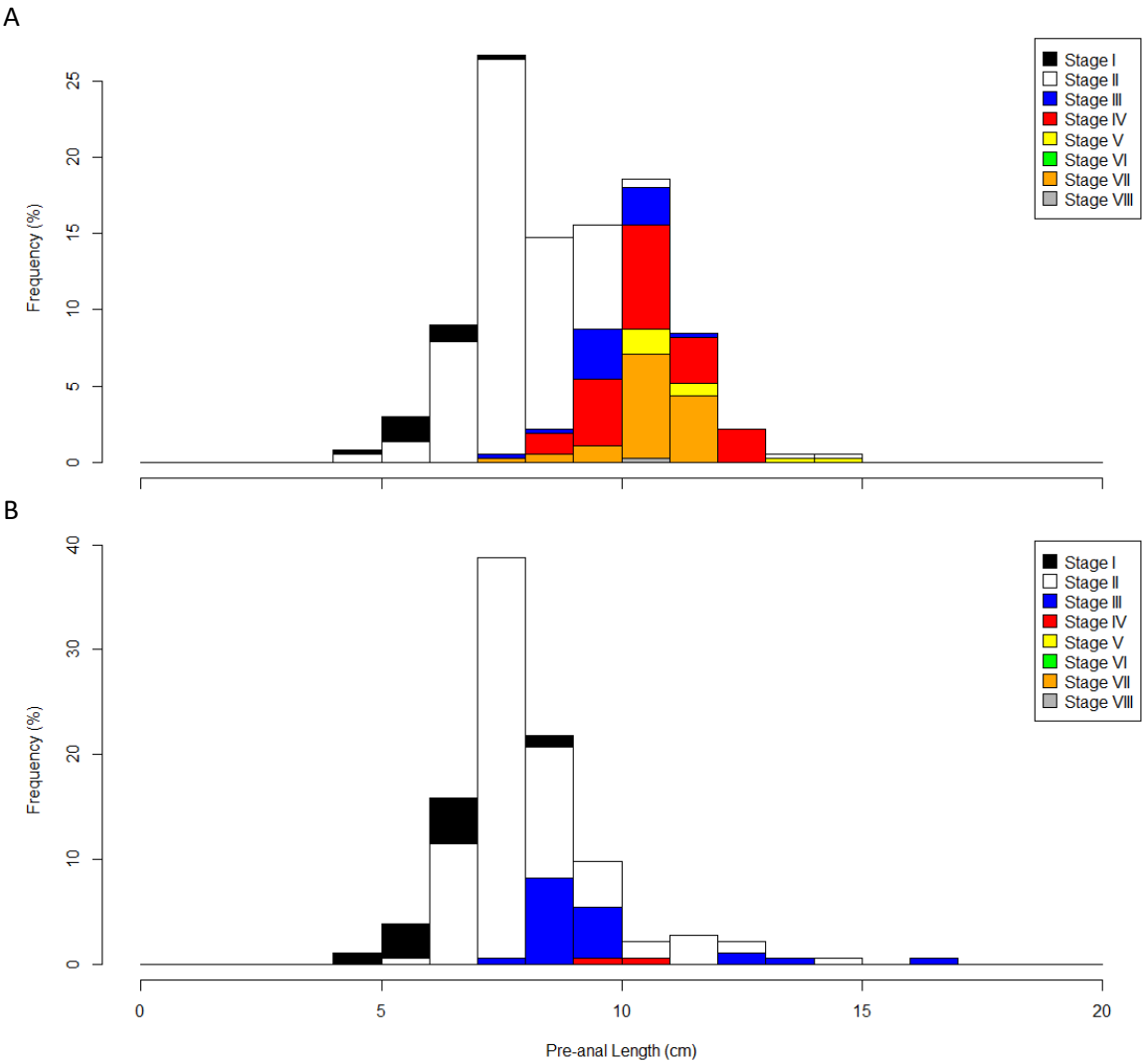

Fig 40. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Coelorinchus fasciatus* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 367) and (B) males (N = 183).

3.10.2 *Coelorinchus fasciatus* – Banded whiptail grenadier – Area 2

The total catch of *C. fasciatus* in Area 2 was 10.140 kg (Table 4) and the total density was 6.1 kg/km^2. It was caught at a single of the eight stations sampled in Area 2 during this cruise (12.5%). No otoliths were collected from this area. The number of fish sampled for length frequency was 100 (62 females and 38 males). Female PA_L ranged from 6 to 10 cm (mean of 7.00 cm) (Fig 41b), whereas males measured between 6 and 9 cm (mean of 7.26 cm) (Fig 42b). Females were observed Stage I (98.4%) and Stage II (1.6%) (Fig 41b). All males were observed Stage II (Fig 42b). In Area 2, 59 of 62 females sampled (95.2%) and 25 of 38 males (65.8%) were smaller or equal to the median PA_L of 8 and 7 cm, respectively.

3.10.3 *Coelorinchus fasciatus* – Banded whiptail grenadier – Area 3

The total catch of *C. fasciatus* in Area 3 was 1.140 kg (Table 5) and the total density was 0.9 kg/km^2. It was caught at three of the six stations sampled in Area 3 during this cruise (50.0%). Catches ranged from 0.020 to 0.900 kg per station, with densities ranging between < 0.1 and 4.3 kg/km^2 (Fig 38a). Of the three stations where *C. fasciatus* was caught, only one yielded > 1 kg/km^2 (33.3%) and none yielded > 10 kg/km^2. Overall, otoliths were collected from 14 females (PA_L = 4 to 10 cm) and four males (PA_L = 4 to 7 cm) (Fig 39). The number of fish sampled for length frequency was 18 (14 females and 4 males). Female PA_L ranged from 4 to 10 cm (mean of 6.57 cm) (Fig 41c), whereas males measured between 4 and 7 cm (mean of 6.25 cm) (Fig 42c). Females were observed Stage II (92.9%) and Stage IV (7.1%) (Fig 41c). Males were observed Stage I (25.0%) and Stage II (75.0%) (Fig 42c). In Area 3, 10 of 14 females sampled (71.4%) and all 4 males were smaller or equal to the median PA_L of 8 and 7 cm, respectively.

3.10.4 *Coelorinchus fasciatus* – Banded whiptail grenadier – Area 4

The total catch of *C. fasciatus* in Area 4 was 5.658kg (Table 5) and the total density was 1.2 kg/km^2. It was caught at two of the 21 stations sampled in Area 4 during this cruise (9.5%). Catches were 0.098 kg at station 3163 and 5.560 kg at station 3158, with respective densities of 0.5 and 24.8 kg/km^2 (Fig 38a). Of the two stations where *C. fasciatus* was caught, only one yielded > 1 kg/km^2 (50.0%), one yielded > 10 kg/km^2 (50.0%), and none yielded > 100 kg/km^2. No otoliths were collected from Area 4. The number of fish sampled for length frequency was 40 (34 females and 6 males). Female PA_L ranged from 4 to 12 cm (mean of 8.559 cm) (Fig 41d), whereas males measured between 4 and 8 cm (mean of 6.67 cm) (Fig 42d). Females were observed Stage I (8.8%), Stage II (44.1%), Stage III (5.9%), and Stage IV (41.2%) (Fig 41d). Males were observed Stage I (16.7%), Stage II (33.3%), and Stage III (50.0%) (Fig 42d). In Area 4, 17 of 34 females sampled (50.0%) and 4 of 6 males (66.7%) were smaller or equal to the median PA_L of 8 and 7 cm, respectively.

3.10.5 *Coelorinchus fasciatus* – Banded whiptail grenadier – Area 5

The total catch of *C. fasciatus* in Area 5 was 199.608 kg (Table 7) and the total density was 325.1 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 0.148 to 198.200 kg per station, with densities ranging between 0.7 and 959.3 kg/km^2 (Fig 38a). Of the three stations where *C. fasciatus* was caught, two stations yielded > 1 kg/km^2 (66.7%), one yielded > 10 kg/km^2 and > 100 kg/km^2 (33.3%), and none > 1,000 kg/km^2. The number of *C. fasciatus* sampled for otoliths was 28 (range = 0 to 25) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 17 females (PA_L = 5 to 12 cm) and 11 males (PA_L = 5 to 9 cm). The number of fish sampled for length frequency was 120 (82 females and 38 males). Female PA_L ranged from 5 to 12 cm (mean of 8.07 cm) (Fig 41e), whereas males measured between 5 and 10 cm (mean of 6.58 cm) (Fig 42e). Females were observed Stage I (9.8%), Stage II (58.5%), Stage III (13.4%), Stage IV (13.4%), and Stage VII (4.9%) (Fig 41e). Males were observed Stage I (26.3%), Stage II (68.42%), and Stage III (5.3%) (Fig 42e). In Area 5, 45 of 82 females sampled (54.9%) and 32 of 38 males (84.2%) were smaller or equal to the median PA_L of 8 and 7 cm, respectively.

3.10.6 *Coelorinchus fasciatus* – Banded whiptail grenadier – Area 6

The total catch of *C. fasciatus* in Area 6 was 470.640 kg (Table 8) and the total density was 800.7 kg/km^2. It was caught at all three stations sampled in Area 6 during this cruise. Catches ranged from 13.800 to 330.280 kg per station, with densities ranging between 76.8 and 1,636.6 kg/km^2 (Fig 38a). Of the three stations where *C. fasciatus* was caught, all three stations yielded > 1 kg/km^2, > 10 kg/km^2, two stations > 100 kg/km^2 (66.7%), and one station > 1,000 kg/km^2 (33.3%).The number of *C. fasciatus* sampled for otoliths was 75 (range = 0 to 46) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 32 females (PA_L = 7 to 14 cm), 41 males (PA_L = 6 to 16 cm), and two unsexed individuals (PA_L = 9 and 11 cm, respectively). The number of fish sampled for length frequency was 174 (122 females and 52 males). Female PA_L ranged from 7 to 14 cm (mean of 9.86 cm) (Fig 41f), whereas males measured between 6 and 16 cm (mean of 9.21 cm) (Fig 42f). Females were observed Stage I (0.8%), Stage II (13.1%), Stage III (8.2%), Stage IV (32.0%), Stage V (9.0%), Stage VII (36.1%), and Stage VIII (0.8%) (Fig 41f). Males were observed Stage I (7.7%), Stage II (42.3%), Stage III (46.2%) and Stage IV (3.8%) (Fig 42f). In Area 6, 16 of 122 females sampled (13.1%) and 4 of 52 males (7.7%) were smaller or equal to the median PA_L of 8 and 7 cm, respectively.

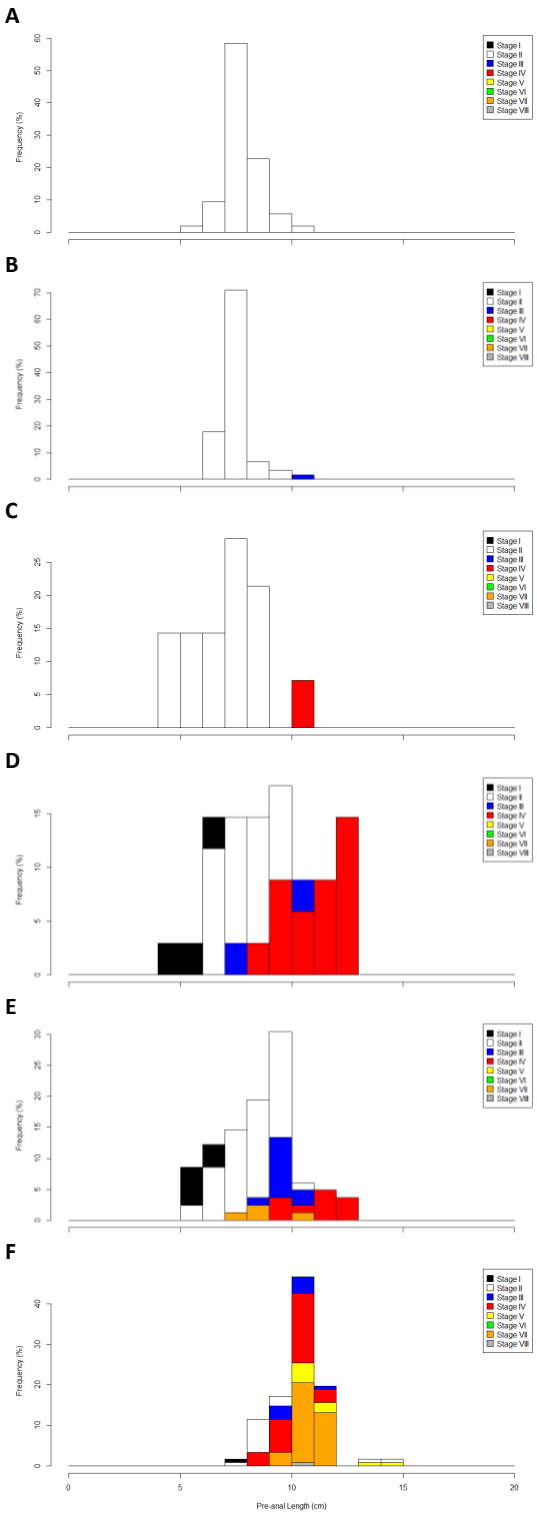

Fig 41. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Coelorinchus fasciatus* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 53), **(B)** Area 2 (N = 62), **(C)** Area 3 (N = 14), **(D)** Area 4 (N = 34), **(E)** Area 5 (N = 82), **(F)** Area 6 (N = 122).

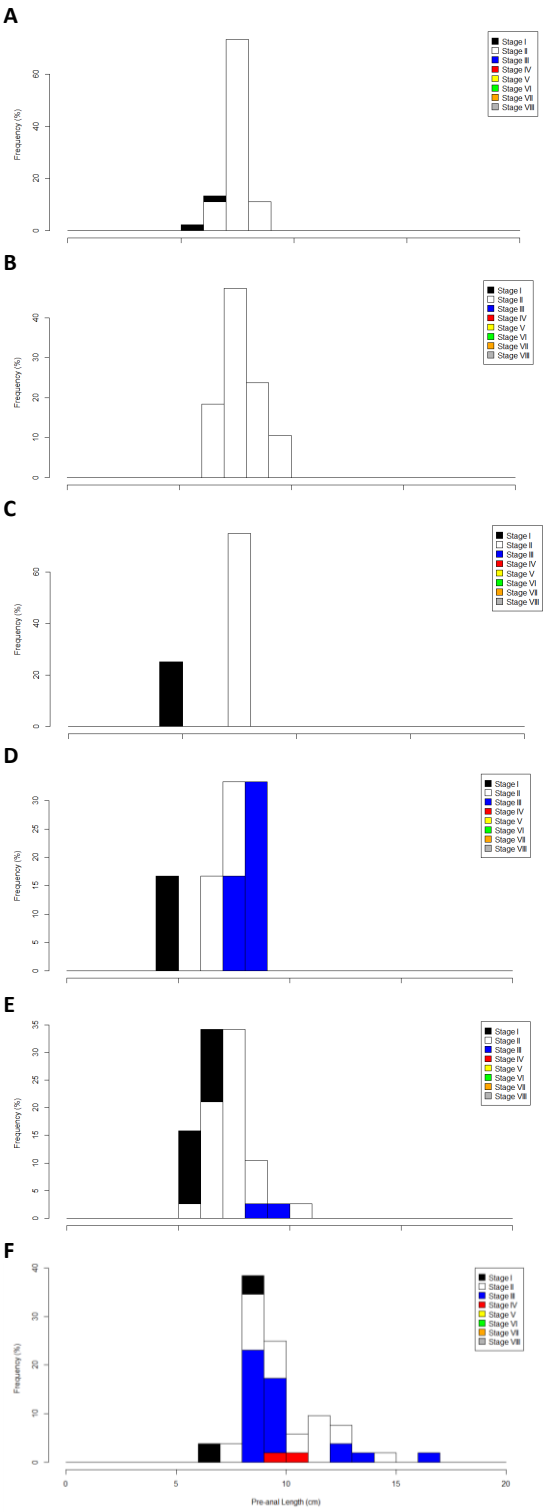

Fig 42. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Coelorinchus fasciatus* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 45), **(B)** Area 2 (N = 38), **(C)** Area 3 (N = 4), **(D)** Area 4 (N = 6), **(E)** Area 5 (N = 38), **(F)** Area 6 (N = 52).

3.11 *Illex argentinus* – Argentine shortfin squid (ILL)

The total catch of *I. argentinus* was 933.394 kg (Table 2). It was caught at 28 of the 45 stations sampled during this cruise (62.2%). Catches ranged from 0.018 to 536.000 kg and densities from < 0.1 to 2,775.1 kg/km^2 (Fig 43). Of the 28 stations where *I. argentinus* was caught, 18 stations yielded > 1 kg/km^2 (64.3%), nine stations yielded > 10 kg/km^2 (32.1%), three yielded > 100 kg/km^2 (10.7%), and a single station > 1,000 kg/km^2 (3.6%). Catches of *I. argentinus* occurred in four areas: Area 1 (abundance = 1,249.1 kg/km^2), Area 2 (abundance = 28.9 kg/km^2), Area 3 (abundance = 1.9 kg/km^2), and Area 4 (abundance = 0.3 kg/km^2) (Fig 43). The number of squid sampled for length frequency was 748 (382 females and 366 males). Female M_L ranged from 7.0 to 33.0 cm (mean of 15.64 cm) (Fig 44a), whereas males measured between 6.5 and 25.5 cm (mean of 16.62 cm) (Fig 44b). The histograms show two distinct modes at 9 and 20 cm, for both females and males (Fig 44). Females were observed Stage I (28.5%), Stage II (59.4%), Stage III (7.9%), Stage IV (1.3%), and Stage V (2.9%) (Fig 44a). Males were observed Stage I (28.7%), Stage II (22.4%), Stage III (14.8%), Stage IV (22.1%), and Stage V (12.0%) (Fig 44b).

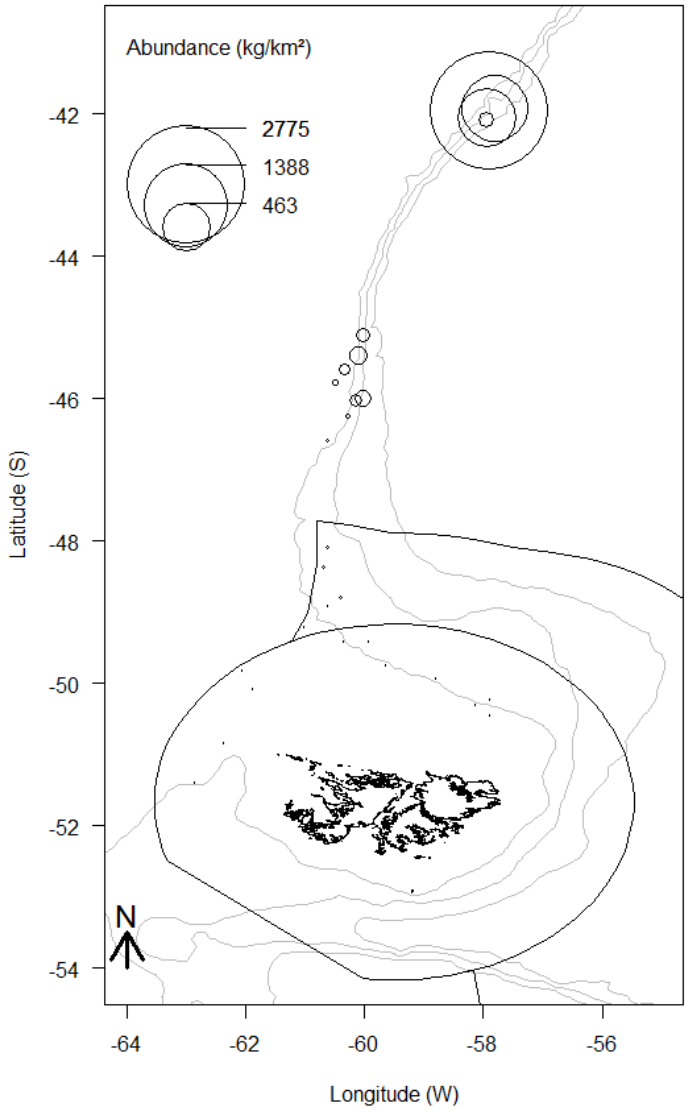

Fig 43. Distribution of densities of *Illex argentinus*.

The greater proportions of individuals smaller than the median M_L of 12.5 cm for females and 19.0 cm for males was observed in shallower waters. In waters shallower than 200 m, 86.8% of the 204 female individuals and 88.5% of the 148 male individuals were smaller than median M_L. In waters between 200 and 300 m depths, 69.6% of the 23 female individuals and all 16 male individuals were smaller than median T_L. In waters deeper than 300 m depths, 1.3% of the 155 female individuals and 25.7% of the 202 male individuals were smaller than median T_L. The depth range for this species during the survey was 121 to 626 m.

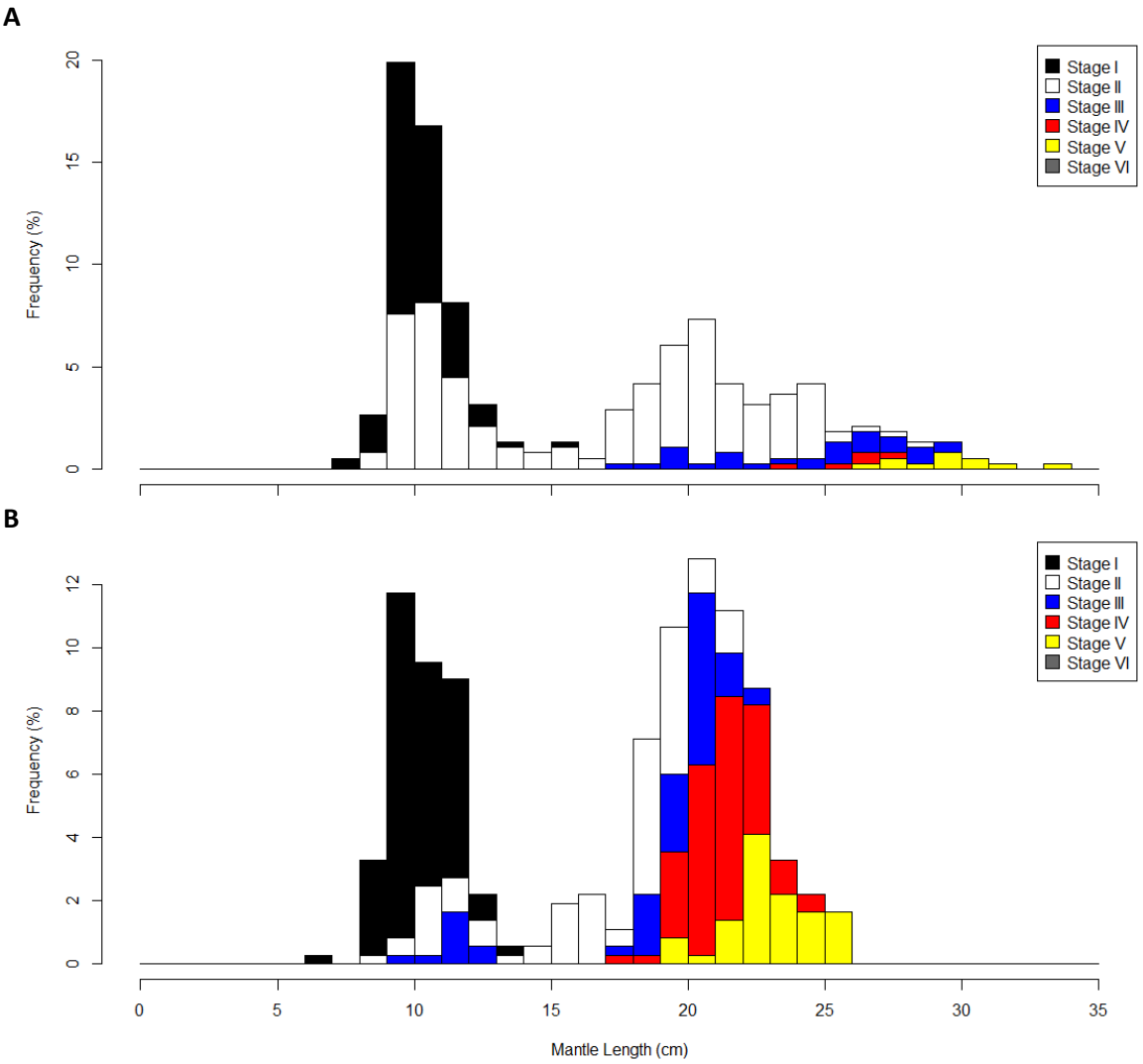

Fig 44. Length frequency (percentage of the total sample collected) of *Illex argentinus* individuals sampled with associated maturity stages (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent) for (A) females (N = 382) and (B) males (N = 366).

3.11.1 *Illex argentinus* – Argentine shortfin squid – Area 1

The total catch of *I. argentinus* in Area 1 was 881.40 kg (Table 3) and the total density was 1,249.1 kg/km^2. It was caught at all four stations sampled in Area 1 during this cruise. Catches ranged from 4.10 to 536.00 kg per station, with densities ranging between 52.4 and 2,775.1 kg/km^2 (Fig 43). Of the four stations where *I. argentinus* was caught, all four stations yielded > 1 kg/km^2 and > 10 kg/km^2, three yielded > 100 kg/km^2 (75.0%), and one yielded > 1,000 kg/km^2 (25.0%). The number of squid sampled for length frequency was 330 (138 females and 192 males). Female M_L ranged from 14.5 to 31.0 cm (mean of 21.32 cm) (Fig 45a), whereas males measured between 15.0 and 25.0 cm (mean of 20.48 cm) (Fig 46a). Females were observed Stage II (84.1%), Stage III (8.7%), Stage IV (2.2%), and Stage V (5.1%) (Fig 45a). Males were observed Stage II (26.6%), Stage III (20.3%), Stage IV (37.5%), and Stage V (15.6%) (Fig 46a). In Area 1, none of the 138 females sampled and 47 of 192 males (24.5%) were smaller or equal to the median M_L of 12.5 and 19.0 cm, respectively.

3.11.2 *Illex argentinus* – Argentine shortfin squid – Area 2

The total catch of *I. argentinus* in Area 2 was 47.90 kg (Table 4) and the total density was 28.9 kg/km^2. It was caught all eight stations sampled in Area 2 during this cruise. Catches ranged from 0.82 to 14.02 kg per station, with densities ranging between 3.5 and 65.1 kg/km^2 (Fig 43). Of the eight stations where *I. argentinus* was caught, all eight stations yielded > 1 kg/km^2, five yielded > 10 kg/km^2 (62.5%), and none yielded > 100 kg/km^2. The number of squid sampled for length frequency was 357 (212 females and 145 males). Female M_L ranged from 7.0 to 33.0 cm (mean of 12.44 cm) (Fig 45b), whereas males measured between 6.5 and 25.5 cm (mean of 12.28 cm) (Fig 46b). Females were observed Stage I (42.0%), Stage II (46.7%), Stage III (8.5%), Stage IV (0.9%), and Stage V (1.9%) (Fig 45b). Males were observed Stage I (61.4%), Stage II (15.9%), Stage III (9.0%), Stage IV (4.8%), and Stage V (9.0%) (Fig 46b). In Area 2, 173 of the 212 females (81.6%) sampled and 125 of 145 males (86.2%) were smaller or equal to the median M_L of 12.5 and 19.0 cm, respectively.

3.11.3 *Illex argentinus* – Argentine shortfin squid – Area 3

The total catch of *I. argentinus* in Area 3 was 2.606 kg (Table 5) and the total density was 1.9 kg/km^2. It was caught at five of the six stations sampled in Area 3 during this cruise (83.3%). Of the five stations where *I. argentinus* was caught, four stations yielded > 1 kg/km^2 (80.0%) and none yielded > 10 kg/km^2. The number of squid sampled for length frequency was 24 (ten females and 14 males). Female M_L ranged from 10.0 to 20.5 cm (mean of 15.60 cm) (Fig 45c), whereas males measured between 9.5 and 21.5 cm (mean of 15.11 cm) (Fig 46c). Females were observed Stage I (20.0%) and Stage II (80.0%) (Fig 45c). Males were observed Stage I (28.6%), Stage II (42.9%), Stage III (7.1%), Stage IV (14.3%), and Stage V (7.1%) (Fig 46c). In Area 3, 4 of the 10 females (40.0%) sampled and 12 of 14 males (85.7%) were smaller or equal to the median M_L of 12.5 and 19.0 cm, respectively.

3.11.4 *Illex argentinus* – Argentine shortfin squid – Area 4

The total catch of *I. argentinus* in Area 4 was 1.488 kg (Table 6) and the total density was 0.3 kg/km^2. It was caught at 11 of the 21 stations sampled in Area 4 during this cruise (52.4%). Catches ranged from 0.018 to 0.460 kg and densities from < 0.1 to 2.1 kg/km^2 (Fig 43). Of the 11 stations where *I. argentinus* was caught in Area 4, two stations yielded > 1 kg/km^2 (18.2%) and none yielded > 10 kg/km^2. The number of squid sampled for length frequency was 37 (22 females and 15 males). Female M_L ranged from 9.0 to 19.0 cm (mean of 10.91 cm) (Fig 45d), whereas males measured between 8.5 and 17.5 cm (mean of 10.57 cm) (Fig 46d). Females were observed Stage I (81.8%) and Stage II (18.2%) (Fig 45d). Males were observed Stage I (80.0%), Stage II (13.3%), and Stage III (6.7%) (Fig 46d). In Area 4, 18 of the 22 females (81.8%) sampled and all 15 males were smaller or equal to the median M_L of 12.5 and 19.0 cm, respectively.

3.11.5 *Illex argentinus* – Argentine shortfin squid – Area 5

No *I. argentinus* was caught in Area 5.

3.11.6 *Illex argentinus* – Argentine shortfin squid – Area 6

No *I. argentinus* was caught in Area 6.

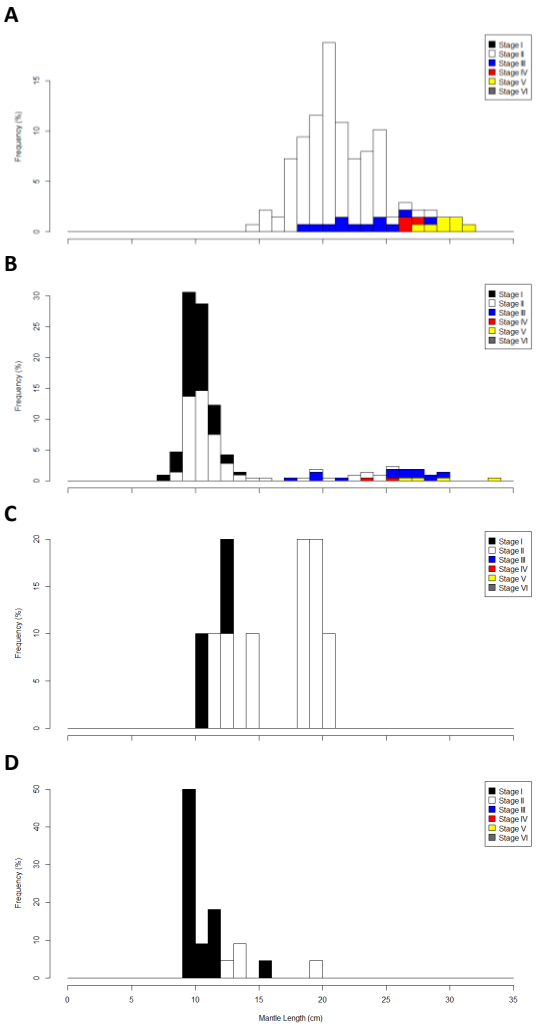

Fig 45. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Illex argentinus* (females) with associated maturity stages (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent) for **(A)** Area 1 (N = 138), **(B)** Area 2 (N = 212), **(C)** Area 3 (N = 10) **(D)** Area 4 (N = 22).

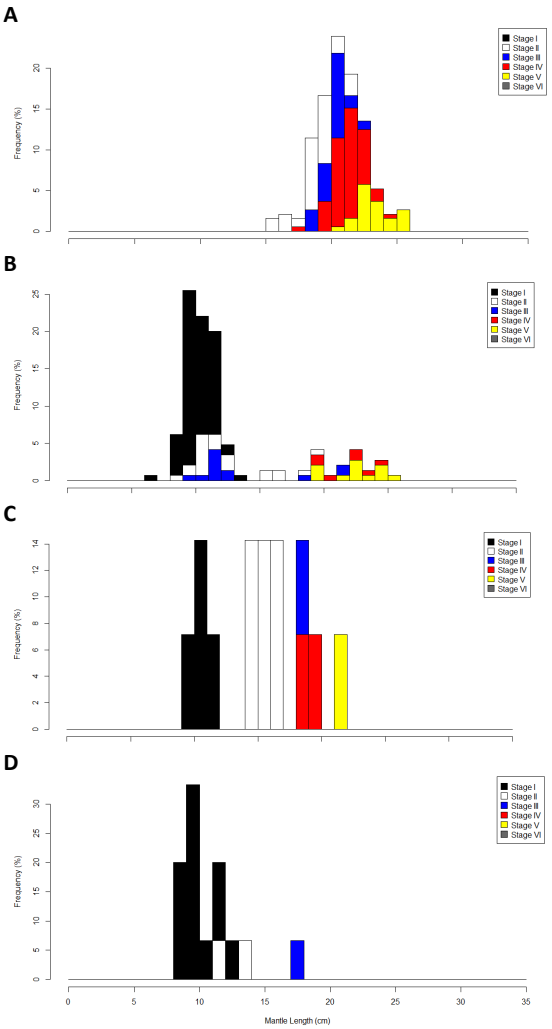

Fig 46. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Illex argentinus* (males) with associated maturity stages (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent) for **(A)** Area 1 (N = 192), **(B)** Area 2 (N = 145), **(C)** Area 3 (N = 14) **(D)** Area 4 (N = 15).

3.12 *Moroteuthis ingens* – Greater hooked squid (ING)

The total catch of *M. ingens* was 38.274 kg (Table 2). It was caught at 15 of the 45 stations sampled during this cruise (33.3%). Catches ranged from 0.014 to 17.680 kg and densities from < 0.1 to 98.5 kg/km^2 (Fig 47). Of the 15 stations where *M. ingens* was caught, 14 stations yielded > 1 kg/km^2 (93.3%), five stations yielded > 10 kg/km^2 (33.3%), and none yielded > 100 kg/km^2. Catches of *M. ingens* occurred in five of the six areas: Area 1 (abundance = 7.0 kg/km^2), Area 2 (abundance = 6.5 kg/km^2), Area 3 (abundance = 0.8 kg/km^2), Area 4 (abundance = 0.6 kg/km^2), and Area 6 (abundance = 32.2 kg/km^2) (Fig 47). The number of squid sampled for length frequency was 28 (16 females and 12 males). Female M_L ranged from 22.0 to 33.5 cm (mean of 27.28 cm) (Fig 48a), whereas males measured between 13.5 and 33.0 cm (mean of 27.79 cm) (Fig 48b). Females were observed Stage II (93.8%) and Stage III (6.3%) (Fig 48a). Males were observed Stage I (8.3%), Stage III (25.0%), and Stage IV (66.7%) (Fig 48b).

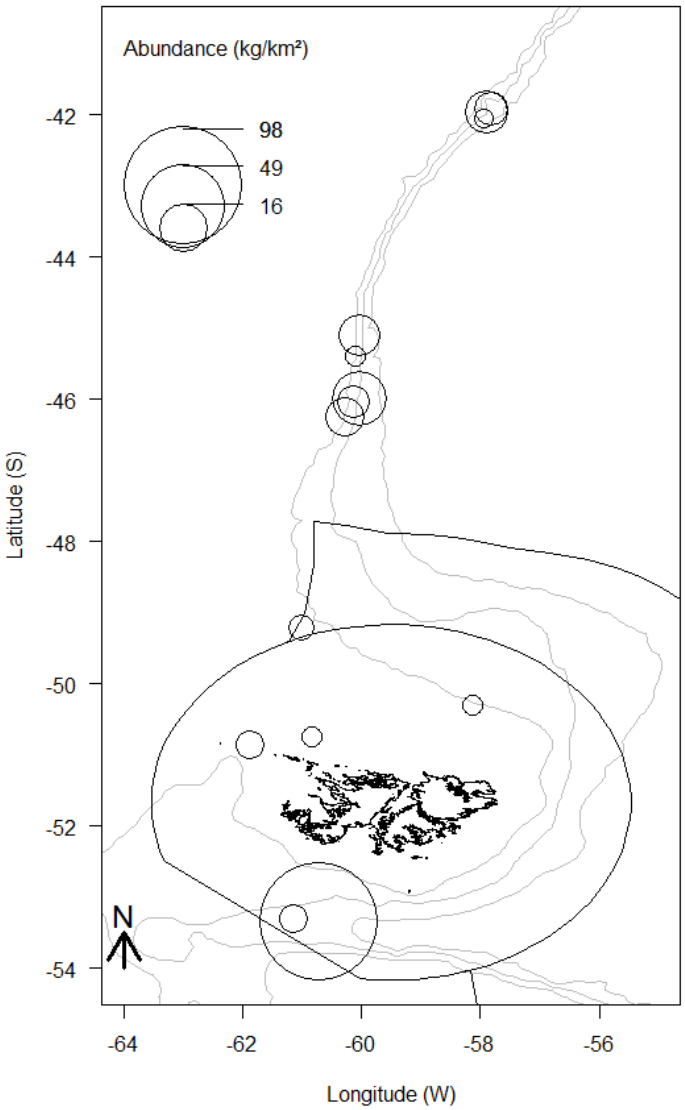

Fig 47. Distribution of densities of *Moroteuthis ingens*.

