Cruise Report 2025-02-ZDLU1

Groundfish survey

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1. Summary

The February 2025 groundfish survey was conducted in the Falkland Islands Conservation Zones finfish fishing area from January 30th 2025 to February 19th 2025, for the first time aboard the F/V Argos Vigo.

The 84 bottom trawl stations and the 84 CTD stations planned were conducted; all bottom trawls were considered valid, and 83 CTD casts produced usable data.

The most abundant species during the survey were rock cod (29%), common hake (22%), Argentine shortfin squid (17%), and southern blue whiting (10%).

CPUE of five finfish species declined (i.e., butterfish, driftfish, hoki, kingclip, and red cod) compared with previous February groundfish surveys.

CPUE of hoki and kingclip were the lowest amongst February groundfish surveys since 2010.

CPUE of seven finfish species increased (i.e., banded whiptail grenadier, common hake, ridge scaled rattail, rock cod, southern blue whiting, southern hake, and Patagonian toothfish) compared with previous February groundfish surveys.

CPUE of common hake and southern blue whiting were the highest amongst February groundfish surveys since 2010.

CPUE of the main commercial squid species, the Argentine shortfin squid and the Patagonian squid, decreased from the February 2024 groundfish survey; in particular, the Patagonian squid saw a considerable decrease in CPUE.

CPUE of each skate species was below average amongst February groundfish surveys since 2010. CPUE of six species of skates were the lowest amongst February groundfish surveys since 2010, i.e., starry skate, grey-tailed skate, Falkland skate, Magellanic skate, sand ray, and roughskin skate. Some skate species caught in Falkland Islands waters are classified as endangered (i.e., grey-tailed skate), vulnerable (i.e., white spotted skate), or near threatened (i.e., blonde skate, Falkland skate, and multispine skate) by The International Union for Conservation of Nature (IUCN).

CPUE of catfish and dogfish were the lowest amongst February groundfish surveys since 2010, and dogfish is classified as vulnerable by the IUCN.

There were no incidental bycatches, nor mortalities, of pinnipeds during the survey.

Temperature was lower to the north-east and to the south-west in the survey area. Chlorophyll concentration was higher in the surface, and along the north. Overall, oxygen, salinity, and density were higher to the north-east and to the south-west.

2. Introduction

The Falkland Islands shelf is located within the Patagonian large marine ecosystem, one of the most productive areas in the world (Arkhipkin et al. 2012). The Patagonian large marine ecosystem is comprised of a southern temperate ecosystem in the north and a sub-Antarctic ecosystem in the south (Boltovskoy 1999). This marine ecosystem lies within waters of subtropical origin, transported onto the shelf by the Brazil Current and mixed with temperate shelf waters.

Several productive zones are revealed in this ecosystem, mainly due to the existence of tidal mixing oceanographic fronts, as well as seasonal fronts originating from cold fresh water inflows into the Strait of Magellan. The sub-Antarctic ecosystem lies within waters of sub-Antarctic origin transported onto the shelf by the Falkland Current (Peterson & Whitworth 1989). The Falkland Current diverges from the main stream of the Antarctic Circumpolar Current in the Drake Passage and turns northwards. The Falkland Current splits at the continental slope south of the Falkland Islands into a weak branch and a stronger branch that flow around the west and east of the Islands, respectively (Bianchi et al. 1982). These oceanographic features affect the distribution and abundance of marine species such as the Argentine shortfin squid (*Illex argentinus*) and hoki (*Macruronus magellanicus*) that migrate to frontal zones for feeding and back to non-frontal zones for spawning (Agnew 2002). In contrast, the intrusion of sub-Antarctic waters favours the migration of deep-water fish such as Patagonian toothfish (*Dissostichus eleginoides*) into the shelf (Laptikhovsky et al. 2008; Arkhipkin & Laptikhovsky 2010).

Scientific surveys are key sources of fisheries-independent data for fisheries ecology and that benefit from a standardised sampling plan and constant catchability (Hilborn & Walters 1992; Alglave et al. 2022; Gallo et al. 2022). The Falkland Islands Fisheries Department (FIFD) has carried out annual fisheries-independent groundfish surveys that consist of a fixed array of bottom trawl stations and oceanographic stations. These fixed stations are conducted to the west and north in the Falkland Islands Interim Conservation and Management Zone (FICZ) and in the northern part of the Falkland Islands Outer Conservation Zone (FOCZ) during summer[1] (February 2010, 2011, 2015–2024) and winter (July 2017, 2022, 2023, and 2024).

The February groundfish surveys were originally conducted to estimate the biomass of rock cod (*Patagonotothen ramsayi*), which at the time represented a management index species. However, the aim of the February groundfish survey extended to other commercial and bycatch species in recent years. Biomass estimates from February groundfish surveys conducted in parallel with calamari pre-season surveys in the 'Loligo Box' revealed the decrease of rock cod, red cod (*Salilota australis*), and southern hake (*Merluccius australis*) abundances from 2010 to 2020, with steady levels or slowly increasing levels from 2021 to 2024. Banded whiptail grenadier (*Coelorinchus fasciatus*), common hake (*Merluccius hubbsi*), hoki, Patagonian toothfish, and southern blue whiting (*Micromesistius australis*) did not have statistically significant trends from 2010 to 2024, although the common hake had a significant increase in biomass from 2010 to 2023 (Ramos & Winter 2024).

The July groundfish surveys were also conducted to examine the biomass of commercial species that are more abundant in Falkland Islands waters during winter, with emphasis on the common hake (Gras et al. 2017a; Lee et al. 2022; Ramos et al. 2023, 2024a). Indeed, increasing abundance of common hake in the Falkland Shelf in recent years (Ramos & Winter 2022a, 2024) triggered a demography survey conducted exclusively for this species during July 2020 (Randhawa et al., 2020a).

The FIFD aims to build a solid time series of abundance, distribution, and biological data of commercial species during February and July, to be able to compare patterns through the years, between summer and winter, and to examine how these patterns are affected by environmental, ecological, and anthropogenic factors. Therefore, the following objectives were established for the February 2025 groundfish survey:

[1] Austral seasons are referred to in this report.

2.1. Survey objectives

1. To examine the abundance, distribution, and biology of demersal fish and squid species along the west and north in the Falkland Shelf.
2. To carry out an oceanographic survey along the west and north in the Falkland Shelf.

3. Material and Methods

3.1. Vessel

The February 2025 groundfish survey (2025-02-ZDLU1) was conducted for the first time aboard the F/V Argos Vigo (ZDLU1), registered in the Falkland Islands (LOA 77.5 m, GRT 2074).

3.2. Survey plan and key dates

The standard plan of the groundfish survey consists of 84 bottom trawl stations of 60 min each, with four trawl stations conducted per day over a 21-day sampling period. Each trawl is preceded or succeeded by an oceanographic station (CTD). These stations are replicated each year according to a systematic transect design based on the division of the shelf area into 0.5 longitude by 0.25 latitude decimal degree grid squares, and each trawl station is allocated to an individual grid square to ensure coverage of the entire study area.

The February 2025 groundfish survey completed the 84 planned stations that covered the full survey area (Fig. 1) despite experiencing several rough weather days. The ship departed from Stanley at 20:00 on January 29th 2025. The first trawl station was conducted to the north of East Falkland early in the morning on January 30th 2025, an area where catches are usually small. This allowed the scientific staff, and in particular the two new scientific staff, to familiarise with the routine of the survey during the least busy stations to the north of East Falkland. Mechanical failure on February 2nd, and rough weather on February 10th and on February 12th prevented conducting one of the four stations planned for those days. In addition, rough weather did not allow conducting any station on February 11th. Summer has more daylight hours compared with winter, hence it was possible to conduct five trawls during daylight in seven days to recover those stations that were not conducted due to mechanical failure and rough weather. The oceanographic stations (CTD) preceded or succeeded each trawl depending on logistics. The last trawl of the survey was hauled on February 19th 2025 to the north of West Falkland. The ship arrived to Stanley on February 20th 2025, and the scientific staff disembarked at 9:00 at FIPASS.

3.3. Trawling

A bottom trawl net owned by the FIFD was used; the net was equipped with rockhopper gear fitted with Injector Cobra (2,600 kg; 6.5 m^2) bottom doors. The cod-end had a 90 mm mesh size fitted with a 40 mm cod-end liner. Sweep length was 110 m, bridle length was 20 m, and footrope was 36.52 m. The MarPort Net Monitoring System was used to monitor the net geometry; all measurement readings were successfully obtained for 84 stations. The duration of each trawl was 60 min on the bottom, and trawling speed varied between 3.8 and 5.1 knots. A total of 84 bottom trawls were conducted with corresponding station numbers ranging from 1205 to 1371 (Table I).

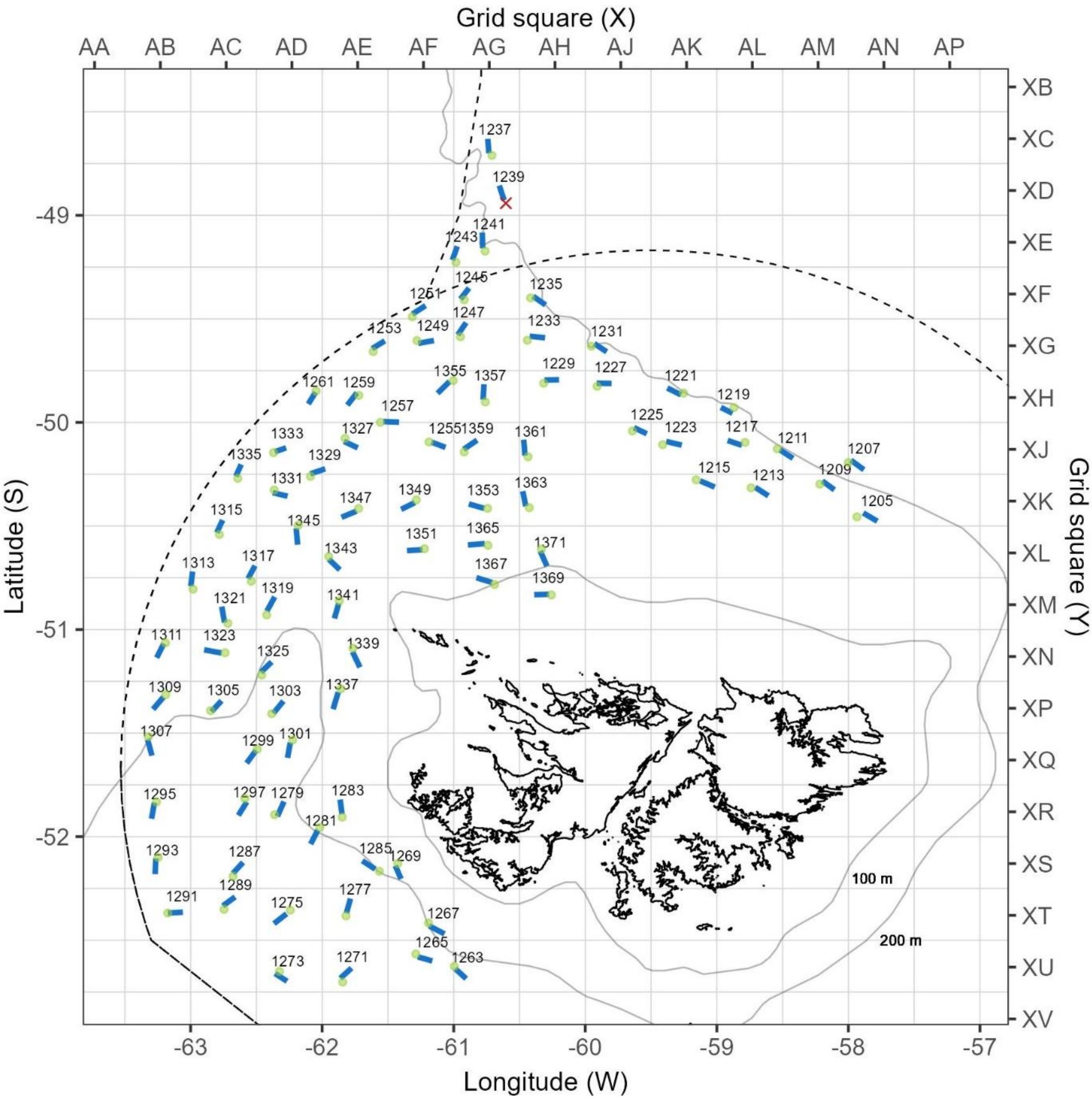

Figure 1. Bottom trawl tracks with survey station numbers conducted (n = 84) during the February 2025 groundfish survey (2025-02-ZDLU1). CTD stations with usable oceanographic data are indicated with green dots (n = 83). CTD stations with not usable oceanographic data due to battery failure (n = 1) are indicated with a red X.

3.4. Biological sampling

At each trawl station, the catch was sorted and the total catch was weighed by species with an electronic Marel balance (150 kg capacity). All commercial species and most bycatch species were sampled, i.e., up to 100 randomly sampled individuals. Biological sampling of finfish included measurement to the lower cm of total length for common hake, driftfish (*Seriolella porosa*), kingclip (*Genypterus blacodes*), red cod, rock cod, southern blue whiting, and southern hake, or pre-anal length for hoki and grenadiers (*C. fasciatus* and *Macrourus carinatus*). Total length and fork length were recorded for butterfish (*Stromateus brasiliensis*) to the lower cm. Macroscopic assessment of sex and maturity were conducted following an eight-stage maturity scale used at FIFD (Brickle et al. 2005, modified from Nikolsky 1963). For squid, the sampling included the measurement of dorsal mantle length to the lower 0.5 cm, and recording of sex and maturity using a six-stage maturity scale used at FIFD (Lipinski 1979). For skates, disc width and total length were measured to the lower cm, and weight was measured to the nearest gram; sex and maturity were examined macroscopically using a six-stage maturity scale used at FIFD (Arkhipkin et al. 2008). For sharks, total length was recorded, and sex and maturity were examined macroscopically using a six-stage maturity scale used at FIFD (Arkhipkin et al. 2008). Female skates and sharks were dissected for maturity examination during part of the survey for training of new scientific staff; when possible, females in good shape were examined externally and released alive immediately. Maturity of male skates and sharks was examined externally. Identification of length-groups were based on discrete modal lengths and bell-shaped length frequencies.

Otoliths were taken from fish according to a combined fixed (FOS) and random (ROS) otolith sampling strategy. For the FOS, otoliths were extracted from 2 to 5 individuals for each 1 cm length bin per sex. Otoliths from two additional individuals per species (hakes, kingclip, red cod, rock cod and Patagonian toothfish) were also randomly extracted per station as part of the ROS strategy to increase the spatial coverage of the otoliths collection. During otolith collection, individual length was measured to the lower cm and total body weight was measured to the nearest gram. A total of 100 individuals of Argentine shortfin squid and Patagonian squid (*Doryteuthis gahi*) each, were collected from the north and south, in deep (>190 m) and shallow (<170 m) stations, and frozen for statolith extraction at the FIFD laboratory. Several fish specimens were frozen for further analyses ashore. In addition, several fish specimens were frozen for training of scientific observers on maturity stage identification.

Gonad sampling, including ovaries and testes, was conducted opportunistically for six species: common hake, kingclip, Patagonian toothfish, red cod, rock cod, and southern blue whiting. Preliminary identification of the maturity stage of the gonad was made based on macroscopic characteristics following the eight-stage maturity scale used at FIFD (Brickle et al. 2005, modified from Nikolsky 1963). Fresh gonads were photographed for morpho-chromatic analysis, and fixed in 10% neutral buffered formalin (4% v/v formaldehyde) for histological examination following the FIFD finfish gonad sampling protocol (Soeth 2024a).

Table I. Station data of the February 2025 groundfish survey (2025-02-ZDLU1).

Station	Date	Latitude start	Longitude start	Latitude finish	Longitude finish	Mean depth (m)
1205	30/01/2025	-50.4770	-57.7802	-50.4368	-57.8872	155
1207	30/01/2025	-50.2285	-57.8820	-50.1822	-57.9813	275
1209	30/01/2025	-50.3255	-58.1063	-50.2825	-58.1985	149
1211	30/01/2025	-50.1735	-58.4208	-50.1318	-58.5225	168
1213	31/01/2025	-50.3543	-58.6082	-50.3132	-58.7085	144
1215	31/01/2025	-50.3122	-59.0158	-50.2820	-59.1272	151
1217	31/01/2025	-50.0870	-58.9183	-50.1105	-58.8090	156
1219	31/01/2025	-49.9277	-58.9693	-49.9557	-58.8803	187
1221	01/02/2025	-49.8337	-59.3768	-49.8672	-59.2713	189
1223	01/02/2025	-50.1097	-59.2668	-50.0917	-59.3855	158
1225	01/02/2025	-50.0548	-59.5320	-50.0252	-59.6297	162
1227	01/02/2025	-49.8120	-59.8002	-49.8107	-59.9135	167
1229	01/02/2025	-49.7937	-60.1992	-49.7955	-60.3102	166
1231	02/02/2025	-49.6590	-59.8368	-49.6192	-59.9320	189
1233	02/02/2025	-49.5913	-60.3055	-49.5837	-60.4227	173
1235	02/02/2025	-49.4328	-60.3017	-49.3907	-60.3972	200
1237	03/02/2025	-48.6310	-60.7417	-48.7005	-60.7325	245
1239	03/02/2025	-48.8562	-60.6540	-48.9277	-60.6167	241
1241	03/02/2025	-49.0832	-60.7833	-49.1595	-60.7795	188
1243	03/02/2025	-49.1493	-60.9730	-49.2165	-61.0105	173
1245	04/02/2025	-49.3510	-60.8837	-49.4043	-60.9487	169
1247	04/02/2025	-49.5182	-60.9057	-49.5773	-60.9693	165
1249	04/02/2025	-49.6048	-61.1507	-49.6180	-61.2700	163
1251	04/02/2025	-49.4358	-61.2138	-49.4768	-61.3140	163
1253	04/02/2025	-49.6062	-61.5240	-49.6438	-61.6207	158

Station	Date	Latitude start	Longitude start	Latitude finish	Longitude finish	Mean depth (m)
1255	05/02/2025	-50.1205	-61.0623	-50.0950	-61.1700	159
1257	05/02/2025	-49.9988	-61.4152	-49.9957	-61.5363	156
1259	05/02/2025	-49.9165	-61.8087	-49.8567	-61.7355	158
1261	05/02/2025	-49.9108	-62.1055	-49.8543	-62.0503	151
1263	06/02/2025	-52.6857	-60.9053	-52.6372	-60.9890	380
1265	06/02/2025	-52.6003	-61.1625	-52.5800	-61.2733	375
1267	06/02/2025	-52.4695	-61.0698	-52.4307	-61.1870	270
1269	06/02/2025	-52.2042	-61.4005	-52.1402	-61.4442	182
1271	07/02/2025	-52.6343	-61.7768	-52.6837	-61.8620	284
1273	07/02/2025	-52.6982	-62.2668	-52.6605	-62.3582	324
1275	07/02/2025	-52.4197	-62.3663	-52.3723	-62.2705	295
1277	07/02/2025	-52.2990	-61.7848	-52.3700	-61.8160	320
1279	08/02/2025	-51.8302	-62.2903	-51.9020	-62.3405	262
1281	08/02/2025	-52.0357	-62.0878	-51.9682	-62.0332	277
1283	08/02/2025	-51.8208	-61.8637	-51.8915	-61.8490	187
1285	08/02/2025	-52.1162	-61.6952	-52.1568	-61.5967	251
1287	09/02/2025	-52.1240	-62.6013	-52.1778	-62.6793	256
1289	09/02/2025	-52.2908	-62.6620	-52.3342	-62.7552	268
1291	09/02/2025	-52.3645	-63.0588	-52.3687	-63.1727	258
1293	09/02/2025	-52.1812	-63.2702	-52.1048	-63.2643	228
1295	09/02/2025	-51.9135	-63.2973	-51.8357	-63.2750	203
1297	10/02/2025	-51.8973	-62.6372	-51.8322	-62.5730	229
1299	10/02/2025	-51.6450	-62.5740	-51.5838	-62.5035	213
1301	10/02/2025	-51.6193	-62.2637	-51.5453	-62.2418	249
1303	12/02/2025	-51.3453	-62.2950	-51.4043	-62.3708	211
1305	12/02/2025	-51.3438	-62.7652	-51.3963	-62.8417	183
1307	12/02/2025	-51.6088	-63.2937	-51.5310	-63.3273	177
1309	13/02/2025	-51.3850	-63.2857	-51.3258	-63.2063	165
1311	13/02/2025	-51.1360	-63.2578	-51.0683	-63.2043	154
1313	13/02/2025	-50.7203	-62.9848	-50.7907	-62.9990	153
1315	13/02/2025	-50.4715	-62.7565	-50.5322	-62.8012	146
1317	14/02/2025	-50.6917	-62.5105	-50.7542	-62.5635	165
1319	14/02/2025	-50.8422	-62.3607	-50.9115	-62.4208	183
1321	14/02/2025	-50.8890	-62.7633	-50.9663	-62.7418	166
1323	14/02/2025	-51.0980	-62.8975	-51.1130	-62.7647	169
1325	14/02/2025	-51.1562	-62.3842	-51.2058	-62.4647	188
1327	15/02/2025	-50.1228	-61.7295	-50.0917	-61.8338	159
1329	15/02/2025	-50.2240	-61.9768	-50.2482	-62.0898	159
1331	15/02/2025	-50.3563	-62.2630	-50.3390	-62.3757	154
1333	15/02/2025	-50.1225	-62.2738	-50.1417	-62.3597	147
1335	15/02/2025	-50.2025	-62.6155	-50.2600	-62.6562	145
1337	16/02/2025	-51.3843	-61.9170	-51.3023	-61.8780	197
1339	16/02/2025	-51.1825	-61.7127	-51.1075	-61.7693	179
1341	16/02/2025	-50.9465	-61.9068	-50.8733	-61.8738	175
1343	16/02/2025	-50.7117	-61.8658	-50.6602	-61.9502	180
1345	16/02/2025	-50.5905	-62.1865	-50.5110	-62.1977	165
1347	17/02/2025	-50.4578	-61.8528	-50.4282	-61.7387	166