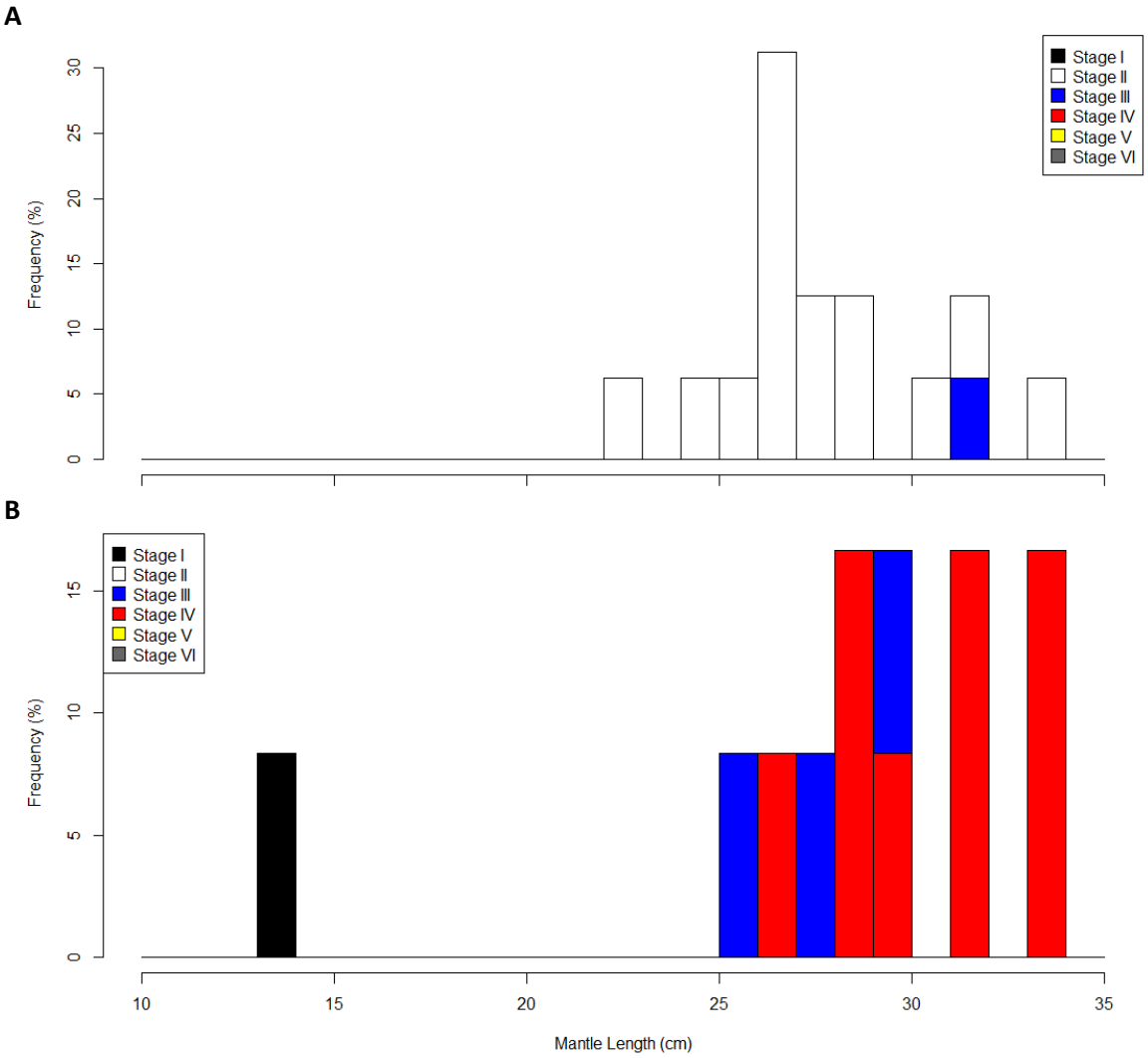

Fig 48. Length frequency (percentage of the total sample collected) of *Moroteuthis ingens* individuals sampled with associated maturity stages (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent) for (A) females (N = 16) and (B) males (N = 12).

3.13 *Genypterus blacodes* – Kingclip (KIN)

The total catch of *G. blacodes* was 1,951.42 kg (Table 2). It was caught at 31 of the 45 stations sampled during this cruise (68.9%). Catches ranged from 0.34 to 410.38 kg and densities from 1.6 to 1,997.5 kg/km^2 (Fig 49a). Of the 31 stations where *G. blacodes* was caught, all stations yielded > 1 kg/km^2, 27 stations yielded > 10 kg/km^2 (87.1%), 17 stations yielded > 100 kg/km^2 (54.8%), and two stations > 1,000 kg/km^2 (6.5%). Catches of *G. blacodes* occurred in five of six areas: Area 1 (abundance = 10.7 kg/km^2), Area 2 (abundance = 64.9 kg/km^2), Area 3 (abundance = 45.6 kg/km^2), Area 4 (abundance = 336.0 kg/km^2), and Area 5 (abundance = 371.4 kg/km^2) (Fig 49a). The number of *G. blacodes* sampled for otoliths was 444 (range = 0 to 64 per station) (Fig 49b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 233 females (T_L = 36 to 113 cm) and 211 males (T_L = 38 to 113 cm) (Fig 50). The number of fish sampled for length frequency was 1,106 (584 females and 522 males). Female T_L ranged from 36 to 113 cm (mean of 62.15 cm) (Fig 51a), whereas males measured between 38 and 113 cm (mean of 59.75 cm) (Fig 51b). The histograms show two distinct modes at 55 and 62 to 63 cm, respectively, for females and one distinct mode at 60 cm, for males (Fig 51). Females were observed Stage I (3.9%), Stage II (87.3%), Stage III (8.6%), and Stage VIII (0.2%) (Fig 51a). Males were observed Stage I (10.7%), Stage II (83.1%), Stage III (5.7%), Stage IV (0.2%), and Stage VIII (0.2%) (Fig 51b).

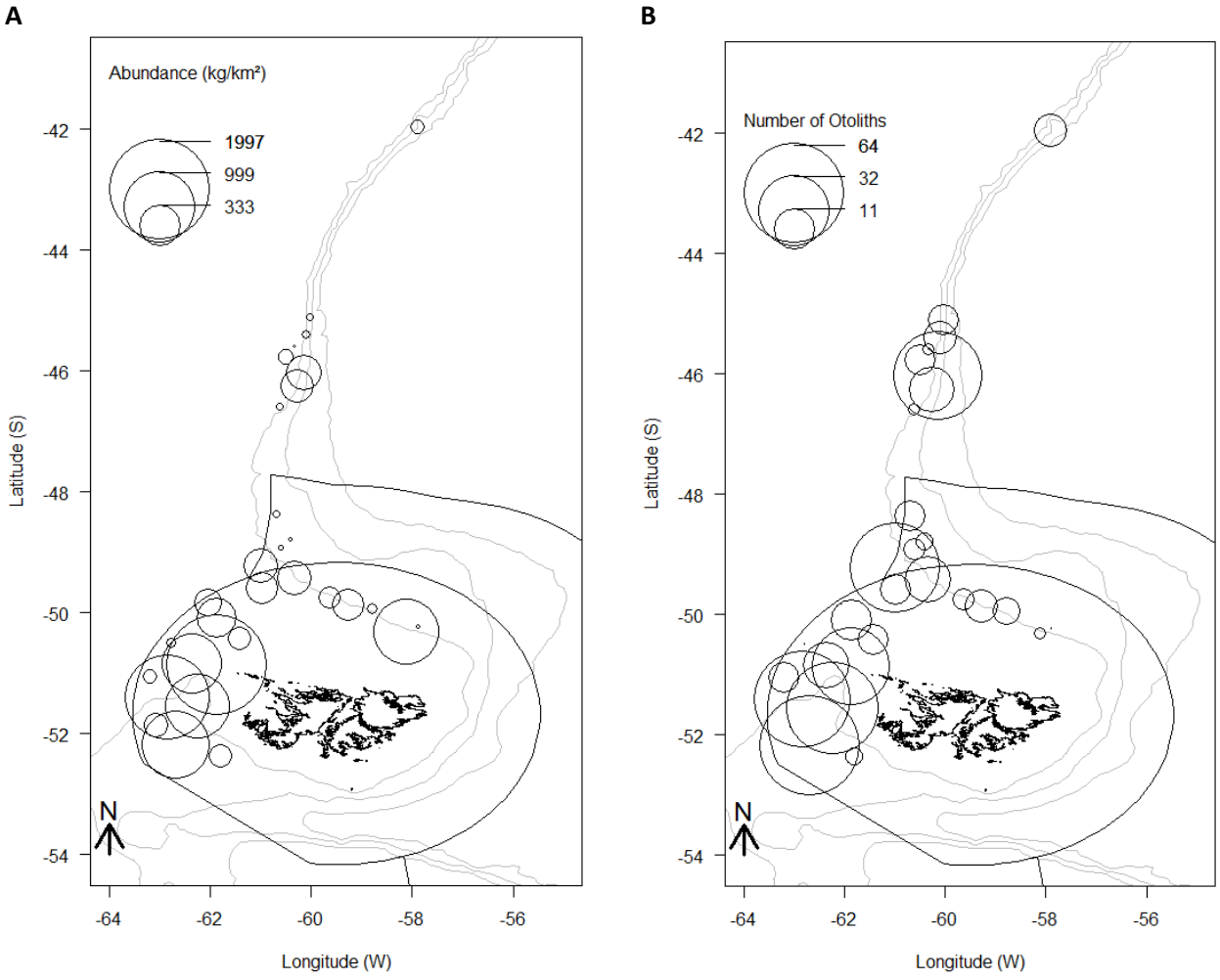

Fig 49. Distribution of (A) densities and (B) otolith samples (N = 444) of *Genypterus blacodes*.

The greater proportions of individuals smaller than the median T_L of 60 cm for females and 58 cm for males was observed in shallower waters (< 200 m) and in deeper waters (> 300 m). In waters shallower than 200 m, 54.5% of the 385 female individuals and 54.1% of the 344 male individuals were smaller than median T_L. In waters between 200 m and 300 m depths, 36.2% of the 141 female individuals and 31.7% of the 123 male individuals were smaller than median T_L. In waters deeper than 300 m, 82.8% of the 58 female individuals and 78.2% of the 55 male individuals were smaller than median T_L; most of these occurring on the High Seas. The depth range for this species during the survey was 131 to 375 m.

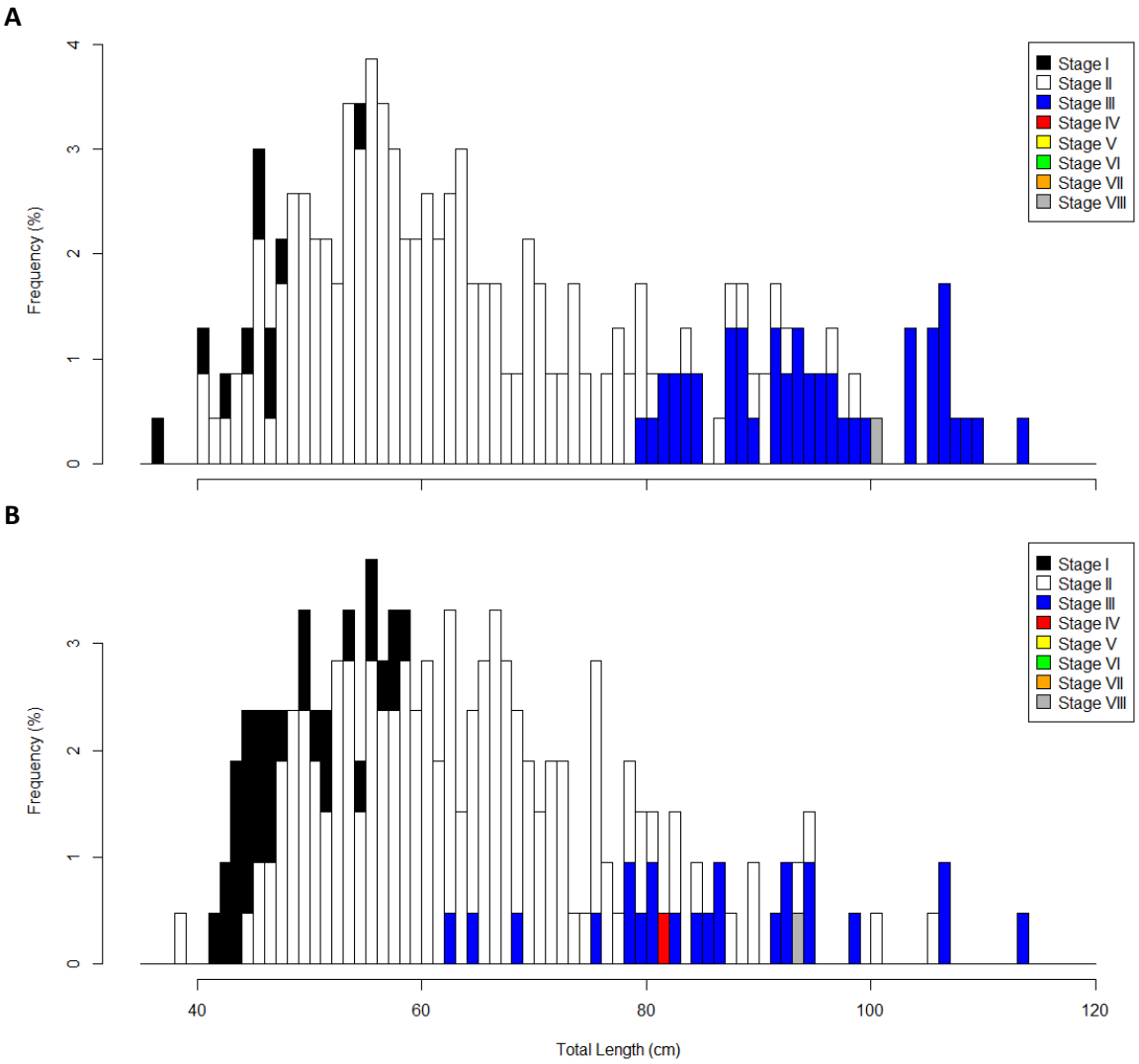

Fig 50. Length frequency (percentage of the total sample collected) of *Genypterus blacodes* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 233) and (B) males (N = 211).

3.13.1 *Genypterus blacodes* – Kingclip – Area 1

The total catch of *G. blacodes* in Area 1 was 7.54 kg (Table 3) and the total density was 10.7 kg/km^2. It was caught at a single of the four stations sampled in Area 1 during this cruise (25.0%) (Fig 49a). The number of *G. blacodes* sampled for otoliths was six. Overall, otoliths were collected from a single female (T_L = 55 cm) and five males (T_L = 47 to 93 cm). The number of fish sampled for length frequency was six (one female and five males). Female T_L was 55 cm (Fig 52a), whereas males measured between 47 and 93 cm (mean of 67.40 cm) (Fig 53a). The lone female was observed Stage II (Fig 52a). Males were observed Stage II (80.0%) and Stage III (20.0%) (Fig 53a). In Area 1, the lone female sampled and 3 of 5 males (60.0%) were smaller or equal to the median T_L of 60 and 58 cm, respectively.

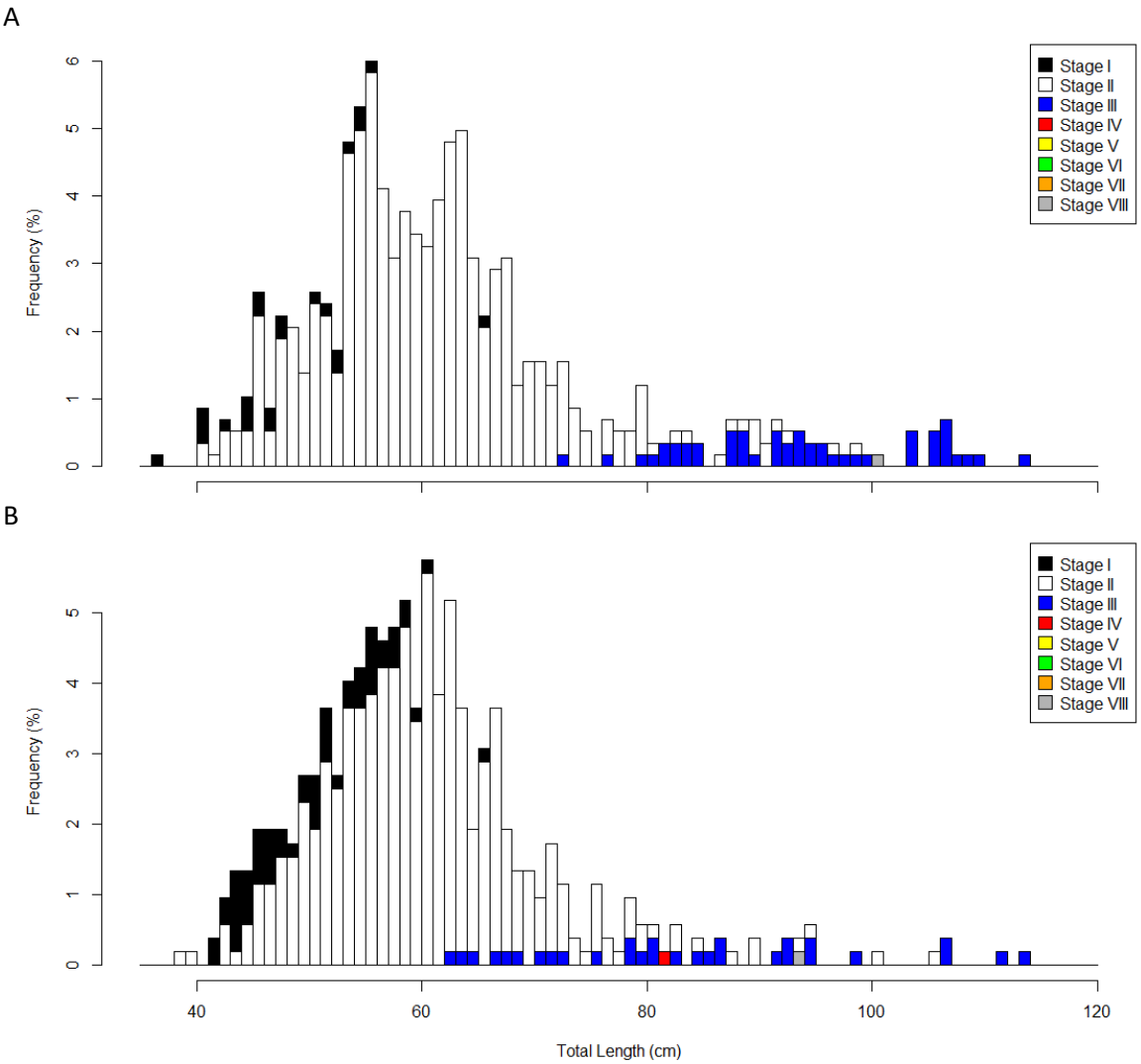

Fig 51. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Genypterus blacodes* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 584) and (B) males (N = 522).

3.13.2 *Genypterus blacodes* – Kingclip – Area 2

The total catch of *G. blacodes* in Area 2 was 107.44 kg (Table 4) and the total density was 64.9 kg/km^2. It was caught at seven of the eight stations sampled in Area 2 during this cruise (87.5%). Catches ranged from 0.34 to 43.52 kg per station, with densities ranging between 1.6 and 243.9 kg/km^2 (Fig 49a). Of the seven stations where *G. blacodes* was caught, all stations yielded > 1 kg/km^2, six stations yielded > 10 kg/km^2 (85.7%), and two stations yielded > 100 kg/km^2 (33.3%). The number of *G. blacodes* sampled for otoliths was 84 (1 to 50 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 47 females (T_L = 41 to 106 cm) and 37 males (T_L = 38 to 85 cm). The number of fish sampled for length frequency was 129 (74 females and 55 males). Female T_L ranged from 41 to 106 cm (mean of 55.68 cm) (Fig 52b), whereas males measured between 38 and 85 cm (mean of 50.16 cm) (Fig 53b). Females were observed Stage I (9.5%), Stage II (74.3%), Stage III (14.9%), and Stage VIII (1.4%) (Fig 52b). Males were observed Stage I (25.5%), Stage II (65.5%), and Stage III (9.1%) (Fig 53b). In Area 2, 62 of 74 females sampled (83.8%) and 47 of 55 males (85.5%) were smaller or equal to the median T_L of 60 and 58 cm, respectively.

3.13.3 *Genypterus blacodes* – Kingclip – Area 3

The total catch of *G. blacodes* in Area 3 was 61.20 kg (Table 5) and the total density was 45.6 kg/km^2. It was caught at four of the six stations sampled in Area 3 during this cruise (66.7%). Catches ranged from 0.80 to 56.38 kg per station, with densities ranging between 3.7 and 238.1 kg/km^2 (Fig 49a). Of the four stations where *G. blacodes* was caught, all stations yielded > 1 kg/km^2, two stations yielded > 10 kg/km^2 (50.0%), and one station yielded > 100 kg/km^2 (25.0%). The number of *G. blacodes* sampled for otoliths was 63 (2 to 52 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 31 females (T_L = 45 to 70 cm) and 32 males (T_L = 42 to 68 cm). The number of fish sampled for length frequency was 92 (47 females and 45 males). Female T_L ranged from 45 to 70 cm (mean of 55.15 cm) (Fig 52c), whereas males measured between 42 and 68 cm (mean of 56.69 cm) (Fig 53c). Females were observed Stage I (2.1%) and Stage II (97.8%) (Fig 52c). Males were observed Stage I (2.2%) and Stage II (97.8%) (Fig 53c). In Area 3, 38 of 47 females sampled (80.9%) and 31 of 45 males (68.9%) were smaller or equal to the median T_L of 60 and 58 cm, respectively.

3.13.4 *Genypterus blacodes* – Kingclip – Area 4

The total catch of *G. blacodes* in Area 4 was 1,547.20 kg (Table 6) and the total density was 336.0 kg/km^2. It was caught at 16 of the 21 stations sampled in Area 4 during this cruise (76.2%). Catches ranged from 0.70 to 410.38 kg and densities from 3.0 to 1,997.5 kg/km^2 (Fig 49a). Of the 16 stations where *G. blacodes* was caught in Area 4, all stations yielded > 1 kg/km^2, 15 stations yielded > 10 kg/km^2 (93.8%), 11 stations yielded > 100 kg/km^2 (68.9%), and two stations yielded > 1,000 kg/km^2 (12.5%). The number of *G. blacodes* sampled for otoliths was 225 (0 to 60 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 118 females (T_L = 36 to 113 cm) and 107 males (T_L range = 43 to 113 cm). The number of fish sampled for length frequency was 726 (384 females and 342 males). Female T_L ranged from 36 to 113 cm (mean of 64.38 cm) (Fig 52d), whereas males measured between 42 and 113 cm (mean of 61.62 cm) (Fig 53d). Females were observed Stage I (3.6%), Stage II (86.7%), and Stage III (9.6%) (Fig 52d). Males were observed Stage I (9.1%), Stage II (83.3%), Stage III (7.0%), Stage IV (0.3%), and Stage VIII (0.3%) (Fig 53d). In Area 4, 176 of 384 females sampled (45.8%) and 155 of 342 males (45.3%) were smaller or equal to the median T_L of 60 and 58 cm, respectively.

3.13.5 *Genypterus blacodes* – Kingclip – Area 5

The total catch of *G. blacodes* in Area 5 was 228.04 kg (Table 7) and the total density was 371.4 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 22.28 to 180.68 kg and densities from 107.8 to 908.1 kg/km^2 (Fig 49a). Of the three stations where *G. blacodes* was caught in Area 5, all stations yielded > 1 kg/km^2, > 10 kg/km^2 and > 100 kg/km^2, and none yielded > 1,000 kg/km^2. The number of *G. blacodes* sampled for otoliths was 66 (0 to 64 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 36 females (T_L = 47 to 97 cm) and 30 males (T_L range = 45 to 82 cm). The number of fish sampled for length frequency was 153 (78 females and 75 males). Female T_L ranged from 42 to 97 cm (mean of 61.64 cm) (Fig 52e), whereas males measured between 39 and 82 cm (mean of 59.60 cm) (Fig 53e). Females were observed Stage I (1.3%), Stage II (96.2%), and Stage III (2.6%) (Fig 52e). Males were observed Stage I (13.3%) and Stage II (86.7%) (Fig 53e). In Area 5, 32 of 78 females sampled (41.0%) and 32 of 75 males (42.7%) were smaller or equal to the median T_L of 60 and 58 cm, respectively.

3.13.6 *Genypterus blacodes* – Kingclip – Area 6

No *G. blacodes* was caught in Area 6.

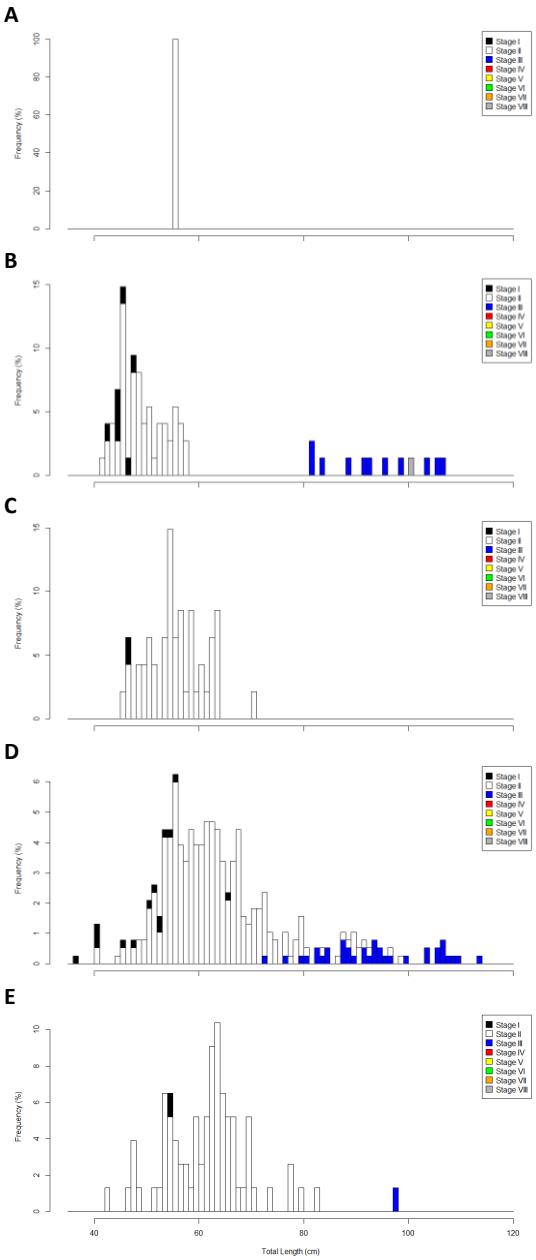

Fig 52. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Genypterus blacodes* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 1), **(B)** Area 2 (N = 74), **(C)** Area 3 (N = 47), **(D)** Area 4 (N = 384), **(E)** Area 5 (N = 78).

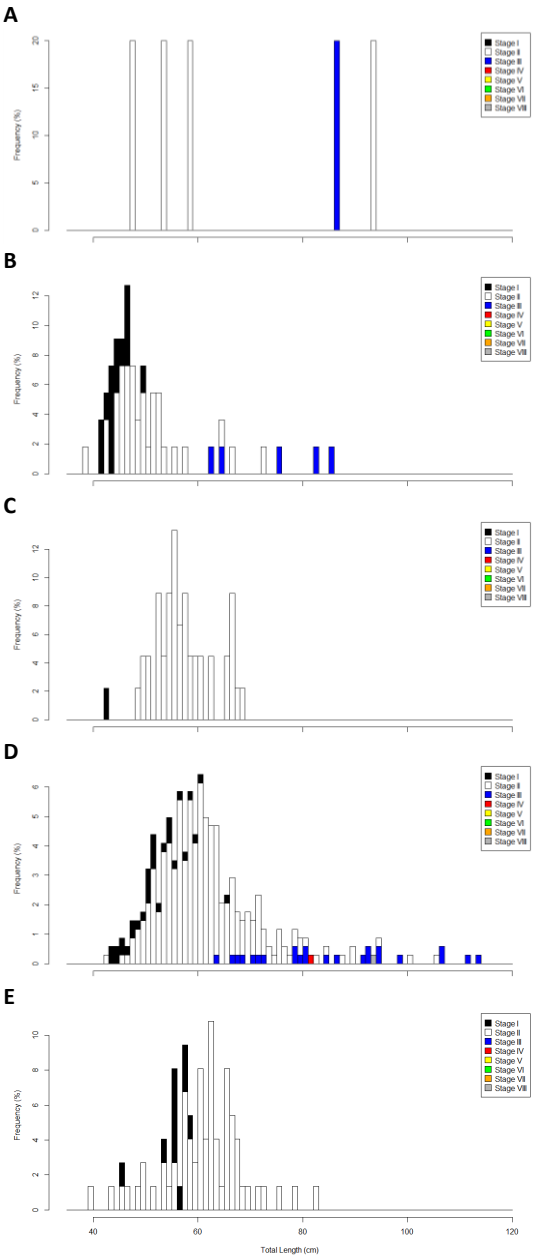

Fig 53. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Genypterus blacodes* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 5), **(B)** Area 2 (N = 55), **(C)** Area 3 (N = 45), **(D)** Area 4 (N = 342), **(E)** Area 5 (N = 75).

3.14 *Doryteuthis gahi* – Patagonian longfin squid (LOL)

The total catch of *D. gahi* was 5,740.928 kg (Table 2). It was caught at 43 of the 45 stations sampled during this cruise (95.6%). Catches ranged from 0.040 to 736.580 kg and densities from 0.5 to 3,289.8 kg/km^2 (Fig 54). Of the 43 stations where *D. gahi* was caught, 42 stations yielded > 1 kg/km^2 and > 10 kg/km^2 (97.7%), 33 stations yielded > 100 kg/km^2 (76.7%), and nine stations yielded > 1,000 kg/km^2 (20.9%). Catches of *D. gahi* occurred in all six areas: Area 1 (abundance = 67.8 kg/km^2), Area 2 (abundance = 596.9 kg/km^2), Area 3 (abundance = 1,545.9 kg/km^2), Area 4 (abundance = 491.2 kg/km^2), Area 5 (abundance = 519.1 kg/km^2), and Area 6 (abundance = 88.3 kg/km^2) (Fig 54). The number of squid sampled for length frequency was 4,340 (2,570 females, 1,768 males, 1 juvenile, and 1 unsexed individual). Female M_L ranged from 4.5 to 26.5 cm (mean of 9.98 cm) (Fig 55a), whereas males measured between 5.0 and 30.5 cm (mean of 10.52 cm) (Fig 55b). The juvenile and unsexed individuals measured 5.0 cm and 6.5 cm M_L, respectively. The histograms show a single distinct mode at 9 cm, for both females and males (Fig 55). Females were observed Stage I (1.6%), Stage II (82.2%), Stage III (11.9%), Stage IV (3.2%), and Stage V (1.1%) (Fig 55a). Males were observed Stage I (3.3%), Stage II (25.5%), Stage III (36.1%), Stage IV (25.6%), and Stage V (9.4%) (Fig 55b).

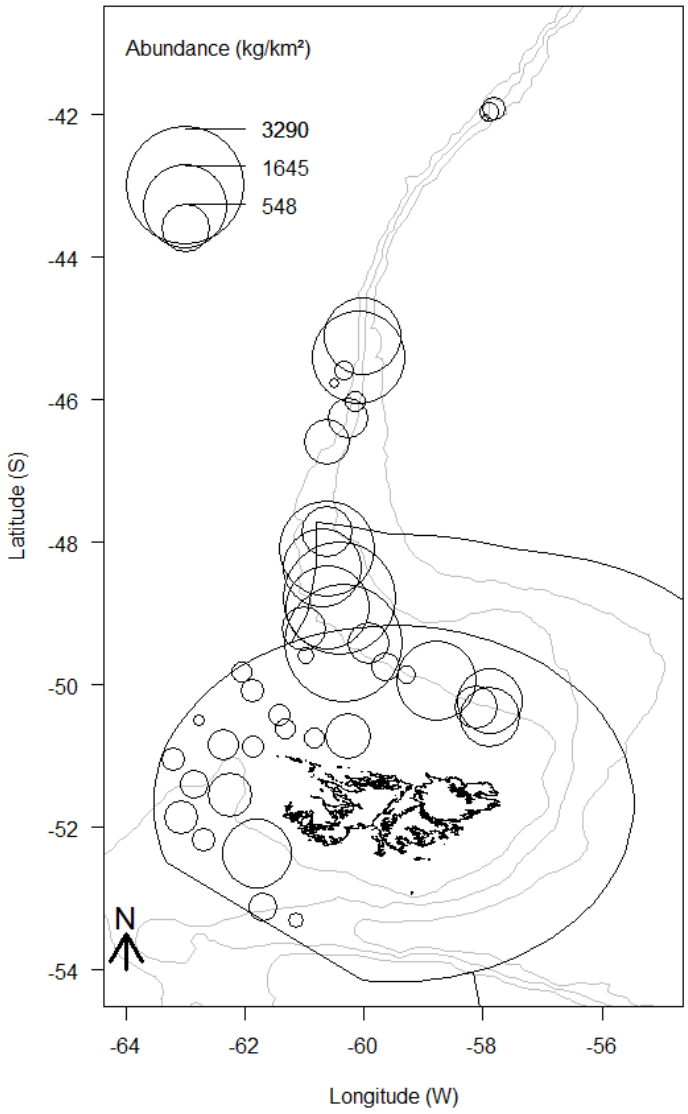

Fig 54. Distribution of densities of *Doryteuthis gahi*.

The greater proportions of individuals smaller than the median M_L of 10.0 cm for females and 10.0 cm for males was observed in shallower waters. In waters shallower than 200 m, 87.3% of the 1,193 female individuals and 67.8% of the 1,103 male individuals were smaller than median M_L. In waters between 200 and 300 m depths, 52.1% of the 682 female individuals and 40.9% of the 406 male individuals were smaller than median T_L. In waters deeper than 300 m depths, 9.6% of the 695 female individuals and 5.8% of the 259 male individuals were smaller than median T_L. The depth range for this species during the survey was 121 to 587 m.