Station	Date	Latitude start	Longitude start	Latitude finish	Longitude finish	Mean depth (m)
1349	17/02/2025	-50.4198	-61.3997	-50.3872	-61.2958	162
1351	17/02/2025	-50.6192	-61.3558	-50.6145	-61.2377	152
1353	17/02/2025	-50.3938	-60.8853	-50.4152	-60.7667	153
1355	18/02/2025	-49.8593	-61.1228	-49.8022	-61.0317	163
1357	18/02/2025	-49.8160	-60.7697	-49.8903	-60.7767	165
1359	18/02/2025	-50.0855	-60.8223	-50.1298	-60.9247	161
1361	18/02/2025	-50.0832	-60.4678	-50.1600	-60.4587	159
1363	18/02/2025	-50.3320	-60.4752	-50.4047	-60.4525	155
1365	19/02/2025	-50.5918	-60.8923	-50.5852	-60.7640	151
1367	19/02/2025	-50.7495	-60.8280	-50.7730	-60.7078	134
1369	19/02/2025	-50.8315	-60.3880	-50.8295	-60.2758	136
1371	19/02/2025	-50.6938	-60.2913	-50.6212	-60.3422	145

3.5. Catch density

Catch density per species (D; kg/km^2) was calculated at each trawl station following Gras (2016):

$$\mathrm{D} = \frac{\mathrm{C}}{\mathrm{d} \times \mathrm{NHO}}$$

where C = catch (kg), d = trawl distance covered (km) calculated as the distance between the initial and the final position of the net at the seabed, and NHO = net horizontal opening (km) recorded by the MarPort Net Monitoring System.

3.6. Catch-per-unit-effort

Catch-per-unit-effort (CPUE) was calculated for each individual trawl as the catch (kg) of the species of interest for the duration of the trawl (h):

$$\mathrm{CPUE} = \frac{\mathrm{Catch\ (kg)}}{\mathrm{Trawl\ duration\ (h)}}$$

Mean CPUE was calculated including stations where the catch of the species was 0.

3.7. Interactions with pinnipeds

The presence of pinnipeds around the vessel during shooting, hauling, or manoeuvring, and incidental bycatch and mortality were monitored from the bridge.

3.8. Oceanography

An oceanographic station using a CTD (SBE-25, Sea-Bird Electronics Inc., Bellevue, USA) preceded or succeeded each bottom trawl station (Table II). The CTD was deployed to a depth of c.10 m below the surface for a soak time of two minutes to allow the pump to start circulating water and to flush the system. Then the CTD was raised to about 2 m below surface, and it was immediately lowered at 1 m/sec to a maximum depth of 1 m above seabed. The CTD recorded chlorophyll (µg/l), temperature (°C), dissolved oxygen (ml/l), salinity (PSU), density (sigma t = kg/m^3 - 1000), and pressure (atm). The raw hex file was converted and processed using SBE Data Processing Version.7.22.5 using the CON file 0247_2019_09.xmlcon with the instrument calibrated in July 2019. Up-cast data were filtered out. Depth (m) was calculated from pressure. Ocean Data View version 5.15 (Schlitzer, R., Ocean Data View, http://odv.awi.de, 2013) was used to make the plots of each environmental variable at 10 m, 50 m, 100 m, and seabed, except for chlorophyll that was plotted at 10 m, 20 m, 30 m, 40 m, 50 m, and 60 m, being absent at greater depths. The CTD memory capacity allows storing about 30 runs; nonetheless, oceanographic data were downloaded after every CTD run to corroborate that the CTD was working properly and to avoid loss of data.

Table II. CTD station data of the February 2025 groundfish survey (2025-02-ZDLU1). A total of 84 CTD stations were conducted during the February 2025 groundfish survey. †CTD cast not usable due to battery failure. * CTD cast failed. † CTD did not record chlorophyll.

Station	Date	Latitude start	Longitude start	Latitude finish	Longitude finish	Mean depth (m)
1206†	30/01/2025	-50.4553	-57.9345	-50.4567	-57.9357	139
1208†	30/01/2025	-50.1913	-58.0003	-50.1953	-58.0002	266
1210†	30/01/2025	-50.2965	-58.2170	-50.2995	-58.2158	138
1212†	30/01/2025	-50.1258	-58.5417	-50.1287	-58.5388	162
1214†	31/01/2025	-50.3148	-58.7370	-50.3167	-58.7425	146
1216†	31/01/2025	-50.2767	-59.1555	-50.2775	-59.1590	151
1218†	30/01/2025	-50.0990	-58.7872	-50.0940	-58.7843	157
1220†	31/01/2025	-49.9337	-58.8687	-49.9233	-58.8703	239
1222	01/02/2025	-49.8595	-59.2527	-49.8575	-59.2532	207
1224	01/02/2025	-50.1058	-59.4088	-50.1092	-59.4150	159
1226	01/02/2025	-50.0393	-59.6418	-50.0435	-59.6408	160
1228	01/02/2025	-49.8242	-59.9125	-49.8273	-59.9075	166
1230	01/02/2025	-49.8090	-60.3180	-49.8123	-60.3147	166
1232	02/02/2025	-49.6300	-59.9532	-49.6338	-59.9545	182
1234	02/02/2025	-49.6012	-60.4392	-49.6053	-60.4410	172
1236	02/02/2025	-49.3978	-60.4155	-49.3997	-60.4158	195
1238	03/02/2025	-48.7118	-60.7115	-48.7100	-60.7073	248
1240*	03/02/2025	-48.9415	-60.6048	-48.9418	-60.6027	241
1242	03/02/2025	-49.1720	-60.7633	-49.1738	-60.7598	186
1244	03/02/2025	-49.2273	-60.9870	-49.2265	-60.9793	172
1246	04/02/2025	-49.4090	-60.9233	-49.4077	-60.9167	172
1248	04/02/2025	-49.5867	-60.9510	-49.5863	-60.9467	164
1250	04/02/2025	-49.6052	-61.2793	-49.6045	-61.2790	161
1252	04/02/2025	-49.4898	-61.3158	-49.4895	-61.3138	161
1254	04/02/2025	-49.6583	-61.6143	-49.6577	-61.6098	157
1256	05/02/2025	-50.0943	-61.1877	-50.0945	-61.1880	159
1258	05/02/2025	-49.9988	-61.5575	-50.0003	-61.5577	157
1260	05/02/2025	-49.8682	-61.7205	-49.8712	-61.7223	159
1262	05/02/2025	-49.8468	-62.0463	-49.8497	-62.0463	149
1264	06/02/2025	-52.6245	-60.9982	-52.6277	-60.9932	370
1266	06/02/2025	-52.5667	-61.2890	-52.5662	-61.2872	361
1268	06/02/2025	-52.4170	-61.1923	-52.4167	-61.1907	261
1270	06/02/2025	-52.1295	-61.4282	-52.1295	-61.4223	169
1272	07/02/2025	-52.7005	-61.8473	-52.7033	-61.8400	342
1274	07/02/2025	-52.6498	-62.3310	-52.6508	-62.3180	318
1276	07/02/2025	-52.3558	-62.2460	-52.3535	-62.2395	294
1278	07/02/2025	-52.3838	-61.8200	-52.3815	-61.8187	318
1280	08/02/2025	-51.8953	-62.3623	-51.8927	-62.3617	256
1282	08/02/2025	-51.9552	-62.0192	-51.9550	-62.0157	250

Station	Date	Latitude start	Longitude start	Latitude finish	Longitude finish	Mean depth (m)
1284	08/02/2025	-51.9045	-61.8508	-51.9063	-61.8448	181
1286	08/02/2025	-52.1658	-61.5692	-52.1683	-61.5613	244
1288	09/02/2025	-52.1908	-62.6783	-52.1918	-62.6755	256
1290	09/02/2025	-52.3495	-62.7492	-52.3522	-62.7422	272
1292	09/02/2025	-52.3680	-63.1770	-52.3695	-63.1705	256
1294	09/02/2025	-52.0997	-63.2480	-52.1000	-63.2458	224
1296	09/02/2025	-51.8322	-63.2592	-51.8332	-63.2598	200
1298	10/02/2025	-51.8172	-62.5840	-51.8145	-62.5897	229
1300	10/02/2025	-51.5775	-62.4923	-51.5788	-62.4943	215
1302	10/02/2025	-51.5348	-62.2328	-51.5322	-62.2158	246
1304	12/02/2025	-51.4062	-62.3862	-51.4065	-62.3810	211
1306	12/02/2025	-51.3917	-62.8505	-51.3910	-62.8455	181
1308	12/02/2025	-51.5175	-63.3223	-51.5162	-63.3202	174
1310	13/02/2025	-51.3150	-63.1903	-51.3143	-63.1882	167
1312	13/02/2025	-51.0642	-63.1927	-51.0642	-63.1905	156
1314	13/02/2025	-50.8047	-62.9840	-50.8052	-62.9788	153
1316	13/02/2025	-50.5412	-62.7842	-50.5408	-62.7790	148
1318	14/02/2025	-50.7670	-62.5412	-50.7670	-62.5370	167
1320	14/02/2025	-50.9290	-62.4223	-50.9295	-62.4213	183
1322	14/02/2025	-50.9702	-62.7187	-50.9698	-62.7152	169
1324	14/02/2025	-51.1123	-62.7407	-51.1117	-62.7353	171
1326	14/02/2025	-51.2200	-62.4608	-51.2190	-62.4572	187
1328	15/02/2025	-50.0770	-61.8275	-50.0770	-61.8240	158
1330	15/02/2025	-50.2602	-62.0897	-50.2607	-62.0875	159
1332	15/02/2025	-50.3263	-62.3665	-50.3265	-62.3628	152
1334	15/02/2025	-50.1462	-62.3723	-50.1458	-62.3665	146
1336	15/02/2025	-50.2707	-62.6437	-50.2693	-62.6392	147
1338	16/02/2025	-51.2870	-61.8598	-51.2853	-61.8558	196
1340	16/02/2025	-51.0905	-61.7668	-51.0893	-61.7648	181
1342	16/02/2025	-50.8615	-61.8698	-50.8620	-61.8693	170
1344	16/02/2025	-50.6472	-61.9525	-50.6472	-61.9480	179
1346	16/02/2025	-50.4975	-62.1853	-50.4962	-62.1790	157
1348	17/02/2025	-50.4165	-61.7247	-50.4143	-61.7215	165
1350	17/02/2025	-50.3745	-61.2845	-50.3733	-61.2835	160
1352	17/02/2025	-50.6095	-61.2233	-50.6100	-61.2230	150
1354	17/02/2025	-50.4148	-60.7442	-50.4153	-60.7413	152
1356	18/02/2025	-49.7973	-61.0057	-49.7987	-61.0017	164
1358	18/02/2025	-49.9003	-60.7610	-49.9023	-60.7587	164
1360	18/02/2025	-50.1420	-60.9218	-50.1432	-60.9193	160
1362	18/02/2025	-50.1657	-60.4377	-50.1667	-60.4327	159
1364	18/02/2024	-50.4113	-60.4280	-50.4117	-60.4235	153
1366	19/02/2025	-50.5928	-60.7410	-50.5943	-60.7390	148
1368	19/02/2025	-50.7817	-60.6902	-50.7833	-60.6895	134
1370	19/02/2025	-50.8323	-60.2582	-50.8340	-60.2570	137
1372	19/02/2025	-50.6115	-60.3340	-50.6118	-60.3325	146

4. Results

4.1. Catch composition

Catch weight of all identified species/taxa in the survey are presented in Table III. The most abundant species in terms of catch weight were rock cod (PAR: 29.5%), common hake (HAK: 21.7%), Argentine shortfin squid (ILL: 16.5%), and southern blue whiting (BLU: 10.5%). Four more species contributed >3% of the total catch each, i.e., Banded whiptail grenadier (GRF: 5.2%), red cod (BAC: 4.1%), Patagonian squid (LOL: 3.4%), and kingclip (KIN: 3.1%). The rest of the species contributed ≤1.4% of the total catch. Higher catches occurred to the north-west in the FICZ (Appendix I).

Table III. Catch weight by species/taxon during the February 2025 groundfish survey (2025-02-ZDLU1).

Species Code	Latin name	Total caught (kg)	Total sampled (kg)	Total discarded (kg)	Catch proportion (%)
PAR	*Patagonotothen ramsayi*	23046.018	898.085	22816.578	29.478
HAK	*Merluccius hubbsi*	16981.642	1865.750	498.862	21.721
ILL	*Illex argentinus*	12917.002	825.830	739.984	16.522
BLU	*Micromesistius australis*	8195.716	400.777	8195.716	10.483
GRF	*Coelorinchus fasciatus*	4095.592	301.195	4094.770	5.239
BAC	*Salilota australis*	3169.879	1392.636	536.884	4.055
LOL	*Doryteuthis gahi*	2636.474	131.461	278.797	3.372
KIN	*Genypterus blacodes*	2396.155	1554.755	397.457	3.065
GRC	*Macrourus carinatus*	1068.516	369.698	1068.516	1.367
WHI	*Macruronus magellanicus*	824.133	432.773	85.957	1.054
TOO	*Dissostichus eleginoides*	727.921	727.921	711.849	0.931
MED	*Medusa* spp.	376.754	0.000	376.754	0.482
PAT	*Merluccius australis*	320.090	320.090	320.090	0.409
CGO	*Cottoperca gobio*	179.612	179.608	179.612	0.230
PYM	*Notophycis marginata*	123.626	0.000	123.626	0.158
RBR	*Bathyraja brachyurops*	109.924	109.924	107.370	0.141
PAU	*Patagolycus melastomus*	105.790	0.754	105.790	0.135
DGS	*Squalus acanthias*	92.419	92.419	92.419	0.118
ALG	Algae	84.465	0.000	84.465	0.108
SPN	Porifera	82.045	0.000	82.045	0.105
POR	*Lamna nasus*	65.132	65.132	65.132	0.083
RFL	*Dipturus lamillai*	65.111	65.111	65.111	0.083
BUT	*Stromateus brasiliensis*	61.153	61.153	61.153	0.078
SQT	Ascidiacea	55.512	0.000	55.512	0.071
RGR	*Bathyraja griseocauda*	43.682	43.682	43.682	0.056
COP	*Congiopodus peruvianus*	38.181	0.000	38.181	0.049
ING	*Moroteuthopsis ingens*	37.275	36.907	37.275	0.048
CHE	*Champsocephalus esox*	30.211	20.291	30.211	0.039
MXX	*Myctophidae* spp.	30.315	0.000	30.315	0.039
RTR	*Dipturus trachyderma*	26.240	26.240	26.240	0.034
DGH	*Schroederichthys bivius*	17.287	17.287	17.287	0.022
RAL	*Bathyraja albomaculata*	17.283	17.283	17.283	0.022
MUN	*Grimothea gregaria*	15.880	0.000	15.880	0.020

Species Code	Latin name	Total caught (kg)	Total sampled (kg)	Total discarded (kg)	Catch proportion (%)
RBZ	*Bathyraja cousseauae*	10.065	10.065	10.065	0.013
BRY	Bryozoa	8.592	0.000	8.592	0.011
RDA	*Dipturus argentinensis*	8.280	8.280	8.280	0.011
LIS	*Lithodes santolla*	7.470	0.000	7.470	0.010
ALF	*Allothunnus fallai*	6.025	6.025	6.025	0.008
HYD	Hydrozoa	5.954	0.000	5.954	0.008
MUG	*Grimothea gregaria*	6.187	0.000	6.187	0.008
ZYP	*Zygochlamys patagonica*	6.597	0.000	6.597	0.008
CTA	*Ctenodiscus australis*	5.843	0.000	5.843	0.007
RED	*Sebastes oculatus*	5.581	5.581	5.581	0.007
RSC	*Bathyraja scaphiops*	5.089	5.089	5.089	0.007
SHT	Mixed invertebrates	4.966	0.000	4.966	0.006
STA	*Sterechinus agassizii*	4.824	0.000	4.824	0.006
ANM	Anemonia	4.274	0.000	4.274	0.005
CIR	Cirripedia	3.726	0.000	3.726	0.005
GOC	*Gorgonocephalus chilensis*	4.052	0.000	4.052	0.005
SEP	*Seriolella porosa*	3.893	3.893	3.893	0.005
RMC	*Bathyraja macloviana*	2.753	2.753	2.753	0.004
COT	*Cottunculus granulosus*	2.106	0.290	2.106	0.003
FLX	*Flabellum* spp.	2.433	0.000	2.433	0.003
OPV	*Ophiosabine vivipara*	2.253	0.000	2.253	0.003
RMU	*Bathyraja multispinis*	2.208	2.208	2.208	0.003
BAO	*Bathybiaster loripes*	1.486	0.000	1.486	0.002
FUM	*Fusitriton magellanicus*	1.477	0.000	1.477	0.002
MUE	*Muusoctopus eureka*	1.219	0.203	1.219	0.002
MUU	*Munida subrugosa*	1.516	0.000	1.516	0.002
NEM	*Psychrolutes marmoratus*	1.254	0.000	1.254	0.002
OCM	*Enteroctopus megalocyathus*	1.509	1.509	1.509	0.002
THO	Thouarella	1.244	0.000	1.244	0.002
ASA	*Astrotoma agassizii*	0.890	0.000	0.890	0.001
AUC	*Austrocidaris canaliculata*	0.863	0.000	0.863	0.001
AUL	*Austrolycus laticinctus*	0.735	0.456	0.735	0.001
BIV	Bivalvia	0.468	0.000	0.468	0.001
BOM	*Bougainvillia macloviana*	0.874	0.000	0.874	0.001
CAS	*Campylonotus semistriatus*	0.928	0.000	0.928	0.001
CAZ	*Calyptraster* sp.	0.784	0.000	0.784	0.001
CEX	*Ceramaster* sp.	1.142	0.000	1.142	0.001
EGG	Egg mass	0.420	0.000	0.420	0.001
ERR	*Errina* sp.	0.559	0.000	0.559	0.001
GOR	Gorgonacea	0.488	0.000	0.488	0.001
MIR	*Mirostenella* sp.	0.620	0.000	0.620	0.001
ODM	*Odontocymbiola magellanica*	0.590	0.000	0.590	0.001
OPL	*Ophiuroglypha lymani*	0.892	0.000	0.892	0.001
POA	*Glabraster antarctica*	0.850	0.000	0.850	0.001
POL	Polychaeta	0.640	0.000	0.640	0.001