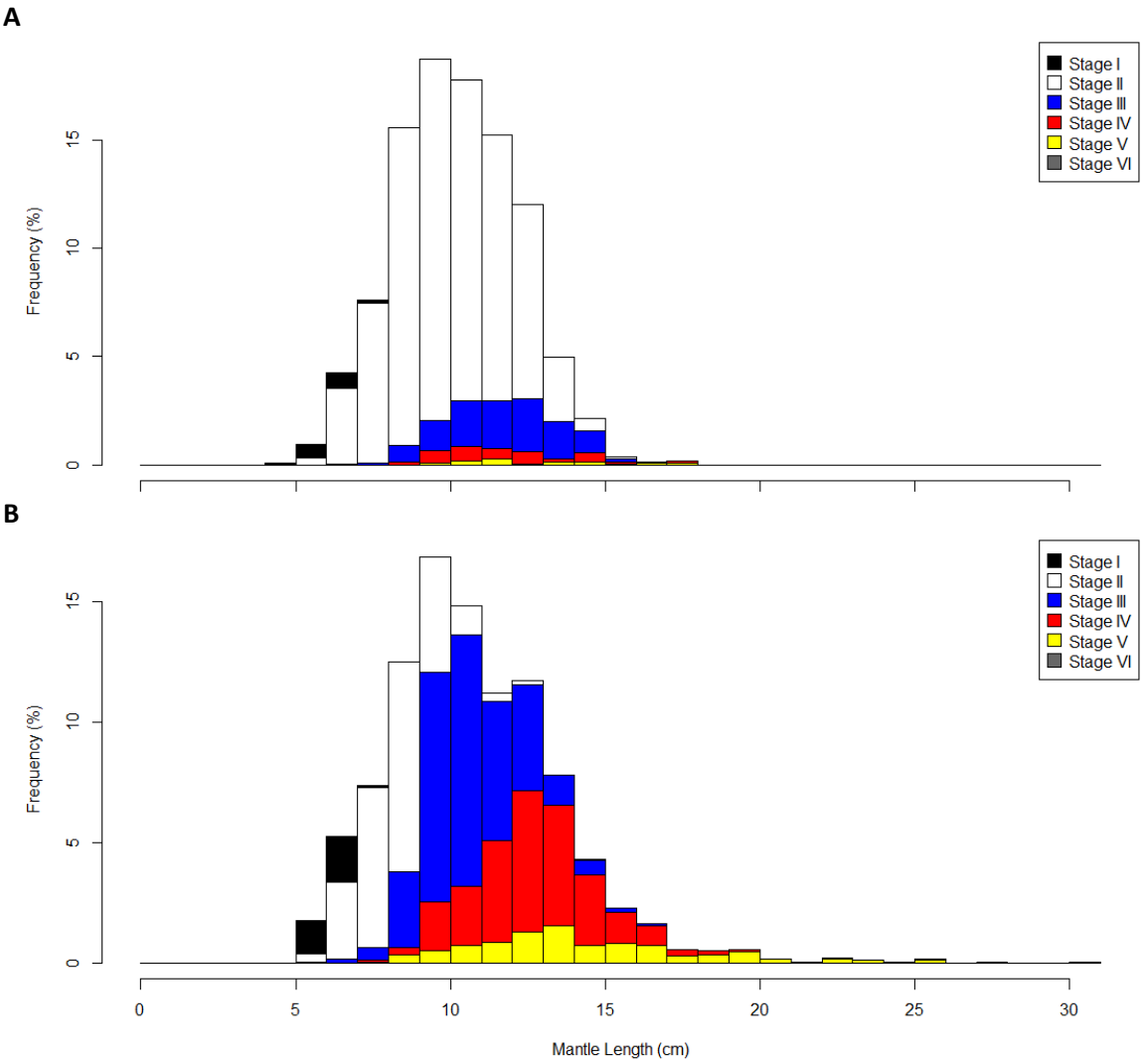

Fig 55. Length frequency (percentage of the total sample collected) of *Doryteuthis gahi* individuals sampled with associated maturity stages (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent) for (A) females (N = 2,570) and (B) males (N = 1,768).

3.14.1 *Doryteuthis gahi* – Patagonian longfin squid – Area 1

The total catch of *D. gahi* in Area 1 was 47.840 kg (Table 3) and the total density was 67.8 kg/km^2. It was caught at all four stations sampled in Area 1 during this cruise. Catches ranged from 0.040 to 28.320 kg per station, with densities ranging between 0.5 and 128.3 kg/km^2 (Fig 54). Of the four stations where *D. gahi* was caught, three stations yielded > 1 kg/km^2 and > 10 kg/km^2 (75.0%), a single one yielded > 100 kg/km^2 (25.0%), and none yielded > 1,000 kg/km^2. The number of squid sampled for length frequency was 215 (168 females and 47 males). Female M_L ranged from 7.5 to 15.0 cm (mean of 11.26 cm) (Fig 56a), whereas males measured between 9.0 and 15.5 cm (mean of 12.32 cm) (Fig 57a). Females were observed Stage II (95.8%) and Stage III (4.2%) (Fig 56a). Males were observed Stage II (6.4%), Stage III (51.1%), Stage IV (38.3%), and Stage V (4.3%) (Fig 57a). In Area 1, 34 of the 168 females (20.2%) sampled and 2 of 47 males (4.3%) were smaller or equal to the median M_L of 10.0 and 10.0 cm, respectively.

3.14.2 *Doryteuthis gahi* – Patagonian longfin squid – Area 2

The total catch of *D. gahi* in Area 2 was 988.073 kg (Table 4) and the total density was 596.9 kg/km^2. It was caught at seven of the eight stations sampled in Area 2 during this cruise (87.5%). Catches ranged from 5.780 to 432.580 kg per station, with densities ranging between 28.1 and 2,009.8 kg/km^2 (Fig 54). Of the seven stations where *D. gahi* was caught, all seven stations yielded > 1 kg/km^2 and > 10 kg/km^2, five yielded > 100 kg/km^2 (71.4%), and two stations yielded > 1,000 kg/km^2 (28.6%). The number of squid sampled for length frequency was 735 (447 females and 288 males). Female M_L ranged from 4.5 to 16.0 cm (mean of 9.85 cm) (Fig 56b), whereas males measured between 5.0 and 18.0 cm (mean of 8.91 cm) (Fig 57b). Females were observed Stage I (2.5%), Stage II (84.3%), Stage III (9.2%), Stage IV (2.0%), and Stage V (2.0%) (Fig 56b). Males were observed Stage I (9.7%), Stage II (38.2%), Stage III (30.6%), Stage IV (15.3%), and Stage V (6.3%) (Fig 57b). In Area 2, 229 of the 447 females (51.2%) sampled and 214 of 288 males (74.3%) were smaller or equal to the median M_L of 10.0 and 10.0 cm, respectively.

3.14.3 *Doryteuthis gahi* – Patagonian longfin squid – Area 3

The total catch of *D. gahi* in Area 3 was 2,072.540 kg (Table 5) and the total density was 1,545.9 kg/km^2. It was caught at all six stations sampled in Area 3 during this cruise. Of the six stations where *D. gahi* was caught, all stations yielded > 1 kg/km^2, > 10 kg/km^2, and > 100 kg/km^2, and four yielded > 1,000 kg/km^2 (66.7%). The number of squid sampled for length frequency was 658 (411 females and 247 males). Female M_L ranged from 7.0 to 17.5 cm (mean of 11.11 cm) (Fig 56c), whereas males measured between 5.0 and 30.5 cm (mean of 11.91 cm) (Fig 57c). Females were observed Stage II (90.0%), Stage III (6.8%), Stage IV (2.2%), and Stage V (1.0%) (Fig 56c). Males were observed Stage II (17.8%), Stage III (30.8%), Stage IV (33.6%), and Stage V (17.8%) (Fig 57c). In Area 3, 123 of the 411 females (29.9%) sampled and 96 of 247 males (38.9%) were smaller or equal to the median M_L of 10.0 and 10.0 cm, respectively.

3.14.4 *Doryteuthis gahi* – Patagonian longfin squid – Area 4

The total catch of *D. gahi* in Area 4 was 2,261.810 kg (Table 6) and the total density was 491.2 kg/km^2. It was caught at all 21 stations sampled in Area 4 during this cruise. Catches ranged from 7.400 to 736.580 kg and densities from 35.4 to 3,289.8 kg/km^2 (Fig 54). Of the 21 stations where *D. gahi* was caught in Area 4, all stations yielded > 1 kg/km^2 and > 10 kg/km^2, 17 yielded > 100 kg/km^2 (81.0%), and two yielded > 1,000 kg/km^2 (9.5%). The number of squid sampled for length frequency was 2,198 (1,201 females and 997 males). Female M_L ranged from 5.0 to 17.5 cm (mean of 9.19 cm) (Fig 56d), whereas males measured between 5.0 and 22.5 cm (mean of 10.26 cm) (Fig 57d). Females were observed Stage I (2.3%), Stage II (81.0%), Stage III (11.2%), Stage IV (4.2%), and Stage V (1.2%) (Fig 56d). Males were observed Stage I (3.1%), Stage II (26.8%), Stage III (37.8%), Stage IV (23.1%),

and Stage V (9.2%) (Fig 57d). In Area 4, 934 of the 1,201 females (77.8%) sampled and 570 of 997 males (57.2%) were smaller or equal to the median M_L of 10.0 and 10.0 cm, respectively.

3.14.5 *Doryteuthis gahi* – Patagonian longfin squid – Area 5

The total catch of *D. gahi* in Area 5 was 318.760 kg (Table 7) and the total density was 519.1 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 27.240 to 236.800 kg and densities from 136.9 to 1,146.1 kg/km^2 (Fig 54). Of the three stations where *D. gahi* was caught in Area 5, all stations yielded > 1 kg/km^2, > 10 kg/km^2, and > 100 kg/km^2, and one yielded > 1,000 kg/km^2 (33.3%). The number of squid sampled for length frequency was 325 (207 females and 118 males). Female M_L ranged from 6.0 to 26.5 cm (mean of 9.96 cm) (Fig 56e), whereas males measured between 7.5 and 19.0 cm (mean of 11.11 cm) (Fig 57e). Females were observed Stage I (0.5%), Stage II (72.5%), Stage III (22.2%), Stage IV (4.3%), and Stage V (0.5%) (Fig 56e). Males were observed Stage II (19.5%), Stage III (36.4%), Stage IV (38.1%), and Stage V (5.9%) (Fig 57e). In Area 5, 135 of the 207 females (65.2%) sampled and 46 of 118 males (39.0%) were smaller or equal to the median M_L of 10.0 and 10.0 cm, respectively.

3.14.6 *Doryteuthis gahi* – Patagonian longfin squid – Area 6

The total catch of *D. gahi* in Area 6 was 51.905 kg (Table 8) and the total density was 88.3 kg/km^2. It was caught at two of the three stations sampled in Area 6 during this cruise (66.7%). Catches were 12.105 at station 3152 and 39.800 kg at station 3150, with respective densities of 58.7 and 197.2 kg/km^2 (Fig 54). The number of squid sampled for length frequency was 207 (136 females and 71 males). Female M_L ranged from 9.5 to 17.5 cm (mean of 12.37 cm) (Fig 56f), whereas males measured between 9.5 and 20.0 cm (mean of 13.63 cm) (Fig 57f). Females were observed Stage II (60.3%), Stage III (36.8%), and Stage IV (2.9%) (Fig 56f). Males were observed Stage II (4.2%), Stage III (43.7%), Stage IV (46.5%), and Stage V (5.6%) (Fig 57f). In Area 6, 9 of the 136 females (6.6%) sampled and 1 of 71 males (1.4%) were smaller or equal to the median M_L of 10.0 and 10.0 cm, respectively.

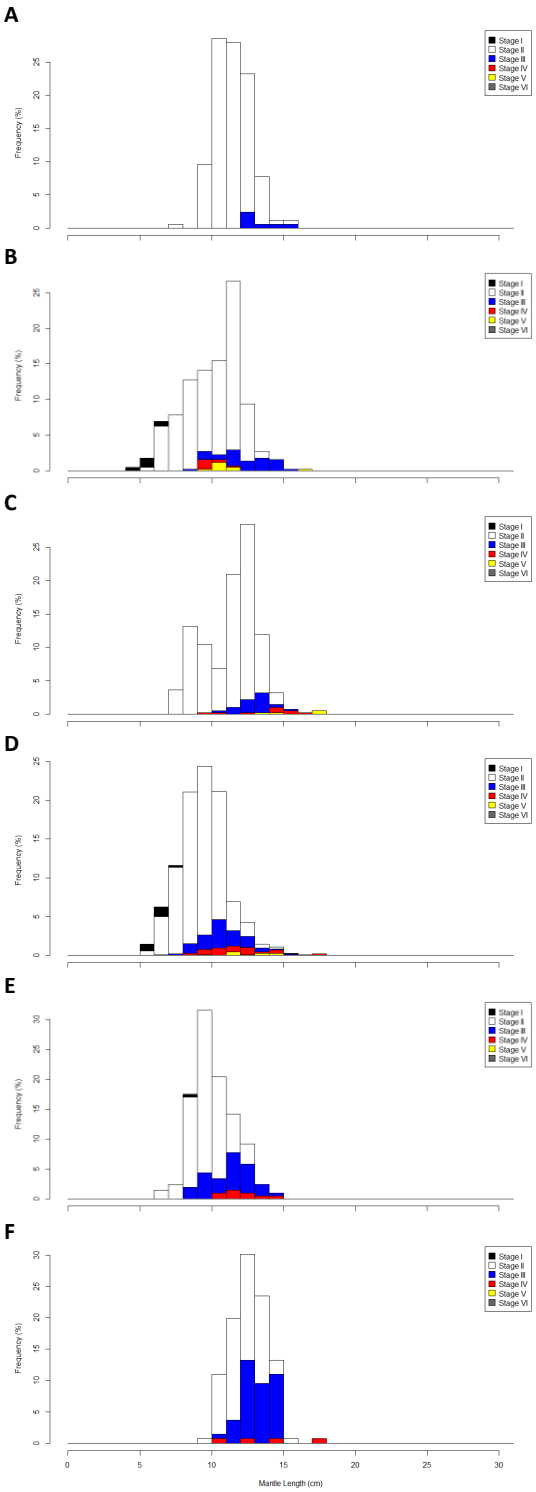

Fig 56. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Doryteuthis gahi* (females) with associated maturity stages (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent) for **(A)** Area 1 (N = 168), **(B)** Area 2 (N = 447), **(C)** Area 3 (N = 411) **(D)** Area 4 (N = 1,201), **(E)** Area 5 (N = 207) **(F)** Area 6 (N = 136).

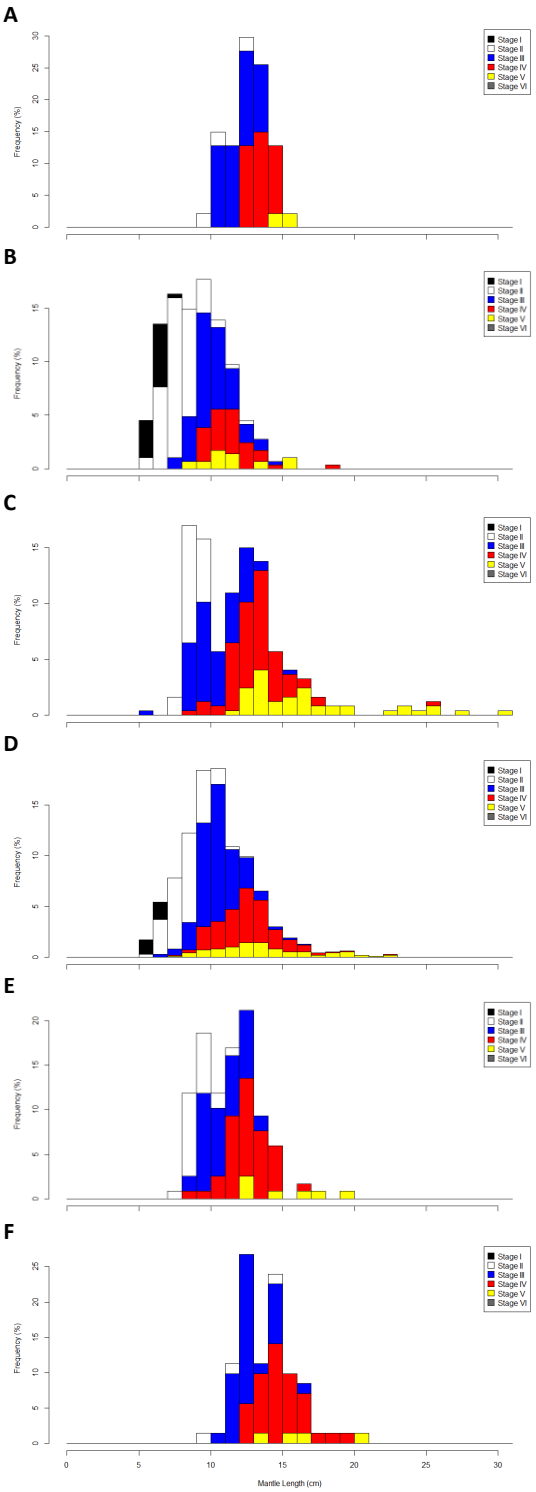

Fig 57. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Doryteuthis gahi* (males) with associated maturity stages (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent) for **(A)** Area 1 (N = 47), **(B)** Area 2 (N = 288), **(C)** Area 3 (N = 247) **(D)** Area 4 (N = 997), **(E)** Area 5 (N = 118) **(F)** Area 6 (N = 71).

3.15 *Patagonotothen ramsayi* – Rock cod (PAR)

The total catch of *P. ramsayi* was 757.072 kg (Table 2). It was caught at 43 of the 45 stations sampled during this cruise (95.6%). Catches ranged from 0.560 to 193.560 kg and densities from 2.4 to 906.5 kg/km^2 (Fig 58a). Of the 43 stations where *P. ramsayi* was caught, all stations yielded > 1 kg/km^2, 33 stations yielded > 10 kg/km^2 (76.7%), eight stations yielded > 100 kg/km^2 (18.6%), and none yielded > 1,000 kg/km^2. Catches of *P. ramsayi* occurred in all six areas sampled during this survey: Area 1 (abundance = 425.5 kg/km^2), Area 2 (abundance = 76.8 kg/km^2), Area 3 (abundance = 69.9 kg/km^2), Area 4 (abundance = 45.9 kg/km^2), Area 5 (abundance = 24.0 kg/km^2), and Area 6 (abundance = 16.9 kg/km^2) (Fig 58a). The number of *P. ramsayi* sampled for otoliths was 295 (range = 0 to 36 per station) (Fig 58b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 164 females (T_L = 7 to 35 cm), 130 males (T_L = 8 to 33 cm), and one juvenile individual (T_L = 7 cm) (Fig 59). The number of fish sampled for length frequency was 2,805 (1,648 females, 1,154 males, and three juvenile individuals). Female T_L ranged from 7 to 35 cm (mean of 19.47 cm) (Fig 60a), whereas males measured between 8 and 33 cm (mean of 19.06 cm) (Fig 60b), and juveniles between 7 and 9 cm (mean of 7.67 cm). The histograms show a distinct mode at 18 cm for both females and males (Fig 60). Females were observed Stage I (3.2%), Stage II (69.5%), Stage III (6.9%), Stage IV (19.7%), and Stage V (0.7%) (Fig 60a). Males were observed Stage I (4.9%), Stage II (78.2%), Stage III (16.6%), and Stage IV (0.3%) (Fig 60b).

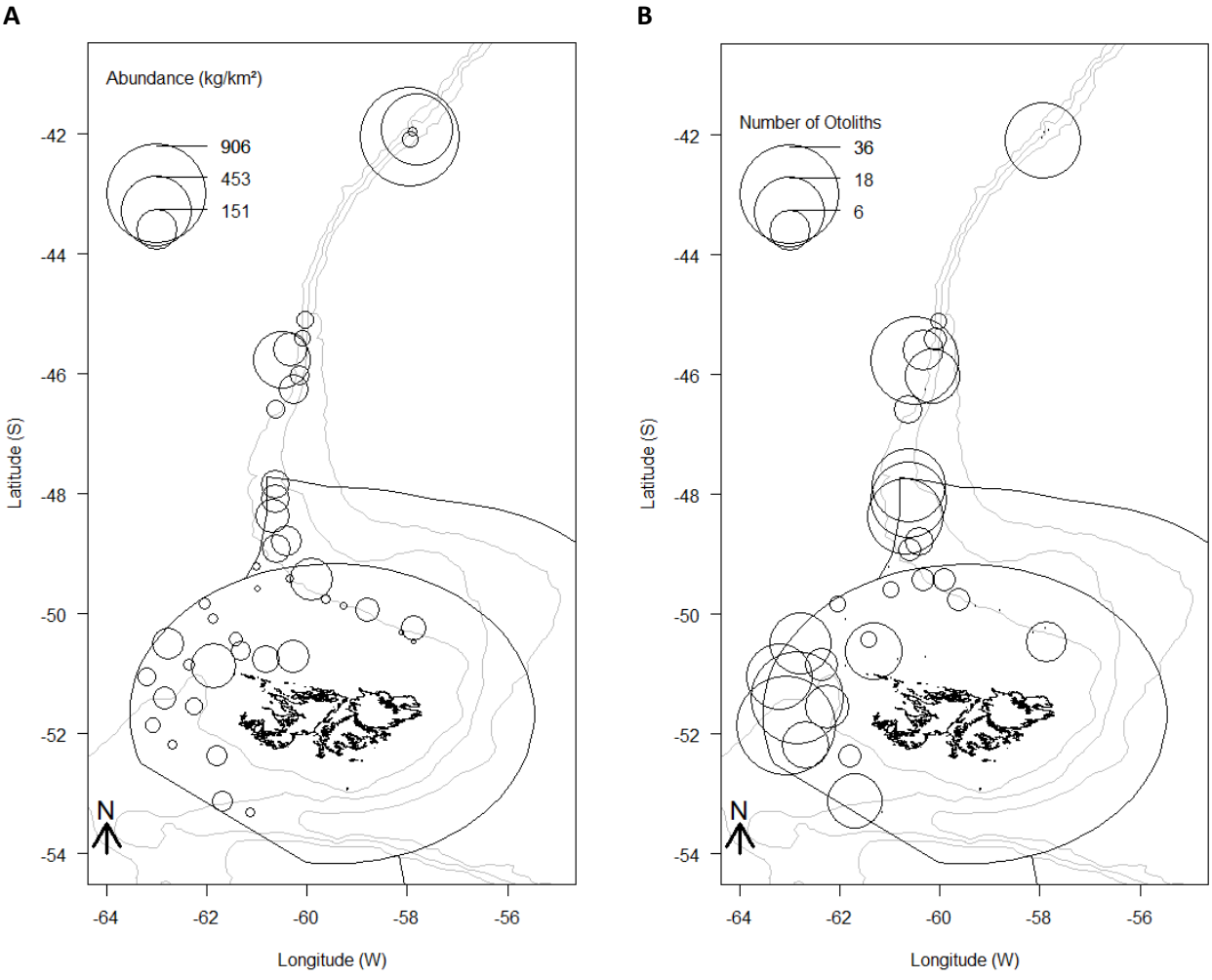

Fig 58. Distribution of (A) densities and (B) otolith samples (N = 295) of *Patagonotothen ramsayi*.

The proportions of individuals smaller than the median T_L of 19 cm for females and 19 cm for males was similar at all depths. In waters shallower than 200 m, 63.6% of the 758 female individuals and 64.4% of the 503 male individuals were smaller than median T_L. In waters between 200 m and 300 m depths, 53.4% of the 421 female individuals and 67.5% of the 317 male individuals were smaller than median T_L. In waters deeper than 300 m, 65.0% of the 469 female individuals and 66.5% of the 334 male individuals were smaller than median T_L. The depth range for this species during the survey was 121 to 626 m. The lack of a trend is an artefact of reverse patterns depending on the sampling area. For instance, most individuals collected on the High Seas are smaller than the median T_L, irrespective of depth.

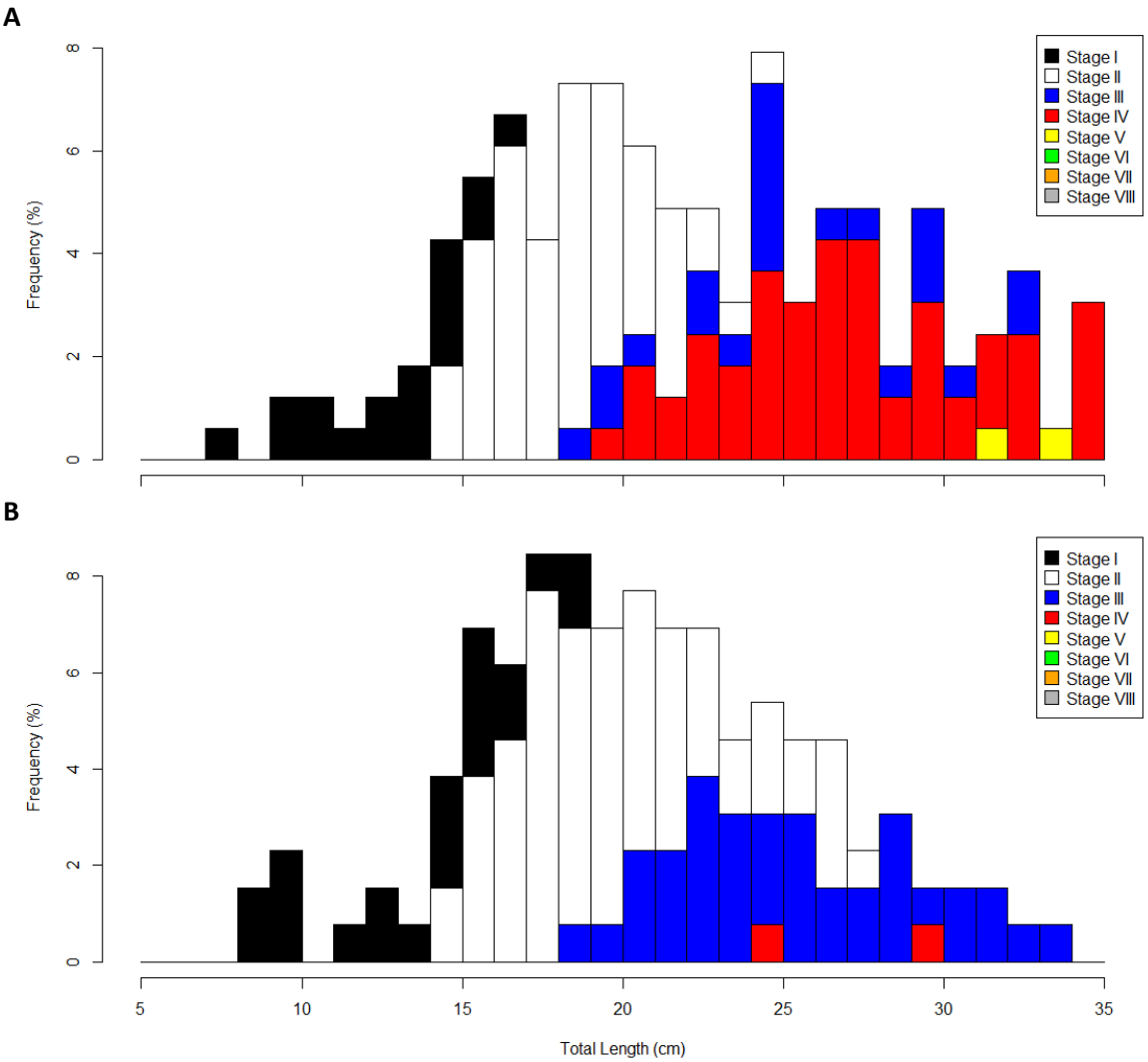

Fig 59. Length frequency (percentage of the total sample collected) of *Patagonotothen ramsayi* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 164) and (B) males (N = 130).

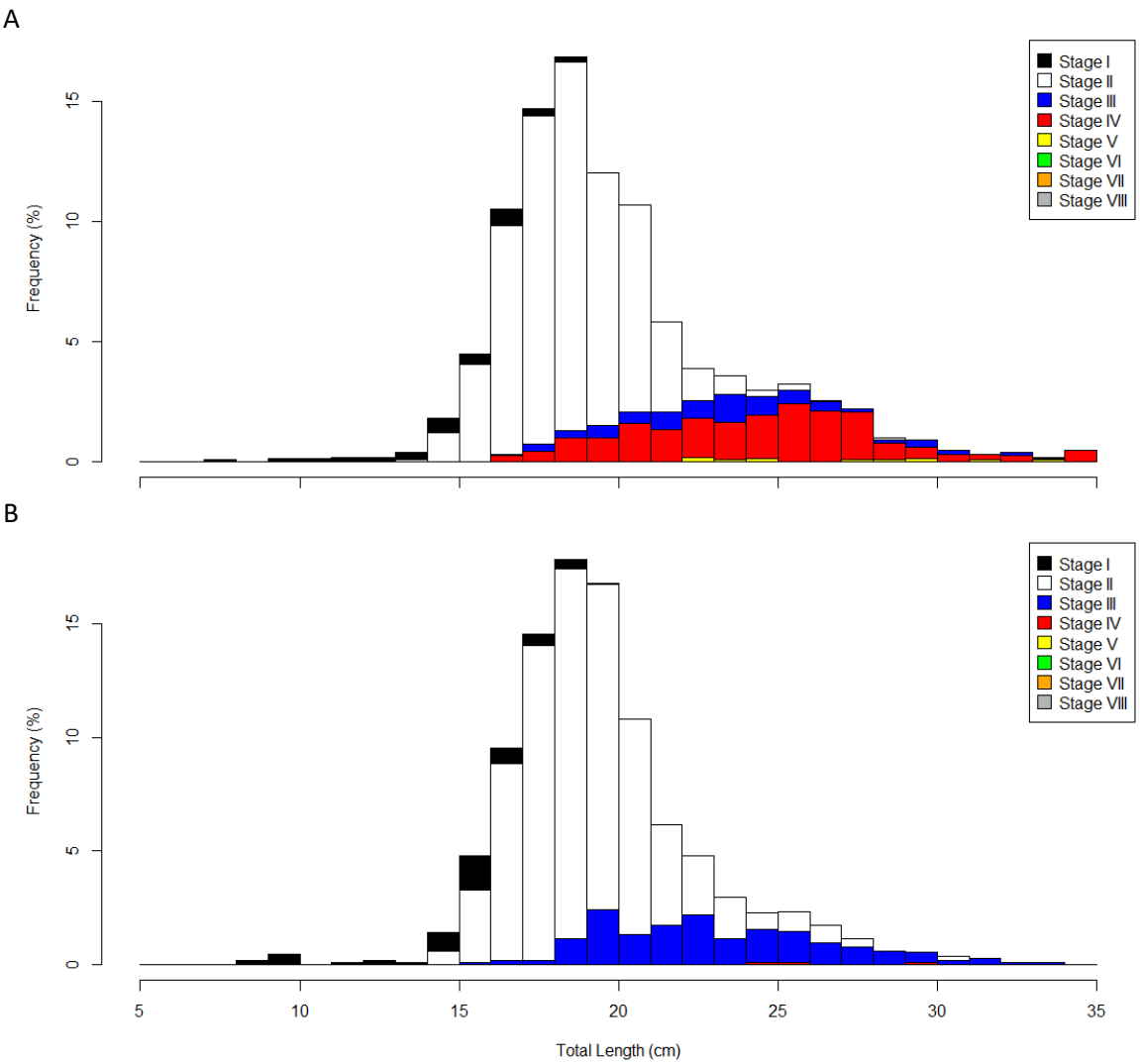

Fig 60. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Patagonotothen ramsayi* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 1,648) and (B) males (N = 1,154).

3.15.1 *Patagonotothen ramsayi* – Rock cod – Area 1

The total catch of *P. ramsayi* in Area 1 was 300.24 kg (Table 3) and the total density was 425.5 kg/km^2. It was caught at four of the four stations sampled in Area 1 during this cruise (Fig 58a). The number of *P. ramsayi* sampled for otoliths was 21 (from a single station) (Fig 58b). Overall, otoliths were collected from 10 females (T_L = 16 to 24 cm) and 11 males (T_L = 15 to 24 cm). The number of fish sampled for length frequency was 262 (143 female and 119 males). Female T_L ranged from 14 to 25 cm (mean of 18.07 cm) (Fig 61a), whereas males measured between 15 and 27 cm (mean of 18.61 cm) (Fig 62a). Females were observed Stage II (97.9%), Stage III (0.7%), and Stage IV (1.4%) (Fig 61a). Males were observed Stage I (2.5%), Stage II (95.0%) and Stage III (2.5%) (Fig 62a). In Area 1, 123 of the 143 female individuals (86.0%) sampled and 92 of 119 males (77.3%) were smaller or equal to the median T_L of 19 and 19 cm, respectively.

3.15.2 *Patagonotothen ramsayi* – Rock cod – Area 2

The total catch of *P. ramsayi* in Area 2 was 127.06 kg (Table 4) and the total density was 76.8 kg/km^2. It was caught at seven of the eight stations sampled in Area 2 during this cruise (87.5%). Catches ranged from 5.44 to 60.90 kg per station, with densities ranging between 25.3 and 295.8 kg/km^2 (Fig 58a). Of the seven stations where *P. ramsayi* was caught, all stations yielded > 1 kg/km^2 and > 10 kg/km^2, and two stations yielded > 100 kg/km^2 (33.3%). The number of *P. ramsayi* sampled for otoliths was 51 (0 to 28 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 28 females (T_L = 9 to 27 cm) and 23 males (T_L = 9 to 26 cm). The number of fish sampled for length frequency was 635 (382 females and 253 males). Female T_L ranged from 9 to 27 cm (mean of 19.10 cm) (Fig 61b), whereas males measured between 9 and 26 cm (mean of 18.95 cm) (Fig 62b). Females were observed Stage I (4.2%), Stage II (88.2%), Stage III (1.0%), and Stage IV (6.5%) (Fig 61b). Males were observed Stage I (6.3%), Stage II (90.1%), and Stage III (3.6%) (Fig 62b). In Area 2, 224 of the 382 female individuals (58.6%) sampled and 157 of 253 males (62.1%) were smaller or equal to the median T_L of 19 and 19 cm, respectively.

3.15.3 *Patagonotothen ramsayi* – Rock cod – Area 3

The total catch of *P. ramsayi* in Area 3 was 93.68 kg (Table 5) and the total density was 69.9 kg/km^2. It was caught at all six stations sampled in Area 3 during this cruise. Catches ranged from 1.64 to 23.52 kg per station, with densities ranging between 6.9 and 107.1 kg/km^2 (Fig 58a). Of the six stations where *P. ramsayi* was caught, all stations yielded > 1 kg/km^2, five stations yielded > 10 kg/km^2 (83.3%), and one station yielded > 100 kg/km^2 (16.7%). The number of *P. ramsayi* sampled for otoliths was 67 (0 to 21 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 34 females (T_L = 13 to 29 cm) and 33 males (T_L = 12 to 32 cm). The number of fish sampled for length frequency was 522 (320 females and 202 males). Female T_L ranged from 13 to 29 cm (mean of 19.21 cm) (Fig 61c), whereas males measured between 12 and 32 cm (mean of 18.32 cm) (Fig 62c). Females were observed Stage I (5.0%), Stage II (67.8%), Stage III (12.8%), Stage IV (14.1%), and Stage V (0.3%) (Fig 61c). Males were observed Stage I (7.4%) Stage II (76.7%), and Stage III (15.8%) (Fig 62c). In Area 3, 201 of the 320 female individuals (62.8%) sampled and 157 of 202 males (77.7%) were smaller or equal to the median T_L of 19 and 19 cm, respectively.

3.15.4 *Patagonotothen ramsayi* – Rock cod – Area 4

The total catch of *P. ramsayi* in Area 4 was 211.39 kg (Table 6) and the total density was 45.9 kg/km^2. It was caught at all 21 stations sampled in Area 4 during this cruise. Catches ranged from 0.56 to 38.76 kg and densities from 2.4 to 188.7 kg/km^2 (Fig 58a). Of the 21 stations where *P. ramsayi* was caught in Area 4, all stations yielded > 1 kg/km^2, 15 stations yielded > 10 kg/km^2 (71.4%), three stations yielded > 100 kg/km^2 (14.3%), and none yielded > 1,000 kg/km^2. The number of *P. ramsayi* sampled for otoliths was 99 (0 to 31 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 55 females (T_L = 7 to 35 cm), 43 males (T_L range = 8 to 33 cm), and a single juvenile (T_L = 7 cm). The number of fish sampled for length frequency was 1,129 (662 females and 467 males). Female T_L ranged from 7 to 35 cm (mean of 19.94 cm) (Fig 61d), whereas males measured between 8 and 33 cm (mean of 19.40 cm) (Fig 62d). Females were observed Stage I (1.7%), Stage II (57.9%), Stage III (8.2%), Stage IV (30.7%), and Stage V (1.7%) (Fig 61d). Males were observed Stage I (1.7%), Stage II (71.9%), Stage III (25.7%), and Stage IV (0.6%) (Fig 62d). In Area 4, 392 of the 662 female individuals (59.2%) sampled and 295 of 467 males (63.2%) were smaller or equal to the median T_L of 19 and 19 cm, respectively.

3.15.5 *Patagonotothen ramsayi* – Rock cod – Area 5

The total catch of *P. ramsayi* in Area 5 was 14.76 kg (Table 7) and the total density was 24.0 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 1.62 to 8.36 kg and densities from 8.1 to 40.5 kg/km^2 (Fig 58a). Of the three stations where *P. ramsayi* was caught in Area 5, all stations yielded > 1 kg/km^2, two stations yielded > 10 kg/km^2 (66.7%), and none > 100 kg/km^2. The number of *P. ramsayi* sampled for otoliths was 46 (2 to 36 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 30 females (T_L = 12 to 35 cm) and 16 males (T_L range = 15 to 26 cm). The number of fish sampled for length frequency was 189 (106 females and 83 males). Female T_L ranged from 12 to 35 cm (mean of 19.37 cm) (Fig 61e), whereas males measured between 14 and 29 cm (mean of 18.77 cm) (Fig 62e). Females were observed Stage I (9.4%), Stage II (54.7%), Stage III (11.3%), and Stage IV (24.5%) (Fig 61e). Males were observed Stage I (18.1%), Stage II (63.9%), and Stage III (18.1%) (Fig 62e). In Area 5, 64 of the 106 female individuals (60.4%) sampled and 53 of 83 males (63.9%) were smaller or equal to the median T_L of 19 and 19 cm, respectively.

3.15.6 *Patagonotothen ramsayi* – Rock cod – Area 6

The total catch of *P. ramsayi* in Area 6 was 9.942 kg (Table 8) and the total density was 16.9 kg/km^2. It was caught at two of the three stations sampled in Area 6 during this cruise (66.7%). Catches were 1.942 kg at station 3152 and 8.000 kg at station 3150, with respective densities 9.4 and 39.6 kg/km^2 (Fig 58a). The number of *P. ramsayi* sampled for otoliths was 11 (collected from station 3150). Overall, otoliths were collected from 7 females (T_L = 15 to 31 cm) and 4 males (T_L range = 18 to 26 cm). The number of fish sampled for length frequency was 65 (35 females and 30 males). Female T_L ranged from 14 to 31 cm (mean of 22.91 cm) (Fig 61f), whereas males measured between 14 and 30 cm (mean of 22.30 cm) (Fig 62f). Females were observed Stage II (28.6%), Stage III (5.7%), and Stage IV (65.7%) (Fig 61f). Males were observed Stage II (60.0%), and Stage III (40.0%) (Fig 62f). In Area 6, 8 of the 35 female individuals (22.9%) sampled and 6 of 30 males (20.0%) were smaller or equal to the median T_L of 19 and 19 cm, respectively.

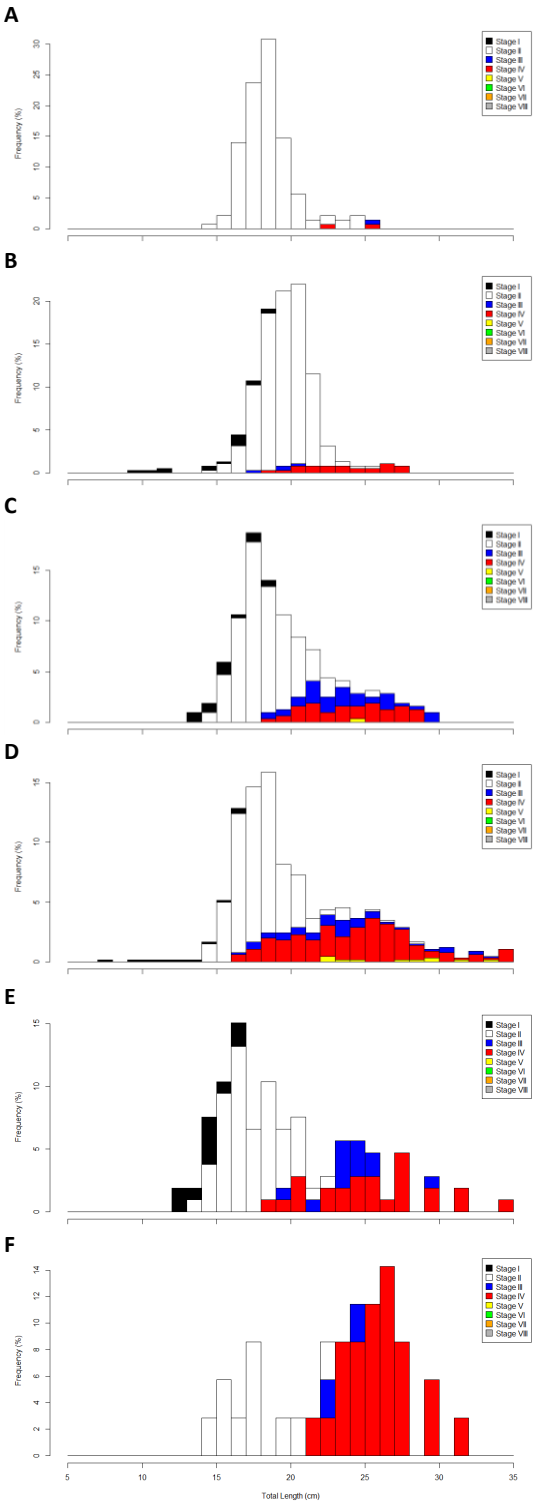

Fig 61. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Patagonotothen ramsayi* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 143), **(B)** Area 2 (N = 382), **(C)** Area 3 (N = 320), **(D)** Area 4 (N = 662), **(E)** Area 5 (N = 106), **(F)** Area 5 (N = 35).

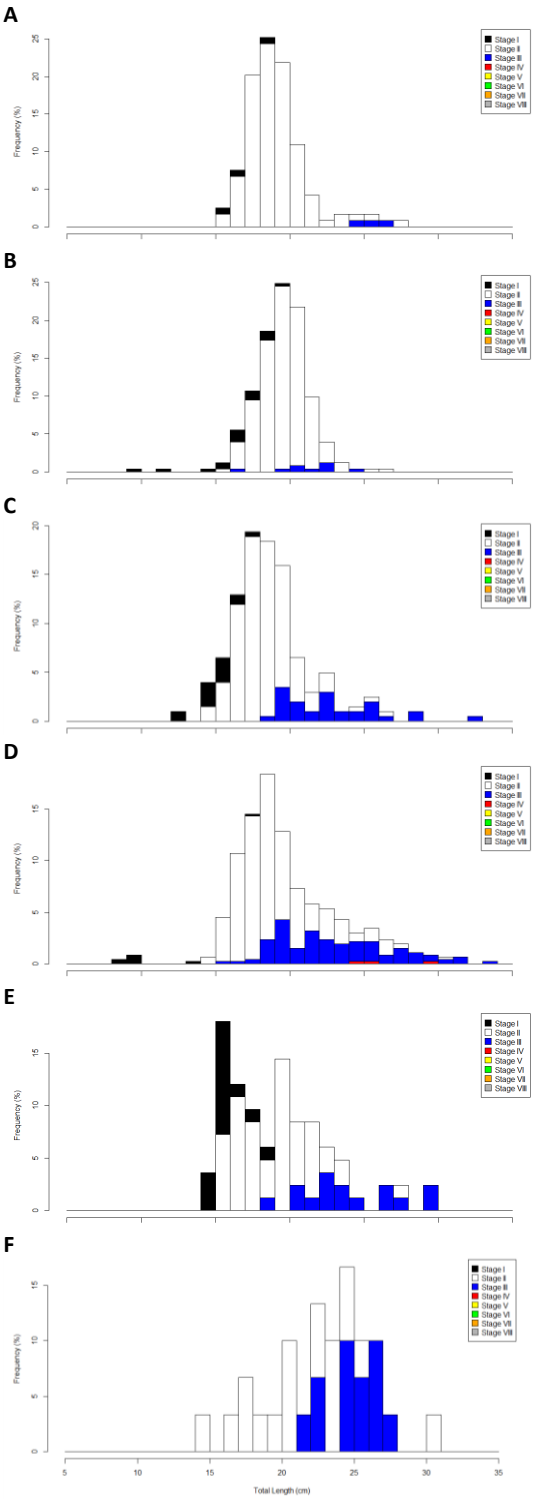

Fig 62. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Patagonotothen ramsayi* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 119), **(B)** Area 2 (N = 253), **(C)** Area 3 (N = 202), **(D)** Area 4 (N = 467), **(E)** Area 5 (N = 83), **(F)** Area 5 (N = 30).

3.16 *Bathyraja albomaculata* – White-spotted skate (RAL)

The total catch of *B. albomaculata* was 69.832 kg (Table 2). It was caught at 20 of the 45 stations sampled during this cruise (44.4%). Catches ranged from 0.024 to 12.880 kg and densities from 0.1 to 59.7 kg/km^2 (Fig 63). Of the 20 stations where *B. albomaculata* was caught, 17 stations yielded > 1 kg/km^2 (85.0%), 12 stations yielded > 10 kg/km^2 (60.0%), and none yielded > 100 kg/km^2. Catches of *B. albomaculata* occurred in all six areas sampled during this survey: Area 1 (abundance = 6.3 kg/km^2), Area 2 (abundance = 1.1 kg/km^2), Area 3 (abundance = 25.2 kg/km^2), Area 4 (abundance = 2.7 kg/km^2), Area 5 (abundance = 17.3 kg/km^2), and Area 6 (abundance = 11.1 kg/km^2) (Fig 63). The number of skates sampled for length frequency was 46 (22 females and 24 males). Female D_W ranged from 14 to 48 cm (mean of 37.14 cm) (Fig 64a), whereas males measured between 14 and 47 cm (mean of 37.83 cm) (Fig 64b). Females were observed Stage I (13.6%), Stage II (45.5%), Stage III (13.6%), Stage IV (9.1%), Stage V (4.5%), and Stage VI (13.6%) (Fig 64a). Males were observed Stage I (4.2%), Stage II (16.7%), Stage III (16.7%), Stage IV (29.2%), and Stage V (33.3%) (Fig 64b). The depth distribution of *B. albomaculata* during the survey was 131 to 728 m.

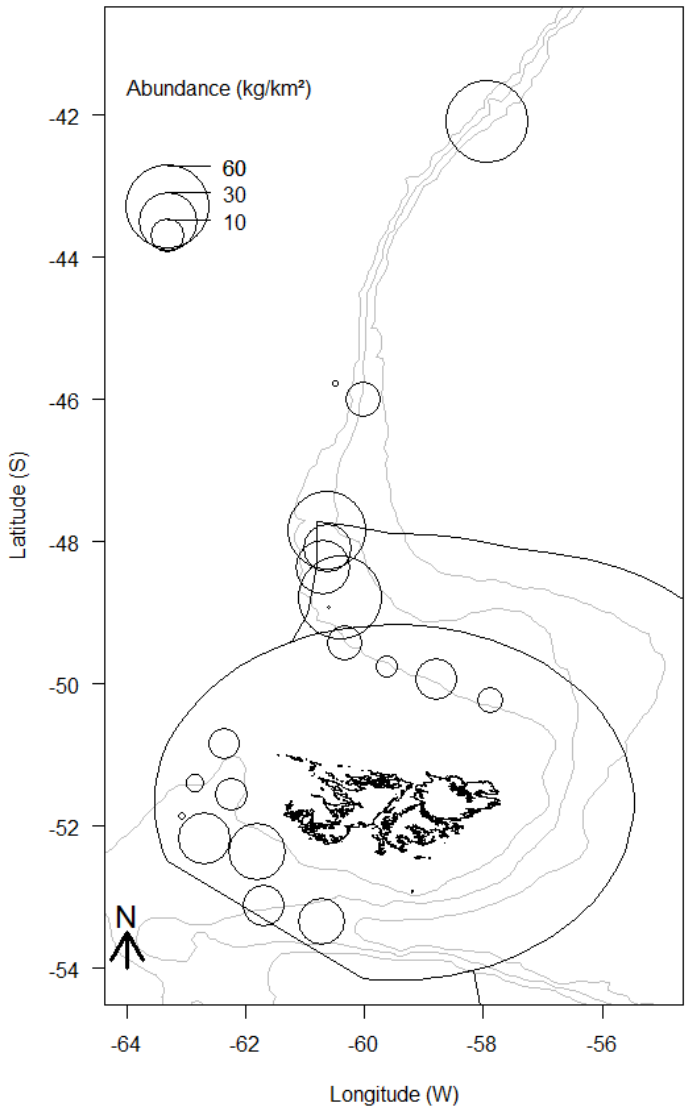

Fig 63. Distribution of densities of *Bathyraja albomaculata*.

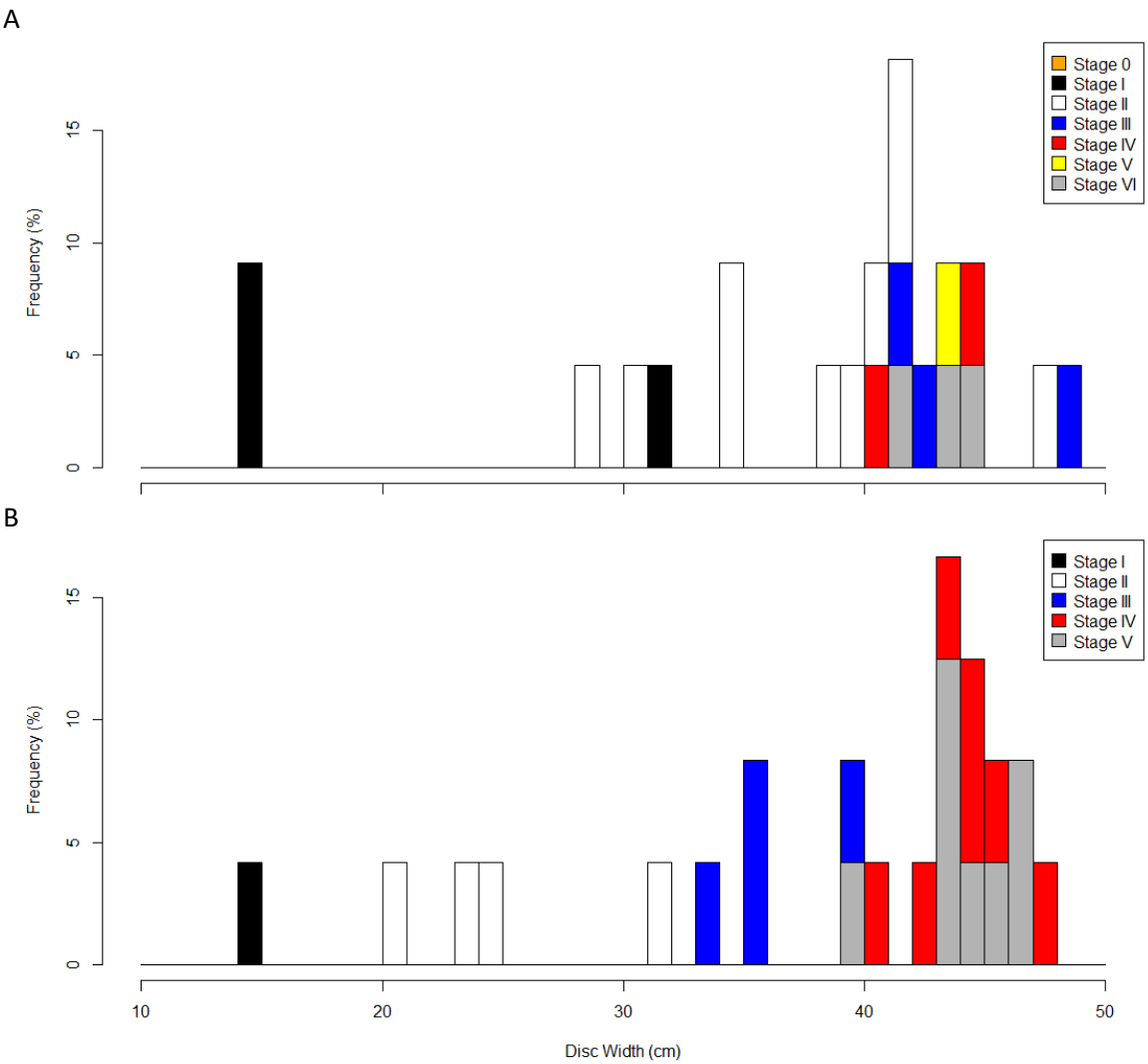

Fig 64. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Bathyraja albomaculata* with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for (A) females (N = 22) and (B) males (N = 24).

The proportions of individuals smaller than the median D_W of 40 cm for females and 42 cm for males was greatest in shallower waters. In waters shallower than 200 m, both female individuals were smaller than the median D_W, whereas the lone male sampled was wider than the median D_W. In waters between 200 m and 300 m depths, 83.3% of the 6 female individuals and 60.0% of the 10 male individuals were smaller than median D_W. In waters deeper than 300 m, 28.6% of the 18 female individuals and 46.2% of the 13 male individuals were smaller than median D_W. The depth range for this species during the survey was 131 to 728 m.

3.16.1 *Bathyraja albomaculata* – White-spotted skate – Area 1

The total catch of *B. albomaculata* was 4.48 kg (Table 3). It was caught at one of the four stations sampled during this cruise (25.0%). The density was 6.3 kg/km^2 (Fig 63). The number of skates sampled for length frequency was 2 (1 female and 1 male). Female D_W was 44 cm (maturity Stage IV), whereas the lone male measured 47 cm (maturity Stage IV). In Area 1, neither of the lone female nor the lone male sampled was smaller or equal to the median D_W of 40 and 42 cm, respectively.

3.16.2 *Bathyraja albomaculata* – White-spotted skate – Area 2

The total catch of *B. albomaculata* was 1.808 kg (Table 4). It was caught at two of the eight stations sampled during this cruise (25.0%). The density was 1.1 kg/km^2 (Fig 63). The number of skates sampled for length frequency was 2 (both females). Female D_W was 14 and 41 cm. Females were observed Stage I (50.0%) and Stage II (50.0%). In Area 2, 1 of the 2 female individuals (50.0%) sampled was smaller or equal to the median D_W of 40 cm. No males were sampled from this area.

3.16.3 *Bathyraja albomaculata* – White-spotted skate – Area 3

The total catch of *B. albomaculata* was 33.804 kg (Table 5). It was caught at five of the six stations sampled during this cruise in Area 3 (83.3%). Catches ranged from 0.024 to 12.880 kg and densities from 0.1 to 59.7 kg/km^2 (Fig 63). Of the five stations where *B. albomaculata* was caught, four stations yielded > 1 kg/km^2 and > 10 kg/km^2 (80.0%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 23 (8 females and 15 males). Female D_W ranged from 14 to 47 cm (mean = 36.62 cm), whereas males measured between 14 and 46 cm (mean 36.73 cm). Females were observed Stage I (12.5%), Stage II (62.5%), Stage V (12.5%), and Stage VI (12.5%). Males were observed Stage I (6.7%), Stage II (20.0%), Stage III (13.3%), Stage IV (26.7%), and Stage V (33.3%). In Area 3, 4 of the 8 female individuals (50.0%) sampled and 8 of the 15 males (53.3%) were smaller or equal to the median D_W of 40 and 42 cm, respectively.

3.16.4 *Bathyraja albomaculata* – White-spotted skate – Area 4

The total catch of *B. albomaculata* was 12.60 kg (Table 6). It was caught at seven of the 21 stations sampled during this cruise in Area 4 (33.3%). Catches ranged from 0.58 to 3.30 kg and densities from 2.7 to 14.7 kg/km^2 (Fig 63). Of the seven stations where *B. albomaculata* was caught, all stations yielded > 1 kg/km^2, two stations yielded > 10 kg/km^2 (28.6%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 9 (3 females and 6 males). Female D_W ranged from 28 to 40 cm (mean = 35.33 cm), whereas males measured between 20 and 45 cm (mean 36.50 cm). Females were observed Stage II (66.7%) and Stage IV (33.3%). Males were observed Stage II (16.7%), Stage III (33.3%), Stage IV (33.3%), and Stage V (16.7%). In Area 4, all 3 female individuals sampled and 4 of the 6 males (66.7%) were smaller or equal to the median D_W of 40 and 42 cm, respectively.

3.16.5 *Bathyraja albomaculata* – White-spotted skate – Area 5

The total catch of *B. albomaculata* was 10.62 kg (Table 7). It was caught at all three stations sampled during this cruise in Area 5. Catches ranged from 0.10 to 5.90 kg and densities from 0.5 to 28.6 kg/km^2 (Fig 63). Of the three stations where *B. albomaculata* was caught, two stations yielded > 1 kg/km^2 and > 10 kg/km^2 (66.7%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 7 (5 females and 2 males). Female D_W ranged from 31 to 43 cm (mean = 38.00 cm), whereas males measured 45 and 46 cm, respectively. Females were observed Stage I (20.0%), Stage II (20.0%), Stage III (20.0%), and Stage VI (40.0%). Both males were observed Stage V. In Area 5, 2 of the 5 female individuals (40.0%) sampled and none of the 2 males were smaller or equal to the median D_W of 40 and 42 cm, respectively.

3.16.6 *Bathyraja albomaculata* – White-spotted skate – Area 6

The total catch of *B. albomaculata* was 6.52 kg (Table 8). It was caught at two of the three stations sampled during this cruise in Area 6 (66.7%). Catches were 3.02 kg at station 3150 and 3.50 kg at station 3153, with respective densities of 15.0 and 19.5 kg/km^2 (Fig 63). The number of skates sampled for length frequency was 3 (all females). Female D_W ranged from 39 to 48 cm (mean = 43.0 cm). Females were observed Stage II (33.3%) and Stage III (66.7%). In Area 6, 1 of the 3 female individuals (33.3%) sampled was smaller or equal to the median D_W of 40 cm. No males were sampled from this area.

3.17 *Bathyraja brachyurops* – Blonde skate (RBR)

The total catch of *B. brachyurops* was 204.12 kg (Table 2). It was caught at 25 of the 45 stations sampled during this cruise (55.6%). Catches ranged from 0.08 to 44.70 kg and densities from 0.4 to 203.6 kg/km^2 (Fig 65). Of the 25 stations where *B. brachyurops* was caught, 23 stations yielded > 1 kg/km^2 (92.0%), 18 stations yielded > 10 kg/km^2 (72.0%), and three yielded > 100 kg/km^2 (12.0%). Catches of *B. brachyurops* occurred in five of the six areas sampled during this survey: Area 1 (abundance = 22.9 kg/km^2), Area 2 (abundance = 1.2 kg/km^2), Area 3 (abundance = 72.1 kg/km^2), Area 4 (abundance = 14.2 kg/km^2), and Area 5 (abundance = 39.1 kg/km^2) (Fig 65). The number of skates sampled for length frequency was 111 (70 females and 41 males). Female D_W ranged from 18 to 68 cm (mean of 43.59 cm) (Fig 66a), whereas males measured between 15 and 58 cm (mean of 40.12 cm) (Fig 66b). Females were observed Stage I (2.9%), Stage II (74.3%), Stage III (7.1%), Stage IV (10.0%), Stage V (1.4%), and Stage VI (4.3%) (Fig 66a). Males were observed Stage I (9.8%), Stage II (48.8%), Stage III (14.6%), Stage IV (19.5%), and Stage V (7.3%) (Fig 66b).

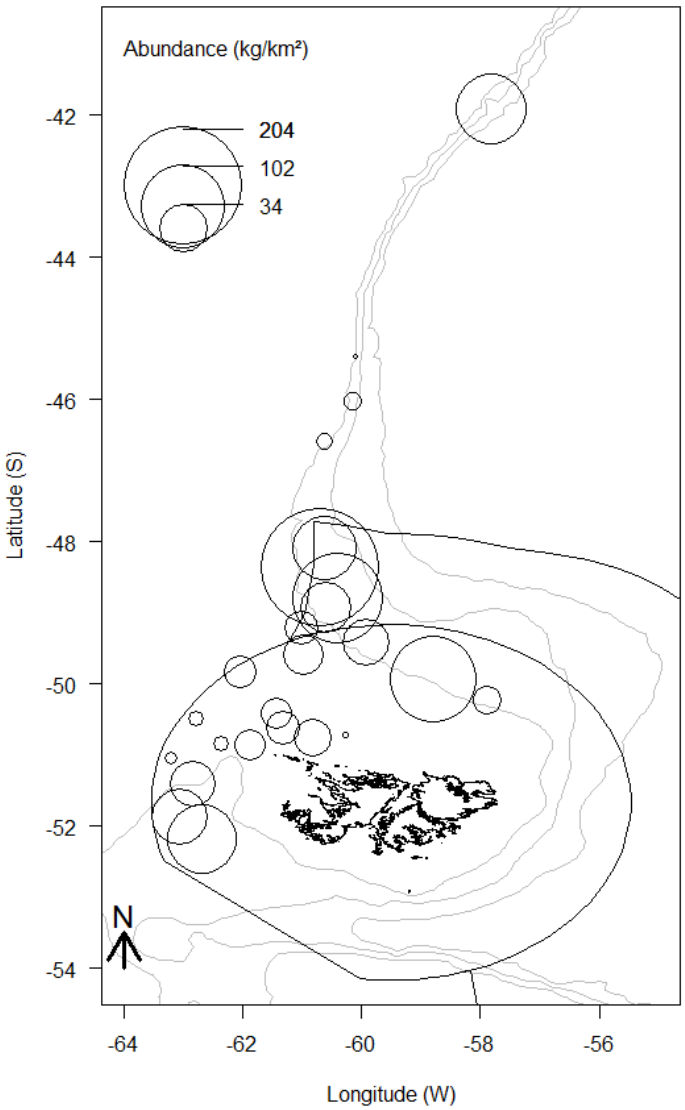

Fig 65. Distribution of densities of *Bathyraja brachyurops*.

The proportions of individuals smaller than the median D_W of 43 cm for females and 39 cm for males was greatest in shallower waters. In waters shallower than 200 m, 16 of the 20 female (80.0%) individuals and 7 of the 9 males (77.8%) were smaller than the median D_W, respectively. In waters between 200 m and 300 m depths, 48.4% of the 31 female individuals and 37.0% of the 27 male individuals were smaller than median D_W. In waters deeper than 300 m, 26.3% of the 19 female individuals and 80.0% of the 5 male individuals were smaller than median D_W. The depth range for this species during the survey was 132 to 425 m.

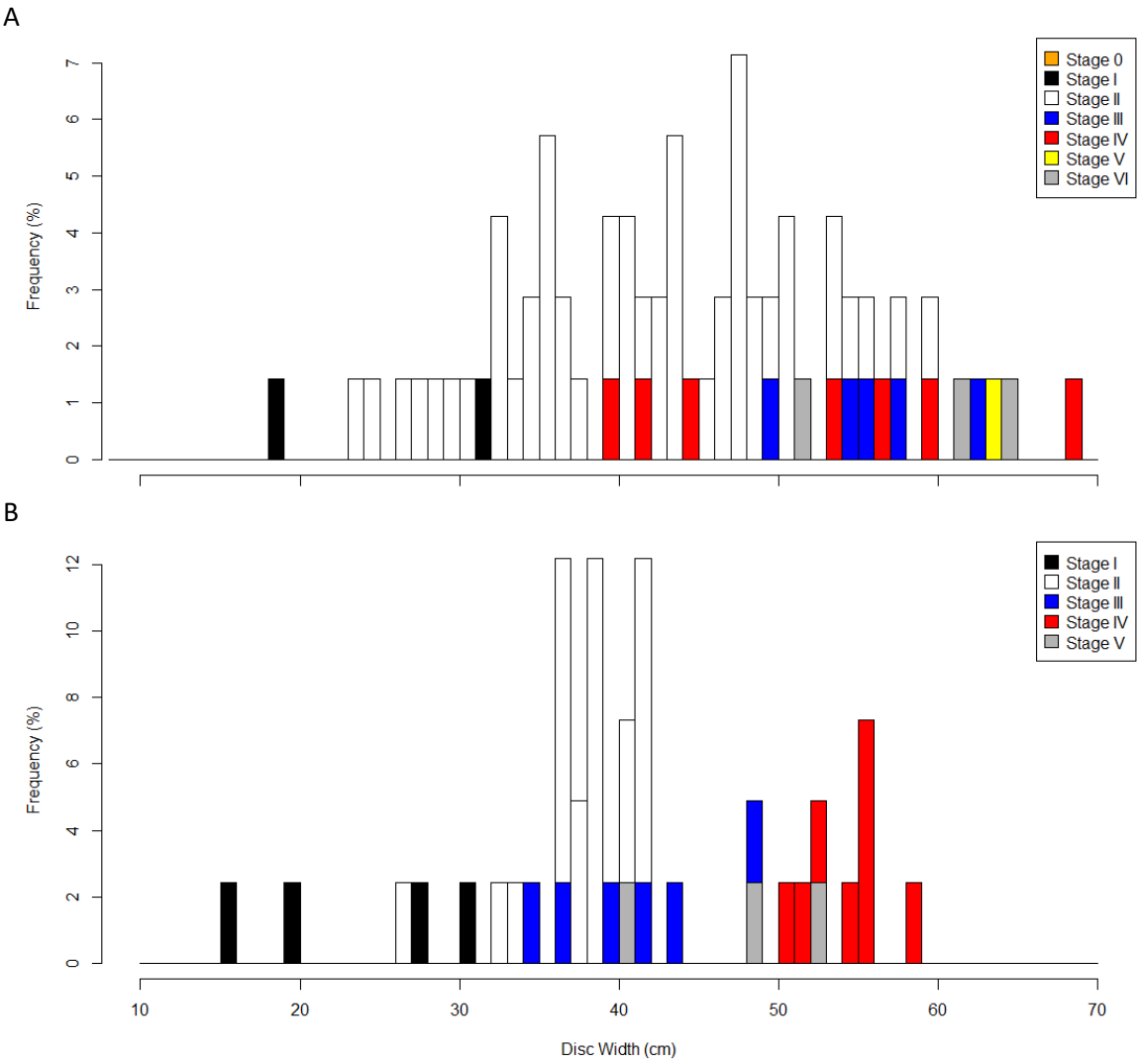

Fig 66. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Bathyraja brachyurops* with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for (A) females (N = 70) and (B) males (N = 41).

3.17.1 *Bathyraja brachyurops* – Blonde skate – Area 1

The total catch of *B. brachyurops* was 16.14 kg (Table 3). It was caught at one of the four stations sampled during this cruise (25.0%). The density was 22.9 kg/km^2 (Fig 65). The number of skates sampled for length frequency was 5 (4 female and 1 male). Female D_W ranged from 35 to 59 cm (mean = 49.50 cm), whereas the lone male measured 55 cm (maturity Stage IV). Females were observed Stage II (50.0%), Stage III (25.0%), and Stage IV (25.0%). In Area 1, 1 of the 4 female individuals (25.0%) sampled was smaller or equal to the median D_W of 43 cm. The lone male sampled from this area was wider than the median D_W of 39 cm.

3.17.2 *Bathyraja brachyurops* – Blonde skate – Area 2

The total catch of *B. brachyurops* was 1.94 kg (Table 4). It was caught at three of the eight stations sampled during this cruise (37.5%). Catches ranged from 0.08 to 1.02 kg and densities from 0.4 to 4.3 kg/km^2 (Fig 65). The number of skates sampled for length frequency was 3 (1 female and 2 males). Female D_W was 34 cm (maturity Stage II), whereas males measured 15 and 38 cm, respectively. Males were observed Stage I (50.0%) and Stage II (50.0%). In Area 2, the lone female and both males sampled were smaller or equal to the median D_W of 43 and 39 cm, respectively.

3.17.3 *Bathyraja brachyurops* – Blonde skate – Area 3

The total catch of *B. brachyurops* was 96.62 kg (Table 5). It was caught at five of the six stations sampled during this cruise in Area 3 (83.3%). Catches ranged from 4.02 to 44.70 kg and densities from 17.0 to 203.6 kg/km^2 (Fig 65). Of the five stations where *B. brachyurops* was caught, all stations yielded > 1 kg/km^2 and > 10 kg/km^2, and two yielded > 100 kg/km^2 (40.0%). The number of skates sampled for length frequency was 47 (29 females and 18 males). Female D_W ranged from 18 to 68 cm (mean = 48.03 cm), whereas males measured between 27 and 55 cm (mean 37.94 cm). Females were observed Stage I (3.4%), Stage II (79.3%), Stage III (6.9%), Stage IV (6.9%), and Stage VI (3.4%). Males were observed Stage I (11.1%), Stage II (77.8%), Stage III (5.6%), and Stage IV (5.6%). In Area 3, 10 of the 29 female individuals (34.5%) sampled and 12 of the 18 males (66.7%) were smaller or equal to the median D_W of 43 and 39 cm, respectively.

3.17.4 *Bathyraja brachyurops* – Blonde skate – Area 4

The total catch of *B. brachyurops* was 65.42 kg (Table 6). It was caught at 14 of the 21 stations sampled during this cruise in Area 4 (66.7%). Catches ranged from 0.14 to 24.34 kg and densities from 0.6 to 108.4 kg/km^2 (Fig 65). Of the 14 stations where *B. brachyurops* was caught, 13 stations yielded > 1 kg/km^2 (92.9%), ten stations yielded > 10 kg/km^2 (71.4%), and one yielded > 100 kg/km^2 (7.1%). The number of skates sampled for length frequency was 45 (29 females and 16 males). Female D_W ranged from 23 to 64 cm (mean = 37.69 cm), whereas males measured between 19 and 58 cm (mean 41.62 cm). Females were observed Stage I (3.4%), Stage II (69.0%), Stage III (6.9%), Stage IV (13.8%), and Stage VI (6.9%). Males were observed Stage I (6.3%), Stage II (25.0%), Stage III (25.0%), Stage IV (25.0%), and Stage IV (18.8%). In Area 4, 22 of the 29 female individuals (75.9%) sampled and 7 of the 16 males (43.8%) were smaller or equal to the median D_W of 43 and 39 cm, respectively.

3.17.5 *Bathyraja brachyurops* – Blonde skate – Area 5

The total catch of *B. brachyurops* was 24.00 kg (Table 7). It was caught at two of the three stations sampled during this cruise in Area 5 (66.7%). Catches were 9.82 kg at station 3157 and 14.18 kg at station 3156, with respective densities of 47.1 and 71.3 kg/km^2 (Fig 65). The number of skates sampled for length frequency was 11 (7 females and 4 males). Female D_W ranged from 39 to 63 cm (mean = 47.57 cm), whereas males measured between 40 and 54 cm (mean 47.00 cm). Females were observed Stage II (85.7%) and Stage V (14.3%). Males were observed Stage II (25.0%), Stage III (25.0%), and Stage IV (50.0%). In Area 5, 2 of the 7 female individuals (28.6%) sampled and none of the 4 males were smaller or equal to the median D_W of 43 and 39 cm, respectively.

3.17.6 *Bathyraja brachyurops* – Blonde skate – Area 6

No *B. brachyurops* was caught in Area 6.

3.18 *Bathyraja cousseauae* – Joined-fin skate (RBZ)

The total catch of *B. cousseauae* was 14.80kg (Table 2). It was caught at four of the 45 stations sampled during this cruise (8.9%). Catches ranged from 1.80 to 7.40 kg and densities from 8.7 to 45.0 kg/km^2 (Fig 67). Of the four stations where *B. cousseauae* was caught, all stations yielded > 1 kg/km^2, three stations yielded > 10 kg/km^2 (75.0%), and none yielded > 100 kg/km^2. Catches of *B. cousseauae* occurred in four of the six areas sampled during this survey: Area 1 (abundance = 5.0 kg/km^2), Area 2 (abundance = 1.3 kg/km^2), Area 3 (abundance = 5.5 kg/km^2), and Area 5 (abundance = 2.9 kg/km^2) (Fig 67). The number of skates sampled for length frequency was 5 (2 females and 3 males). Female D_W was 36 and 38 cm, respectively, whereas males measured between 47 and 71 cm (mean of 57.67 cm). Females were observed Stage I (50.0%) and Stage II (50.0%). Males were observed Stage I (33.3%), Stage II (33.3%), and Stage IV (33.3%). The depth distribution for this species during the survey was 323 to 616 m.

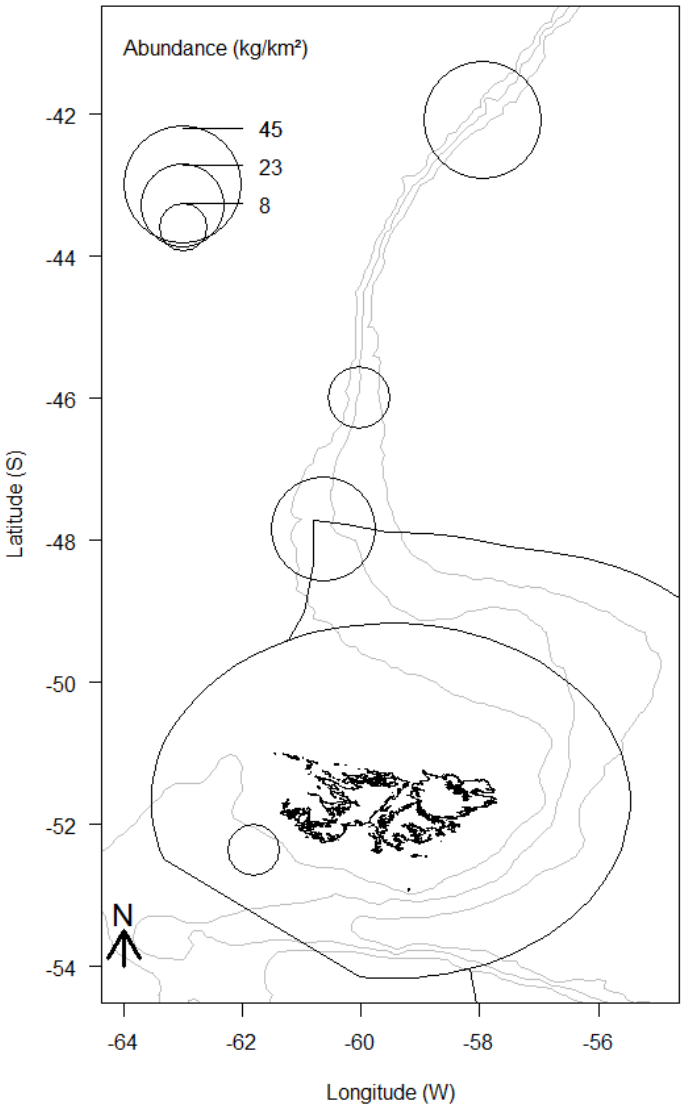

Fig 67. Distribution of densities of *Bathyraja cousseauae*.