Species Code	Latin name	Total caught (kg)	Total sampled (kg)	Total discarded (kg)	Catch proportion (%)
PRX	*Paragorgia* sp.	0.512	0.000	0.512	0.001
SCC	*Scomber colias*	0.595	0.595	0.595	0.001
SUN	*Labidiaster radiosus*	0.446	0.000	0.446	0.001
TRP	*Tripylaster philippii*	0.468	0.000	0.468	0.001
ZYX	*Zygochlamys* sp.	0.614	0.000	0.614	0.001
ACS	*Acanthoserolis schythei*	0.359	0.000	0.359	<0.001
ACY	*Armadillogorgia cyathella*	0.002	0.000	0.002	<0.001
ALC	Alcyoniina	0.004	0.000	0.004	<0.001
AST	Asteroidea	0.325	0.000	0.325	<0.001
BEO	*Beroe ovata*	0.046	0.000	0.046	<0.001
BUC	*Falsilunatia carcellesi*	0.008	0.000	0.008	<0.001
COG	*Patagonotothen guntheri*	0.127	0.127	0.127	<0.001
COL	*Cosmasterias lurida*	0.098	0.000	0.098	<0.001
CRI	Crinoidea	0.006	0.000	0.006	<0.001
CRY	*Crossaster* sp.	0.218	0.000	0.218	<0.001
CTE	Ctenophora	0.002	0.000	0.002	<0.001
CYX	*Cycethra* sp.	0.076	0.000	0.076	<0.001
DDT	*Desmophyllum dianthus*	0.008	0.000	0.008	<0.001
DEG	*Dendrobathypathes* cf. *grandis*	0.180	0.000	0.180	<0.001
DIA	*Diaulula* spp.	0.024	0.000	0.024	<0.001
EEL	*Iluocoetes/Patagolycus* mix	0.004	0.000	0.004	<0.001
EUL	*Eurypodius latreillii*	0.060	0.000	0.060	<0.001
HEO	*Henricia obesa*	0.022	0.000	0.022	<0.001
HEX	*Henricia* sp.	0.257	0.000	0.257	<0.001
HOL	Holothuroidea	0.302	0.000	0.302	<0.001
ICA	*Icichthys australis*	0.014	0.014	0.014	<0.001
ILF	*Iluocoetes fimbriatus*	0.352	0.150	0.352	<0.001
ISO	Isopoda	0.093	0.000	0.093	<0.001
LAP	*Variolipallium patagonicum*	0.038	0.000	0.038	<0.001
LEA	*Lepas australis*	0.218	0.000	0.218	<0.001
LIR	*Limopsis marionensis*	0.020	0.000	0.020	<0.001
LOA	*Loxechinus albus*	0.058	0.000	0.058	<0.001
LOS	*Lophaster stellans*	0.188	0.000	0.188	<0.001
MAN	*Mancopsetta* sp.	0.018	0.018	0.018	<0.001
MAV	*Magellania venosa*	0.017	0.000	0.017	<0.001
MMA	*Mancopsetta maculata*	0.310	0.310	0.310	<0.001
MUO	*Muraenolepis orangiensis*	0.180	0.180	0.180	<0.001
NEB	*Nemadactylus bergi*	0.018	0.000	0.018	<0.001
NED	*Neolithodes diomedeae*	0.002	0.000	0.002	<0.001
NEP	Nephtheidae	0.017	0.000	0.017	<0.001
NUD	Nudibranchia	0.065	0.000	0.065	<0.001
NUH	*Nuttallochiton hyadesi*	0.009	0.000	0.009	<0.001
OCT	*Octopus* spp.	0.138	0.000	0.138	<0.001
ODP	*Odontaster penicillatus*	0.042	0.000	0.042	<0.001
OPH	Ophiuroidea	0.040	0.000	0.040	<0.001

Species Code	Latin name	Total caught (kg)	Total sampled (kg)	Total discarded (kg)	Catch proportion (%)
OPS	*Ophiactis asperula*	0.102	0.000	0.102	<0.001
PAM	*Pagurus comptus*	0.016	0.000	0.016	<0.001
PES	*Peltarion spinulosum*	0.257	0.000	0.257	<0.001
PHA	*Phakellia* sp.	0.001	0.000	0.001	<0.001
PLB	Primnoidae	0.010	0.000	0.010	<0.001
PLU	Primnoidae	0.004	0.000	0.004	<0.001
POC	*Poromitra crassiceps*	0.002	0.000	0.002	<0.001
PRD	Primnoidae	0.004	0.000	0.004	<0.001
PYX	Pycnogonida	0.291	0.000	0.291	<0.001
RAY	Rajiformes	0.020	0.020	0.020	<0.001
RDO	*Amblyraja doellojuradoi*	0.032	0.032	0.032	<0.001
RPX	*Psammobatis* spp.	0.023	0.021	0.023	<0.001
SCL	Scleractinia	0.014	0.000	0.014	<0.001
SER	*Serolis* spp.	0.020	0.000	0.020	<0.001
SET	Sertulariidae	0.002	0.000	0.002	<0.001
SRP	*Semirossia patagonica*	0.078	0.000	0.078	<0.001
TED	*Terebratella dorsata*	0.140	0.000	0.140	<0.001
THB	*Thymops birsteini*	0.364	0.000	0.364	<0.001
THN	*Thysanopsetta naresi*	0.020	0.020	0.020	<0.001
TRX	*Trophon* sp.	0.024	0.000	0.024	<0.001
WRM	Annelida	0.002	0.000	0.002	<0.001
XXX	Unidentified animal	0.002	0.000	0.002	<0.001

4.2. Biological information of finfish species

4.2.1. BAC – Red cod, *Salilota australis*

Red cod were caught at 46 (55%) of the 84 survey trawl stations. Total catch was 3,170 kg, and mean CPUE was 38 kg/h. Positive catches ranged from 0.28 to 910 kg per trawl, and positive densities ranged from 1.34 to 4,134 kg/km^2, with higher densities occurring mostly to the south-west in the FICZ (Fig. 2A). Most females were at resting maturity stage (maturity stage II); males were mainly at resting or early developing maturity stages (maturity stages II–III; Fig. 2B). Females were 15–79 cm, and males were 17–73 cm. Length frequency distributions were multimodal, and overlap of lengths did not allow identifying the length-groups present (Fig. 2C).

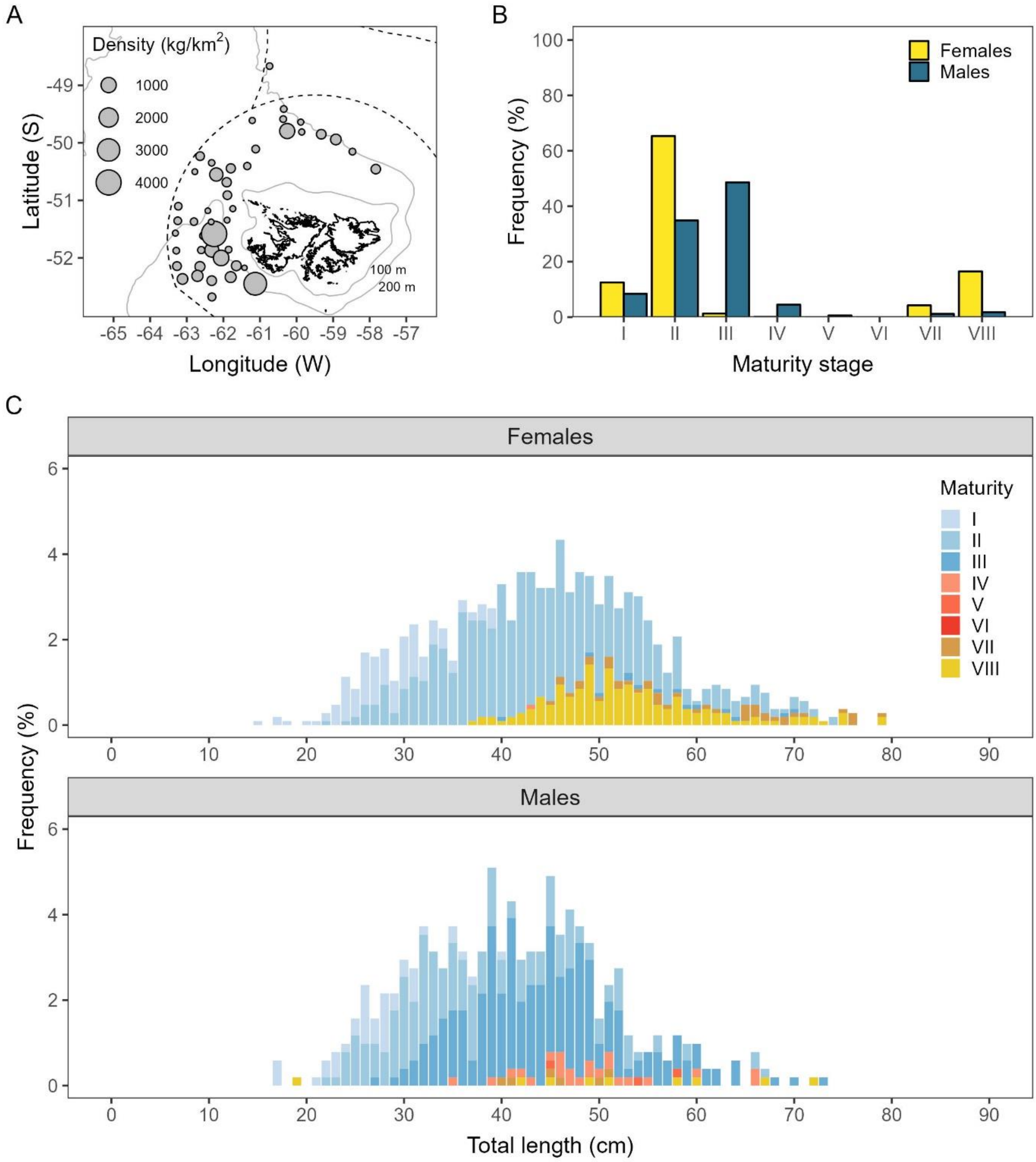

Figure 2. Biological data of *Salilota australis* (Red cod; BAC). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 1,061) and male (n = 510) lengths with 1 cm size class.

4.2.2. BLU – Southern blue whiting, *Micromesistius australis*

Southern blue whiting were caught at 21 (25%) of the 84 survey trawl stations. Total catch was 8,196 kg, and mean CPUE was 98 kg/h. Positive catches ranged from 0.046 to 4,811 kg per trawl, and positive densities ranged from 0.21 to 20,491 kg/km^2, with the highest density in one trawl to the north-west and high densities to the south-west in the FICZ, around the 200 m isobath and in deeper stations (Fig. 3A). Females and males were mainly immature (maturity stage I) or at resting maturity stage (maturity stages II; Fig. 3B). Females were 20–58 cm length and males were 20–62 cm length. Several length-groups were detected for both females and males, with the main modes at about 23 cm, 31 cm, 36 cm, and 52 cm length for females and males (Fig. 3C).

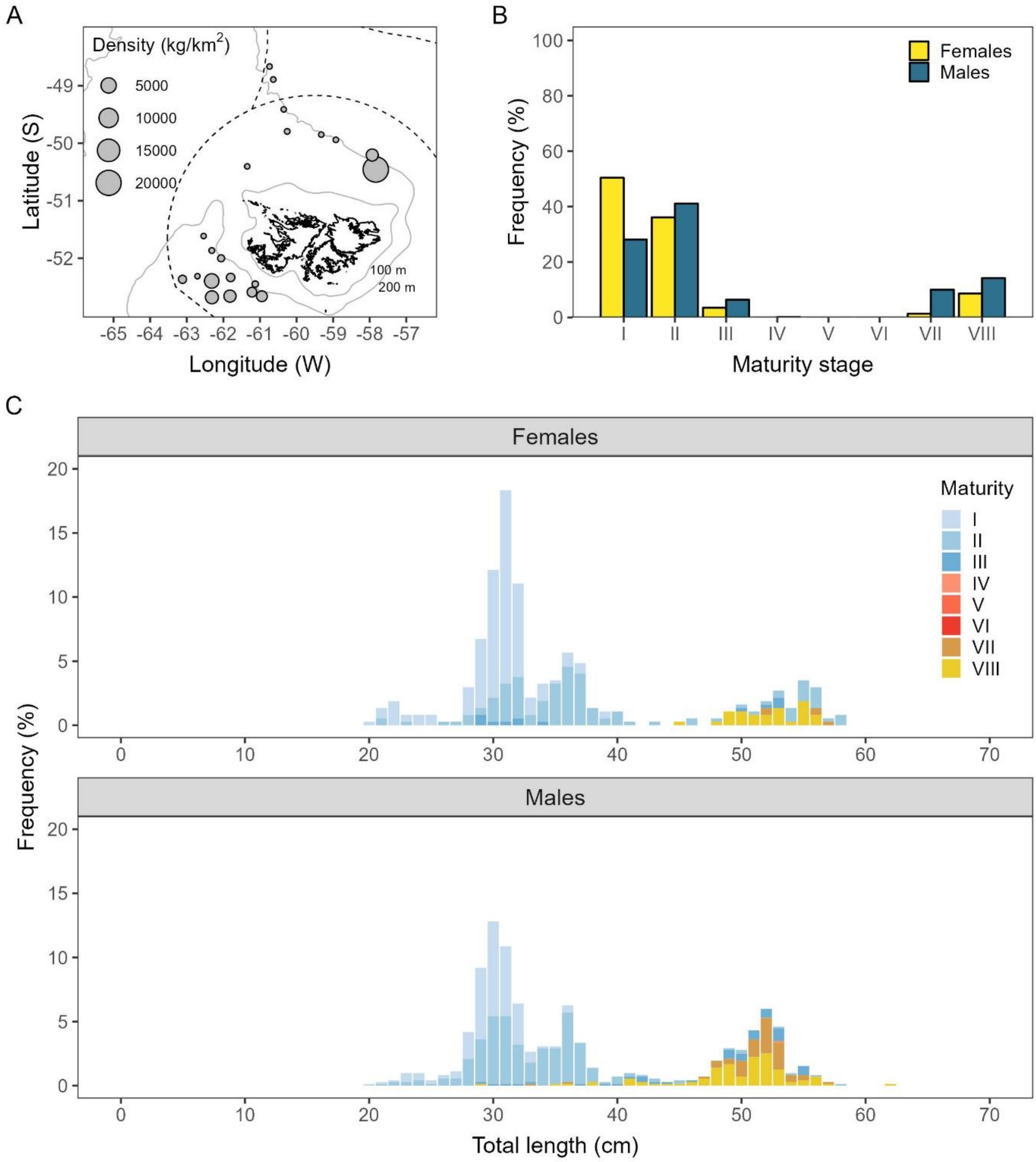

Figure 3. Biological data of *Micromesistius australis* (Southern blue whiting; BLU). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 371) and male (n = 718) lengths with 1 cm size class.

4.2.3. BUT – Butterfish, *Stromateus brasiliensis*

Butterfish were caught at 24 (29%) of the 84 survey trawl stations. Total catch was 61 kg, and mean CPUE was 1 kg/h. Positive catches ranged from 0.4 to 17 kg, and positive densities ranged from 1.5 to 78 kg/km^2, with higher densities to the north-west in the FICZ (Fig. 4A). Females and males were mostly at early developing maturity stage (maturity stage III); minor proportions of resting, late developing, and ripe maturity stages were also observed (maturity stages II, IV, and V, respectively; Fig. 4B). Females were 28–39 cm length and males were 26–34 cm length. Modal length of females was detected at 31 cm and modal length of males was detected at 29 cm (Fig. 4C).

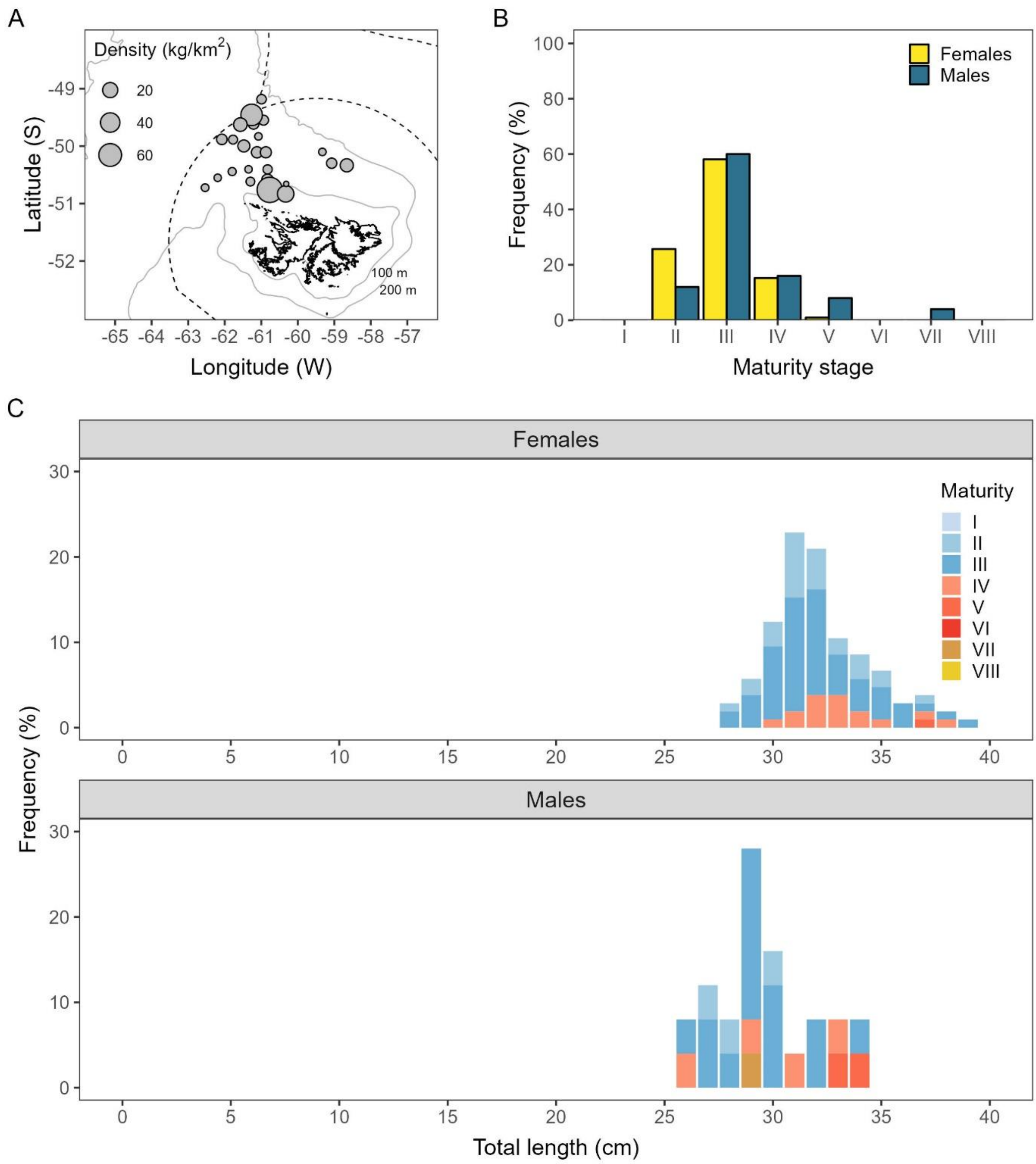

Figure 4. Biological data of *Stromateus brasiliensis* (Butterfish; BUT). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 105) and male (n = 25) lengths with 1 cm size class.

4.2.4. GRC – Ridge scaled rattail, *Macrourus carinatus*

Ridge scaled rattail were caught at 9 (11%) of the 84 survey trawl stations. Total catch was 1,069 kg, and mean CPUE was 13 kg/h. Positive catches ranged from 1.5 to 839 kg, and positive densities ranged from 7 to 4,174 kg/km^2, observed to the south-west in the FICZ (Fig. 5A). Females were in relatively similar proportions of late developing, spent, and recovering spent maturity stages (maturity stages IV, VII, and VIII), with minor proportions of resting, early developing, and ripe individuals (maturity stages II, III, and V, respectively). Males were mainly at developing maturity stages (maturity stages III–IV; Fig. 5B). Females were 18–34 cm length; males were 15–23 cm length. The length frequency distributions allowed detecting a single length-group with modal length at 24–27 cm for females and at 19 cm for males (Fig. 5C).