3.19 *Zearaja argentinensis* – Argentine black skate (RDA)

The total catch of *Z. argentinensis* was 2.28kg (Table 2). It was caught at two of the 45 stations sampled during this cruise (4.4%). Catches were 1.32 kg at station 3200 and 3.24 kg at station 3175, with respective densities of 6.1 and 14.6 kg/km^2 (Fig 68). Catches of *Z. argentinensis* occurred in a single of the six areas sampled during this survey: Area 3 (abundance = 3.3 kg/km^2) (Fig 68). The number of skates sampled for length frequency was 2 (1 female and 1 male). Female D_W was 48 and, whereas male D_W was 63 cm. The single observed female was Stage I. The lone male was observed Stage I. This species was recovered at 302 and 355 m depths.

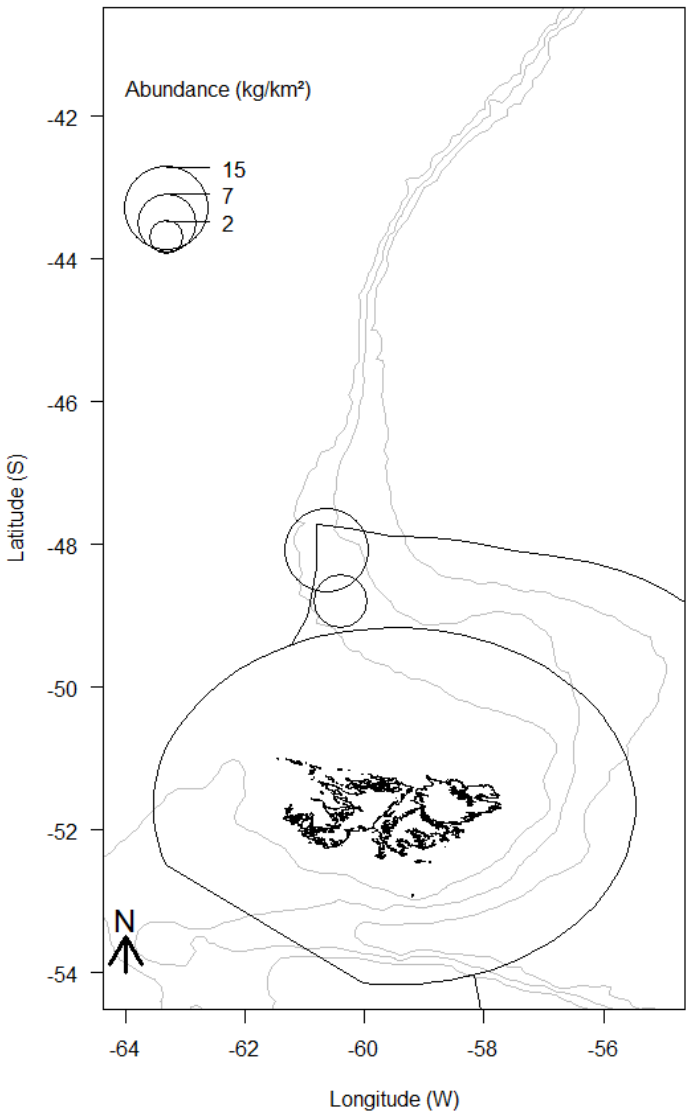

Fig 68. Distribution of densities of *Zearaja argentinensis*.

3.20 *Amblyraja doellojuradoi* – Starry skate (RDO)

The total catch of *A. doellojuradoi* was 27.556 kg (Table 2). It was caught at 14 of the 45 stations sampled during this cruise (31.1%). Catches ranged from 0.016 to 6.020 kg and densities from < 0.1 to 29.8 kg/km^2 (Fig 69). Of the 14 stations where *A. doellojuradoi* was caught, 12 stations yielded > 1 kg/km^2 (85.7%), four stations yielded > 10 kg/km^2 (28.6%), and none yielded > 100 kg/km^2. Catches of *A. doellojuradoi* occurred in all six areas sampled during this survey: Area 1 (abundance = 0.4 kg/km^2), Area 2 (abundance = 6.0 kg/km^2), Area 3 (abundance = 7.4 kg/km^2), Area 4 (abundance = 1.4 kg/km^2), Area 5 (abundance = 0.2 kg/km^2), and Area 6 (abundance = 1.7 kg/km^2) (Fig 69). The number of skates sampled for length frequency was 67 (31 females and 36 males). Female D_W ranged from 7 to 35 cm (mean of 22.97 cm) (Fig 70a), whereas males measured between 11 and 37 cm (mean of 24.19 cm) (Fig 70b). Females were observed Stage I (35.4%), Stage II (32.3%), Stage III (25.8%), Stage IV (3.2%), and Stage V (3.2%) (Fig 70a). Males were observed Stage I (52.8%), Stage II (5.6%), Stage III (19.4%), Stage IV (11.1%), and Stage V (11.1%) (Fig 70b). The depth distribution for this species during the survey was 157 to 616 m.

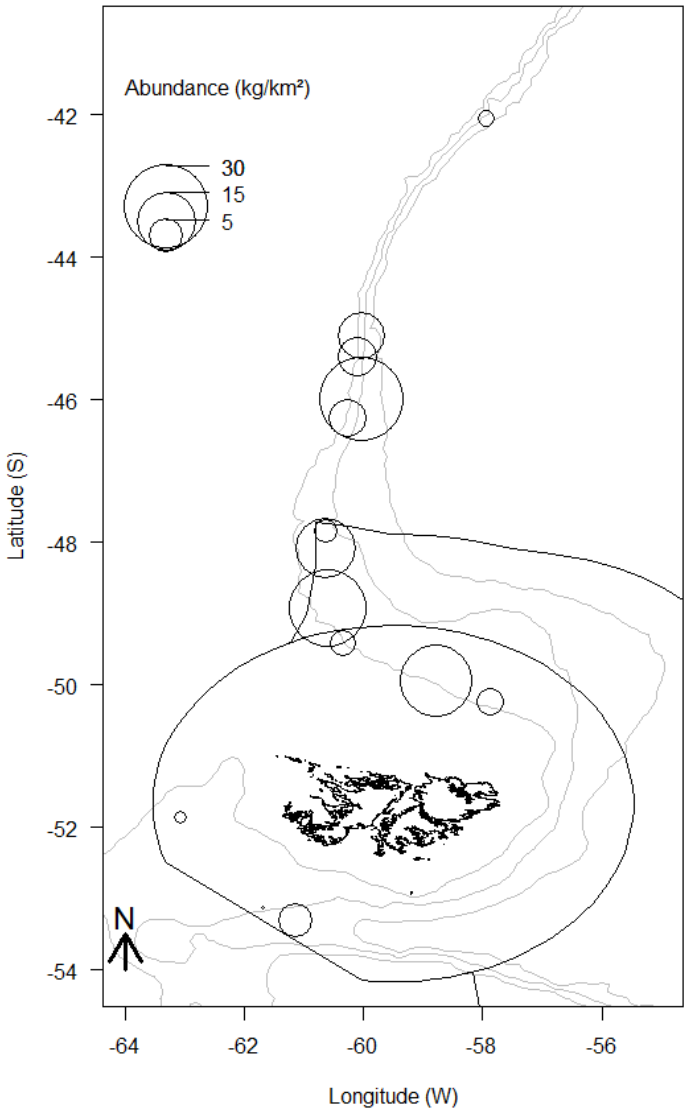

Fig 69. Distribution of densities of *Amblyraja doellojuradoi*.

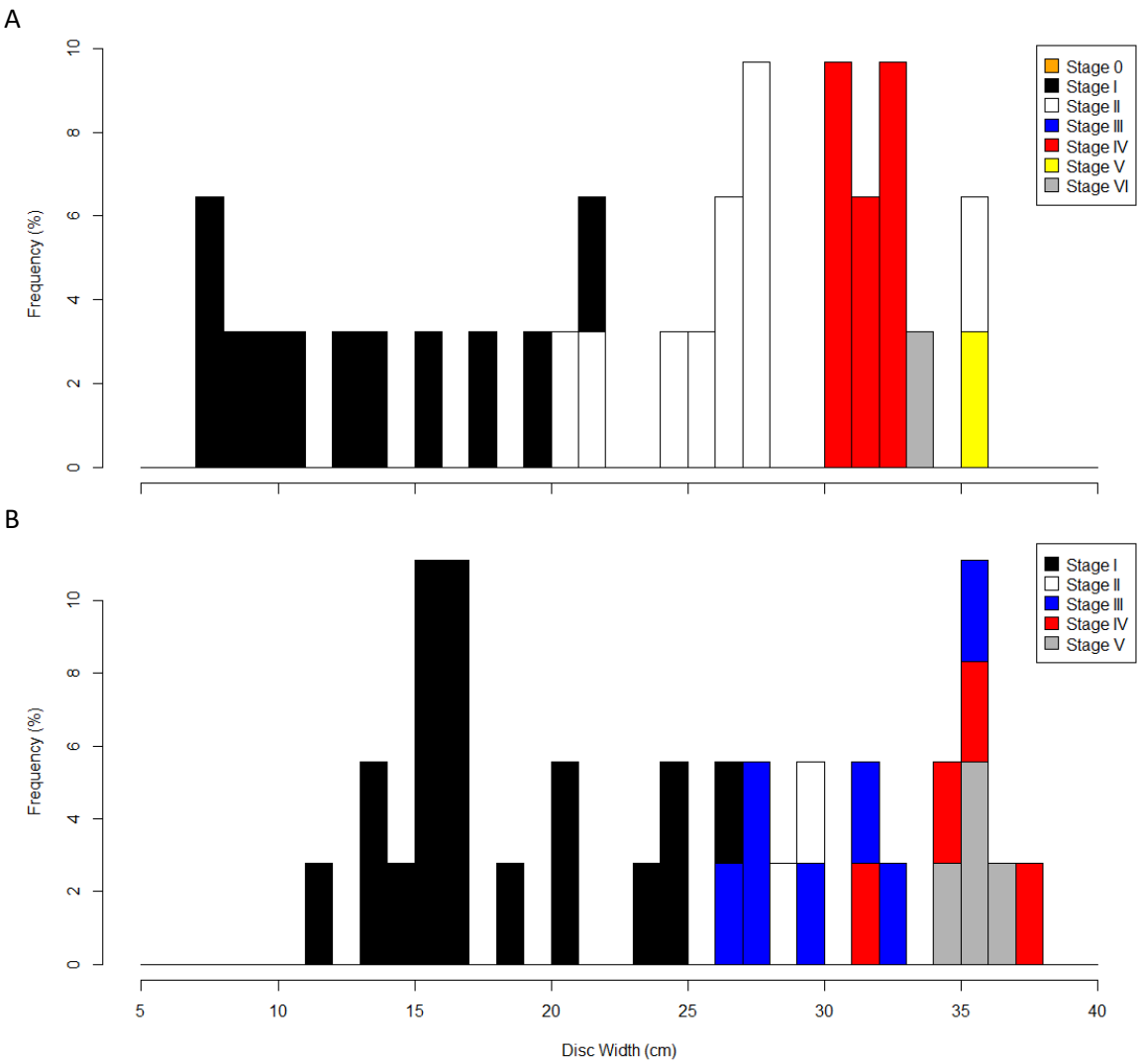

Fig 70. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Amblyraja doellojuradoi* with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for (A) females (N = 31) and (B) males (N = 36).

3.20.1 *Amblyraja doellojuradoi* – Starry skate – Area 1
The total catch of *A. doellojuradoi* was 0.26 kg (Table 3). It was caught at one of the four stations sampled during this cruise (25.0%). The density at that station was 1.2 kg/km^2 (Fig 69). No skate was sampled from this Area.

3.20.2 *Amblyraja doellojuradoi* – Starry skate – Area 2
The total catch of *A. doellojuradoi* was 9.880 kg (Table 4). It was caught at four of the eight stations sampled during this cruise (50.0%). Catches ranged from 1.34 to 4.94 kg and densities from 6.3 to 29.8 kg/km^2 (Fig 69). Of the four stations where *A. doellojuradoi* was caught, four stations yielded > 1 kg/km^2, one yielded > 10 kg/km^2 (25.0%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 21 (8 females and 13 males). Female D_W ranged from 19 to 32 cm (mean = 27.00 cm), whereas males measured between 11 and 35 cm (mean 24.00 cm). Females were observed Stage I (12.5%), Stage II (37.5%), and Stage IV (50.0%). Males were observed Stage I (61.5%), Stage III (23.1%), and Stage IV (15.4%).

3.20.3 *Amblyraja doellojuradoi* – Starry skate – Area 3
The total catch of *A. doellojuradoi* was 9.94 kg (Table 5). It was caught at three of the six stations sampled during this cruise in Area 3 (50.0%). Catches ranged from 0.48 to 6.02 kg and densities from 2.3 to 25.3 kg/km^2 (Fig 69). Of the three stations where *A. doellojuradoi* was caught, all three stations yielded > 1 kg/km^2, two yielded > 10 kg/km^2 (66.7%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 26 (16 females and 10 males). Female D_W ranged from 7 to 35 cm (mean = 21.44 cm), whereas males measured between 13 and 37 cm (mean 24.00 cm). Females were observed Stage I (43.8%), Stage II (37.5%), Stage IV (6.3%), Stage V (6.3%), and Stage VI (6.3%). Males were observed Stage I (60.0%), Stage IV (10.0%), and Stage V (30.0%).

3.20.4 *Amblyraja doellojuradoi* – Starry skate – Area 4
The total catch of *A. doellojuradoi* was 6.32 kg (Table 6). It was caught at three of the 21 stations sampled during this cruise in Area 4 (14.3%). Catches ranged from 0.66 to 4.94 kg and densities from 2.9 to 22.0 kg/km^2 (Fig 69). Of the three stations where *A. doellojuradoi* was caught, all stations yielded > 1 kg/km^2, one station yielded > 10 kg/km^2 (33.3%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 11 (4 females and 7 males). Female D_W ranged from 26 to 32 cm (mean = 29.50 cm), whereas males measured between 23 and 35 cm (mean 28.86 cm). Females were observed Stage II (25.0%) and Stage IV (75.0%). Males were observed Stage I (14.3%), Stage III (57.1%), Stage IV (14.3%), and Stage V (14.3%).

3.20.5 *Amblyraja doellojuradoi* – Starry skate – Area 5
The total catch of *A. doellojuradoi* was 0.14 kg (Table 7). It was caught at a single stations sampled during this cruise in Area 5 (three stations). The density at that station was 0.7 kg/km^2 (Fig 69). The number of skates sampled for length frequency was 1 (a single male). The male measured 28 cm D_W, (maturity Stage II).

3.20.6 *Amblyraja doellojuradoi* – Starry skate – Area 6
The total catch of *A. doellojuradoi* was 1.016 kg (Table 8). It was caught at two of the three stations sampled during this cruise in Area 6 (66.7%). Catches were 0.016 kg at station 3150 and 1.000 kg at station 3153, with respective densities of < 0.1 and 4.8 kg/km^2 (Fig 69). The number of skates sampled for length frequency was 8 (3 females and 5 males). Female D_W ranged from 10 to 13 cm (mean = 11.67 cm), whereas males measured between 14 and 29 cm (mean 17.80 cm). All three females were observed Stage I. Males were observed Stage I (80.0%) and Stage II (20.0%).

3.21 *Zearaja chilensis* – Yellow-nosed skate (RFL)

The total catch of *Z. chilensis* was 373.10 kg (Table 2). It was caught at 30 of the 45 stations sampled during this cruise (66.7%). Catches ranged from 0.68 to 57.08 kg and densities from 3.2 to 260.0 kg/km^2 (Fig 71). Of the 30 stations where *Z. chilensis* was caught, all stations yielded > 1 kg/km^2, 26 stations yielded > 10 kg/km^2 (86.7%), and five yielded > 100 kg/km^2 (16.7%). Catches of *Z. chilensis* occurred in all six areas sampled during this survey: Area 1 (abundance = 14.3 kg/km^2), Area 2 (abundance = 13.4 kg/km^2), Area 3 (abundance = 81.4 kg/km^2), Area 4 (abundance = 31.5 kg/km^2), Area 5 (abundance = 106.2 kg/km^2), and Area 6 (abundance = 36.4 kg/km^2) (Fig 71). The number of skates sampled for length frequency was 138 (115 females and 23 males). Female D_W ranged from 32 to 89 cm (mean of 54.60 cm) (Fig 72a), whereas males measured between 32 and 73 cm (mean of 52.00 cm) (Fig 72b). Females were observed Stage I (11.3%), Stage II (72.2%), Stage III (14.8%), and Stage IV (1.7%) (Fig 72a). Males were observed Stage I (13.0%), Stage II (26.1%), Stage III (39.1%), and Stage V (21.7%) (Fig 72b).

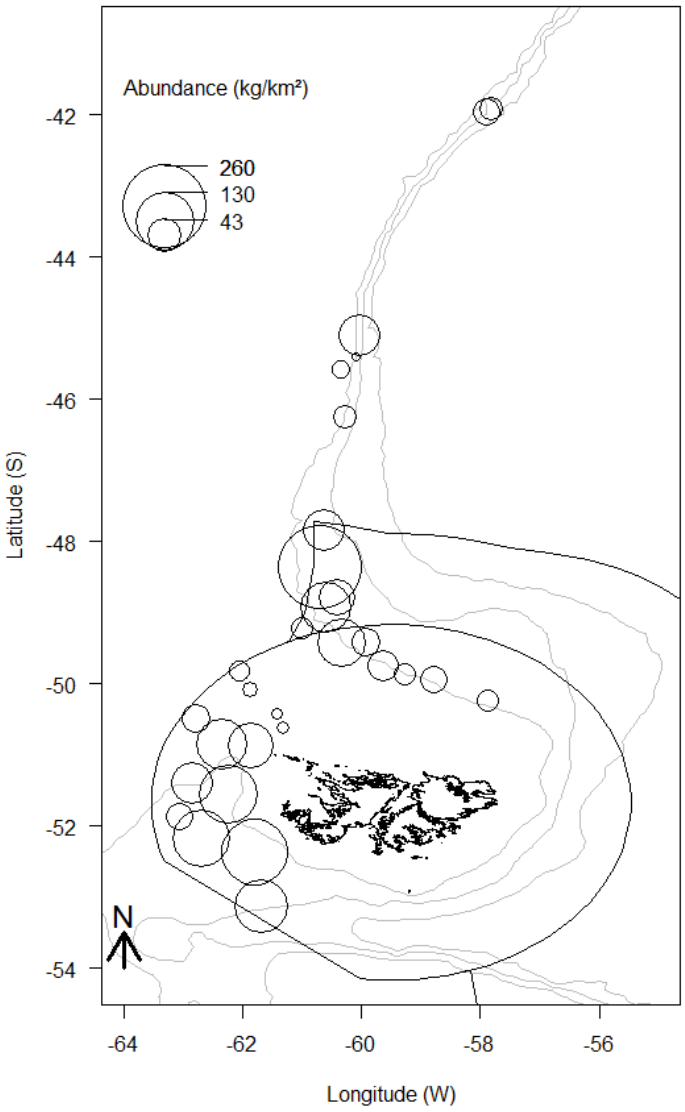

Fig 71. Distribution of densities of *Zearaja chilensis*.

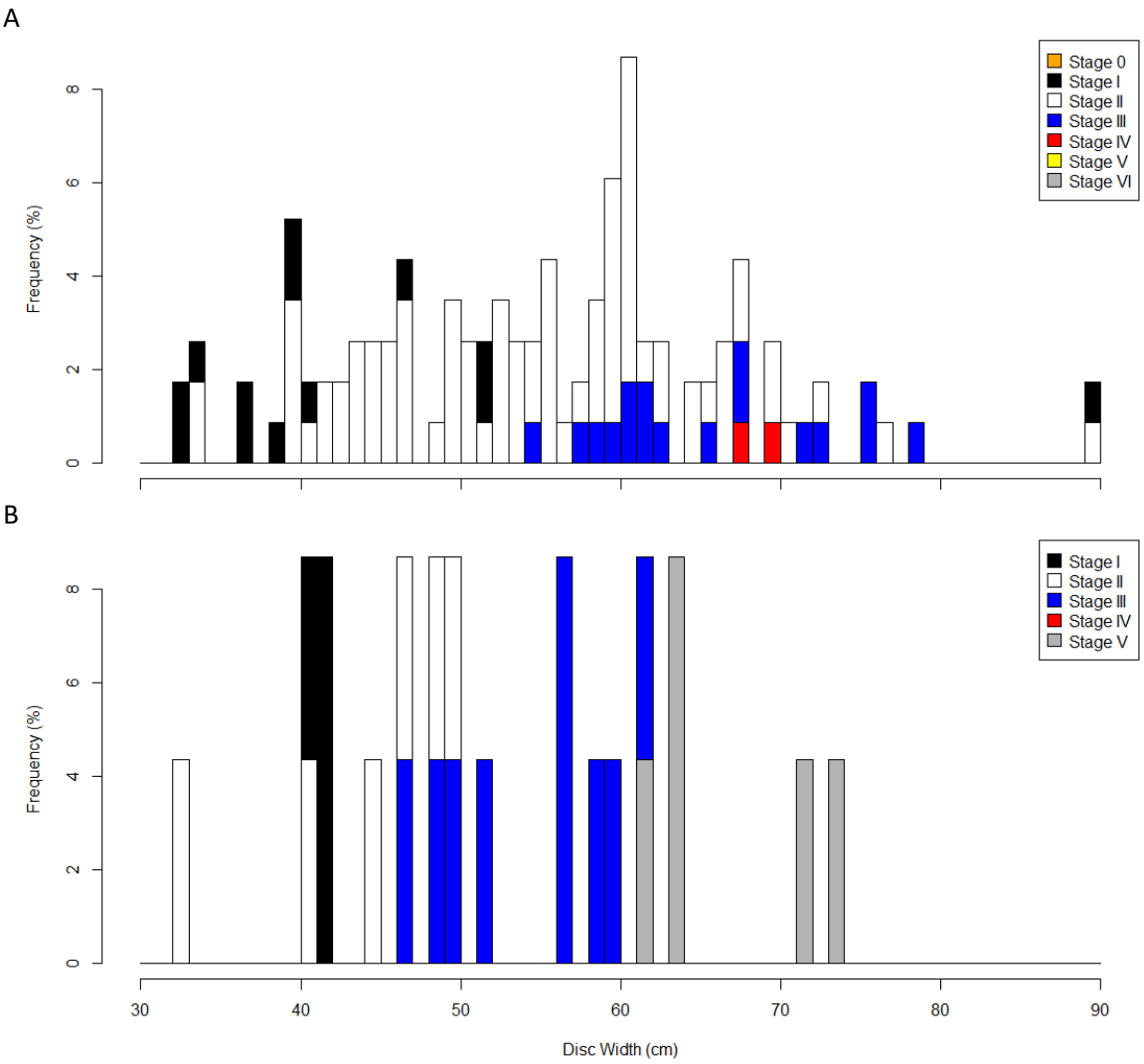

Fig 72. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Zearaja chilensis* with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for (A) females (N = 115) and (B) males (N = 23).

The proportions of individuals smaller than the median D_W of 55 cm for females and 49 cm for males was greatest in shallower waters. In waters shallower than 200 m, 27 of the 37 female (73.0%) individuals and 8 of the 13 males (61.5%) were smaller than the median D_W, respectively. In waters between 200 m and 300 m depths, 48.2% of the 56 female individuals and 44.4% of the 9 male individuals were smaller than median D_W. In waters deeper than 300 m, 31.6% of the 19 female individuals and none of the lone male were smaller than median D_W. The depth range for this species during the survey was 121 to 478 m.

3.21.1 *Zearaja chilensis* – Yellownose skate – Area 1

The total catch of *Z. chilensis* 10.08 kg (Table 3). It was caught at two of the four stations sampled during this cruise (50.0%). Catches were 4.68 kg at station 3186 and 5.40 kg at station 3188, with respective densities of 21.2 and 28.0 kg/km^2 (Fig 71). The number of skates sampled for length frequency was 5 (all females). Female D_W ranged from 33 to 64 cm (mean = 50.00 cm). All females were observed Stage II. In Area 1, 3 of the 5 female individuals (60.0%) sampled were smaller or equal to the median D_W of 55. No male was sampled from this area.

3.21.2 *Zearaja chilensis* – Yellownose skate – Area 2

The total catch of *Z. chilensis* was 22.10 kg (Table 4). It was caught at four of the eight stations sampled during this cruise (50.0%). Catches ranged from 0.68 to 14.14 kg and densities from 3.2 to 63.7 kg/km^2 (Fig 69). Of the four stations where *Z. chilensis* was caught, all stations yielded > 1 kg/km^2, three yielded > 10 kg/km^2 (75.0%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 14 (12 females and 2 males). Female D_W ranged from 32 to 69 cm (mean = 43.92 cm), whereas males measured 32 and 48 cm, respectively. Females were observed Stage I (33.3%), Stage II (50.0%), and Stage IV (16.7%). Males were observed Stage II (50.0%), and Stage III (50.0%). In Area 2, 10 of the 12 female individuals (83.3%) sampled neither of the 2 males were smaller or equal to the median D_W of 55 and 49 cm, respectively.

3.21.3 *Zearaja chilensis* – Yellownose skate – Area 3

The total catch of *Z. chilensis* was 109.16 kg (Table 5). It was caught at five of the six stations sampled during this cruise in Area 3 (83.3%). Catches ranged from 4.50 to 57.08 kg and densities from 19.0 to 260.0 kg/km^2 (Fig 71). Of the five stations where *Z. chilensis* was caught, all five stations yielded > 1 kg/km^2 and > 10 kg/km^2, and one yielded > 100 kg/km^2 (20.0%). The number of skates sampled for length frequency was 27 (25 females and 2 males). Female D_W ranged from 38 to 89 cm (mean = 62.96 cm), whereas males measured 71 and 73 cm, respectively. Females were observed Stage I (8.0%), Stage II (72.0%), and Stage III (20.0%). Both males were observed Stage V. In Area 3, 3 of the 25 female individuals (12.0%) sampled and neither of the 2 males were smaller or equal to the median D_W of 55 and 49 cm, respectively.

3.21.4 *Zearaja chilensis* – Yellownose skate – Area 4

The total catch of *Z. chilensis* was 145.12 kg (Table 6). It was caught at 15 of the 21 stations sampled during this cruise in Area 4 (71.4%). Catches ranged from 1.22 to 28.62 kg and densities from 5.6 to 127.5 kg/km^2 (Fig 71). Of the 15 stations where *Z. chilensis* was caught, all stations yielded > 1 kg/km^2, 12 station yielded > 10 kg/km^2 (80.0%), and one yielded > 100 kg/km^2 (6.7%). The number of skates sampled for length frequency was 66 (49 females and 17 males). Female D_W ranged from 33 to 78 cm (mean = 51.08 cm), whereas males measured between 40 and 63 cm (mean 50.88 cm). Females were observed Stage I (12.2%), Stage II (69.4%) and Stage III (18.4%). Males were observed Stage I (17.6%), Stage II (23.5%), Stage III (41.2%), and Stage V (17.6%). In Area 4, 33 of the 49 female individuals (67.3%) sampled and 9 of the 17 males (52.9%) were smaller or equal to the median D_W of 55 and 49 cm, respectively.

3.21.5 *Zearaja chilensis* – Yellownose skate – Area 5

The total catch of *Z. chilensis* was 65.22 kg (Table 7). It was caught at all three stations sampled during this cruise in Area 5. Catches ranged from 5.84 to 34.64 kg and densities from 28.0 to 167.7 kg/km^2 (Fig 71). Of the three stations where *Z. chilensis* was caught, all stations yielded > 1 kg/km^2 and > 10 kg/km^2, and two yielded > 100 kg/km^2 (66.7%). The number of skates sampled for length frequency was 21 (19 females and 2 males). Female D_W ranged from 46 to 75 cm (mean = 58.26 cm), whereas males measured 46 and 61 cm, respectively. Females were observed Stage I (5.3%), Stage II (78.9%) and Stage III (15.8%). Males were observed Stage II (50.0%) and Stage III (50.0%). In Area 5,

10 of the 19 female individuals (52.6%) sampled and 1 of the 2 males (50.0%) were smaller or equal to the median D_W of 55 and 49 cm, respectively.

3.21.6 *Zearaja chilensis* – Yellownose skate – Area 6

The total catch of *Z. chilensis* was 21.42 kg (Table 8). It was caught at a single of the three stations sampled during this cruise in Area 6 (33.3%). The density at that station was 106.1 kg/km^2 (Fig 71). The number of skates sampled for length frequency was 5 (all females). Female D_W ranged from 55 to 76 cm (mean = 63.60 cm). All five females were observed Stage II. In Area 6, 1 of the 5 female individuals (20.0%) sampled was smaller or equal to the median D_W of 55 cm. No males were sampled from this area.

3.22 *Bathyraja griseocauda* – Grey-tailed skate (RGR)

The total catch of *B. griseocauda* was 316.02 kg (Table 2). It was caught at 17 of the 45 stations sampled during this cruise (37.8%). Catches ranged from 0.08 to 67.10 kg and densities from 0.3 to 302.5 kg/km^2 (Fig 73). Of the 17 stations where *B. griseocauda* was caught, 16 stations yielded > 1 kg/km^2 (94.1%), ten stations yielded > 10 kg/km^2 (58.8%), and seven yielded > 100 kg/km^2 (41.2%). Catches of *B. griseocauda* occurred in five of the six areas sampled during this survey: Area 1 (abundance = 2.1 kg/km^2), Area 2 (abundance = 9.8 kg/km^2), Area 3 (abundance = 111.4 kg/km^2), Area 4 (abundance = 9.2 kg/km^2), and Area 6 (abundance = 181.1 kg/km^2) (Fig 73). The number of skates sampled for length frequency was 123 (55 females and 68 males). Female D_W ranged from 16 to 97 cm (mean of 40.69 cm) (Fig 74a), whereas males measured between 16 and 95 cm (mean of 41.31 cm) (Fig 74b). Females were observed Stage I (49.1%), Stage II (47.3%), Stage III (1.8%), and Stage V (1.8%) (Fig 74a). Males were observed Stage I (45.6%), Stage II (38.2%), Stage III (5.9%), Stage IV (5.9%), and Stage V (4.4%) (Fig 74b).

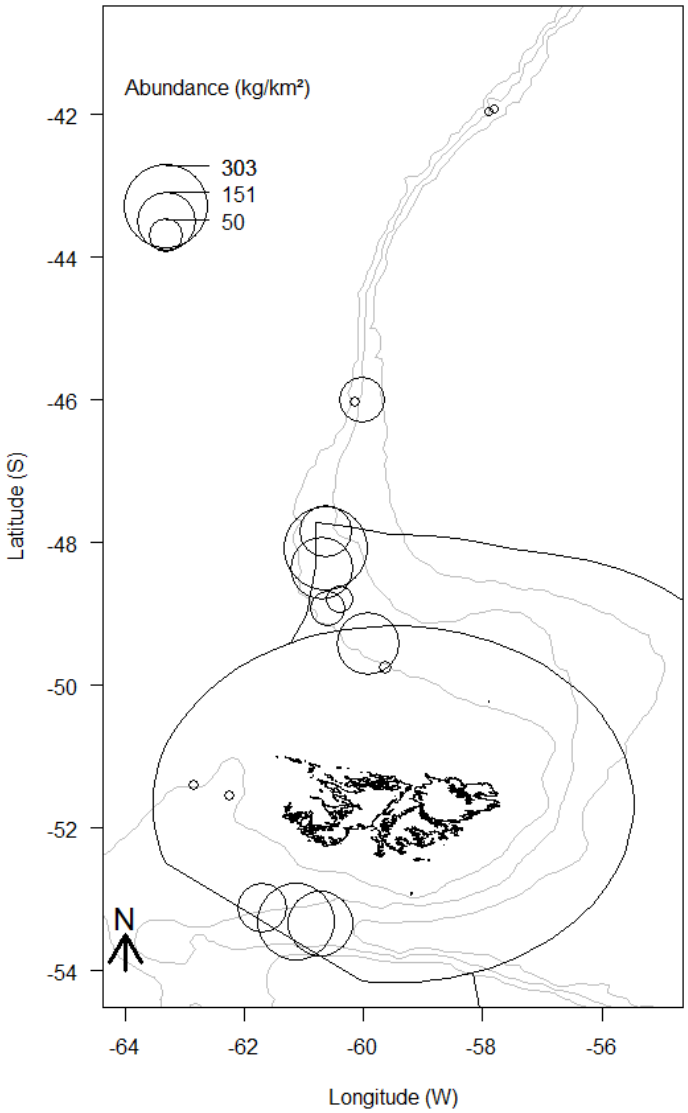

Fig 73. Distribution of densities of *Bathyraja griseocauda*.

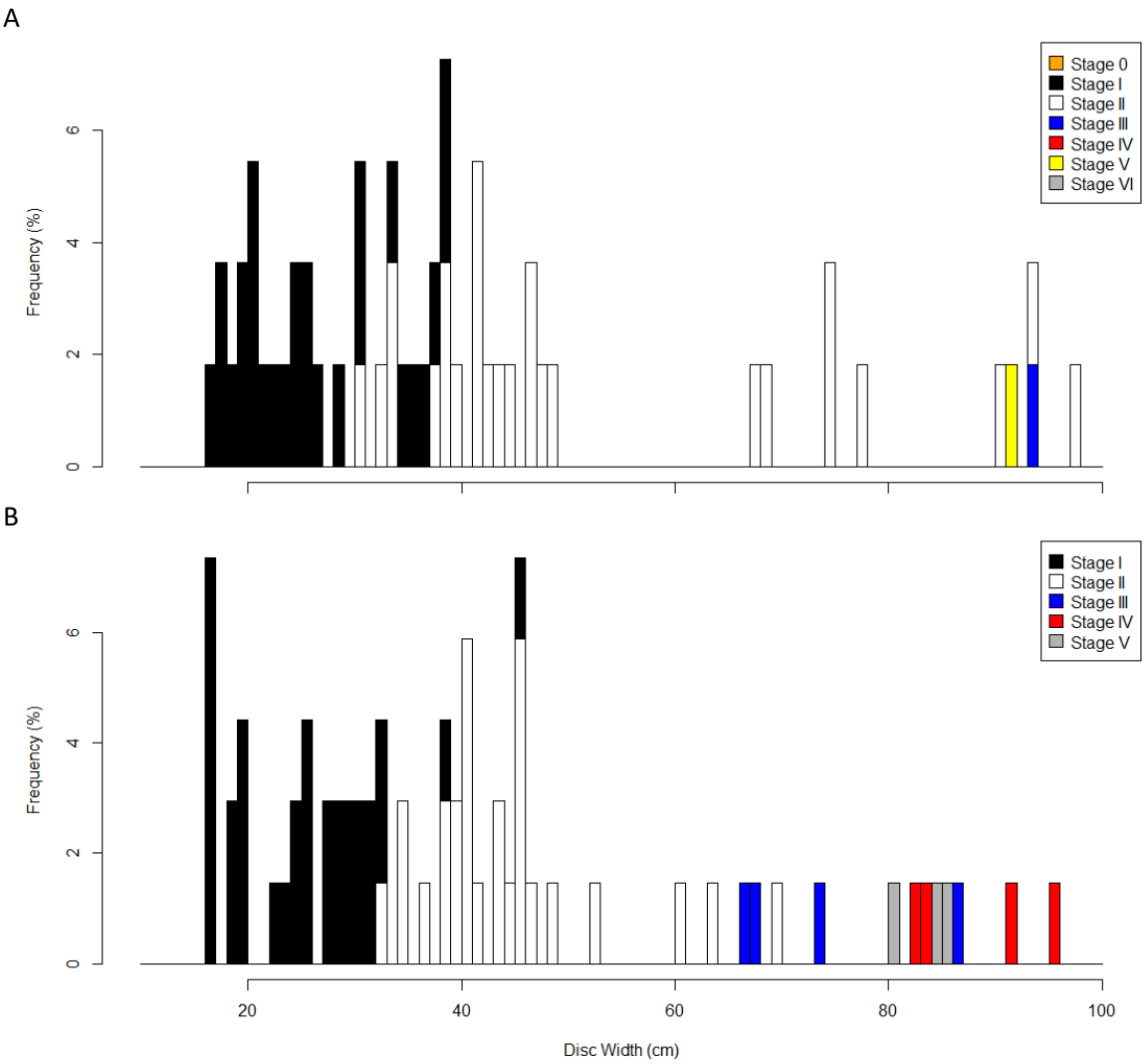

Fig 74. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Bathyraja griseocauda* with associated maturity stages (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting) for (A) females (N = 55) and (B) males (N = 68).

The proportions of individuals smaller than the median D_W of 36 cm for females and 38 cm for males was greatest in shallower waters (< 300 m). In waters shallower than 200 m, neither of the female nor male individuals were smaller than the median D_W, respectively. In waters between 200 m and 300 m depths, 53.8% of the 26 female individuals and 63.0% of the 27 male individuals were smaller than median D_W. In waters deeper than 300 m, 50.0% of the 28 female individuals and 19 of the 40 males (47.5%) were smaller than median D_W. The depth range for this species during the survey was 181 to 728 m.