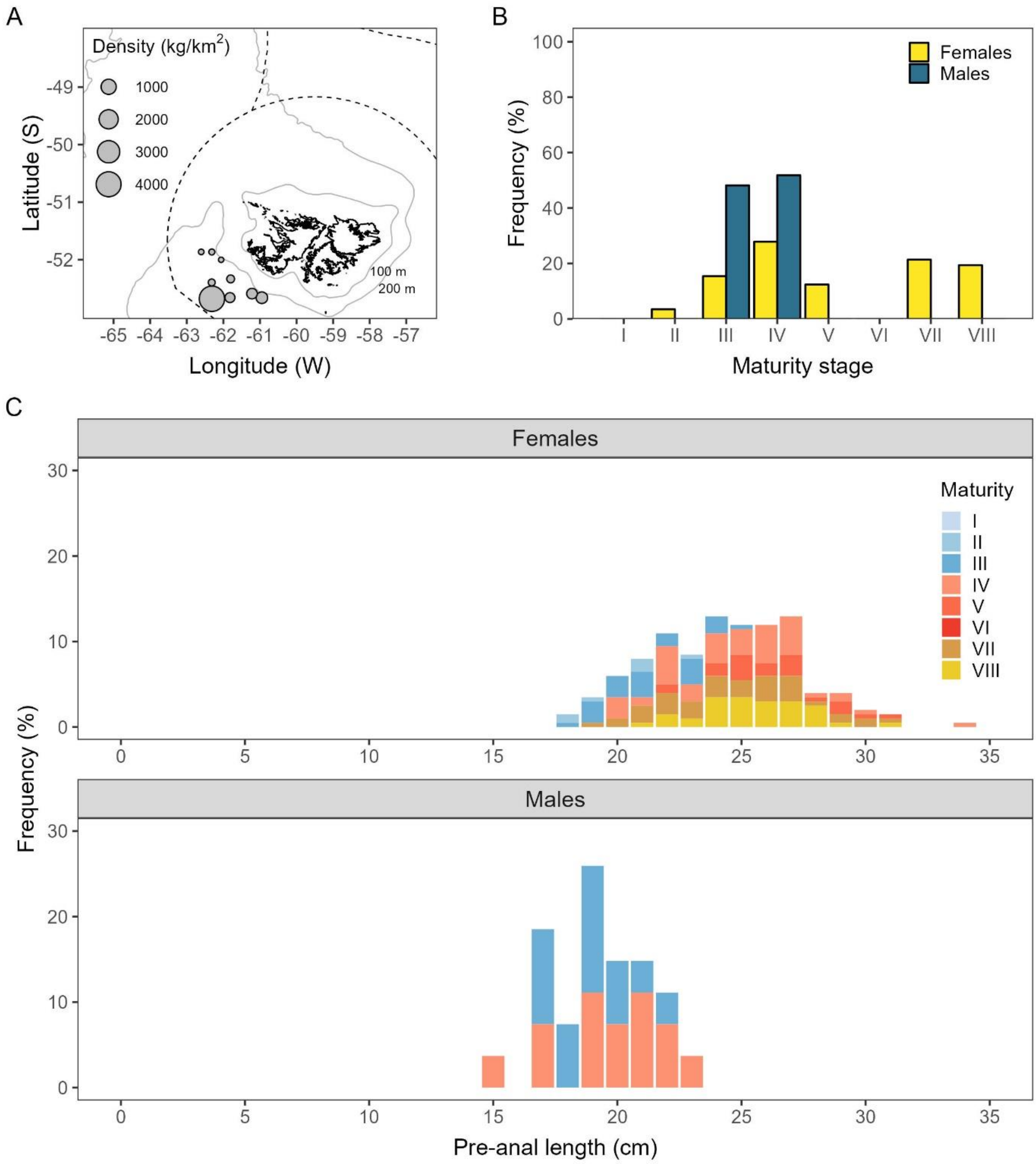

Figure 5. Biological data of *Macrourus carinatus* (Ridge scaled rattail; GRC). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 201) and male (n = 27) lengths with 1 cm size class.

4.2.5. GRF – Banded whiptail grenadier, *Coelorinchus fasciatus*

Banded whiptail grenadier were caught at 24 (29%) of the 84 survey trawl stations. Total catch was 4,096 kg, and mean CPUE was 49 kg/h. Positive catches ranged from 0.1 to 511 kg, and positive densities ranged from 0.6 to 2,323 kg/km^2, observed to the south-west in the FICZ (Fig. 6A). Females and males were mostly at resting or early developing maturity stages (maturity stages II–III). Minor proportions of individuals were immature, late developing, ripe, spent, or recovering spent (maturity stages I, IV, V, VII, VIII, respectively; Fig. 6B). Females were 5–15 cm length; males were 5–11 cm length. The length frequency distributions allowed detecting a single length-group with modal length at 10 cm for females and at 9 cm for males (Fig. 6C).

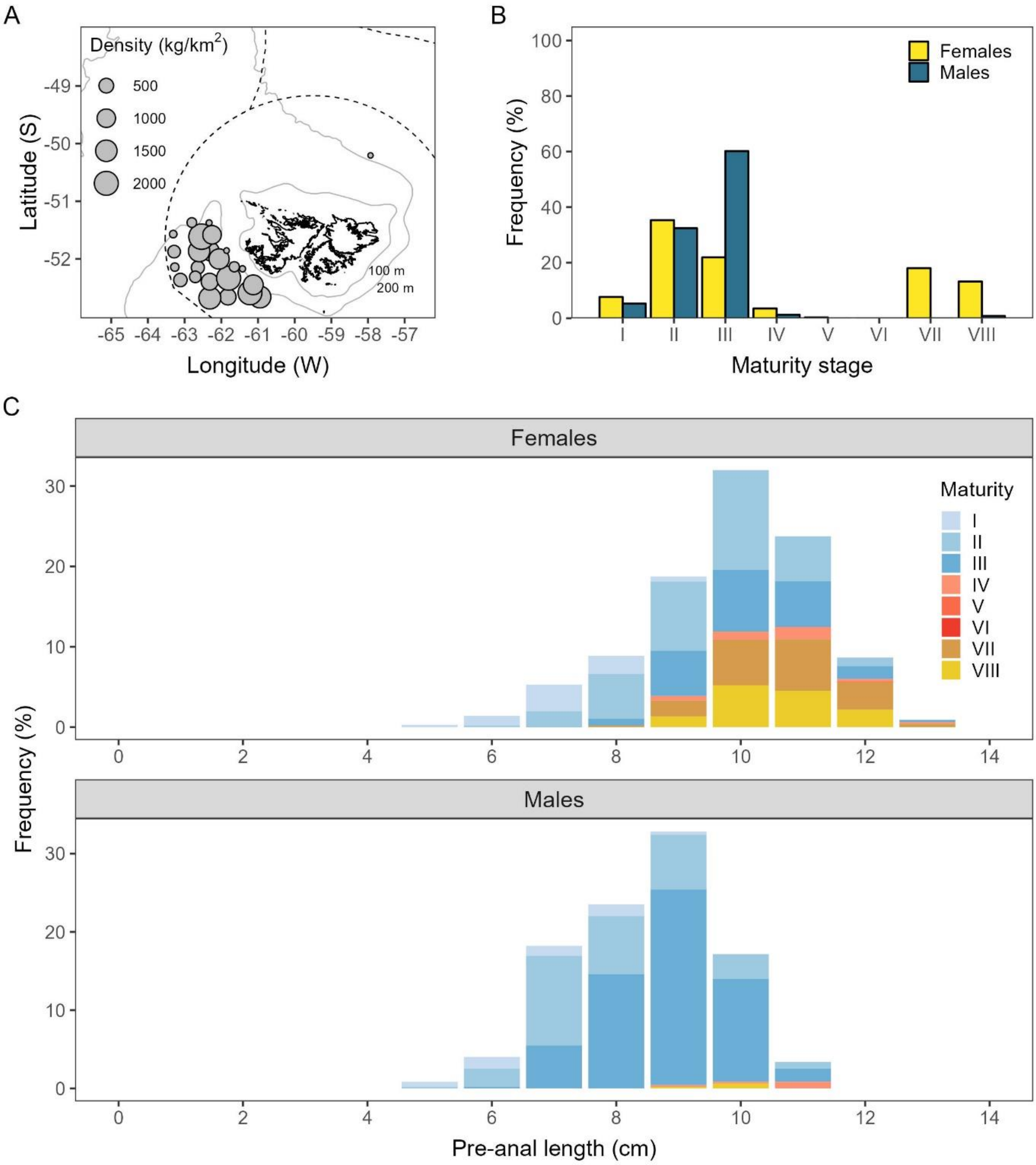

Figure 6. Biological data of *Coelorinchus fasciatus* (Banded whiptail grenadier; GRF). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 1,419) and male (n = 472) lengths with 1 cm size class.

4.2.6. HAK – Common hake, *Merluccius hubbsi*

Common hake were caught at 64 (76%) of the 84 survey trawl stations. Total catch was 16,982 kg, and mean CPUE was 202 kg/h. Positive catches ranged from 0.31 to 1,827 kg per trawl, and positive densities ranged from 1.5 to 8,294 kg/km^2, with high densities through the north-west in the FICZ (Fig. 7A). Most females were at resting or spent maturity stages (maturity stages II and VII, respectively), with minor proportions of immature, developing, and recovering spent maturity stages (maturity stage I, III, IV, and VIII, respectively). Most males were at late developing maturity stage (maturity stage IV; Fig. 7B). Females were 21–74 cm length and males were 26–45 cm length. The length frequency histogram allowed identifying at least one length-group with mode at 32 cm and 38 cm length for females; larger females were also observed but in small numbers. The length modes for males were 33 cm and 36 cm (Fig. 7C).

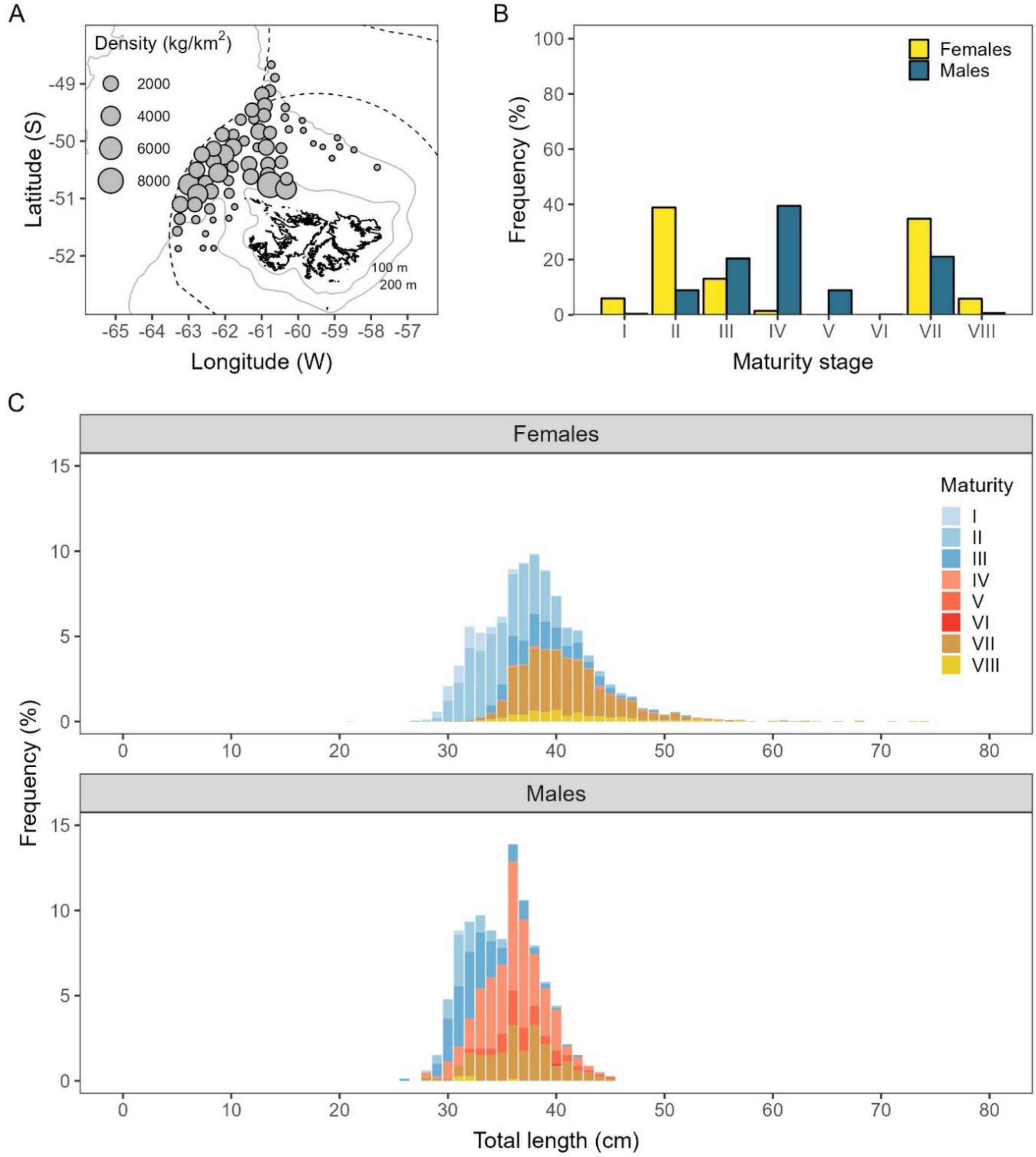

Figure 7. Biological data of *Merluccius hubbsi* (Common hake; HAK). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 3,784) and male (n = 793) lengths with 1 cm size class.

4.2.7. KIN – Kingclip, *Genypterus blacodes*

Kingclip were caught at 52 (62%) of the 84 survey trawl stations. Total catch was 2,396 kg, and mean CPUE was 29 kg/h. Positive catches ranged from 0.19 to 1,007 kg per trawl, and positive densities ranged from 0.84 to 4,835 kg/km^2, with higher densities observed to the south-west in the FICZ (Fig. 8A). Most females were at resting maturity stage (maturity stage II). Most males were at resting or early developing maturity stages (maturity stages II and III; Fig. 8B). Females were 44–119 cm length, and males were 39–97 cm length. Length frequency distributions were multimodal, and overlap of lengths did not allow identifying all the length-groups present. The main modes were detected at 56 cm, 66 cm, 75 cm, 80 cm and 86 cm length for females. The main modes for males were detected at 61 cm, and 69-73 cm length (Fig. 8C).

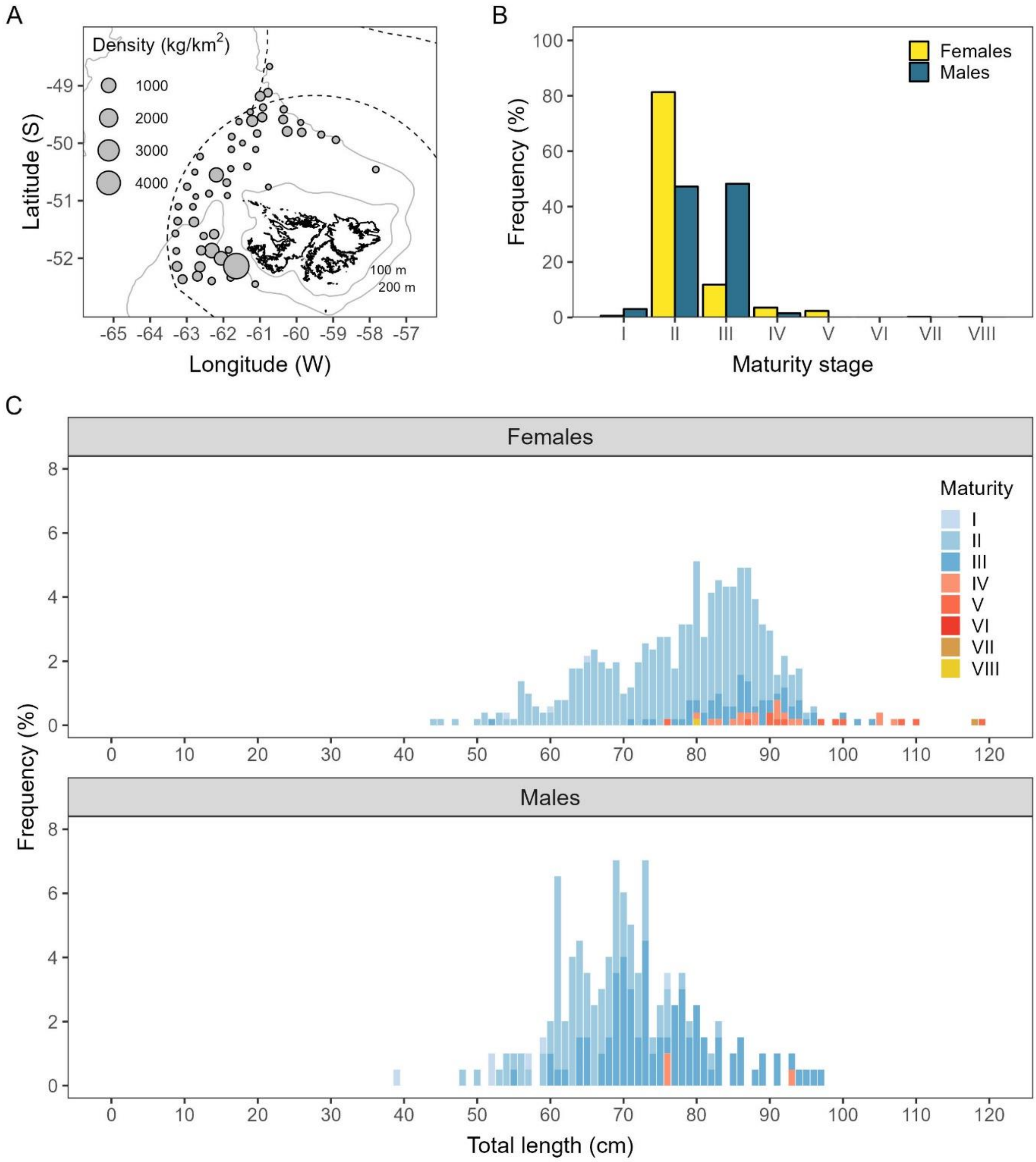

Figure 8. Biological data of *Genypterus blacodes* (Kingclip; KIN). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 508) and male (n = 199) lengths with 1 cm size class.

4.2.8. PAR – Common rock cod, *Patagonotothen ramsayi*

Rock cod were caught at all 84 (100%) survey trawl stations. Total catch was 23,046 kg and mean CPUE was 274 kg/h. Catches ranged from 1.5 to 5,769 kg per trawl, and densities ranged from 6 to 35,688 kg/km^2, with higher densities observed to the north-west in the FICZ (Fig. 9A). Most females and males were at immature or resting maturity stages (maturity stages I and II, respectively), with resting individuals being predominant; a small proportion of females were spent or recovering spent (maturity stages VII–VIII; Fig. 9B). Females were 9–39 cm length, males were 10–36 cm length, and 21 juveniles were 4–5 cm length. Two length-groups were identified; modal lengths of females were 14 cm and 22 cm, whereas modal lengths of males were 14 cm and 23 cm (Fig. 9C).

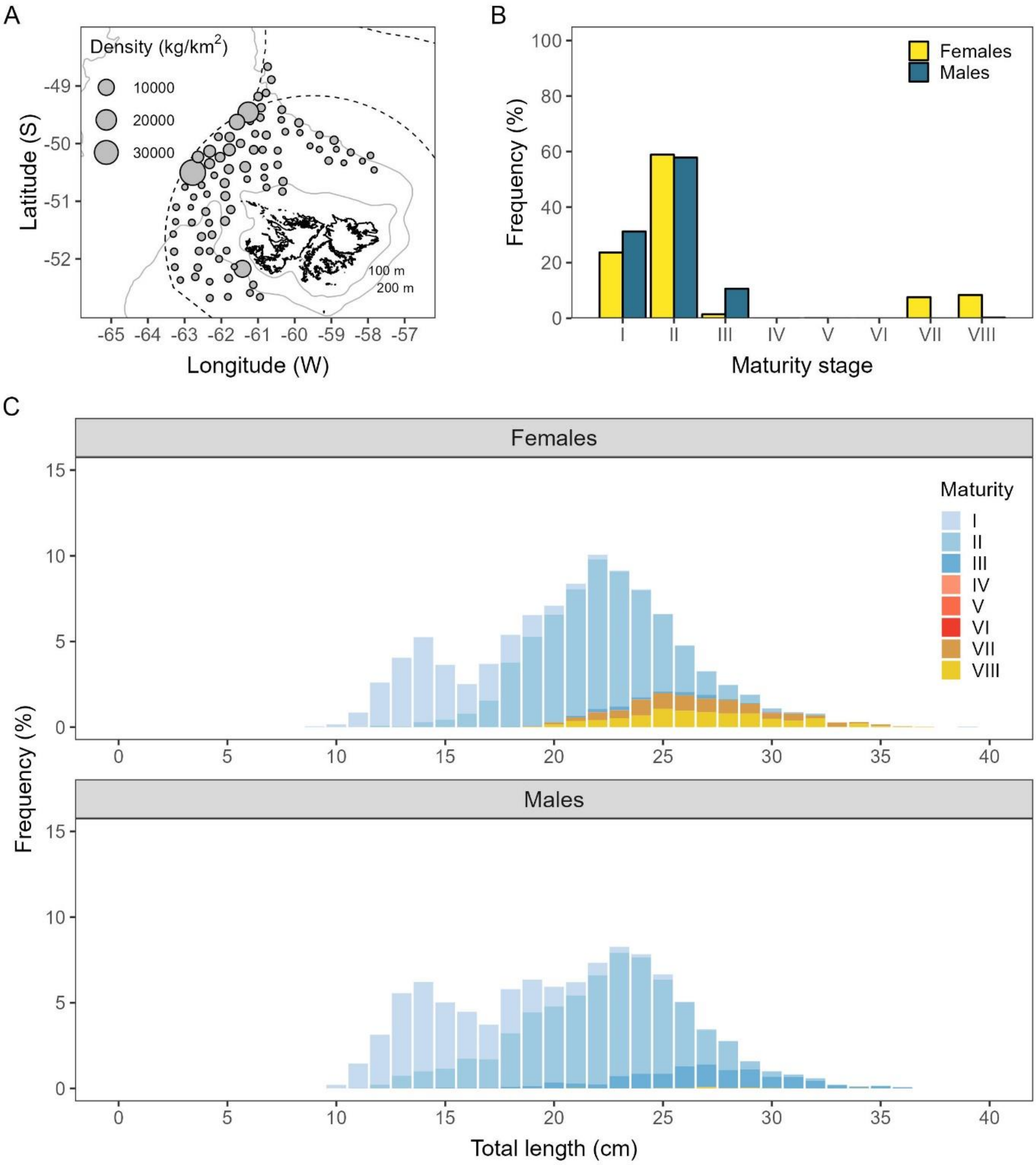

Figure 9. Biological data for *Patagonotothen ramsayi* (Common rock cod; PAR). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 3,656) and male (n = 4,404) lengths with 1 cm size class.

4.2.9. PAT – Southern hake, *Merluccius australis*

Southern hake were caught at 19 (23%) of the 84 survey trawl stations. Total catch was 320 kg, and mean CPUE was 4 kg/h. Positive catches ranged from 1.2 to 71 kg per trawl, and positive densities ranged from 6 to 362 kg/km^2, with higher densities to the south-west in deeper waters (> 200 m depth) where southern hake are more abundant (Fig. 10A). Most females and males were at resting or early developing maturity stages (maturity stages II–III), with minor proportions of post-spawning females (maturity stages VII–VIII; Fig. 10B). Females were 46–97 cm length with mode at 62 cm length, and males were 59–68 cm length (Fig. 10C). Southern hake is often misidentified as common hake *M. hubbsi*; therefore, more southern hake could have been present given the large volumes of hake caught during the survey and our limited capacity to examine every single hake.

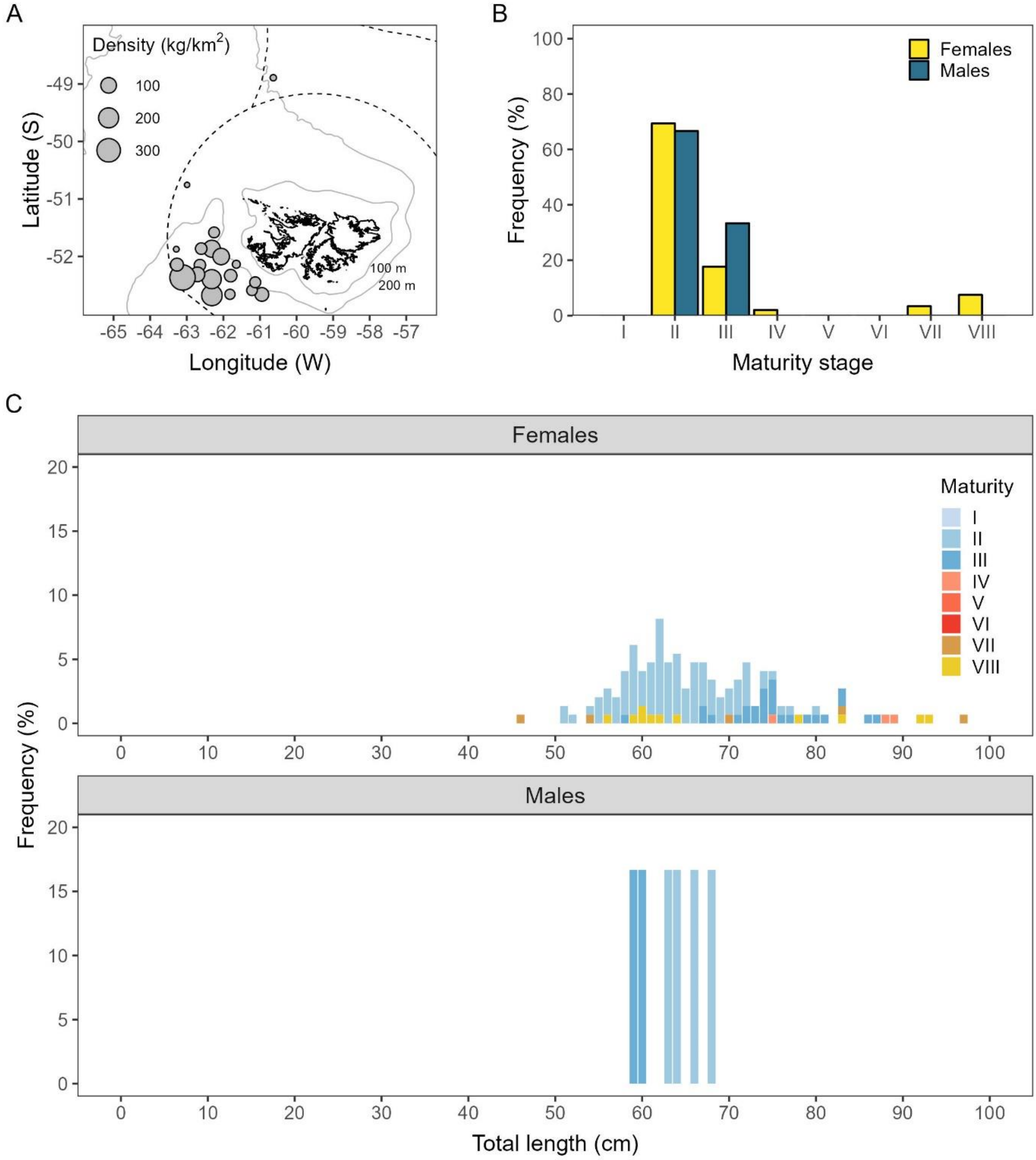

Figure 10. Biological data of *Merluccius australis* (Southern hake; PAT). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 147) and male (n = 6) lengths with 1 cm size class.

4.2.10. SEP – Driftfish, *Seriolella porosa*

Driftfish were caught at 2 (2%) of the 84 survey trawl stations. Total catch was 4 kg, and mean CPUE was 0.05 kg/h. Positive catches ranged from 1.6 to 2.3 kg, and positive densities ranged from 7 to 10 kg/km^2, with the main catch to the south-west in the FICZ (Fig. 11A). One female was in late developing maturity stage (maturity stage IV), and two males were at immature or early developing maturity stages (maturity stages II and III; Fig. 11B). The female was 56 cm length, and the two males were 24 cm and 45 cm length, respectively (Fig. 11C).

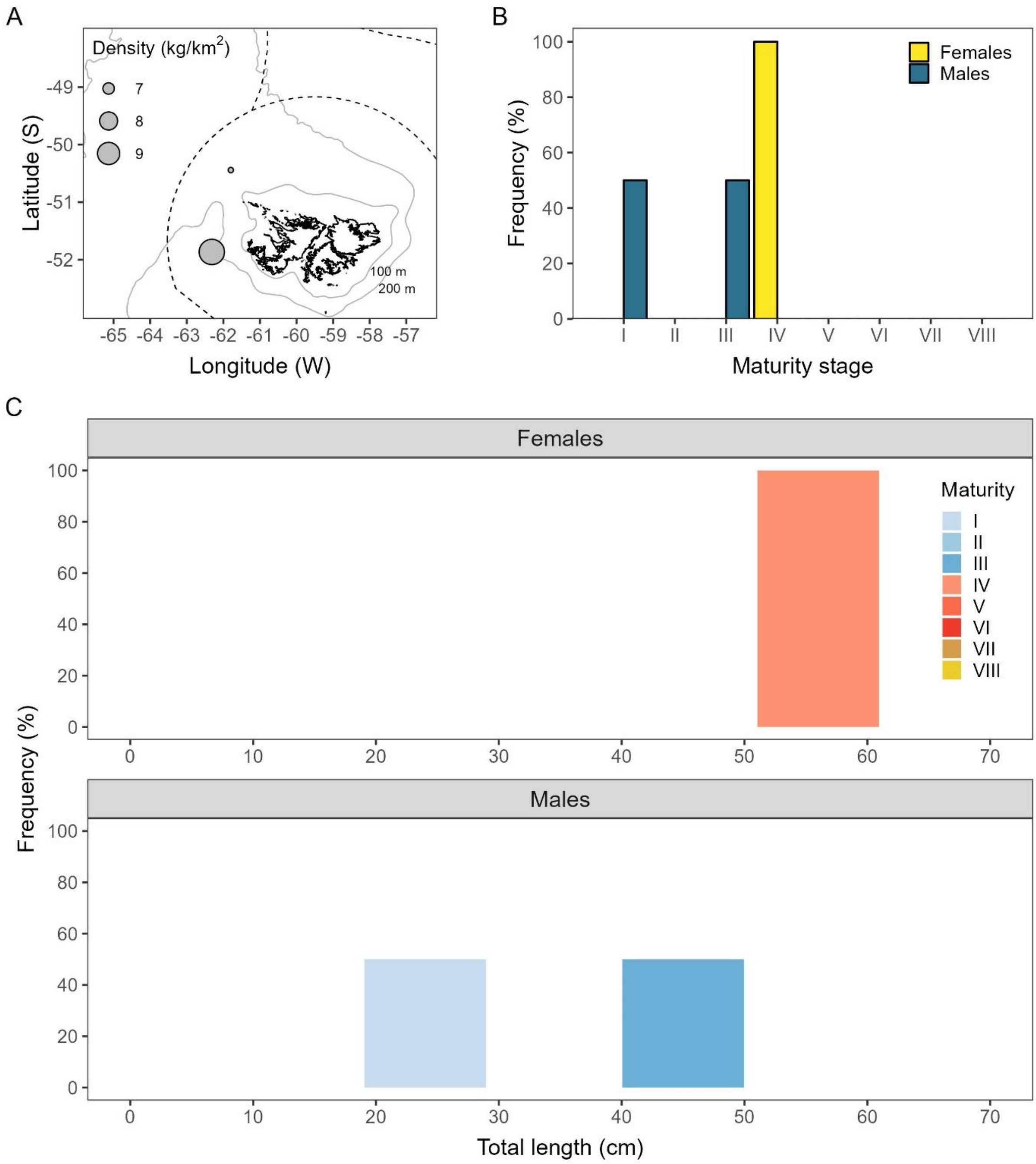

Figure 11. Biological data of *Seriolella porosa* (Driftfish; SEP). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 1) and male lengths (n = 2) lengths with 1 cm size class.

4.2.11. TOO – Patagonian toothfish, *Dissostichus eleginoides*

Patagonian toothfish were caught at 68 (81%) of the 84 survey trawl stations. Total catch was 728 kg, and mean CPUE was 9 kg/h. Positive catches ranged from 0.58 to 88 kg per trawl, and positive densities ranged from 2 to 439 kg/km^2, with higher densities observed mainly to the south-west in the FICZ at stations deeper than 200 m (Fig. 12A). Most individuals were immature or resting (maturity stages ≤II; Fig. 12B). Females were 34–108 cm, males were 34–75 cm. Modal lengths of females were detected at 45-46 cm and at 54 cm, whereas the modal length of males was detected at 45 cm and at 58 cm. However, no distinct length-groups were evident in the length frequency distribution due to the overlap of length-groups (Fig. 12C).

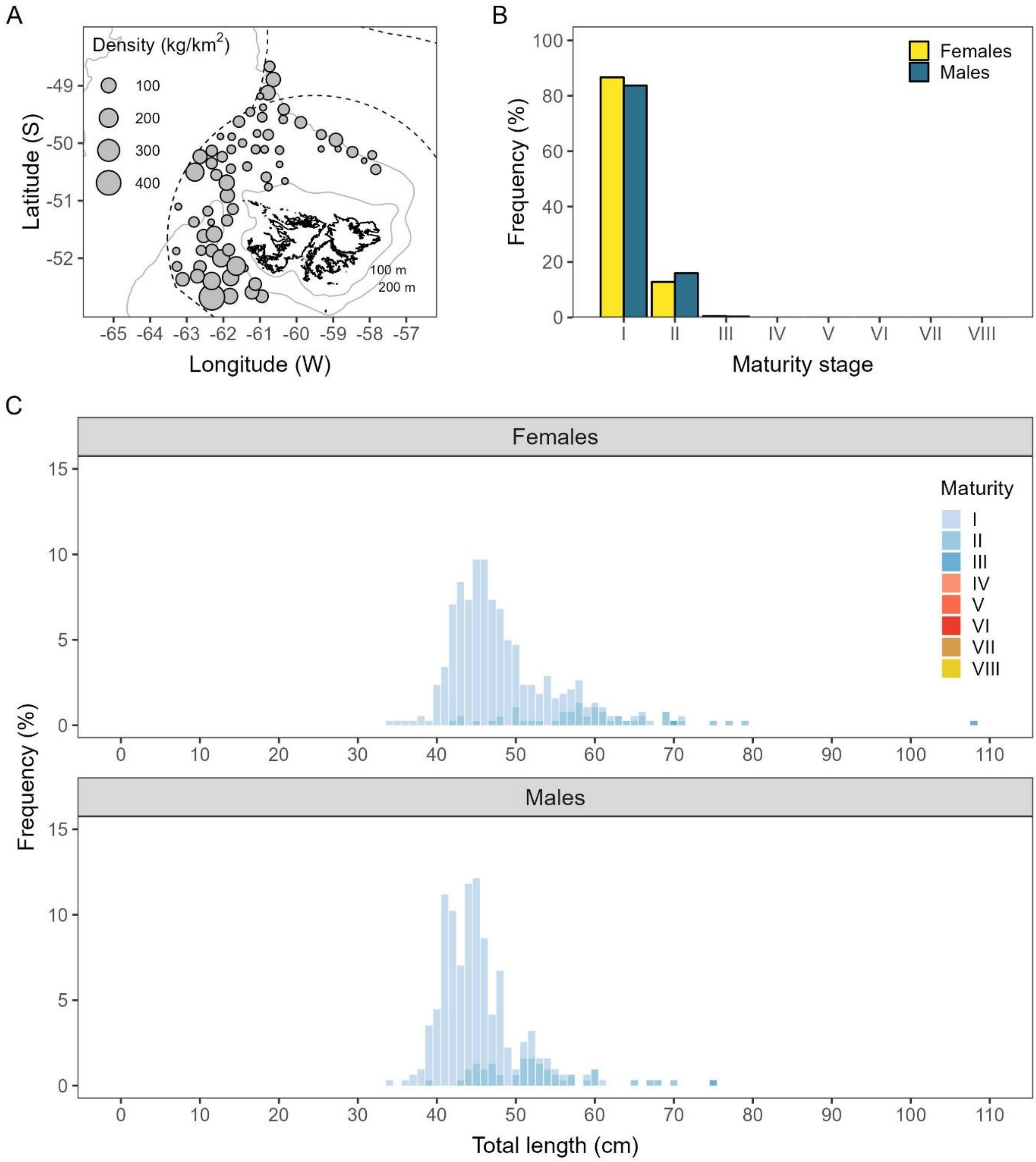

Figure 12. Biological data of *Dissostichus eleginoides* (Patagonian toothfish; TOO). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 382) and male (n = 313) lengths with 1 cm size class.

4.2.12. WHI – Hoki, *Macruronus magellanicus*

Hoki were caught at 21 (25%) of the 84 survey trawl stations. Total catch was 824 kg, and mean CPUE was 10 kg/h. Positive catches ranged from 0.16 to 360 kg per trawl, and positive densities were 1 to 1,792 kg/km^2, with higher densities observed to the south-west in the FICZ at stations deeper than 200 m (Fig. 13A). Most females and males were at resting or early developing maturity stages (maturity stages II–III; Fig. 13B). Females were 17–36 cm length, and males were 17–47 cm length. Length frequency distributions allowed detecting modal lengths at 22 cm and at 28 cm for females and for males (Fig. 13C).

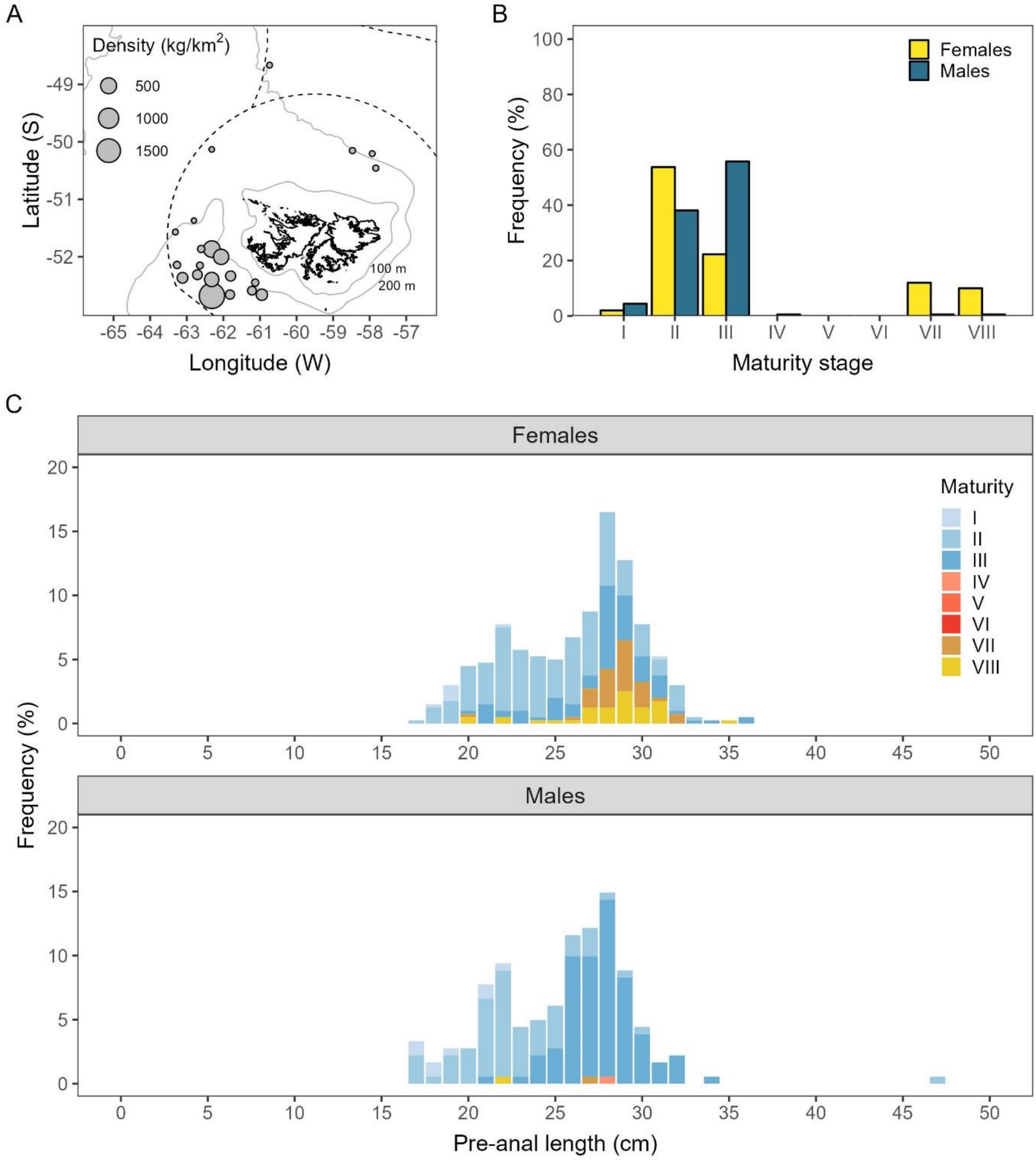

Figure 13. Biological data of *Macruronus magellanicus* (Hoki; WHI). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, immature; II, resting; III, early developing; IV, late developing; V, ripe; VI, running; VII, spent; VIII, recovering spent); C) Relative frequency (%) of female (n = 400) and male (n = 181) lengths with 1 cm size class.