3.22.1 *Bathyraja griseocauda* – Grey-tailed skate – Area 1

The total catch of *B. griseocauda* 1.46 kg (Table 3). It was caught at two of the four stations sampled during this cruise (50.0%). Catches were 0.66 kg at station 3188 and 0.80 kg at station 3186, with respective densities of 3.4 and 3.6 kg/km^2 (Fig 73). The number of skates sampled for length frequency was 2 (all males). Male D_W was 32 and 34 cm, respectively. Both males were observed Stage II. In Area 1, both males were smaller or equal to the median D_W of 38 cm.

3.22.2 *Bathyraja griseocauda* – Grey-tailed skate – Area 2

The total catch of *B. griseocauda* was 16.16 kg (Table 4). It was caught at two of the eight stations sampled during this cruise (25.0%). Catches were 0.80 kg at station 3192 and 15.36 kg at station 3190, with respective densities of 4.5 and 92.5 kg/km^2 (Fig 73). The number of skates sampled for length frequency was 3 (all females). Female D_W ranged from 34 to 74 cm (mean = 60.67 cm). Females were observed Stage I (33.3%) and Stage II (66.7%). In Area 2, 2 of the 3 female individuals (66.7%) sampled were smaller or equal to the median D_W of 36 cm.

3.22.3 *Bathyraja griseocauda* – Grey-tailed skate – Area 3

The total catch of *B. griseocauda* was 149.42 kg (Table 5). It was caught at five of the six stations sampled during this cruise in Area 3 (83.3%). Catches ranged from 6.98 to 67.10 kg and densities from 32.4 to 302.5 kg/km^2 (Fig 73). Of the five stations where *B. griseocauda* was caught, all five stations yielded > 1 kg/km^2 and > 10 kg/km^2, and three yielded > 100 kg/km^2 (60.0%). The number of skates sampled for length frequency was 79 (37 females and 42 males). Female D_W ranged from 17 to 90 cm (mean = 34.92 cm), whereas males measured between 16 and 95 cm (mean 41.12 cm). Females were observed Stage I (56.8%) and Stage II (43.2%). Males were observed Stage I (45.2%), Stage II (38.1%), Stage III (9.5%), Stage IV (4.8%), and Stage V (2.4%). In Area 3, 21 of the 37 female individuals (56.8%) sampled and 22 of the 42 males (52.4%) were smaller or equal to the median D_W of 36 and 38 cm, respectively.

3.22.4 *Bathyraja griseocauda* – Grey-tailed skate – Area 4

The total catch of *B. griseocauda* was 42.54 kg (Table 6). It was caught at five of the 21 stations sampled during this cruise in Area 4 (23.8%). Catches ranged from 0.08 to 38.80 kg and densities from 0.3 to 169.0 kg/km^2 (Fig 73). Of the five stations where *B. griseocauda* was caught, four stations yielded > 1 kg/km^2 (80.0%), one station yielded > 10 kg/km^2 (20.0%), and one yielded > 100 kg/km^2 (20.0%). The number of skates sampled for length frequency was 26 (10 females and 16 males). Female D_W ranged from 20 to 91 cm (mean = 38.80 cm), whereas males measured between 16 and 83 cm (mean 32.00 cm). Females were observed Stage I (40.0%), Stage II (50.0%) and Stage V (10.0%). Males were observed Stage I (62.5%), Stage II (31.3%), and Stage V (6.3%). In Area 4, 5 of the 10 female individuals (50.0%) sampled and 11 of the 16 males (68.8%) were smaller or equal to the median D_W of 36 and 38 cm, respectively.

3.22.5 *Bathyraja griseocauda* – Grey-tailed skate – Area 5

No *B. griseocauda* was caught in Area 5.

3.22.6 *Bathyraja griseocauda* – Grey-tailed skate – Area 6

The total catch of *B. griseocauda* was 106.44 kg (Table 8). It was caught at all three stations sampled during this cruise in Area 6. Catches ranged from 21.12 to 52.60 kg and densities from 104.7 to 254.9 kg/km^2 (Fig 73). Of the three stations where *B. griseocauda* was caught, all three stations yielded > 1 kg/km^2, > 10 kg/km^2, and > 100 kg/km^2. The number of skates sampled for length frequency was 13 (5 females and 8 males). Female D_W ranged from 16 to 97 cm (mean = 75.20 cm), whereas males measured between 16 and 85 cm (mean 63.00 cm). Females were observed Stage I (20.0%), Stage II (60.0%), and Stage III (20.0%). Males were observed Stage I (25.0%), Stage II (37.5%), Stage IV (12.5%), and Stage V (25.0%). In Area 6, 1 of the 5 female individuals (20.0%) sampled and 1 of the 8 males (12.5%) were smaller or equal to the median D_W of 36 and 38 cm, respectively.

3.23 *Bathyraja macloviana* – Falkland skate (RMC)

The total catch of *B. macloviana* was 19.46 kg (Table 2). It was caught at 12 of the 45 stations sampled during this cruise (26.7%). Catches ranged from 0.44 to 3.32 kg and densities from 1.9 to 15.9 kg/km^2 (Fig 75). Of the 12 stations where *B. macloviana* was caught, all stations yielded > 1 kg/km^2, three stations yielded > 10 kg/km^2 (25.0%), and none yielded > 100 kg/km^2. Catches of *B. macloviana* occurred in two of the six areas sampled during this survey: Area 3 (abundance = 3.8 kg/km^2) and Area 4 (abundance = 3.1 kg/km^2) (Fig 75). The number of skates sampled for length frequency was 22 (11 females and 11 males). Female D_W ranged from 27 to 40 cm (mean of 33.27 cm), whereas males measured between 21 and 35 cm (mean of 29.36 cm). Females were observed Stage II (45.5%), Stage IV (18.2%), Stage V (9.1%), and Stage VI (27.3%). Males were observed Stage I (18.2%), Stage II (18.2%), Stage III (36.4%), Stage IV (18.2%), and Stage V (9.1%). The depth range for this species during the survey was 147 to 403 m.

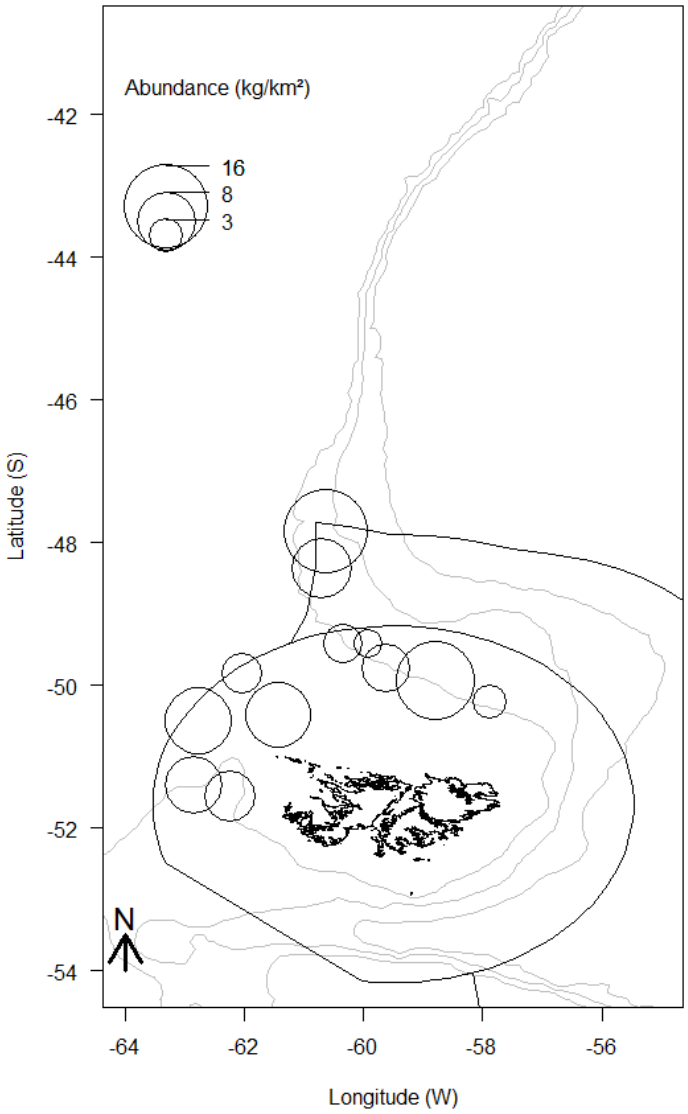

Fig 75. Distribution of densities of *Bathyraja macloviana*.

3.23.1 *Bathyraja macloviana* – Falkland skate – Area 1
No *B. macloviana* was caught in Area 1.

3.23.2 *Bathyraja macloviana* – Falkland skate – Area 2
No *B. macloviana* was caught in Area 2.

3.23.3 *Bathyraja macloviana* – Falkland skate – Area 3
The total catch of *B. macloviana* was 5.16 kg (Table 5). It was caught at two of the six stations sampled during this cruise in Area 3 (33.3%). Catches were 1.84 kg at station 3174 and 3.32 kg at station 3176, with respective densities of 8.4 and 15.9 kg/km^2 (Fig 75). The number of skates sampled for length frequency was 3 (all females). Female D_W ranged from 37 to 40 cm (mean = 38.67 cm). Females were observed Stage IV (33.3%), Stage V (33.3%), and Stage VI (33.3%).

3.23.4 *Bathyraja macloviana* – Falkland skate – Area 4
The total catch of *B. macloviana* was 14.3 kg (Table 6). It was caught at ten of the 21 stations sampled during this cruise in Area 4 (47.6%). Catches ranged from 0.44 to 3.20 kg and densities from 1.9 to 14.2 kg/km^2 (Fig 75). Of the ten stations where *B. macloviana* was caught, all stations yielded > 1 kg/km^2, two station yielded > 10 kg/km^2 (20.0%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 19 (8 females and 11 males). Female D_W ranged from 27 to 37 cm (mean = 31.25 cm), whereas males measured between 21 and 35 cm (mean 29.36 cm). Females were observed Stage II (62.5%), Stage IV (12.5%), and Stage VI (25.0%). Males were observed Stage I (18.2%), Stage II (18.2%), Stage III (36.4%), Stage IV (18.2%), and Stage V (9.1%).

3.23.5 *Bathyraja macloviana* – Falkland skate – Area 5
No *B. macloviana* was caught in Area 5.

3.23.6 *Bathyraja macloviana* – Falkland skate – Area 6
No *B. macloviana* was caught in Area 6.

3.24 *Bathyraja multispinis* – Multispined skate (RMU)

The total catch of *B. multispinis* was 39.44 kg (Table 2). It was caught at nine of the 45 stations sampled during this cruise (20.0%). Catches ranged from 0.32 to 13.54 kg and densities from 1.4 to 61.0 kg/km^2 (Fig 76). Of the nine stations where *B. multispinis* was caught, all stations yielded > 1 kg/km^2, five stations yielded > 10 kg/km^2 (55.6%), and none yielded > 100 kg/km^2. Catches of *B. multispinis* occurred in four of the six areas sampled during this survey: Area 1 (abundance = 1.6 kg/km^2), Area 3 (abundance = 17.8 kg/km^2), Area 4 (abundance = 2.4 kg/km^2), and Area 6 (abundance = 5.6 kg/km^2) (Fig 76). The number of skates sampled for length frequency was 13 (6 females and 7 males). Female D_W ranged from 10 to 67 cm (mean of 37.00 cm), whereas males measured between 18 and 69 cm (mean of 57.00 cm). Females were observed Stage I (50.0%) and Stage II (50.0%). Males were observed Stage I (14.3%), Stage II (28.6%), and Stage III (57.1%). The depth range for this species during the survey was 201 to 587 m.

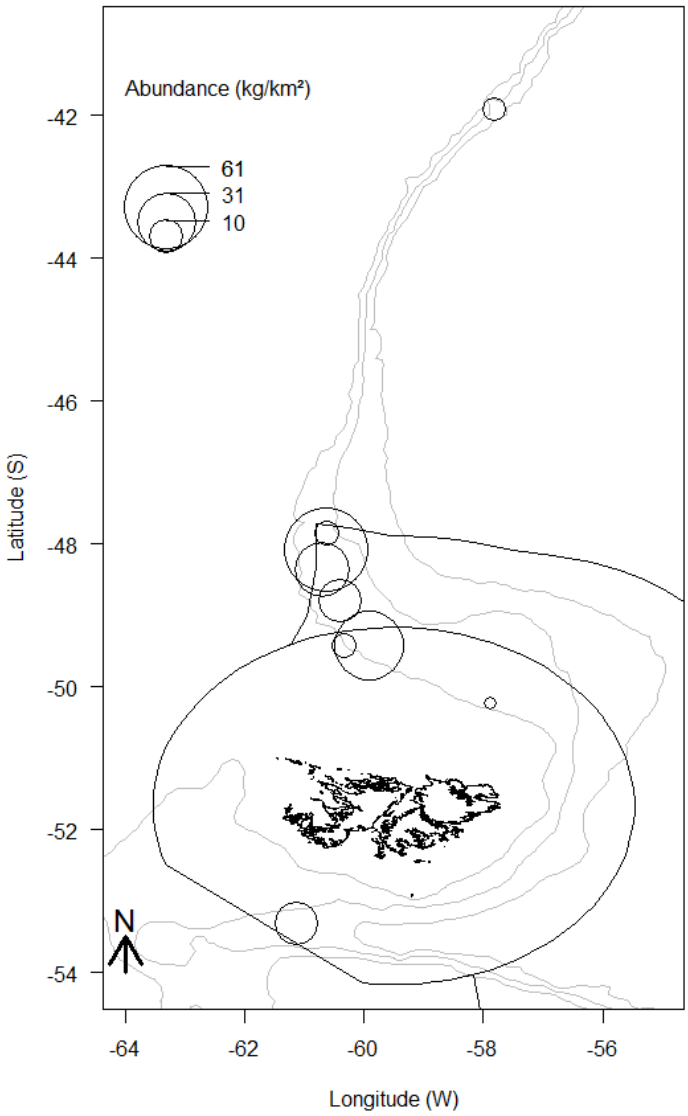

Fig 76. Distribution of densities of *Bathyraja multispinis*.

3.24.1 *Bathyraja multispinis* – Multispined skate – Area 1
The total catch of *B. multispinis* was 1.10 kg in Area 1 (Table 3). It was caught at one of the four stations sampled during this cruise in Area 1 (25.0%). The density at this station was 5.0 kg/km^2 (Fig 76). The number of skates sampled for length frequency was 1 (a single female). The D_W was 39 cm (maturity Stage I).

3.24.2 *Bathyraja multispinis* – Multispined skate – Area 2
No *B. multispinis* was caught in Area 2.

3.24.3 *Bathyraja multispinis* – Multispined skate – Area 3
The total catch of *B. multispinis* was 23.80 kg (Table 5). It was caught at four of the six stations sampled during this cruise in Area 3 (66.7%). Catches ranged from 1.12 to 13.54 kg and densities from 5.4 to 61.0 kg/km^2 (Fig 76). Of the four stations where *B. multispinis* was caught, all stations yielded > 1 kg/km^2, three station yielded > 10 kg/km^2 (75.0%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 7 (3 females and 4 males). Female D_W ranged from 10 to 67 cm (mean = 38.67 cm), whereas males measured between 18 and 69 cm (mean 53.00 cm). Females were observed Stage I (33.3%) and Stage II (66.7%). Males were observed Stage I (25.0%), Stage II (25.0%), and Stage III (50.0%).

3.24.4 *Bathyraja multispinis* – Multispined skate – Area 4
The total catch of *B. multispinis* was 11.22 kg (Table 6). It was caught at three of the 21 stations sampled during this cruise in Area 4 (14.3%). Catches ranged from 0.32 to 9.64 kg and densities from 1.4 to 42.0 kg/km^2 (Fig 76). Of the three stations where *B. multispinis* was caught, all stations yielded > 1 kg/km^2, one station yielded > 10 kg/km^2 (33.3%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 4 (2 females and 2 males). Female D_W were 26 and 41 cm, respectively, whereas male D_W were 65 and 66 cm, respectively. Females were observed Stage I (50.0%) and Stage II (50.0%). Both males were observed Stage II.

3.24.5 *Bathyraja multispinis* – Multispined skate – Area 5
No *B. multispinis* was caught in Area 5.

3.24.6 *Bathyraja multispinis* – Multispined skate – Area 6
The total catch of *B. multispinis* was 3.32 kg (Table 8). It was caught at one of the three stations sampled during this cruise in Area 6 (33.3%). The density at this station was 16.1 kg/km^2 (Fig 76). The number of skates sampled for length frequency was 1 (a lone male). The male had a D_W of 56 cm (maturity Stage II).

3.25 *Psammobatis* spp. – Unidentified sandray (RMU)

The total catch of *Psammobatis* spp. was 13.42 kg (Table 2). It was caught at 11 of the 45 stations sampled during this cruise (24.4%). Catches ranged from 0.02 to 3.70 kg and densities from < 0.1 to 17.7 kg/km^2 (Fig 77). Of the 11 stations where *Psammobatis* spp. was caught, nine stations yielded > 1 kg/km^2 (81.8%), three stations yielded > 10 kg/km^2 (27.3%), and none yielded > 100 kg/km^2. Catches of *Psammobatis* spp. occurred in two of the six areas sampled during this survey: Area 2 (abundance = 0.1 kg/km^2) and Area 4 (abundance = 2.9 kg/km^2) (Fig 77). The number of skates sampled for length frequency was 25 (16 females and 9 males). Female D_W ranged from 21 to 29 cm (mean of 25.56 cm), whereas males measured between 5 and 28 cm (mean of 22.78 cm). Females were observed Stage II (12.5%), Stage IV (31.3%), and Stage VI (56.3%). Males were observed Stage II (22.2%), and Stage V (77.8%). The depth range of these species during the survey was 132 to 188 m.

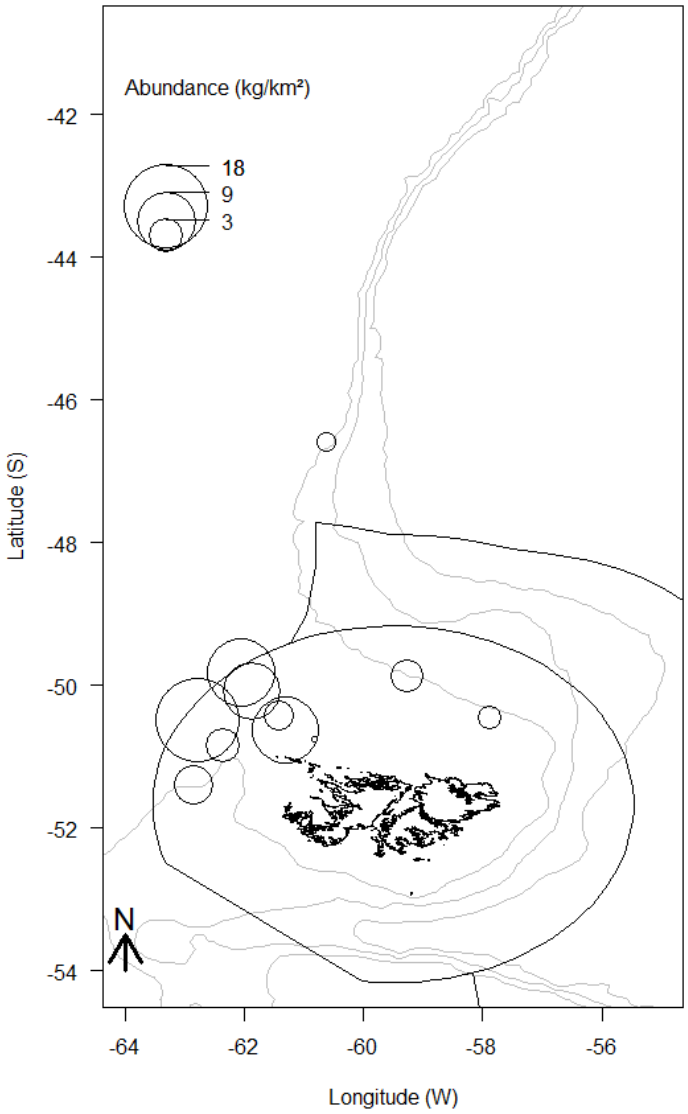

Fig 77. Distribution of densities of *Psammobatis spp*.

3.25.1 *Psammobatis* spp. – Unidentified sandray – Area 1
No *Psammobatis* spp. was caught in Area 1.

3.25.2 *Psammobatis* spp. – Unidentified sandray – Area 2
The total catch of *Psammobatis* spp. was 0.22 kg in Area 2 (Table 4). It was caught at one of the eight stations sampled during this cruise in Area 1 (12.5%). The density at this station was 0.9 kg/km^2 (Fig 77). The number of skates sampled for length frequency was 1 (a single male). The D_W was 19 cm (maturity Stage I).

3.25.3 *Psammobatis* spp. – Unidentified sandray – Area 3
No *Psammobatis* spp. was caught in Area 3.

3.25.4 *Psammobatis* spp. – Unidentified sandray – Area 4
The total catch of *Psammobatis* spp. was 13.20 kg (Table 6). It was caught at ten of the 21 stations sampled during this cruise in Area 4 (47.6%). Catches ranged from 0.02 to 3.70 kg and densities from < 0.1 to 17.7 kg/km^2 (Fig 77). Of the ten stations where *Psammobatis* spp. was caught, nine stations yielded > 1 kg/km^2 (90.0%), three station yielded > 10 kg/km^2 (30.0%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 24 (16 females and 8 males). Female D_W ranged from 21 to 29 cm (mean of 25.56 cm), whereas males measured between 5 and 28 cm (mean of 23.25 cm). Females were observed Stage II (12.5%), Stage IV (31.3%), and Stage VI (56.3%). Males were observed Stage I (12.5%) and Stage V (87.5%).

3.25.5 *Psammobatis spp.* – Unidentified sandray – Area 5
No *Psammobatis* spp. was caught in Area 5.

3.25.6 *Psammobatis spp.* – Unidentified sandray – Area 6
No *Psammobatis* spp. was caught in Area 6.

3.26 *Bathyraja scaphiops* – Cuphead skate (RSC)

The total catch of *B. scaphiops* was 16.68 kg (Table 2). It was caught at eight of the 45 stations sampled during this cruise (17.8%). Catches ranged from 0.06 to 6.00 kg and densities from 0.3 to 26.1 kg/km^2 (Fig 78). Of the eight stations where *B. scaphiops* was caught, seven stations yielded > 1 kg/km^2 (87.5%), three stations yielded > 10 kg/km^2 (37.5%), and none yielded > 100 kg/km^2. Catches of *B. scaphiops* occurred in five of the six areas sampled during this survey: Area 1 (abundance = 4.7 kg/km^2), Area 2 (abundance = 0.6 kg/km^2), Area 3 (abundance = 4.7 kg/km^2), Area 4 (abundance = 1.3 kg/km^2), and Area 5 (abundance < 0.1 kg/km^2) (Fig 78). The number of skates sampled for length frequency was 10 (7 females and 3 males). Female D_W ranged from 40 to 56 cm (mean of 49.43 cm), whereas males measured between 26 and 45 cm (mean of 34.00 cm). Females were observed Stage II (28.6%) and Stage IV (28.6%), and Stage VI (42.9%). Males were observed Stage I (33.3%), Stage II (33.3%), and Stage III (33.3%). The depth range for this species during the survey was 215 to 616 m.

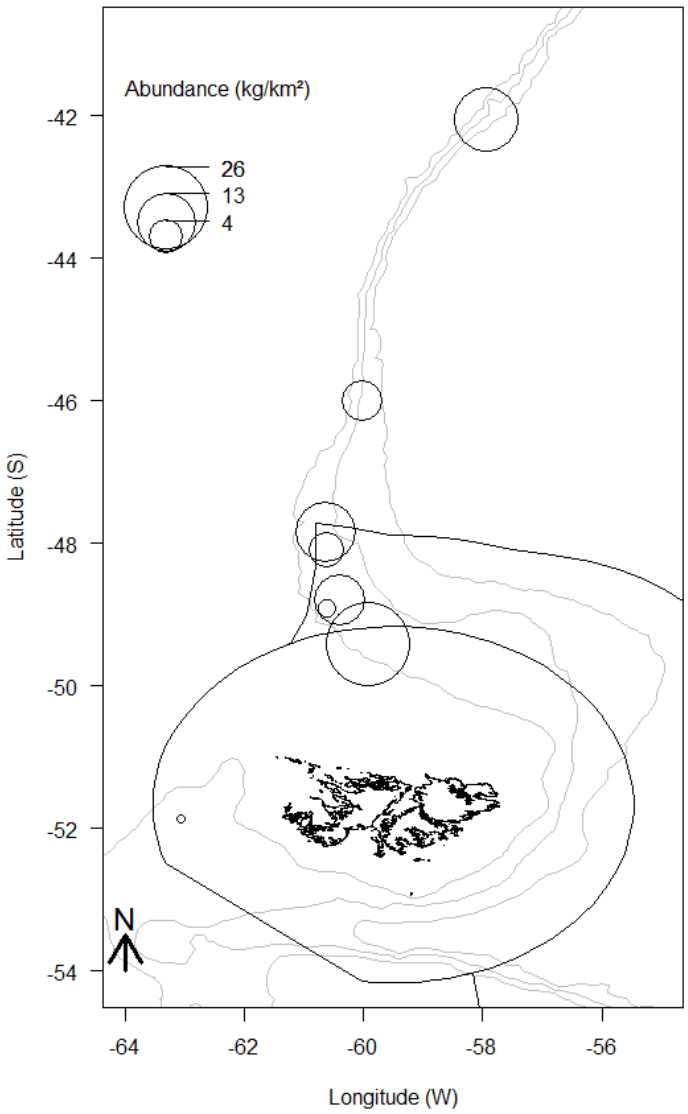

Fig 78. Distribution of densities of *Bathyraja scaphiops*.

3.26.1 *Bathyraja scaphiops* – Cuphead skate – Area 1
The total catch of *B. scaphiops* was 3.32 kg in Area 1 (Table 3). It was caught at one of the four stations sampled during this cruise in Area 1 (25.0%). The density at this station was 15.5 kg/km^2 (Fig 78). The number of skates sampled for length frequency was 1 (a single female). The D_W was 55 cm (maturity Stage VI).

3.26.2 *Bathyraja scaphiops* – Cuphead skate – Area 2
The total catch of *B. scaphiops* was 1.04 kg in Area 2 (Table 4). It was caught at one of the eight stations sampled during this cruise in Area 1 (12.5%). The density at this station was 6.3 kg/km^2 (Fig 78). The number of skates sampled for length frequency was 1 (a single female). The D_W was 40 cm (maturity Stage II).

3.26.3 *Bathyraja scaphiops* – Cuphead skate – Area 3
The total catch of *B. scaphiops* was 6.26 kg (Table 5). It was caught at four of the six stations sampled during this cruise in Area 3 (66.7%). Catches ranged from 0.32 to 2.80 kg and densities from 1.3 to 13.4 kg/km^2 (Fig 78). Of the four stations where *B. scaphiops* was caught, all stations yielded > 1 kg/km^2, one station yielded > 10 kg/km^2 (25.0%), and none yielded > 100 kg/km^2. The number of skates sampled for length frequency was 4 (3 females and 1 male). Female D_W ranged from 41 to 56 cm (mean = 50.33 cm), whereas the lone male measured 26 cm (maturity Stage I). Females were observed Stage II (33.3%) and Stage VI (66.7%).

3.26.4 *Bathyraja scaphiops* – Cuphead skate – Area 4
The total catch of *B. scaphiops* was 6.00 kg (Table 6). It was caught at one of the 21 stations sampled during this cruise in Area 4 (4.8%). The density at this station was 26.1 kg/km^2 (Fig 78). The number of skates sampled for length frequency was 3 (2 females and 1 male). Both female D_W were 50 cm, whereas the lone male D_W was 45 cm. Both females were observed Stage IV. The lone male was observed Stage III.

3.26.5 *Bathyraja scaphiops* – Cuphead skate – Area 5
The total catch of *B. scaphiops* was 0.06 kg (Table 6). It was caught at one of the three stations sampled during this cruise in Area 4 (33.3%). The density at this station was 0.3 kg/km^2 (Fig 78). The number of skates sampled for length frequency was 1 (a lone male). The lone male D_W was 31 cm (maturity Stage II).

3.26.6 *Bathyraja scaphiops* – Cuphead skate – Area 6
No *B. scaphiops* was caught in Area 6.

3.27 *Dipturus trachyderma* – Roughskin skate (RTR)

The total catch of *D. trachyderma* was 6.38kg (Table 2). It was caught at one of the 45 stations sampled during this cruise (2.2%). The density at that station was 31.6 kg/km^2 (Fig 79). Catches of *D. trachyderma* occurred in a single of the six areas sampled during this survey: Area 6 (abundance = 10.9 kg/km^2) (Fig 79). The number of skates sampled for length frequency was 1 (a female). Female D_W was 79 observed as Stage II. The lone RTR was recovered from a depth of 478 m.

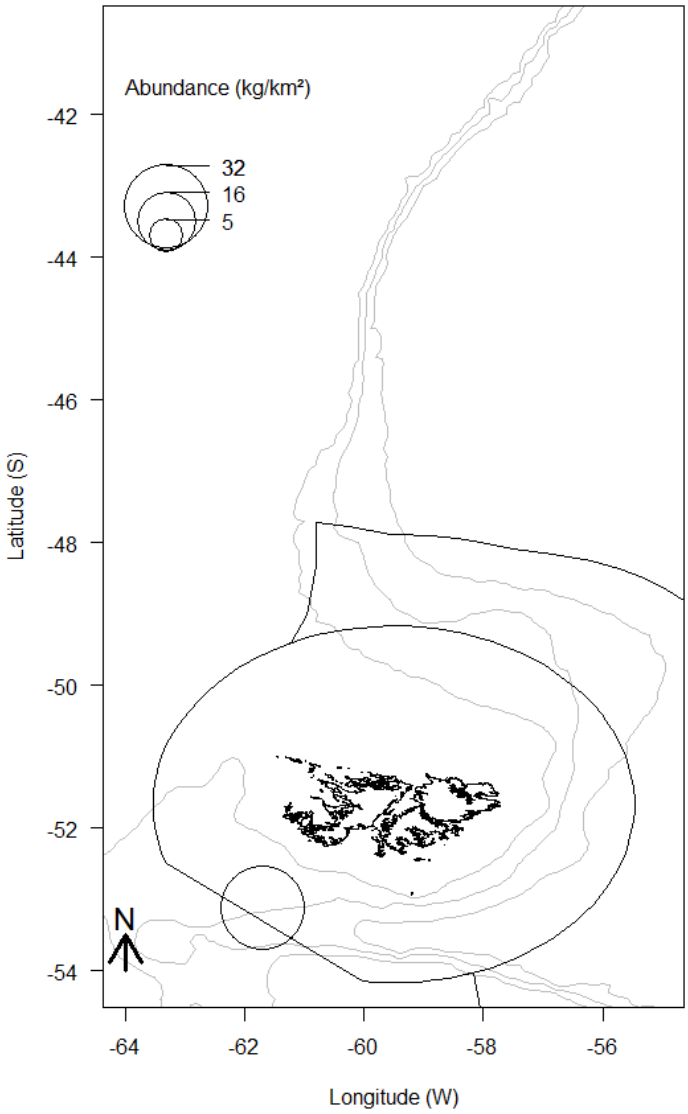

Fig 79. Distribution of densities of *Dipturus trachyderma*.

3.28 *Dissostichus eleginoides* – Patagonian toothfish (TOO)

The total catch of *D. eleginoides* was 473.436 kg (Table 2). It was caught at 14 of the 45 stations sampled during this cruise (31.1%). Catches ranged from 1.62 to 176.78 kg and densities from 10.0 to 984.4 kg/km^2 (Fig 80a). Of the 14 stations where *D. eleginoides* was caught, all stations yielded > 1 kg/km^2, 13 stations yielded > 10 kg/km^2 (92.9%), four stations yielded > 100 kg/km^2 (28.6%), and none > 1,000 kg/km^2. Catches of *D. eleginoides* occurred in all six areas: Area 1 (abundance = 2.3 kg/km^2), Area 2 (abundance = 2.5 kg/km^2), Area 3 (abundance = 50.5 kg/km^2), Area 4 (abundance = 1.8 kg/km^2), Area 5 (abundance = 57.0 kg/km^2), and Area 6 (abundance = 607 kg/km^2) (Fig 80a). The number of *D. eleginoides* sampled for otoliths was 180 (range = 1 to 74 per station) (Fig 80b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 88 females (T_L = 39 to 87 cm) and 92 males (T_L = 35 to 83 cm) (Fig 81). The number of fish sampled for length frequency was 299 (148 females and 151 males). Female T_L ranged from 39 to 87 cm (mean of 53.20 cm) (Fig 82a), whereas males measured between 35 and 83 cm (mean of 54.11 cm) (Fig 82b). Females were observed Stage I (87.2%) and Stage II (12.8%) (Fig 82a). Males were observed Stage I (92.7%) and Stage II (7.3%) (Fig 82b).

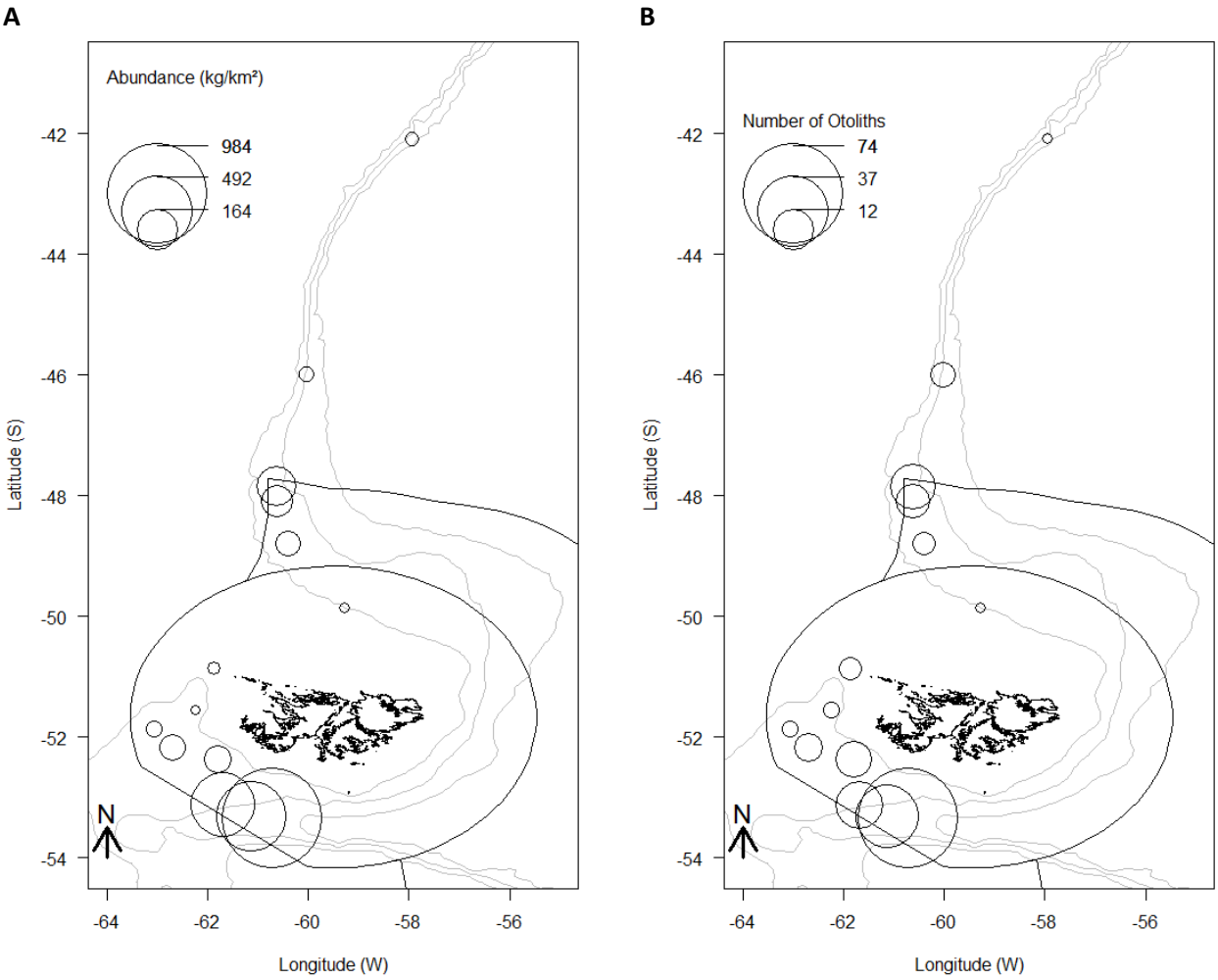

Fig 80. Distribution of (A) densities and (B) otolith samples (N = 180) of *Dissostichus eleginoides*.