4.3. Biological information of squid species

4.3.1. ILL – Argentine shortfin squid, *Illex argentinus*

Argentine shortfin squid were caught at 76 (90%) of the 84 survey trawl stations. Total catch was 12,917 kg, and mean CPUE was 154 kg/h. Positive catches ranged from 0.02 to 2,026 kg, and positive densities ranged from 0.1 to 10,074 kg/km^2, observed along the north-west in the FICZ (Fig. 14A). Most females were young, immature or preparatory (maturity stages ≤III). Males were mainly mature (maturity stage V) or young (maturity stage II; Fig. 14B). Females were 6.0–31.0 cm length, and males were 6.0–27.0 cm length. Length frequency distributions allowed detecting modal lengths at 9.0 cm and at approximately 23.0 cm for females, and at 7.5 cm and at 23.0 cm for males (Fig. 14C).

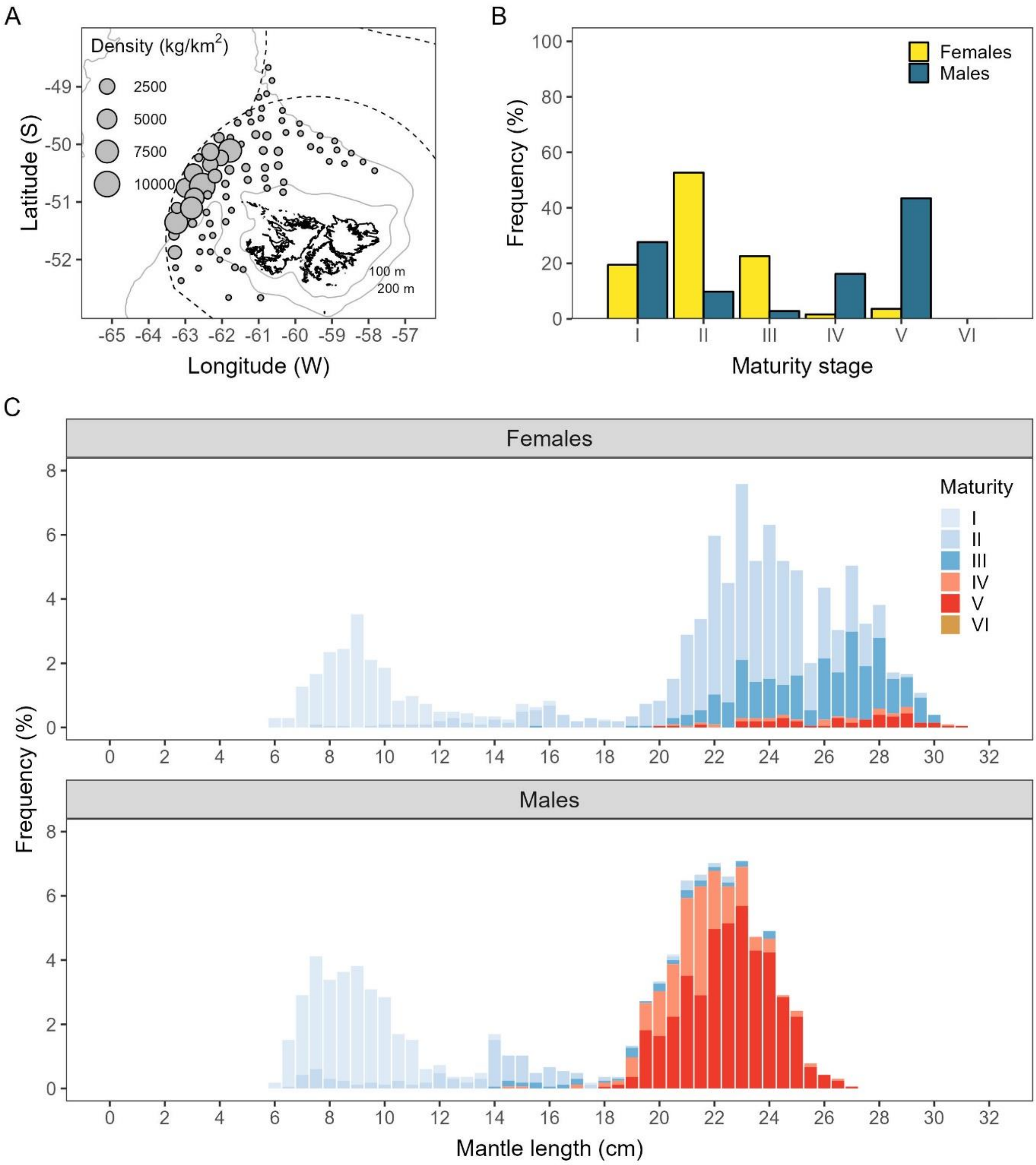

Figure 14. Biological data of *Illex argentinus* (Argentine shortfin squid; ILL). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent); C) Relative frequency (%) of female (n = 2,044) and male (n = 1,652) lengths with 0.5 cm size class.

4.3.2. LOL – Patagonian squid, *Doryteuthis gahi*

Patagonian squid were caught at 82 (98%) of the 84 survey trawl stations. Total catch was 2,636 kg, and mean CPUE was 32 kg/h. Positive catches ranged from 0.07 to 537 kg, and positive densities ranged from 0.32 to 2,580 kg/km^2 along the survey area, with higher densities to the south-west of West Falkland (Fig. 15A). Most females and males were immature (maturity stages I–II), with minor proportions of preparatory to mature individuals (maturity stages ≥III; Fig. 15B). Females were 4.5–15.5 cm length, and males were 4.0–22.5 cm length. Modal length of females and males were detected at 8.0 cm (Fig. 15C).

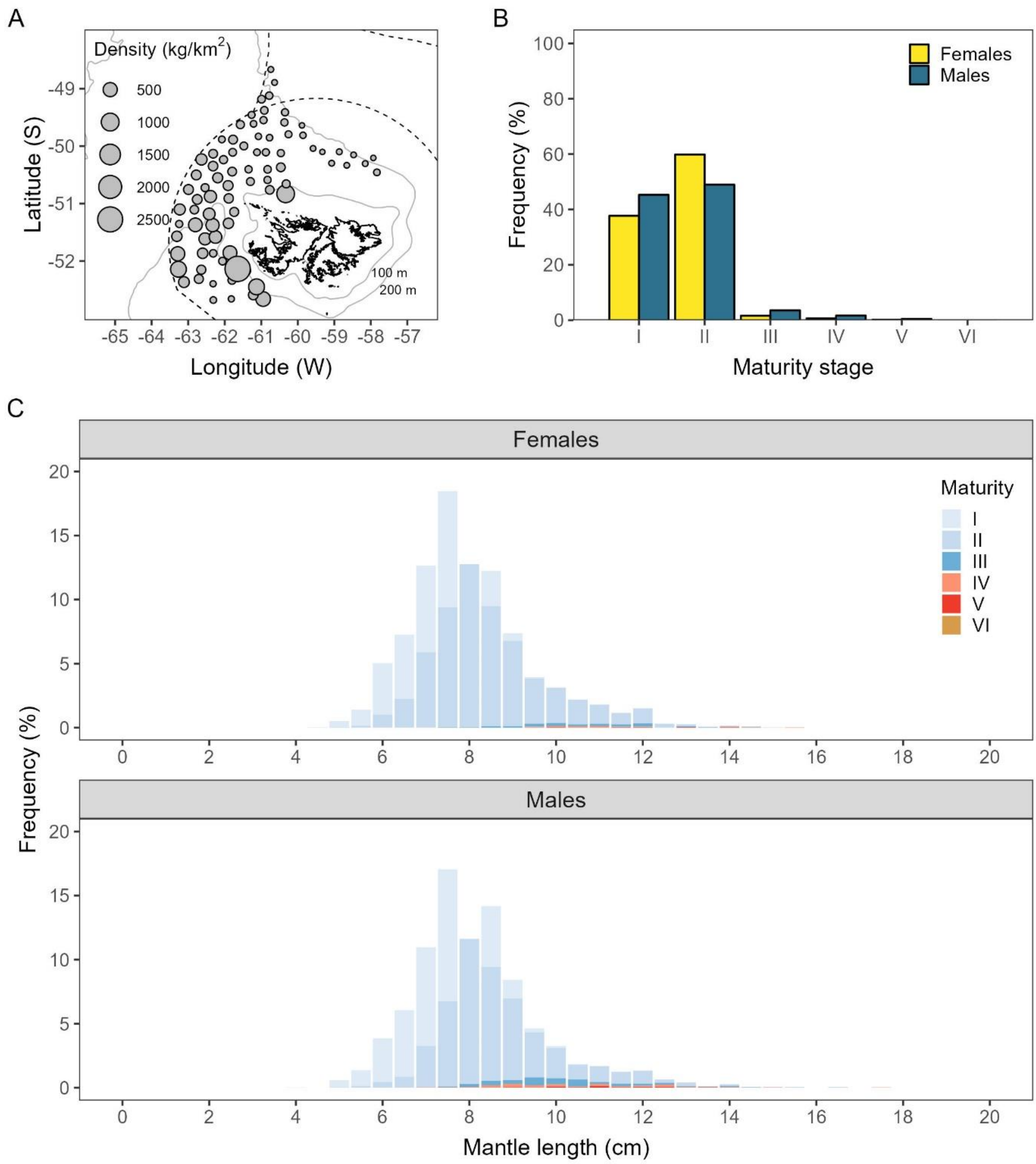

Figure 15. Biological data of *Doryteuthis gahi* (Patagonian squid; LOL). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, young; II, immature; III, preparatory; IV, maturing; V, mature; VI, spent); C) Relative frequency (%) of female (n = 3,856) and male (n = 3,373) lengths with 0.5 cm size class.

4.4. Biological information of skate species

4.4.1. RAL – White spotted skate, *Bathyraja albomaculata*

White spotted skates were caught at 8 (10%) of the 84 survey trawl stations. Total catch was 17 kg, and mean CPUE was 0.2 kg/h. Positive catches ranged from 0.3 to 7 kg, and positive densities ranged from 1 to 36 kg/km^2, observed mainly near the north along the limit of the FOCZ, and to the south-west of West Falkland (Fig. 16A). The females sampled were developing or mature (maturity stages III–IV), and the males were juvenile, developing, or mature (maturity stage I, III, and IV, respectively; Fig. 16B). Females were 24–47 cm disc width; males were 22–43 cm disc width. The small number of individuals (n = 11) caught during the survey did not allow identifying length-groups nor modal lengths (Fig. 16C).

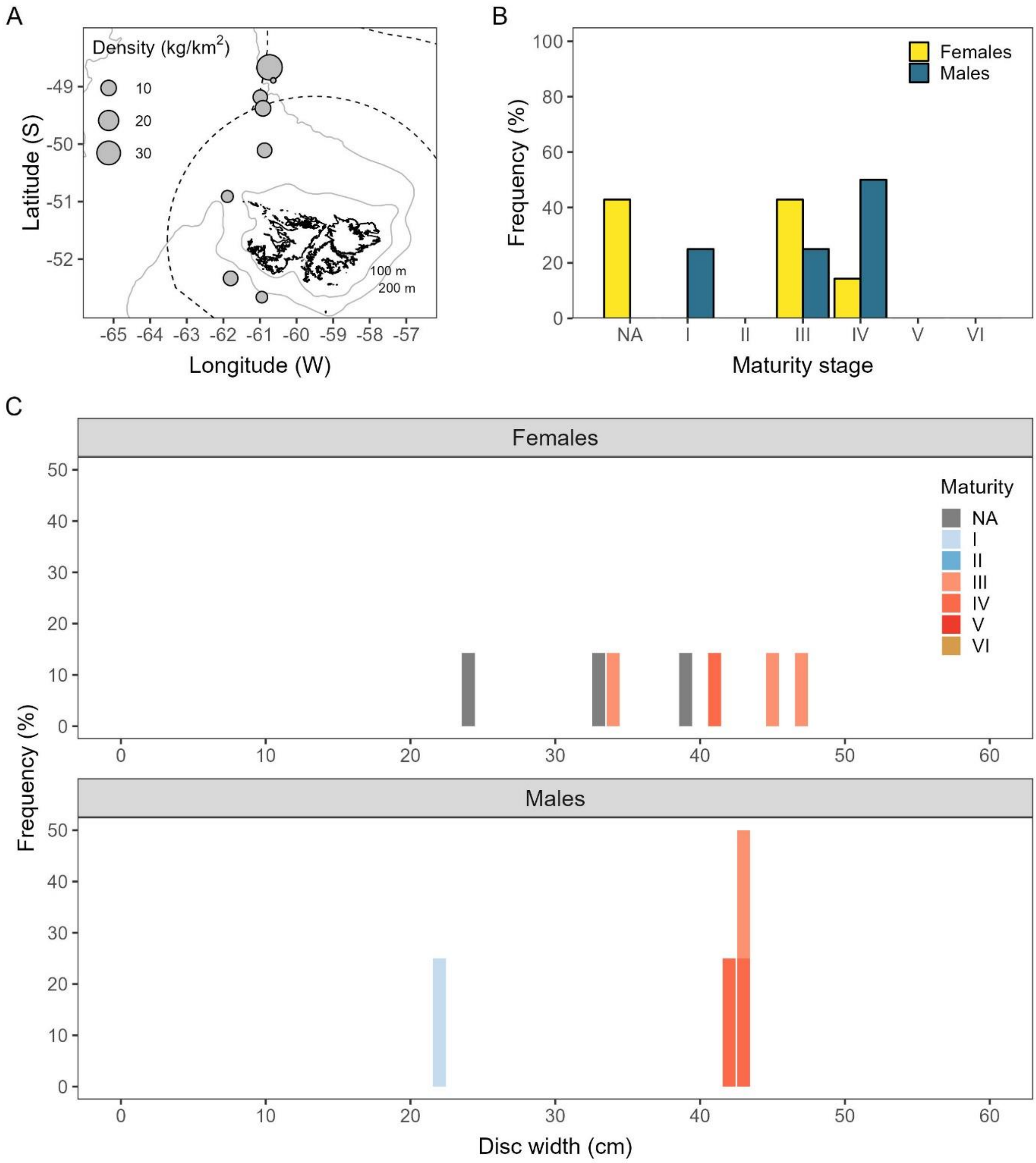

Figure 16. Biological data of *Bathyraja albomaculata* (White spotted skate; RAL). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting); C) Relative frequency (%) of female (n = 7) and male (n = 4) lengths with 1 cm size class.

4.4.2. RBR – Blonde skate, *Bathyraja brachyurops*

Blonde skates were caught at 16 (19%) of the 84 survey trawl stations. Total catch was 110 kg, and mean CPUE was 1.3 kg/h. Positive catches ranged from 0.1 to 32 kg, and positive densities ranged from 0.3 to 143 kg/km^2, with patchy distribution through the survey area (Fig. 17A). Most females and males were juvenile or maturing (maturity stages I–II). Small proportions of developing or mature individuals (maturity stages III and IV, respectively; Fig. 17B) were also observed. Females were 26–65 cm disc width, and males were 7–55 cm disc width. The wide range of sizes and the relatively small number of individuals per size class did not allow detecting length-groups nor modal lengths (Fig. 17C).

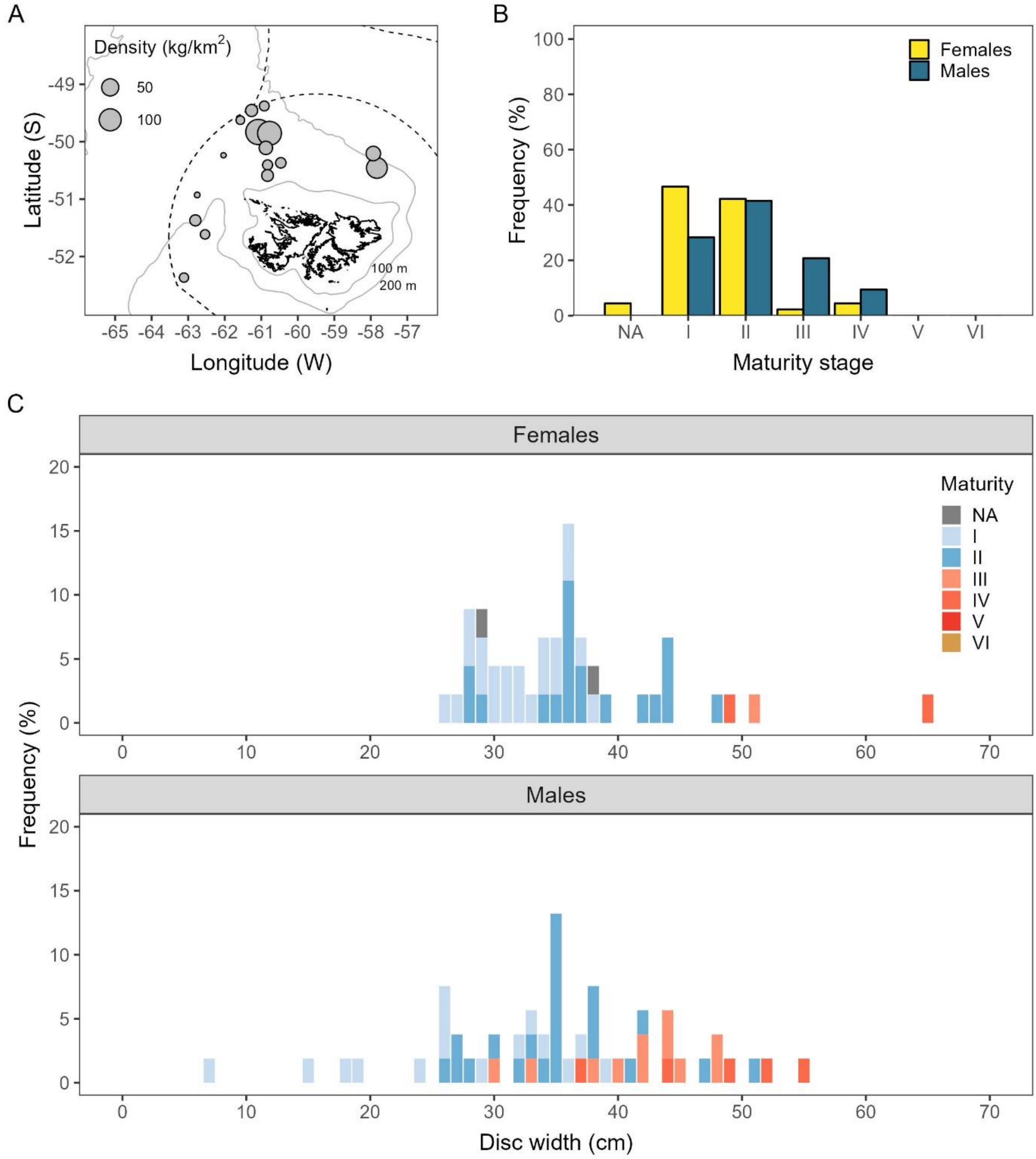

Figure 17. Biological data of *Bathyraja brachyurops* (Blonde skate; RBR). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting); C) Relative frequency (%) of female (n = 45) and male lengths (n = 53) with 1 cm size class.

4.4.3. RFL – Warrah skate, *Dipturus lamillai*

Warrah skates were caught at 14 (17%) of the 84 survey trawl stations. Total catch was 65 kg, and mean CPUE was 0.8 kg/h. Positive catches ranged from 1.5 to 15 kg, and positive densities ranged from 8 to 67 kg/km^2, with patchy distribution through the survey area (Fig. 18A). Most females were maturing (maturity stage II), and most males were developing (maturity stage III; Fig. 18B). Females were 38–71 cm disc width, and males were 49–54 cm disc width. The small number of individuals (n = 19) caught during the survey did not allow identifying length-groups nor modal lengths (Fig. 18C).

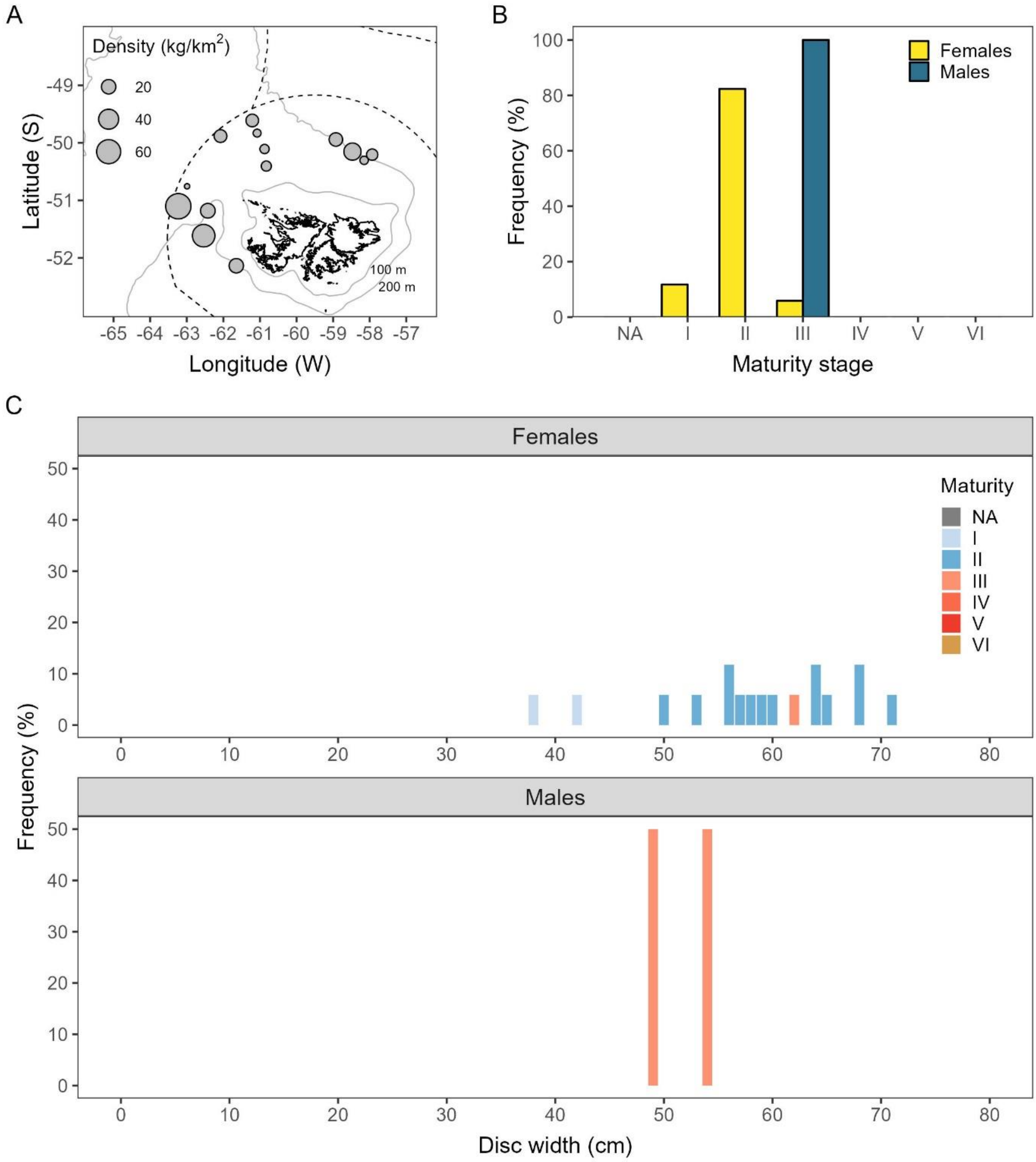

Figure 18. Biological data of *Dipturus lamillai* (Warrah skate; RFL). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting); C) Relative frequency (%) of female (n = 17) and male (n = 2) lengths with 1 cm size class.

4.4.4. RGR – Grey-tailed skate, *Bathyraja griseocauda*

Grey-tailed skates were caught at 6 (7%) of the 84 survey trawl stations. Total catch was 44 kg, and mean CPUE was 0.5 kg/h. Positive catches ranged from 1.3 to 15 kg, and positive densities ranged from 6 to 67 kg/km^2, with higher densities observed to the south-west in the FICZ (Fig. 19A). Females were not sampled due to their small size and were released alive or frozen for training in the laboratory. Males were mainly juvenile or running (maturity stages I and V), with smaller proportions of maturing and mature individuals (maturity stages II and IV, respectively; Fig. 19B). Females were 27–47 cm disc width, and males were 17–89 cm disc width. The small number of individuals (n = 11) caught during the survey did not allow identifying length-groups nor modal lengths (Fig. 19C).

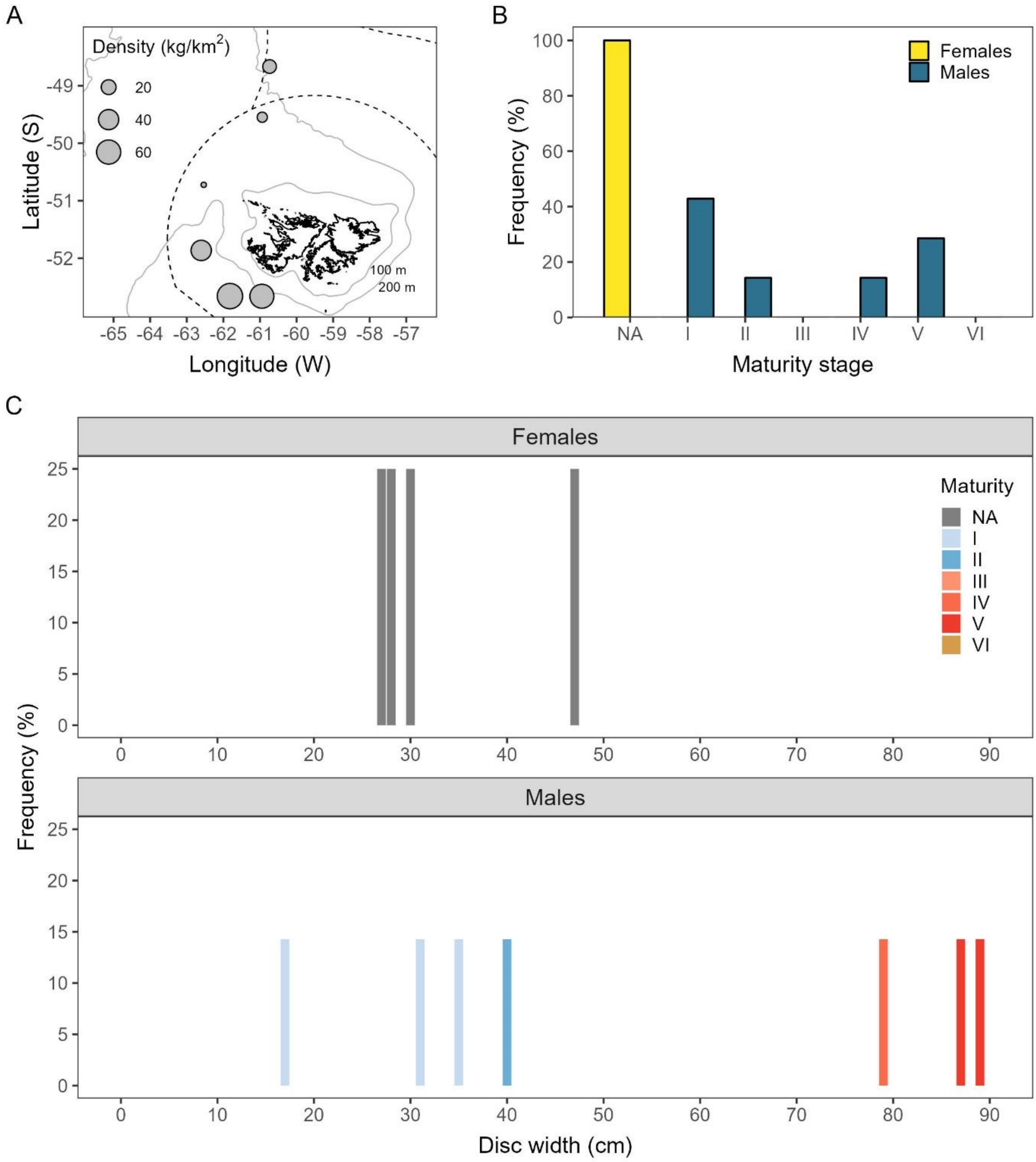

Figure 19. Biological data of *Bathyraja griseocauda* (Grey-tailed skate; RGR). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting); C) Relative frequency (%) of female (n = 4) and male (n = 7) lengths with 1 cm size class.

4.4.5. RMC – Falkland skate, *Bathyraja macloviana*

Falkland skates were caught at 5 (6%) of the 84 survey trawl stations. Total catch was 3 kg, and mean CPUE was 0.03 kg/h. Positive catches ranged from 0.02 to 1.3 kg, and positive densities ranged from 0.1 to 6 kg/km^2, observed to the north in the survey area (Fig. 20A). The female was a juvenile (maturity stage I; Fig. 20B), and measured 29 cm disc width (Fig. 20C). Males were mainly juvenile (maturity stage I), with smaller proportions of maturing and mature individuals (maturity stages II and IV, respectively; Fig. 20B). The small number of individuals (n = 5) caught during the survey did not allow identifying length-groups nor modal lengths (Fig. 20C).

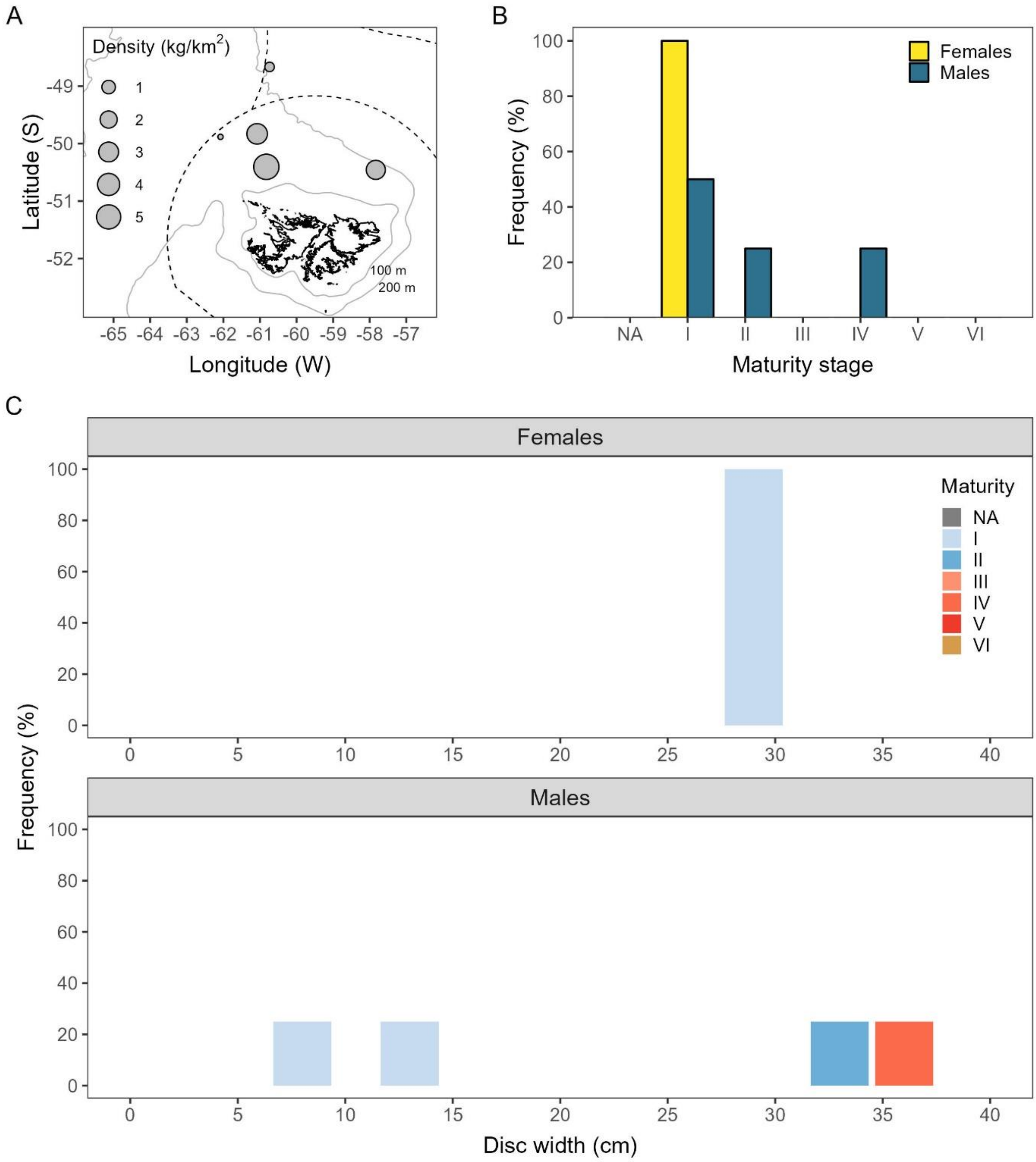

Figure 20. Biological data of *Bathyraja macloviana* (Falkland skate; RMC). A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting); C) Relative frequency (%) of female (n = 1) and male (n = 4) lengths with 1 cm size class.

4.5. Biological information of sharks species

4.5.1. DGH – Catshark, *Schroederichthys bivius*

Catshark were caught at 23 (27%) of the 84 survey trawl stations. Total catch was 17 kg, and mean CPUE was 0.2 kg/h. Positive catches ranged from 0.1 to 2 kg, and positive densities ranged from 0.6 to 10 kg/km^2, with higher densities observed to the north-west in the FICZ (Fig. 21A). The females sampled were mainly immature (maturity stage I), with minor proportions of adolescent, mature, developing, and expecting maturity stages (maturity stages II–V). Most males were juvenile (maturity stage I) or mature (maturity stage IV), with minor proportions of adolescent and mature individuals (maturity stages II–III; Fig. 21B). Females were 25–56 cm length, and males were 34–76 cm length. The small number of individuals (n = 59) caught during the survey did not allow identifying length-groups nor modal lengths (Fig. 21C).

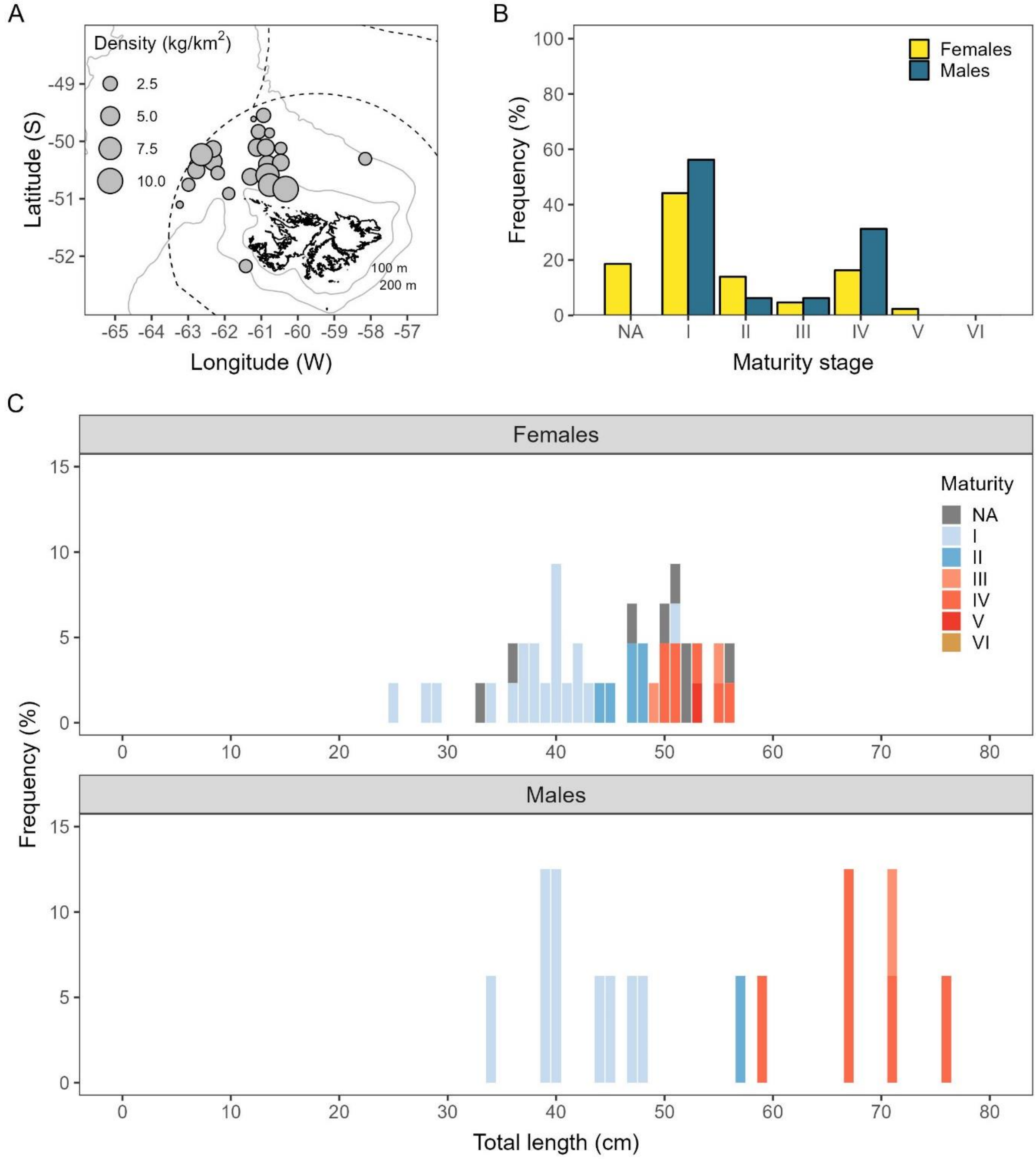

Figure 21. Biological data of *Schroederichthys bivius* (Catshark; DGH); A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting); C) Relative frequency (%) of female (n = 43) and male (n = 16) lengths with 1 cm size class.

4.5.2. DGS – Dogfish, *Squalus acanthias*

Dogfish were caught at 26 (31%) of the 84 survey trawl stations. Total catch was 92 kg, and mean CPUE was 1.1 kg/h. Positive catches ranged from 0.6 to 21 kg, and positive densities ranged from 3 to 103 kg/km^2, with higher densities through the north along the limit of the FOCZ (Fig. 22A). Most females were found alive and released as soon as possible without assessing maturity stage, and their maturity stage was recorded as NA. The few females sampled were juvenile, adolescent, or developing (maturity stages I, II, and IV). Most males were developing (maturity stage IV), with smaller proportions of mature and adolescent individuals (maturity stages III and II, respectively; Fig. 22B). Females were 51–90 cm length, with the main mode at 62 cm length. Males were 55–75 cm length, with the main mode at 69 cm length. The relatively small number of individuals (n = 76) caught during the survey did not allow identifying length-groups nor modal lengths (Fig. 22C).