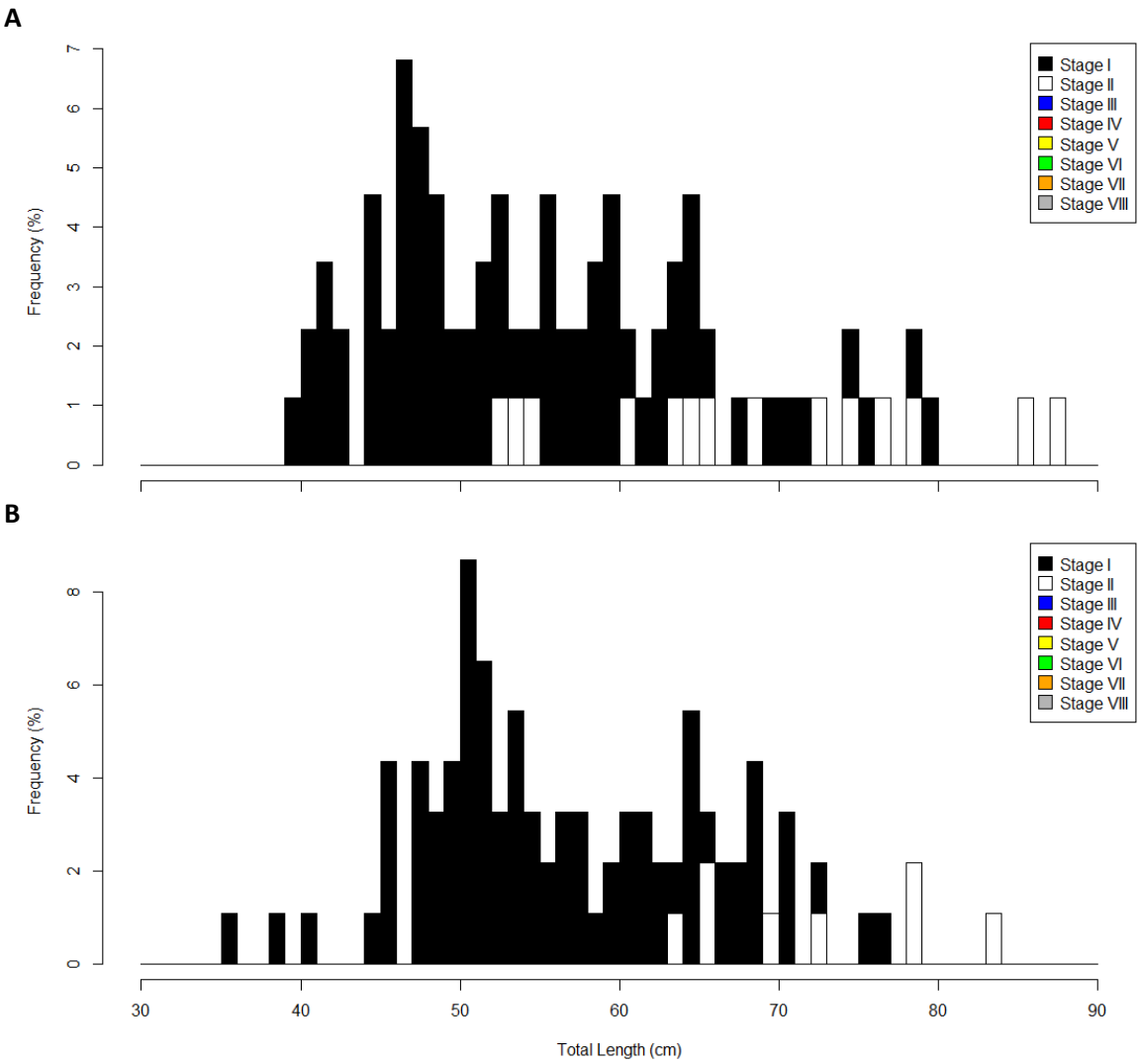

Fig 81. Length frequency (percentage of the total sample collected) of *Dissostichus eleginoides* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 88) and (B) males (N = 92).

The proportions of individuals smaller than the median T_L of 51 cm for females and 52 cm for males was similar at all depths. In waters shallower than 300 m, 36.4% of the 11 female individuals and 25.0% of the 4 male individuals were smaller than median T_L. In waters between 300 m and 500 m depths, 46.2% of the 52 female individuals and 47.8% of the 46 male individuals were smaller than median T_L. In waters deeper than 500 m, 60.0% of the 85 female individuals and 52.5% of the 101 male individuals were smaller than median T_L. The depth range for this species during the survey was 176 to 728 m. The lack of a trend is an artefact of differing patterns depending on the sampling area. For instance, most individuals collected on the High Seas are smaller than the median T_L, irrespective of depth and most individuals from the southwest of the FICZ are smaller regardless of depth. However, the abundance of *D. eleginoides* is positively correlated with depth irrespective of area.

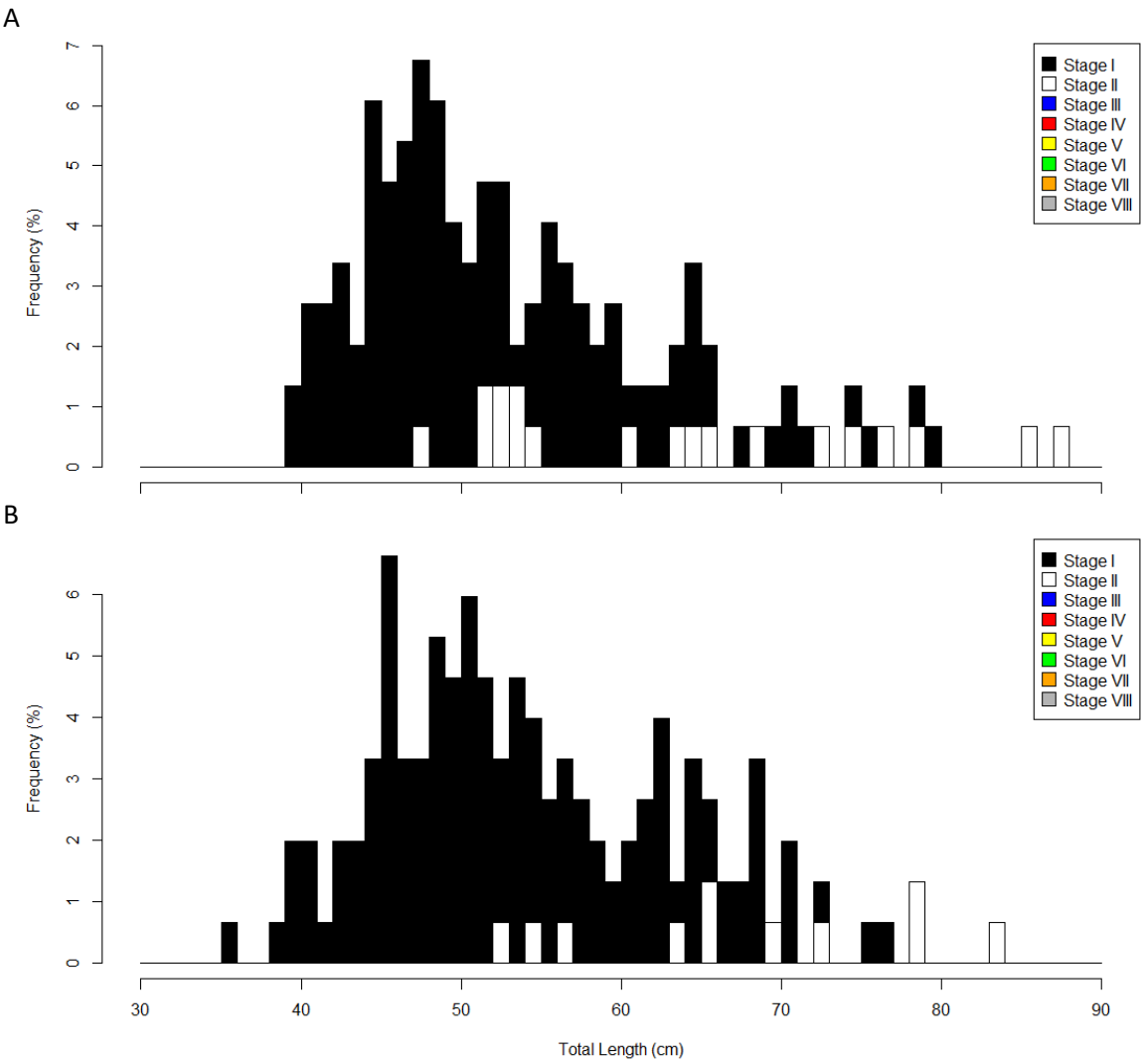

Fig 82. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Dissostichus eleginoides* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 148) and (B) males (N = 151).

3.28.1 *Dissostichus eleginoides* – Patagonian toothfish – Area 1

The total catch of *D. eleginoides* in Area 1 was 1.62 kg (Table 3) and the total density was 2.3 kg/km^2. It was caught at a single of the four stations sampled in Area 1 during this cruise (25.0%) (Fig 80a) and the density at that station was 20.7 kg/km^2 (Fig 80a). The number of *D. eleginoides* sampled for otoliths was 1. Overall, otoliths were collected from a single female (T_L = 57 cm). The number of fish sampled for length frequency was 2 (both females). Each female T_L was 57 cm (both maturity Stage I) (Fig 83a). In Area 1, neither of the 2 females sampled were smaller or equal to the median T_L of 51.

3.28.2 *Dissostichus eleginoides* – Patagonian toothfish – Area 2

The total catch of *D. eleginoides* in Area 2 was 4.08 kg (Table 4) and the total density was 2.5 kg/km^2. It was caught at one of the eight stations sampled in Area 2 during this cruise (12.5%). Density at that station was 24.6 kg/km^2 (Fig 80a). The number of *D. eleginoides* sampled for otoliths was 5. Overall, otoliths were collected from 4 females (T_L = 42 to 48 cm) and a single male (T_L = 45 cm). The number of fish sampled for length frequency was 5 (4 females and 1 male). Female T_L ranged from 42 to 48 cm (mean of 45.50 cm) (Fig 83b), whereas the lone male measured 45 cm (Fig 84b). All toothfish sampled from Area 2 were maturity Stage I (Fig 83b; 84b). In Area 2, all 4 females sampled and the lone male were smaller or equal to the median T_L of 51 and 52 cm, respectively.

3.28.3 *Dissostichus eleginoides* – Patagonian toothfish – Area 3

The total catch of *D. eleginoides* in Area 3 was 67.68 kg (Table 5) and the total density was 50.5 kg/km^2. It was caught at three of the six stations sampled in Area 3 during this cruise (50.0%). Catches ranged from 13.76to 31.84 kg per station, with densities ranging between 63.8 and 152.4 kg/km^2 (Fig 80a). Of the three stations where *D. eleginoides* was caught, all stations yielded > 1 kg/km^2 and > 10 kg/km^2, and one station yielded > 100 kg/km^2 (33.3%). The number of *D. eleginoides* sampled for otoliths was 28 (4 to 15 per station). Overall, otoliths were collected from 14 females (T_L = 46 to 85 cm) and 14 males (T_L = 45 to 83 cm). The number of fish sampled for length frequency was 28 (14 females and 14 males). Female T_L ranged from 46 to 85 cm (mean of 63.29 cm) (Fig 83c), whereas males measured between 45 and 83 cm (mean of 59.36 cm) (Fig 84c). Females were observed Stage I (78.6%) and Stage II (21.4%) (Fig 83c). Males were observed Stage I (92.9%) and Stage II (7.1%) (Fig 84c). In Area 3, 1 of 14 females sampled (7.1%) and 4 of 14 males (28.6%) were smaller or equal to the median T_L of 51 and 52 cm, respectively.

3.28.4 *Dissostichus eleginoides* – Patagonian toothfish – Area 4

The total catch of *D. eleginoides* in Area 4 was 8.32 kg (Table 6) and the total density was 1.8 kg/km^2. It was caught at three of the 21 stations sampled in Area 4 during this cruise (14.3%). Catches ranged from 2.24 to 3.68 kg and densities from 10.0 to 17.9 kg/km^2 (Fig 80a). Of the three stations where *D. eleginoides* was caught in Area 4, all stations yielded > 1 kg/km^2, two stations yielded > 10 kg/km^2 (66.7%), and none yielded > 100 kg/km^2. The number of *D. eleginoides* sampled for otoliths was 7 (1 to 4 per station). Overall, otoliths were collected from 5 females (T_L = 40 to 63 cm) and 2 males (T_L = 50 and 53 cm). The number of fish sampled for length frequency was 7 (5 females and 2 males). Female T_L ranged from 40 to 63 cm (mean of 48.20 cm) (Fig 83d), whereas males measured 50 and 53 cm, respectively (Fig 84d). All females were observed Stage I (Fig 83d). Both males were observed Stage I (Fig 84d). In Area 4, 4 of 5 females sampled (80.0%) and 1 of 2 males (50.0%) were smaller or equal to the median T_L of 51 and 52 cm, respectively.

3.28.5 *Dissostichus eleginoides* – Patagonian toothfish – Area 5

The total catch of *D. eleginoides* in Area 5 was 34.98 kg (Table 7) and the total density was 57.0 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 5.70 to 15.54 kg and densities from 27.3 to 75.2 kg/km^2 (Fig 80a). Of the three stations where *D. eleginoides* was caught in Area 5, all stations yielded > 1 kg/km^2 and > 10 kg/km^2, and none > 100 kg/km^2. The number of *D. eleginoides* sampled for otoliths was 18 (2 to 10 per station). Overall, otoliths were collected from 11 females (T_L = 45 to 75 cm) and 7 males (T_L range = 47 to 59 cm). The number of fish sampled for length frequency was 18 (11 females and 7 males). Female T_L ranged from 45 to 75 cm (mean of 59.00 cm) (Fig 83e), whereas males measured between 47 and 59 cm (mean of 52.57 cm) (Fig 84e). Females were observed Stage I (90.9%) and Stage II (9.1%) (Fig 83e). All males were observed Stage I (Fig 84e). In Area 5, 2 of 11 females sampled (18.2%) and 4 of 7 males (57.1%) were smaller or equal to the median T_L of 51 and 52 cm, respectively.

3.28.6 *Dissostichus eleginoides* – Patagonian toothfish – Area 6

The total catch of *D. eleginoides* in Area 6 was 356.756 kg (Table 8) and the total density was 607.0 kg/km^2. It was caught at all three stations sampled in Area 6 during this cruise. Catches ranged from 82.14 to 176.78 kg and densities from 407.0 to 984.4 kg/km^2 (Fig 80a). Of the three stations where *D. eleginoides* was caught in Area 56, all stations yielded > 1 kg/km^2, > 10 kg/km^2, and > 100 kg/km^2, and none yielded > 1,000 kg/km^2. The number of *D. eleginoides* sampled for otoliths was 121 (17 to 74 per station). Overall, otoliths were collected from 53 females (T_L = 39 to 787 cm) and 68 males (T_L range = 35 to 789 cm) and covered the entire length frequency for both males and females. The number of fish sampled for length frequency was 239 (112 females and 127 males). Female T_L ranged from 39 to 87 cm (mean of 51.79 cm) (Fig 83f), whereas males measured between 35 and 78 cm (mean of 53.73 cm) (Fig 84f). Females were observed Stage I (86.6%) and Stage II (13.4%) (Fig 83f). Males were observed Stage I (92.1%) and Stage II (7.9%) (Fig 84f). In Area 6, 68 of 112 females sampled (60.7%) and 66 of 127 males (52.0%) were smaller or equal to the median T_L of 51 and 52 cm, respectively.

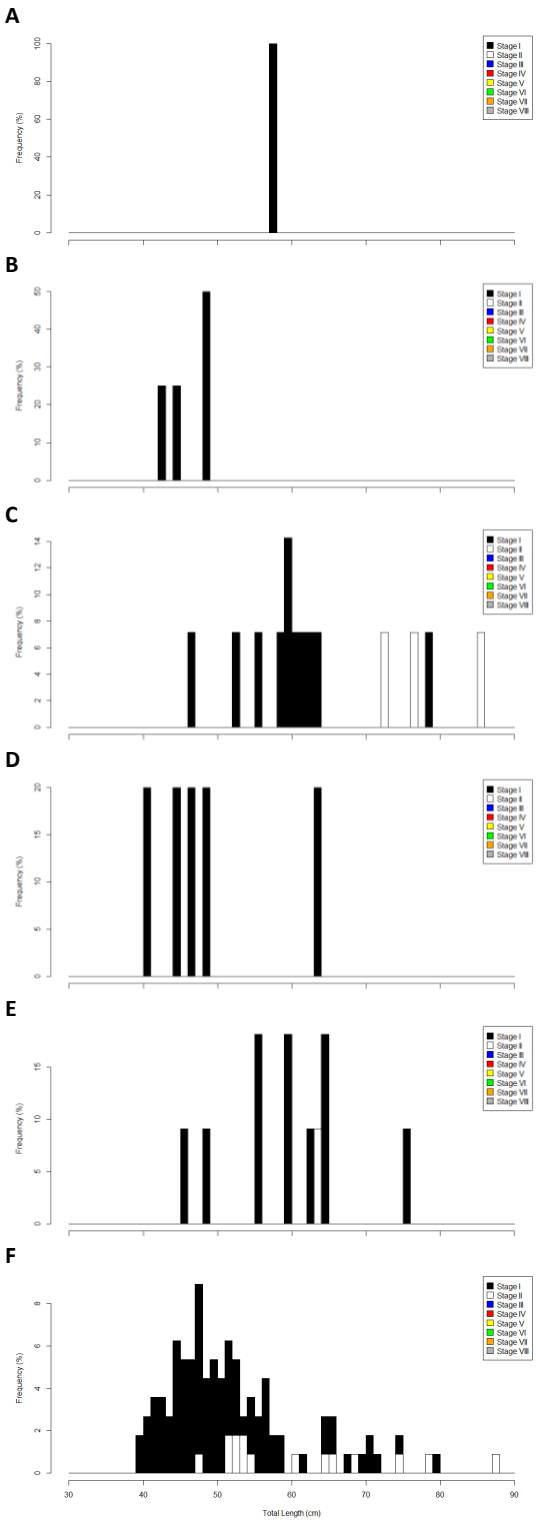

Fig 83. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Dissostichus eleginoides* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 2), **(B)** Area 2 (N = 4), **(C)** Area 3 (N = 14), **(D)** Area 4 (N = 5), **(E)** Area 5 (N = 11), **(F)** Area 6 (N = 112).

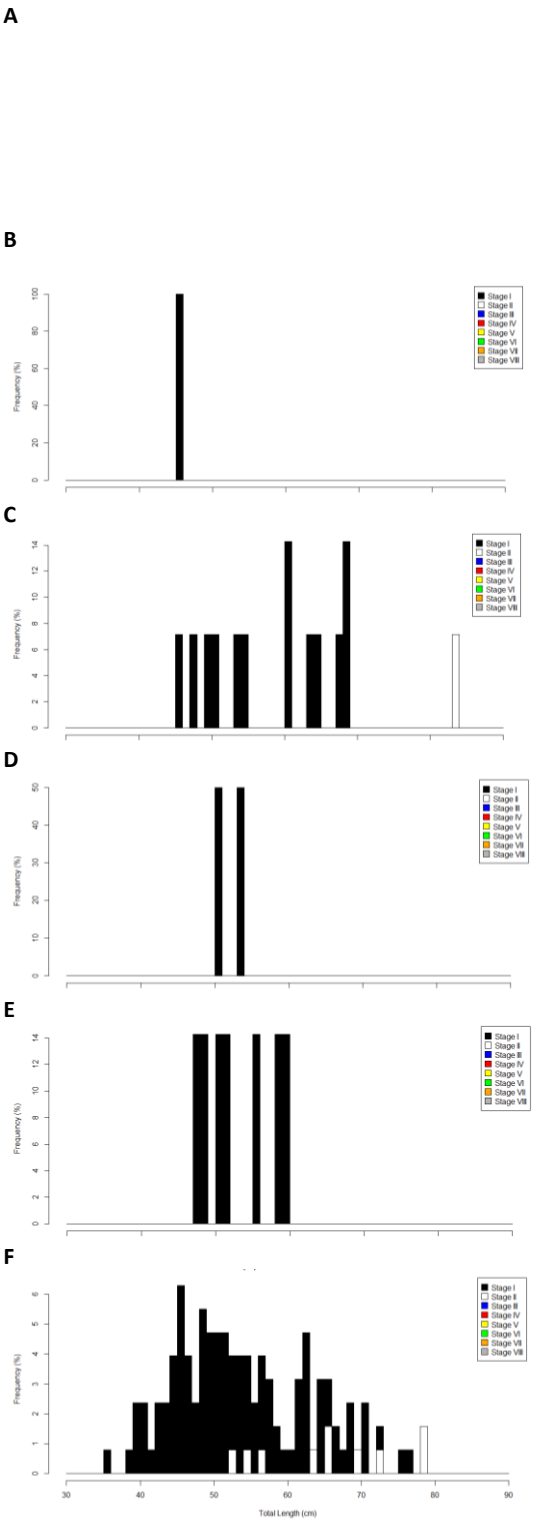

Fig 84. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Dissostichus eleginoides* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 0), **(B)** Area 2 (N = 1), **(C)** Area 3 (N = 14), **(D)** Area 4 (N = 2), **(E)** Area 5 (N = 7), **(F)** Area 6 (N = 127).

3.27 *Macruronus magellanicus*– Hoki (WHI)

The total catch of *M. magellanicus* was 1,741.12 kg (Table 2). It was caught at 23 of the 45 stations sampled during this cruise (51.1%). Catches ranged from 0.20 to 636.76 kg and densities from 0.9 to 3,081.9 kg/km^2 (Fig 85a). Of the 23 stations where *M. magellanicus* was caught, 22 stations yielded > 1 kg/km^2 (95.7%), 18 stations yielded > 10 kg/km^2 (78.3%), six stations yielded > 100 kg/km^2 (26.1%), and three station > 1,000 kg/km^2 (13.0%). Catches of *M. magellanicus* occurred in all six areas: Area 1 (abundance = 20.5 kg/km^2), Area 2 (abundance = 2.9 kg/km^2), Area 3 (abundance = 13.6 kg/km^2), Area 4 (abundance = 13.3 kg/km^2), Area 5 (abundance = 1,433.3 kg/km^2), and Area 6 (abundance = 1,297.0 kg/km^2) (Fig 85a). The number of *M. magellanicus* sampled for otoliths was 220 (range = 0 to 41 per station) (Fig 85b) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 125 females (PA_L = 13 to 31 cm) and 95 males (PA_L = 14 to 32 cm) (Fig 86). The number of fish sampled for length frequency was 621 (407 females and 214 males). Female PA_L ranged from 13 to 31 cm (mean of 22.39 cm) (Fig 87a), whereas males measured between 13 and 32 cm (mean of 22.12 cm) (Fig 87b). The histograms show three distinct modes at 20, 23, and 28 cm, respectively, for females and two distinct modes at 20 and 27 cm, for males, respectively (Fig 87). Females were observed Stage I (1.7%), Stage II (85.3%), Stage III (11.8%), and Stage IV (1.2%) (Fig 87a). Males were observed Stage I (14.0%), Stage II (73.4%), Stage III (11.2%), and Stage IV (1.4%) (Fig 87b).

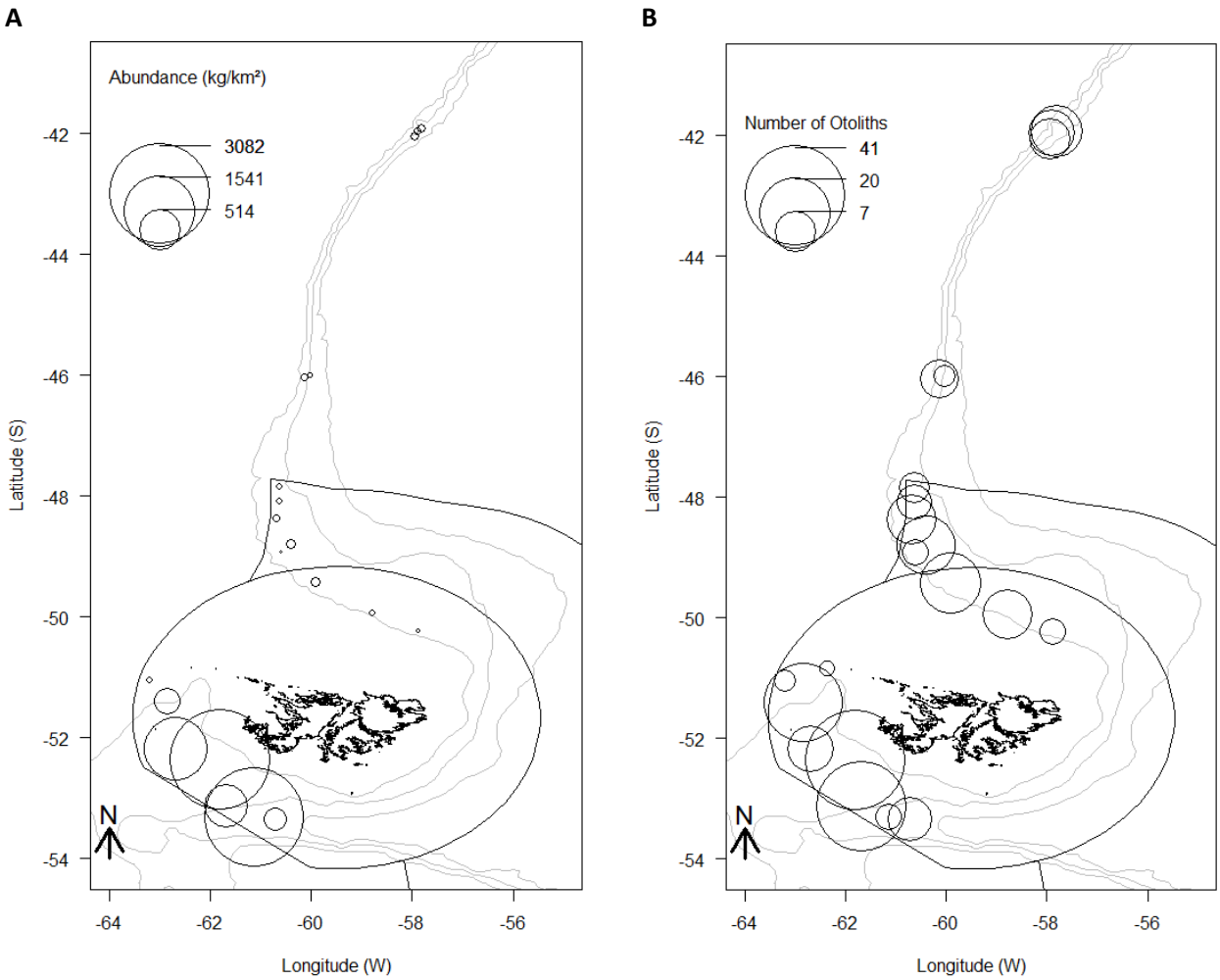

Fig 85. Distribution of (A) densities and (B) otolith samples (N = 220) of *Macruronus magellanicus*.

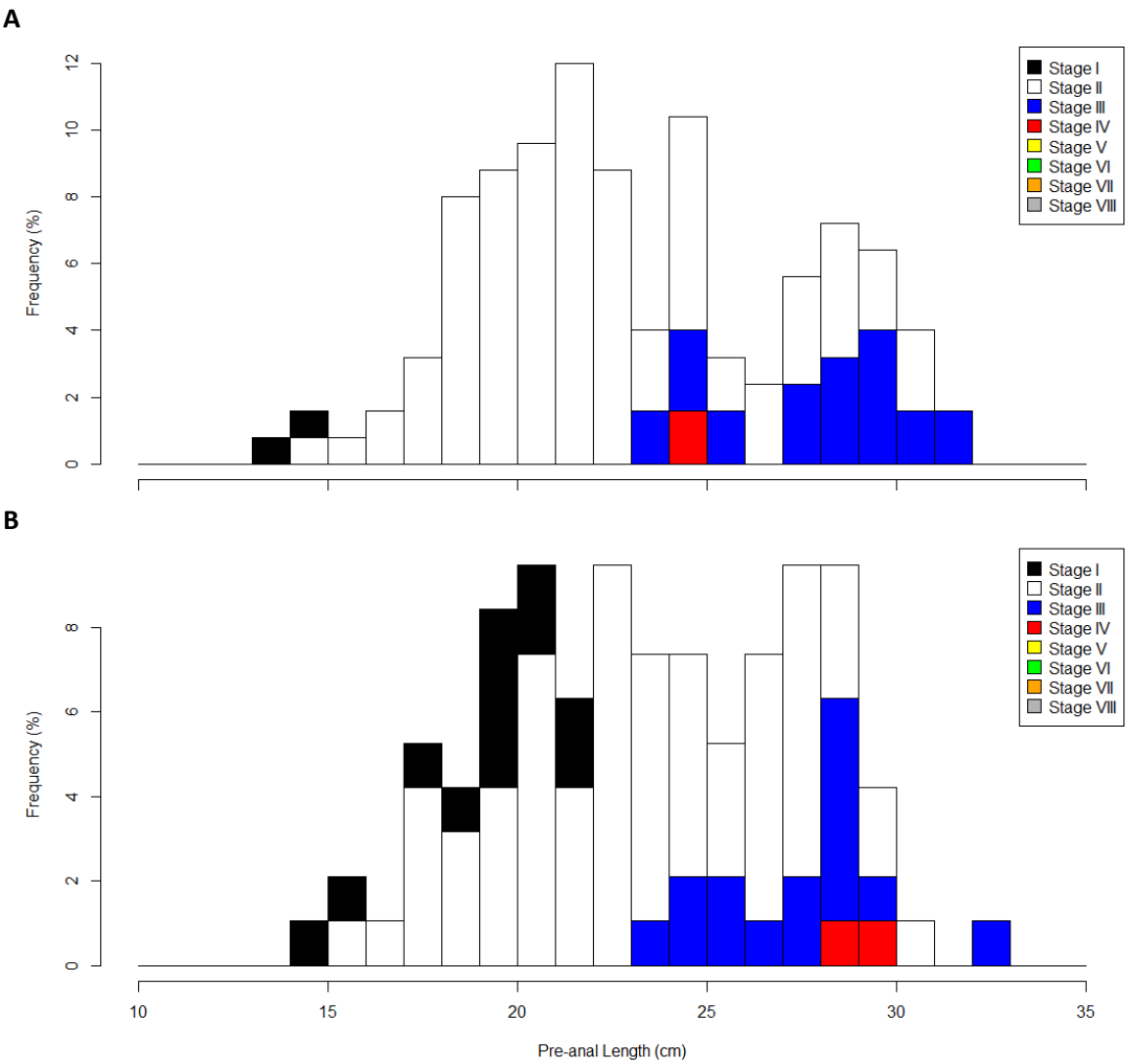

Fig 86. Length frequency (percentage of the total sample collected) of *Macruronus magellanicus* individuals sampled for otoliths with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 125) and (B) males (N = 95).

The greater proportions of individuals smaller than the median PA_L of 22 cm for females and 22 cm for males was observed in shallower waters (< 500 m). In waters shallower than 300 m, 64.3% of the 126 female individuals and 64.9% of the 77 male individuals were smaller than median PA_L. In waters between 300 and 500 m, 64.3% of the 171 females and 64.4% of the 90 males were smaller than median PA_L. In waters deeper than 500 m depths, 29.1% of the 110 female individuals and 42.6% of the 47 male individuals were smaller than median PA_L. The depth range for this species during the survey was 154 to 728 m.

3.29.1 *Macruronus magellanicus* – Hoki – Area 1

The total catch of *M. magellanicus* in Area 1 was 14.46 kg (Table 3) and the total density was 20.5 kg/km^2. It was caught at three of the four stations sampled in Area 1 during this cruise (75.0%). Catches ranged from 3.70 to 5.96 kg per station, with densities ranging between 19.2 and 27.0 kg/km^2 (Fig 85a). Of the three stations where *M. magellanicus* was caught, all three yielded > 1 kg/km^2 and > 10 kg/km^2, and no station yielded > 100 kg/km^2. The number of *M. magellanicus* sampled for otoliths was 26 (7 to 11 per station). Overall, otoliths were collected from 21 females (PA_L = 19 to 29 cm) and 5 males (PA_L = 17 to 27 cm). The number of fish sampled for length frequency was 26 (21 females and 5 males). Female PA_L ranged from 19 to 29 cm (mean of 23.33 cm) (Fig 88a), whereas males measured between 17 and 27 cm (mean of 21.60 cm) (Fig 89a). Females were observed Stage II (81.0%), Stage III (9.5%), and Stage IV (9.5%) (Fig 881a). Males were observed Stage I (20.0%) and Stage II (80.0%) (Fig 89a). In Area 1, 10 of 21 females sampled (47.6%) and 3 of 5 males (60.0%) were smaller or equal to the median PA_L of 22 and 22 cm, respectively.

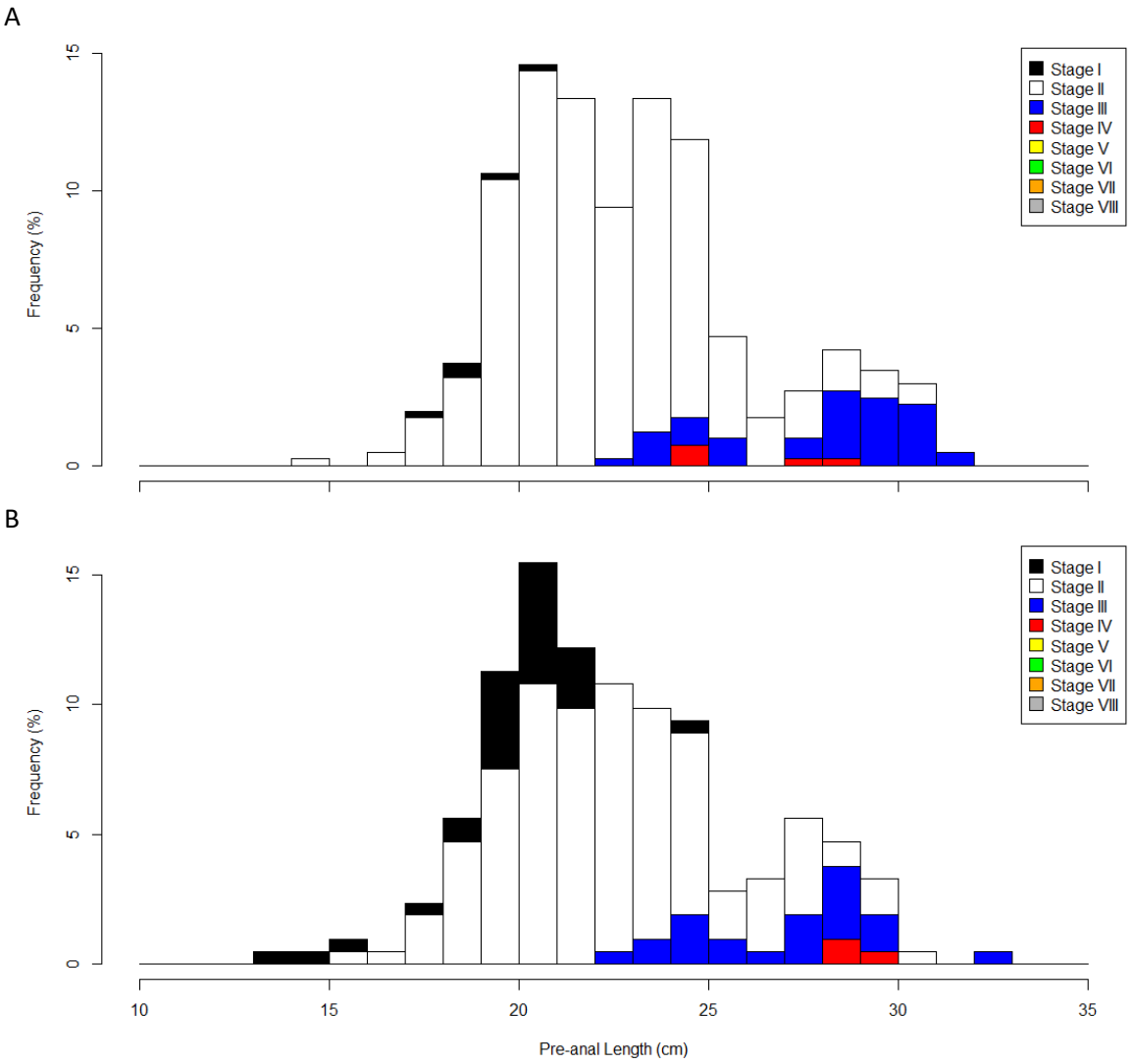

Fig 87. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Macruronus magellanicus* with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for (A) females (N = 407) and (B) males (N = 214).

3.29.2 *Macruronus magellanicus* – Hoki – Area 2

The total catch of *M. magellanicus* in Area 2 was 4.80 kg (Table 4) and the total density was 2.9 kg/km^2. It was caught at two of the eight stations sampled in Area 2 during this cruise (25.0%). Catches were 1.76 kg from station 3190 and 3.04 kg from station 3192, with respective densities of 10.6 and 17.0 kg/km^2 (Fig 85a). The number of *M. magellanicus* sampled for otoliths was 8 (2 and 6 per station, respectively). Overall, otoliths were collected from 4 females (PA_L = 19 to 29 cm) and 4 males (PA_L = 20 to 24 cm). The number of fish sampled for length frequency was 8 (4 females and 4 males). Female PA_L ranged from 19 to 29 cm (mean of 25.50 cm) (Fig 88b), whereas males measured between 20 and 24 cm (mean of 22.50 cm) (Fig 89b). All females were observed Stage II (Fig 88b). All males were observed Stage II (Fig 89b). In Area 2, 1 of 4 females sampled (25.0%) and 1 of 4 males (25.0%) were smaller or equal to the median PA_L of 22 and 22 cm, respectively.

3.29.3 *Macruronus magellanicus* – Hoki – Area 3

The total catch of *M. magellanicus* in Area 3 was 18.30 kg (Table 5) and the total density was 13.6 kg/km^2. It was caught at five of the six stations sampled in Area 3 during this cruise (83.3%). Catches ranged from 0.80 to 7.00 kg per station, with densities ranging between 3.4 and 32.4 kg/km^2 (Fig 85a). Of the five stations where *M. magellanicus* was caught, all yielded > 1 kg/km^2, four yielded > 10 kg/km^2 (80.0%), and none yielded > 100 kg/km^2. The number of *M. magellanicus* sampled for otoliths was 36 (3 to 14 per station). Overall, otoliths were collected from 20 females (PA_L = 18 to 29 cm) and 16 males (PA_L = 15 to 28 cm). The number of fish sampled for length frequency was 36 (20 females and 16 males). Female PA_L ranged from 18 to 29 cm (mean of 21.65 cm) (Fig 88c), whereas males measured between 15 and 28 cm (mean of 23.88 cm) (Fig 89c). Females were observed Stage II (85.0%) and Stage III (15.0%) (Fig 88c). Males were observed Stage I (18.8%), Stage II (56.3%), and Stage III (25.0%) (Fig 89c). In Area 3, 15 of 20 females sampled (75.0%) and 6 of 16 males (37.5%) were smaller or equal to the median PA_L of 22 and 22 cm, respectively.

3.29.4 *Macruronus magellanicus* – Hoki – Area 4

The total catch of *M. magellanicus* in Area 4 was 61.10 kg (Table 5) and the total density was 13.3 kg/km^2. It was caught at seven of the 21 stations sampled in Area 4 during this cruise (33.3%). Catches ranged from 0.20 to 45.88 kg per station, with densities ranging between 0.9 and 213.1 kg/km^2 (Fig 85a). Of the seven stations where *M. magellanicus* was caught, six yielded > 1 kg/km^2 (85.7%), four yielded > 10 kg/km^2 (57.1%), and one yielded > 100 kg/km^2 (14.3%). The number of *M. magellanicus* sampled for otoliths was 56 (0 to 25 per station). Overall, otoliths were collected from 28 females (PA_L = 17 to 31 cm) and 28 males (PA_L = 14 to 32 cm). The number of fish sampled for length frequency was 86 (51 females and 35 males). Female PA_L ranged from 17 to 31 cm (mean of 25.57 cm) (Fig 88d), whereas males measured between 14 and 32 cm (mean of 23.86 cm) (Fig 89d). Females were observed Stage II (39.2%), Stage III (56.9%), and Stage IV (3.9%) (Fig 89d). Males were observed Stage I (2.9%), Stage II (57.1%), Stage III (34.3%), and Stage IV (5.7%) (Fig 89d). In Area 4, 17 of 51 females sampled (33.3%) and 15 of 35 males (42.9%) were smaller or equal to the median PA_L of 22 and 22 cm, respectively.

3.29.5 *Macruronus magellanicus* – Hoki – Area 5

The total catch of *M. magellanicus* in Area 5 was 880.14 kg (Table 7) and the total density was 1,433.3 kg/km^2. It was caught at all three stations sampled in Area 5 during this cruise. Catches ranged from 0.28 to 636.76 kg per station, with densities ranging between 1.3 and 3,081.9 kg/km^2 (Fig 85a). Of the three stations where *M. magellanicus* was caught, all three stations yielded > 1 kg/km^2, two yielded > 10 kg/km^2, > 100 kg/km^2, and two yielded > 1,000 kg/km^2 (66.7%). The number of *M. magellanicus* sampled for otoliths was 50 (range = 0 to 41 per station) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 28 females (PA_L = 13 to 30 cm) and 22 males (PA_L = 17 to 29 cm). The number of fish sampled for length frequency was 209 (128 females and 81 males). Female PA_L ranged from 13 to 30 cm (mean of 20.38 cm) (Fig 88e), whereas males measured between 13 and 29 cm (mean of 20.69 cm) (Fig 89e). Females were observed Stage I (5.5%), Stage II (88.3%), and Stage III (6.3%) (Fig 88e). Males were observed Stage I (22.2%), Stage II (75.3%), and Stage III (2.5%) (Fig 89e). In Area 5, 108 of 128 females sampled (84.4%) and 67 of 81 males (82.7%) were smaller or equal to the median PA_L of 22 and 22 cm, respectively.

3.29.6 *Macruronus magellanicus* – Hoki – Area 6

The total catch of *M. magellanicus* in Area 6 was 762.32 kg (Table 8) and the total density was 1,297.0 kg/km^2. It was caught at all three stations sampled in Area 6 during this cruise. Catches ranged from 29.26 to 616.82 kg per station, with densities ranging between 162.9 and 2,988.9 kg/km^2 (Fig 85a). Of the three stations where *M. magellanicus* was caught, all three stations yielded > 1 kg/km^2, > 10 kg/km^2, and > 100 kg/km^2, and one station > 1,000 kg/km^2 (33.3%).The number of *M. magellanicus* sampled for otoliths was 44 (range = 3 to 33) and covered the entire length frequency for both males and females. Overall, otoliths were collected from 24 females (PA_L = 18 to 30 cm) and 20 males (PA_L = 18 to 28 cm). The number of fish sampled for length frequency was 256 (183 females and 73 males). Female PA_L ranged from 18 to 30 cm (mean of 22.81 cm) (Fig 88f), whereas males measured between 18 and 28 cm (mean of 22.51 cm) (Fig 89f). Females were observed Stage II (96.2%), Stage III (3.3%), and Stage IV (0.5%) (Fig 88f). Males were observed Stage I (9.6%), Stage II (80.8%), Stage III (8.2%) and Stage IV (1.4%) (Fig 89f). In Area 6, 72 of 183 females sampled (39.3%) and 36 of 73 males (49.3%) were smaller or equal to the median PA_L of 22 and 22 cm, respectively.

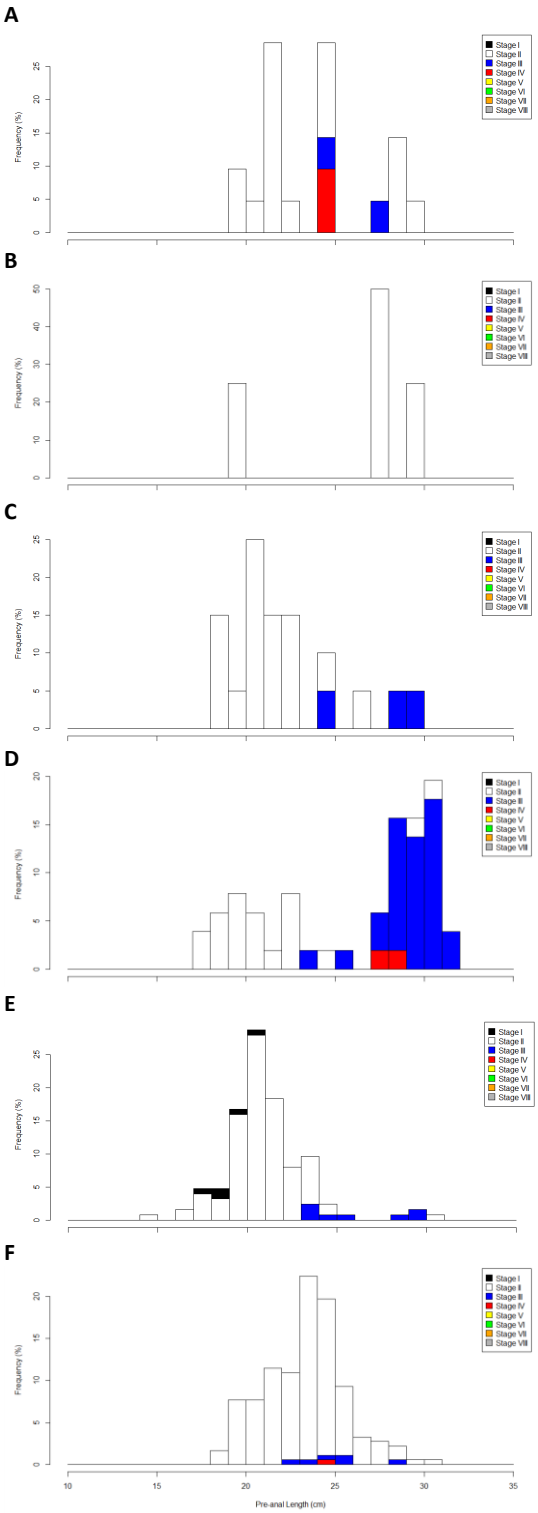

Fig 88. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Macruronus magellanicus* (females) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 21), **(B)** Area 2 (N = 4), **(C)** Area 3 (N = 20), **(D)** Area 4 (N = 51), **(E)** Area 5 (N = 128), **(F)** Area 6 (N = 183).

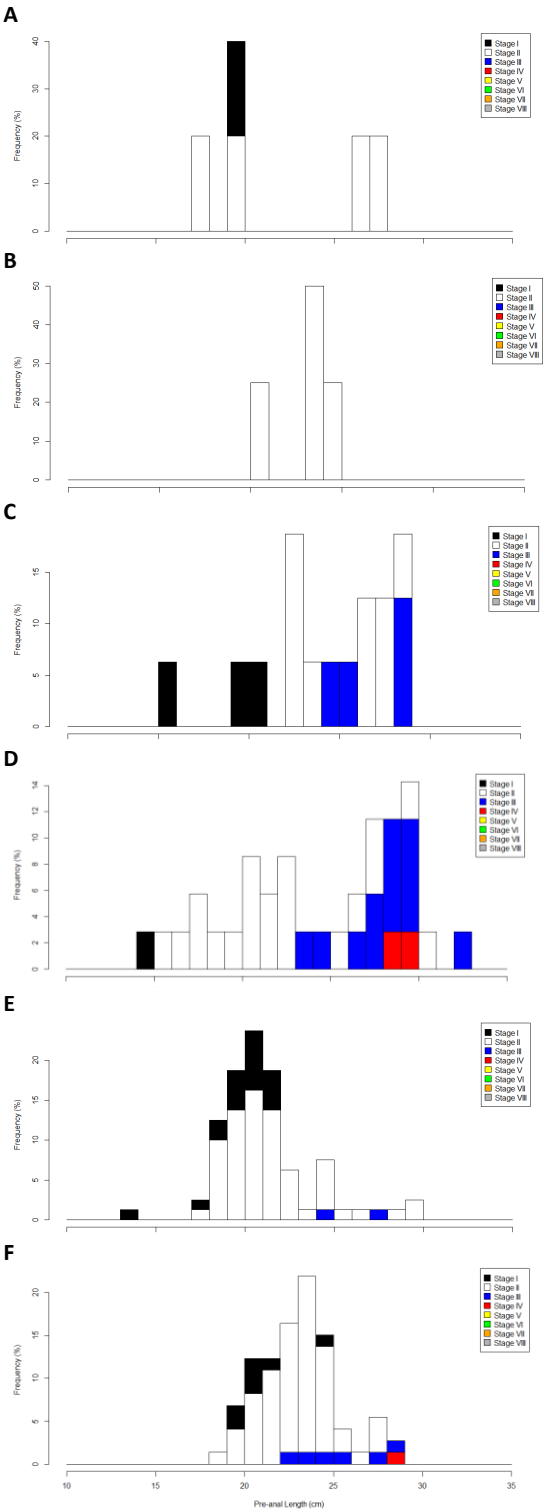

Fig 89. Length frequency (percentage of individuals sampled randomly or as a sub-sample) of the sampled population of *Macruronus magellanicus* (males) with associated maturity stages (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent) for **(A)** Area 1 (N = 5), **(B)** Area 2 (N = 4), **(C)** Area 3 (N = 16), **(D)** Area 4 (N = 35), **(E)** Area 5 (N = 81), **(F)** Area 6 (N = 73).

3.30 Oceanography

Oceanographic data were collected at 32 stations (see Fig 2). The area covered ranged from 41° 54.8'S to 53° 20.6'S and 57° 48.9'W to 63° 3.7'W. Good data were collected at all downcasts of these stations and up-cast data were removed.

Temperature (Fig 90), salinity (Fig 91), and σ-t density (Fig 92), gridded using ODV4 DIVA (gridding software; http://modb.oce.ulg.ac.be/projects/1/diva) gridding algorithm, at depths 10m, 100m and Seabed. The first layer at 10m was the shallowest depth common to all CTD casts. The surveyed area covered a depth range of 132 to 721 m.

The temperature data (Fig 90) had a smaller range than the surveys conducted in in February, with a maximum temperature of 7.55°C. The warmest water measured was on the seabed at station 3161; the western-most station. The following two stations showed an increase in temperature near the seabed (stations 3162 and 3164). Similarly, this was reflected in the salinity (Fig 91) and oxygen levels (Fig 93) with higher salinity and lower oxygen levels at seabed than the surrounding water. The increase in temperature was particularly dramatic at station 3161, with a stable temperature of 6.80 to 6.95°C from surface to 107 m. Over the next 30 metres the temperature increased to 7.55°C. The maximum recorded temperature (7.17°C) at station 3162 was at 140 metres, before decreasing to 6.99°C. At station 3164, the maximum temperature was at 140m (7.37 °C).

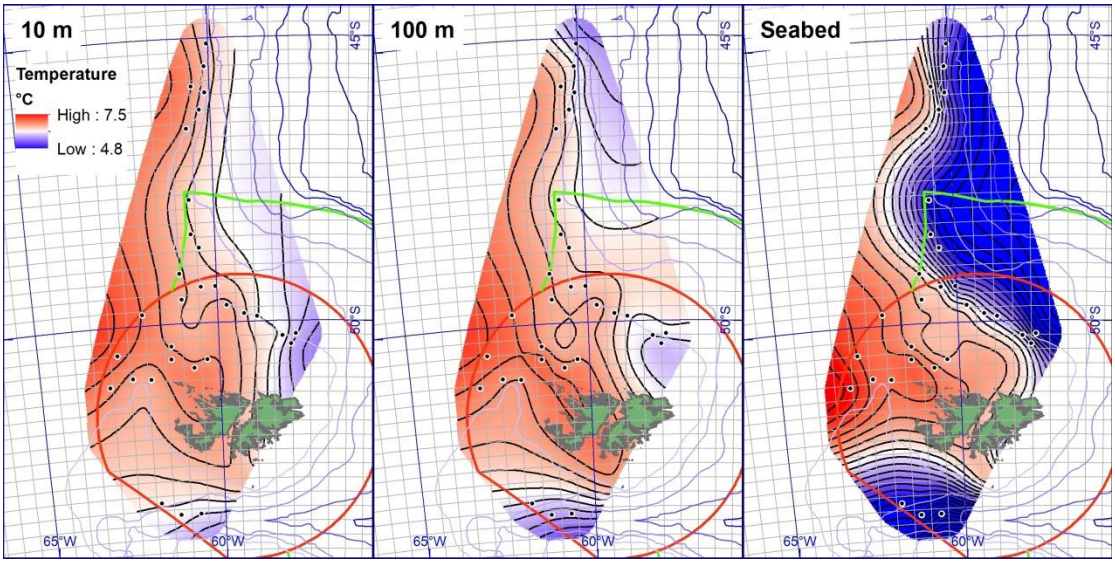

Fig 90. Temperature at 10m, 100m and seabed (contours at 0.25°C)

The salinity over the surveyed area is depicted in Figure 91. At the surface, salinity was relatively stable at between 33.5 and 33.9 PSU (Fig 91). As depth increases, there was a greater variation with significant differences recorded nearer the seabed. In the west, the water was less saline, increasing in salinity towards the east and over the deeper water at all mapped areas and depths. At seabed, salinity was greater (Fig 91) especially for the water mass close to where the Falkland current crosses Burdwood Bank. The waters to the north east along the shelf edge and in the Falkland Trough to the southwest showed measured salinities greater than 34.0 PSU.

A plot of conservative temperature against absolute salinity is shown in Figure 94. The majority of the waters masses sampled were in the transient zone, i.e. lacking Falkland shelf water, with deeper waters exhibiting characteristics of the Falkland Current (both the east and west branches).

The density map (Fig 92) shows lowest density water at 10 m in the West over the shelf, reflecting the higher temperatures and lower salinity (Figs 90; 91). At 100 m and at the seabed over the shelf, the densest waters were in the vicinity of the eastern branch of the Falkland current. Away from the Falklands, in the seabed layer, there was a higher density water mass pushing from the southwest up the west of the Falklands, joining the gyre formed by the eastern branch of the Falkland Current (Fig 92). However these results are less dramatic than those seen in February cruise (e.g. Gras et al. 2018, Arkhipkin et al. 2019; Randhawa et al. 2020).

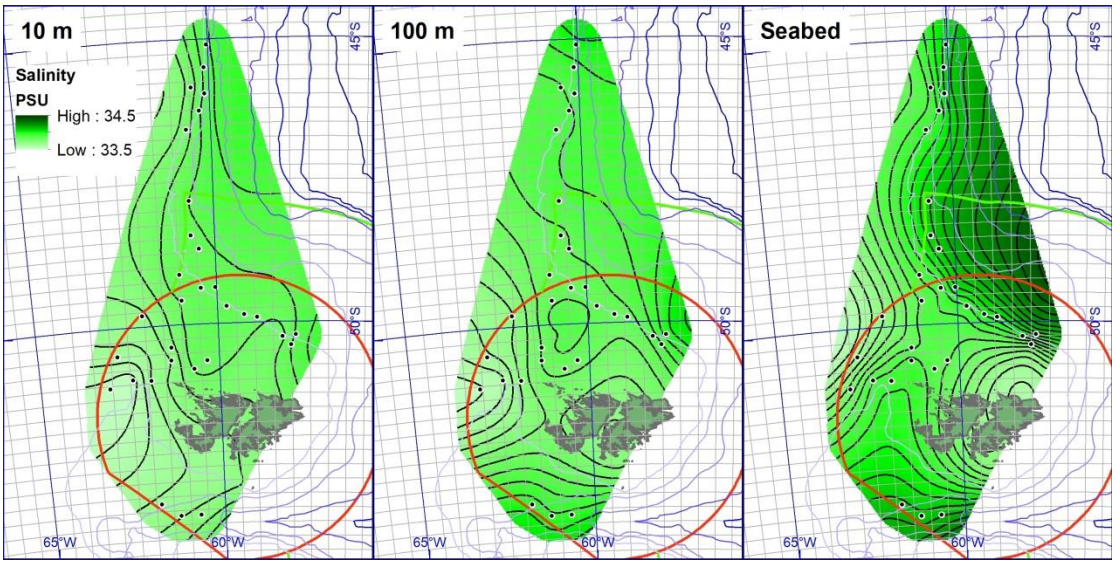

Fig 91. Salinity at 10m, 100m and seabed (contours at 0.05 PSU)

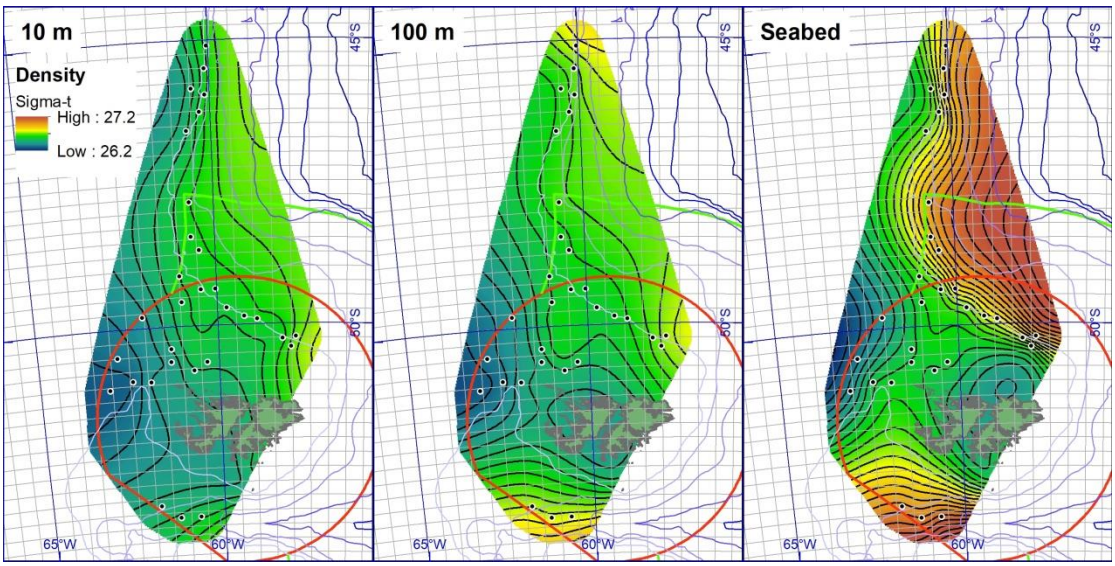

Fig 92. Density at 10m, 100m and seabed (contours at 0.05 sigma-t)

Figure 94 shows the oxygen level at 10 m, 100m, and seabed in mL/L of water. Oxygen concentration were highest at the surface, with levels of 6.0 to 6.7 mL/L. At the seabed, there were 3 clear low oxygen areas, the first to the west at stations 3161, 3162 and 3164. This matches the warm water seen in Figure 90. The second was the area in the FICZ to the north the Falklands. The third area was

where at the border of the FOCZ North and the FICZ. Whilst the second and third areas were similar to the first in terms of oxygenation, the temperature profile dropped with increasing depths.

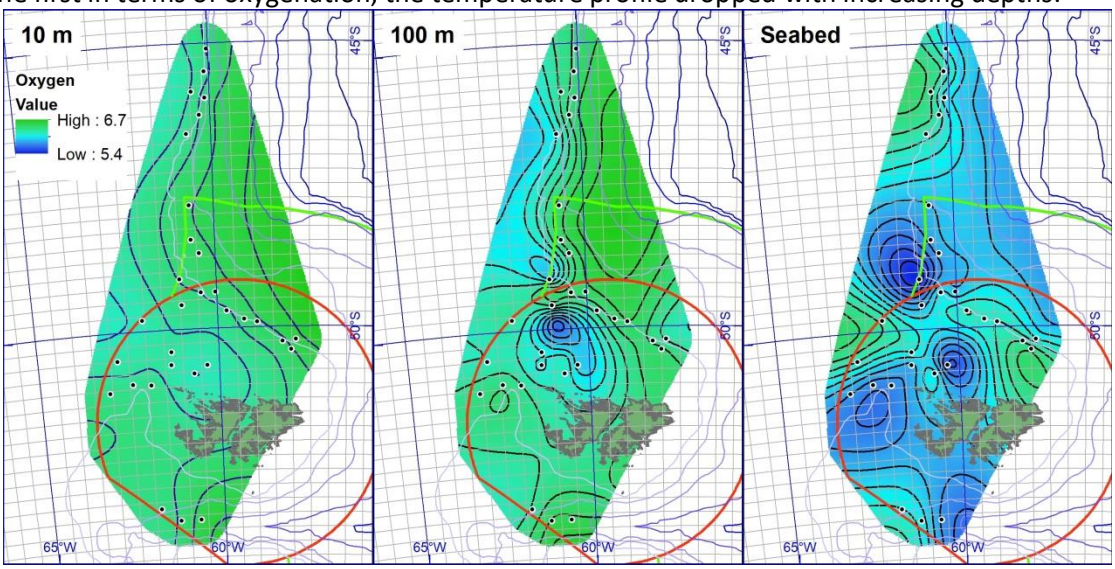

Figure 93. Oxygen at 10m, 100m and seabed (contours at 0.1ml/l)

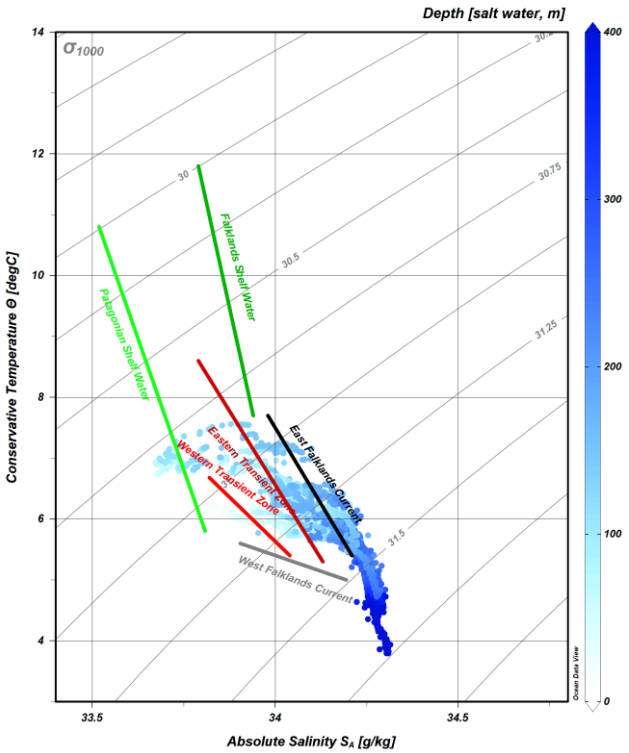

Figure 94. TS plots, 2015 -2020 data on the right (based on Arkhipkin et al. 2013)

Whilst chlorophyll data were collected, the overall pattern showed very low levels throughout the water column. For instance, during the February cruise (see Randhawa et al. 2020) saw maximum levels at 10 µg/L, compared to maximum levels of 0.88 µg/L recorded during the cruise. Provided the low levels and minor variation, the maps have not been included in this report.

4.0 Discussion

The main focus of the research survey was to investigate the distribution, abundance, and size structure of common hake throughout its feeding grounds at its peak in abundance in Falkland waters. Generally, hake was most abundant in Falkland waters within the "Hake Box" and just south of 51°S (Fig 3) and in waters between 150 and 400 m depths. Whilst variation in abundance could not be attributed primarily to Area sampled and depth, the size distribution of both males and females was. Larger individuals of both sexes were found in deeper waters and further south in the FICZ than in other areas, although much of the latter is due to the interaction between depth and Area since all stations in Area 6 were in deeper waters. Of note, even though females were more abundant than males at all stations, the sex ratio of common hake was more skewed towards females in deeper waters than shallow waters. Additionally, hake from Area 2 (High Seas between 45 and 46°S showed the presence of three distinct cohorts, including a greater abundance of individuals in the 20 to 30 cm range (females) than in other areas (see Fig 6), depicting most likely the presence of younger fish at those stations relative to the FICZ. A greater proportion of spent females was observed on the High Seas at 42°S and a greater proportion of maturing/mature individuals was observed in the FICZ (Figs 6; 7) suggesting the presence of different stocks in our sample (see Bezzi & Perrotta 1983, Roldán 1995, Ruarte 1997, Cousseau & Perrotta 1998, Renzi et al. 1999, Sardella & Timi 2004). However, only further analyses using the genetics and/or otolith samples collected during this survey will allow us to confirm this hypothesis.

Opportunistic observations of stomach contents during this survey revealed a greater proportion of individuals feeding on *D. gahi* within the FICZ and a greater proportion of common hake feeding on myctophids (lanternfish), e.g. *Gymnoscopelus nicholsi*. As such, 12 otoliths were collected from the High Seas and the FOCZ to create a reference collection against which stomach contents of common hake collected during the research cruise can be compared to. The detailed qualitative and quantitative analyses of these stomach samples will address potential ontogenetic shifts in diet and variability in diet by common hake size, depth distribution, and areas of their feeding range.

Southern blue whiting were caught at many stations, but over 90% of the catch was in the southwest of the FICZ south of 53°S (Fig 15). The survey was conducted in July, just prior to this species' spawning season. Consistent with Gras et al. (2018), this survey confirms that regardless of season, to get the most accurate estimate of southern blue whiting abundance, research cruises must extend to the southwest of the fishing area and into deeper waters. The same is true for toothfish (Fig 80) and hoki (Fig 85).

The distribution of both grenadier species sampled during this survey were driven by depth (Figs 33; 38) and were the most abundant fish species caught at > 500 m depths (consistent with Laptikhovsky et al 2008; Van Wijk et al. 2000). For the ridged-scale grenadier, different cohorts were observed in different areas; this species is considered a single stock from 41°S to 54°S (Laptikhovski 2011). For instance, the High Seas samples consisted primarily of smaller and immature individuals, whereas samples from the southwest of the FICZ consisted of larger maturing/mature/spent females and larger maturing/mature males (Figs 36; 37). These observations are consistent with spawning and spent individuals being observed at 500 – 900 m depths (50 to 54°S) with juveniles and young adults (immature) observed north of 50°S (Laptikhovsky et al. 2008; Laptikhovsky 2011). Careful consideration must be given to the distribution of the spawning stock if commercial exploitation is to be granted in Falkland waters.

The banded whiptail grenadier is more common than the ridge-scale grenadier in commercial catches (FIG 2020) due to its shallower depth distribution (Cohen et al 1990). However, the paucity

of ecological and biological information available for this species is surprising given the propensity for grenadiers to be vulnerable to overexploitation due to commercial fishing activities. However, the commercial potential for this species is limited given its relative small size compared to other macrourids (see Table 2). To better understand the impacts of the bycatch of this species of grenadier on the population, it is suggested that the FIFD make use of the comprehensive otolith collection gathered across a broad geographical distribution during this survey to undertake a study on the life-history parameters of the banded whiptail grenadier to inform a risk assessment for this species under current commercial (bycatch) exploitation (see Lee et al. 2019 as an example).

The Argentine shortfin squid was caught as a surprisingly high number of stations overall, but in unsurprisingly small quantities in Falkland waters. Nearly 99% of catches were reported from the High Seas during this survey with most of these caught at 42°S (Fig 43). It is important to note the presence of two distinct cohorts (or possibly stocks) in our sample with one cohort consisting of primarily immature (Stage II) squid at 10 cm mantle length (within Falkland waters) and another consisting primarily of immature (Stage II), preparatory (Stage III), and maturing (Stage IV) individuals at 20 cm modal mantle length on the High Seas (Figs 45; 46). These squid caught at 42°S on the High Seas are likely to consist of a mix of summer (larger maturing/mature females of 25+ cm M_L) and winter spawning individuals (smaller young females of 20 cm modal M_L) of the South Patagonian stock whose young will migrate south into Falkland waters for the next feeding season (February to May) (Fig 45a). The squid at 42°S consisted mostly of males (Stages III – V; 20 cm modal M_L) (Fig 46a).

Catches of Patagonian shortfin squid were abundant throughout the survey area, reaching peak densities in the north of the FOCZ (Fig 54). Catches consisted mostly of immature (Stage II) females and preparatory (Stage III) males (Figs 56; 57). Some of the densities observed exceeded those reported from the *'Loligo'* pre-recruitment survey (Winter et al. 2020), suggesting that the pre-season biomass estimates should consider out of '*Loligo* Box' densities as proxies for potential future immigrations into the fishing area.

The abundance of rock cod was highest on the High Seas (Fig 58). Despite being caught at nearly every single station, the abundance of this species was relatively low in the FICZ. Once the most common and most abundant finfish species in Falkland waters, this species has seen a steady decline since 2010 (Winter 2020). Rock cod on the High Seas were generally immature or resting (both males and females observed Stage II) (Figs 61a; b; 62a; b), whereas a greater proportion of individuals of both sexes were observed Stage III – V in Falkland waters (Figs 61c; d; e; f; 62c; d; e; f). Based on otolith core microchemistry (and supported by genetic analyses – Shaw, pers comm), rock cod on the High Seas are thought to consist of a mix of individuals originating from northern Falkland Shelf, Southern Falkland Shelf and High Seas areas, whereas those in Falkland waters of a mix of northern Falkland Shelf and High Seas areas only (Brickle et al. in prep). Given that rock cod larva are dispersed pelagically and passively with prevailing currents, it is unsurprising that larvae from the northern Falkland Shelf are transported north to the High Seas. Given the unidirectional movement of larvae and that rock cod population on the Patagonian Shelf consists of at least two distinct stocks, it is imperative that FIFD gains a better understanding of the reasons behind the decline in rock cod in Falkland waters as this might have a bearing on the genetic diversity of the population and potential for recovery of the stock.

A few interesting facts about catches on this cruise are worth mentioning. First, we collected a specimen of Brazilian codling *Urophycis brasiliensis* at station 3216 (Area 4 within the FICZ) at a depth of 250 m. This is only the second time this species is reported from Falkland waters. According to FishBase (Froese & Pauly 2019), this species does not occur south of 46°S. Additionally, rock cod is not thought to occur at depths greater than 500 m (Nakamura et al. 1986; Froese & Pauly

2019), yet this species was reported from depths of 608 m (station 3189 on the High Seas at 42°S) and 566 m (station 3152 in the southwest of the FICZ) during this survey. Gras et al. (2018) also reported this species from depths exceeding the maximum reported on FishBase (Froese & Pauly 2019).

5.0 Recommendations

5.1 Planning next research cruise

With most of the current crew and officers moving to the Monteferro (ZDLM3) from 2021, it is imperative that the Chief Scientist and Factory coordinator (at the very least) meet with RBC, the *Castelo*'s Captain, and factory bosuns to ensure that protocols are clearly communicated prior to commencement of fishing operations. Ideally, this meeting would take place aboard the vessel at least 24 hours prior to departure.

5.2 Common hake diet study

The large amount of common hake stomachs collected during this study will provide a comprehensive overview of this species diet across its feeding grounds during peak abundance. However, these samples cannot be considered representative without, at the very least, additional replicates. While not necessary to cover the entire area sampled during this research cruise, it is recommended to repeat this diet sampling in July 2021 and/or 2022 so that robust analyses can be performed and outputs contributing to our understanding of the ecological role of common hake in Falkland waters. Furthermore, it is recommended that the same stations within Falkland waters be used for these subsequent research cruises.

5.3 Sharing our findings abroad

Some observations during this survey are worth mention. For instance, PAR was found at depths greater than that reported in the literature and we collected a single specimen of URB (only the second in FIFD's database). Our cruise was not the first to make interesting observations. It is recommended, that where possible, these interesting findings be disseminated. As a result of this research cruise, Toni Trevizan has taken the initiative to contact FishBase so that biological and ecological data for PAR and URB can be updated for the benefit of the entire scientific community. We encourage other cruise participants to do the same in the future.

5.4 PAR

Recent declines in the abundance of PAR have significantly impacted on the Falkland Shelf ecosystem. For instance, the decrease in this common prey species for many piscivorous fishes and higher trophic predators (such as pinnipeds) might have resulted in a diet shift for many species. Furthermore, the abundance of PAR on the High Seas was almost a full order of magnitude greater than in the FICZ/FOCZ. As such, we recommend that the FIFD make an effort to better understand the demography of PAR on the Patagonian Shelf by using some of the otolith samples collected during this survey from the High Seas and Falkland waters for otolith shape and microchemistry analyses. Although the latter was done on samples collected nearly ten years ago (prior to the decline of PAR), analyses of contemporary material could be beneficial to our understanding of the Falkland Shelf ecosystem.

5.5 Limitations with scales

There are some limitations with the weighing of small samples on board. Perhaps FIFD can look into implementing an "anti-vibration system" and bring scales with greater precision for smaller samples such as benthos, gonads, and stomach contents.

5.6 CTD

There was an issue with the CTD winch during the research cruise. Although RBC has committed to perform the necessary repairs so that the CTD winch is fully functional for

the next research cruise, it is imperative that FIFD follow up with RBC prior to the next cruise to ensure this is indeed the case.

5.7 Plankton tows

Although we were successful in deploying the Isaac-Kidd plankton trawl on three separate occasions with the new set-up aboard the *Castelo*, certain improvements can be made for the next research cruise. These have been highlighted to the First Officer and to RBC and changes are planned for next year to the set-up. It is recommended that the next research cruise deploy the plankton net to ensure that this new set-up is fully functional.

5.8 Printer

Due to our reliance on paper forms during the research cruise and the need to update lists, *i.e.* otolith collection, diet samples, stable isotope samples, having a functional printer would be useful and more time efficient than having to print from the bridge. It is recommended that the FIFD invest in a "cheap" printer to reside permanently in the lab aboard the *Castelo* for future research cruises.

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