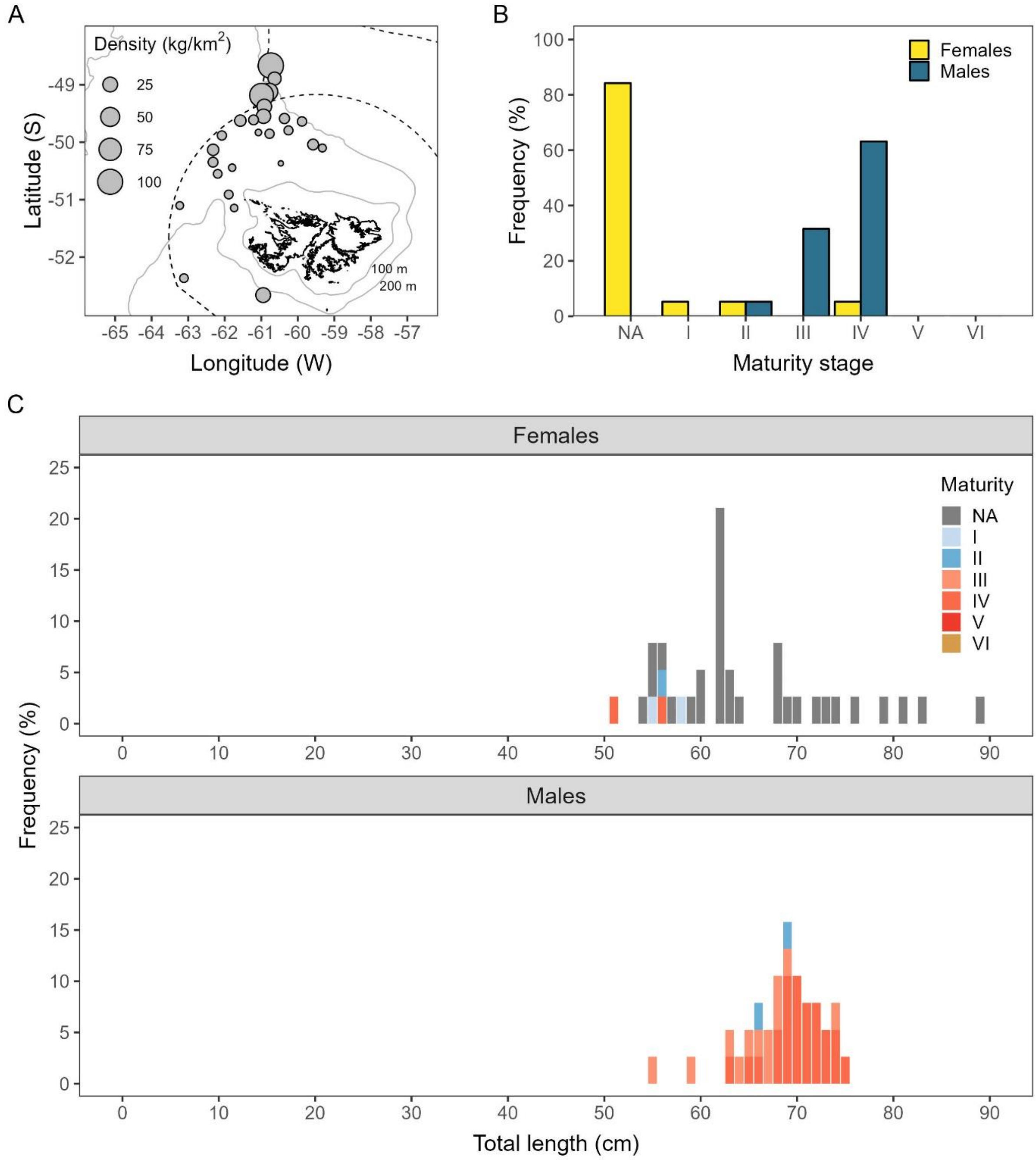

Figure 22. Biological data of *Squalus acanthias* (Dogfish; DGS); A) Map of densities in kg/km^2; B) Relative frequency (%) per maturity stage (I, juvenile; II, adolescent maturing; III, adult developing; IV, adult mature; V, adult laying/running; VI, adult resting); C) Relative frequency (%) of female (n = 38) and male (n = 38) lengths with 1 cm size class.

4.6. Finfish gonads for histology

A total of 254 gonads, including ovaries and testes, of six species (common hake, kingclip, Patagonian toothfish, red cod, rock cod, and southern blue whiting) were sampled for histology in 36 stations, resulting in a photographic reference collection of 2,068 high-quality images. Common hake ovaries (n = 94) and testes (n = 22) accounted for 48% of the gonads sampled (Table IV).

Table IV. Mean fish length ± standard deviation (SD), number of ovaries, testes, and pictures taken per species during the February 2025 groundfish survey (2025-02-ZDLU1). Common hake (*Merluccius hubbsi;* HAK), Kingclip (*Genypterus blacodes*; KIN), Patagonian toothfish (*Dissostichus eleginoides*; TOO); Red cod (*Salilota australis*; BAC), Rock cod (*Patagonotothen ramsayi*; PAR), Southern blue whiting (*Micromesistius australis*; BLU).

Species code	Length (mean ± SD)	Ovaries (n)	Testes (n)	Pictures (n)
Common hake	39.53 ± 8.19	94	28	1,291
Kingclip	63.50 ± 19.87	1	5	95
Patagonian toothfish	54.20 ± 12.79	25	21	18
Red cod	44.43 ± 13.13	13	10	189
Rock cod	21.73 ± 6.84	24	16	309
Southern blue whiting	37.53 ± 12.42	8	9	166
Total		165	89	2,068

4.7. Interactions with pinnipeds

Pinnipeds suspected to be South American fur seals (*Arctocephalus australis*; ARA) were observed from the bridge following the vessel during hauling at three bottom trawl stations (1329, n = 3; 1333, n = 10; 1335, n = 2) and in one CTD station (1350, n = 1). No incidental bycatches, nor mortalities, of pinnipeds occurred during the survey (Fig. 23).

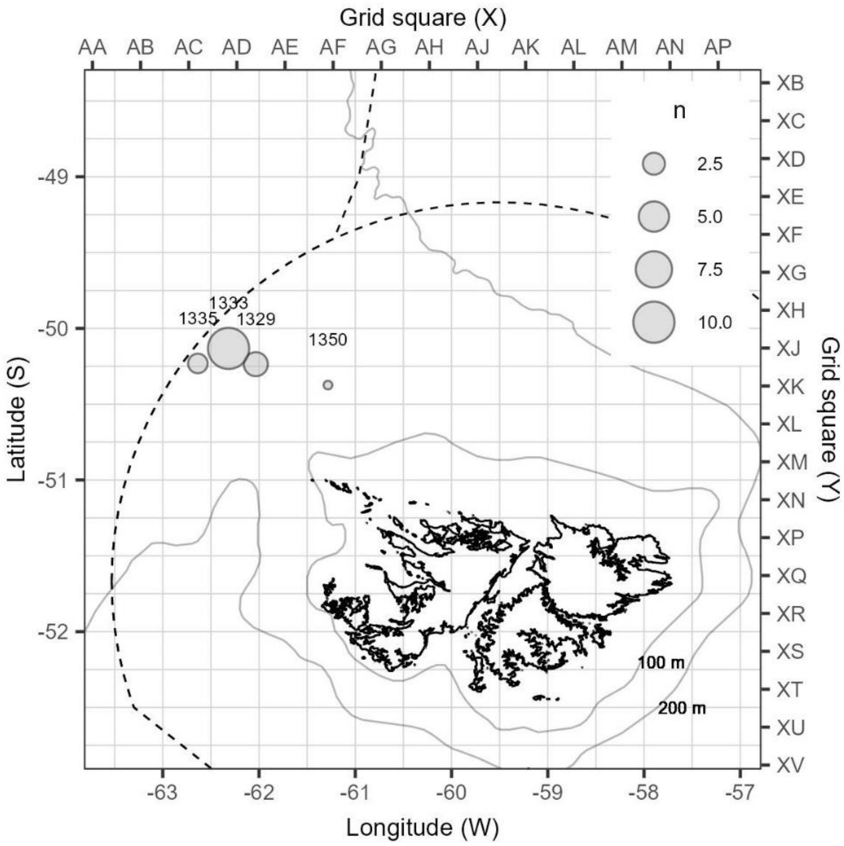

Figure 23. Pinnipeds observed (grey circles) during the February 2025 groundfish survey (2025-02-ZDLU1).

4.8. Oceanography

A total of 84 CTD stations were conducted, producing 83 usable casts. The cast of CTD station 1240 only recorded one line of data due to full memory. The fluorescence sensor experienced unknown issues and did not record chlorophyll data during the first 8 CTD stations (1206–1220; Table II). Usable chlorophyll data were recorded from CTD station 1222 onwards, conducted on February 1st. High levels of chlorophyll developed from the surface to 30 m depth where a gyre from the Falkland Current met warmer waters, probably of the Argentine Current (Fig. 24, black arrow in 10 m depth layer). Below 30 m, chlorophyll levels dropped, and were near to 0 µg/l by 60 m depth. Significant chlorophyll levels were also observed where the western branch of the Falkland Current split around West Falkland, reaching the shallower water of the shelf (Fig. 24).

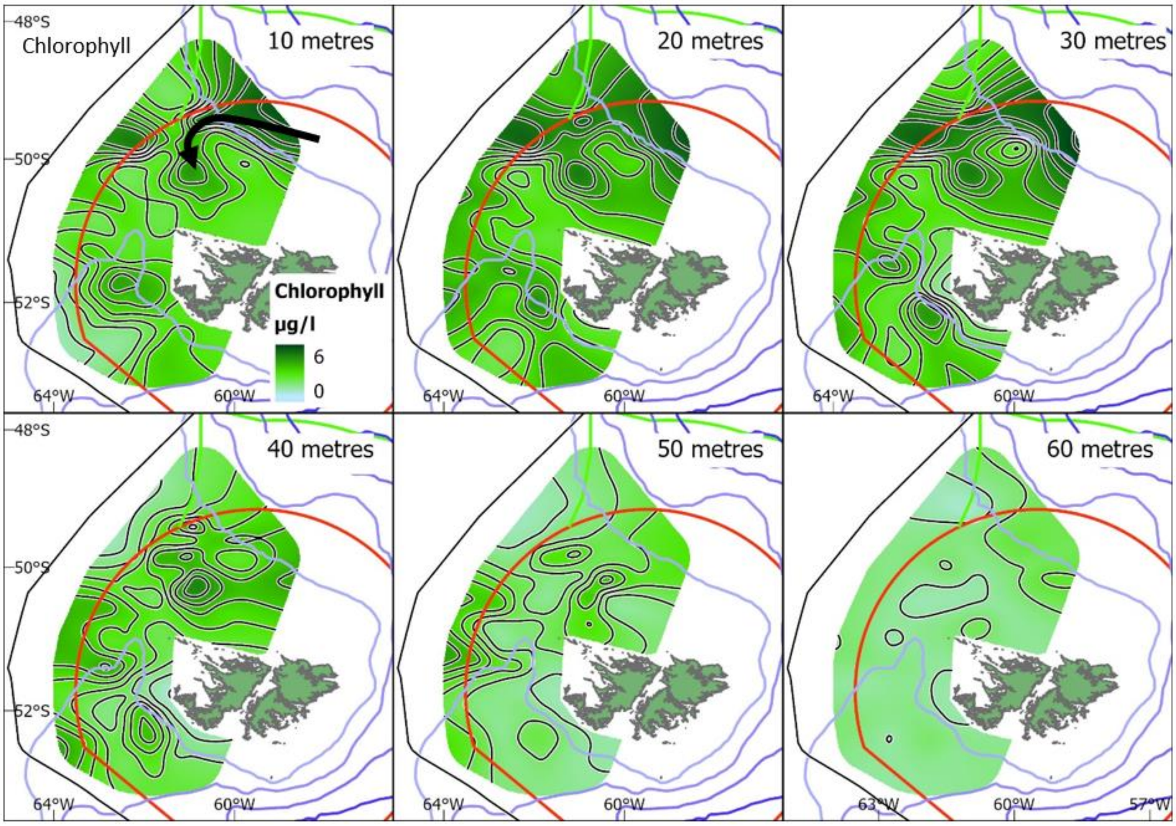

Figure 24. Chlorophyll levels (µg/l) at surface (10 m), and at 10 m intervals from 20 m to 60 m during the February 2025 groundfish survey (2025-02-ZDLU1).

Temperature ranged between 8.5°C and 13.7°C° at the surface, and between 4.6°C and 6.4°C at the seabed. At the surface, the coolest water (<9°C) occurred to the south-west of West Falkland near the limit of the FICZ; warmer waters occurred to the north-east at the shelf edge. At 50 m depth, there was considerable mixing with patchy areas of cold and warm water. At 100 m depth and at the seabed, temperature was lower to the south-west and to the north-east (Fig. 25). Oxygen concentration was higher at the surface, with >5.9 ml/l across the survey area, and the highest oxygen concentration to the south-west and to the north-east. At 50 m and at 100 m depths, the lowest oxygen concentration was directly north of West Falkland, and higher concentrations were observed where the western branch of the Falkland Current flows from deep-water trough to the south and proceeds to the north (Fig. 25, black arrow in 50 m depth layer). At the seabed, oxygen levels were lower compared with the 10 m, 50 m, and 100 m depth layers, and the area with lower oxygen concentration expanded over the northern shelf (Fig. 25). Salinity was higher to the north-east and to the south-west, and it was lower along the western limit of the FICZ. Salinity ranged between 33.4 and 33.8 PSU at 10 m and at 50 m depths, between 33.5 and 34.0 PSU at 100 m depth, and between 33.6 (33.4 in the interpolated area to the west of the FICZ) and 34.1 PSU at the seabed (Fig. 25; the maps show interpolated values outside the measured range of salinity values). Lower levels of salinity occur generally in the area where the Argentine Current enters the FICZ (Fig. 25), given that the less dense Argentine Current water-mass is found above the Falkland Current denser water-mass (Arkhipkin et al. 2013). Density ranged from 25.2 to 27.0 sigma t; on average, density was 1.0 sigma t higher at the seabed than at the surface. Overall, density was also higher to the south-west and to the north-east at the different depth layers. At 10 m depth, higher density (~ 26.1 sigma t) was observed to the south-west. At 50 m depth, there was considerable mixing with patchy areas of low and high density. At 100 m depth, density ranged between 26.4 and 26.7 sigma t. At the seabed, density reached 27 sigma t to the south-west (Fig. 25).

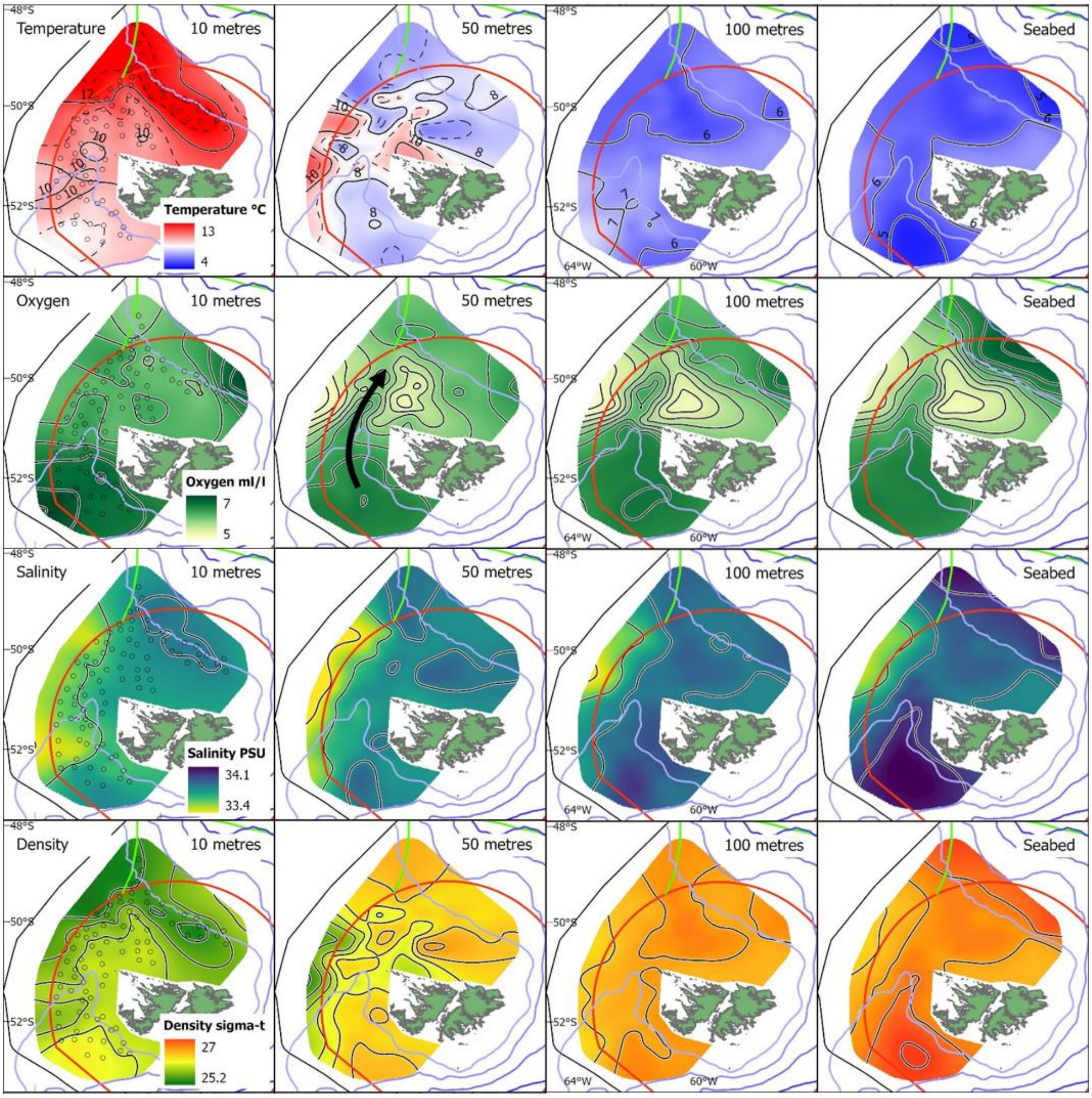

Figure 25. Temperature, oxygen, salinity, and density at surface (10 m), 50 m, 100 m, and seabed during the February 2025 groundfish survey (2025-02-ZDLU1). Contours at 0.25°C, 0.2 ml/l, 0.1 PSU, and 0.1 sigma t, respectively.

5. Discussion

This report summarises the findings of the February 2025 groundfish survey conducted in the FICZ and FOCZ. This fisheries-independent survey followed an array of stations similar to the array of stations originally used in the February 2010 groundfish survey (Brickle & Laptikhovsky 2010), which was replicated in subsequent February groundfish surveys conducted in 2011 (Arkhipkin et al. 2011), and from 2015 to 2024 (Gras et al. 2015, 2016, 2017b, 2018; Arkhipkin et al. 2019; Randhawa et al. 2020b; Trevizan et al. 2021, 2022, 2023; Ramos et al. 2024a). The February groundfish survey provides valuable information on some demersal fisheries resources with higher presence in the FICZ during summer due to their seasonal migratory patterns (Arkhipkin et al. 2012). These fisheries-independent surveys are crucial to better understand the spatial and temporal (seasonal and inter-annual) patterns in species distribution and abundance, and demographic patterns (sex, maturity, and length frequency distributions), in response to environmental, ecological, and anthropogenic factors (e.g., Hilborn & Walters 1992).

CPUE of five finfish species declined for second (i.e., butterfish, driftfish, and kingclip), third (i.e., red cod) or fourth (i.e., hoki) consecutive year. Some of these species reached their lowest CPUE amongst February groundfish surveys since 2010 (i.e., hoki, and kingclip). In contrast, CPUE of 7 finfish species increased compared with the previous year (i.e., banded whiptail grenadier, and common hake), and for the second (i.e., rock cod, and Patagonian toothfish) and third (i.e., ridge scaled rattail, southern blue whiting, and southern hake) consecutive year. Common hake and southern blue whiting had the greatest increase in CPUE compared with the February 2024 groundfish survey, and had the highest CPUE in the time series (Appendix II).

CPUE of the main commercial squid species, the Argentine shortfin squid and the Patagonian squid, decreased from the February 2024 groundfish survey; in particular, the Patagonian squid saw a considerable decrease in CPUE (Appendix II).

CPUE of each skate species was below average amongst February groundfish surveys since 2010. Indeed, six species of skates had the lowest CPUEs in the time series, i.e., starry skate, grey-tailed skate, Falkland skate, Magellanic skate, sand ray, and roughskin skate (Appendix III). Accordingly, skate biomass calculated from surveys designed to assess skate's abundance in Falkland Islands waters was found to decrease approximately 61% from 2013 to 2021; this finding is correlated with continuing skate bycatch in the bottom trawl finfish fishery (Winter & Arkhipkin 2023), and with high discard levels in the late 1990s and again in 2017 (Parkyn et al. 2021) due to the skates being of size smaller than the commercial size. It must be noted that some skate species caught in Falkland Islands waters are classified as endangered (i.e., grey-tailed skate; Pollom et al. 2020a), vulnerable (i.e., white spotted skate; Pollom et al. 2020b), or near threatened (i.e., blonde skate, Falkland skate, and multispine skate; Pollom et al. 2020c, d, e) by The International Union for Conservation of Nature (IUCN). CPUE of catfish (0.2 kg/h) and dogfish (1 kg/h) in the February 2025 groundfish survey were the lowest amongst February groundfish surveys since 2010 (Appendix III), and dogfish is classified as vulnerable by the IUCN (Finucci et al. 2020).

Rock cod was the highest catch (23 t) during the February 2025 groundfish survey and it's CPUE (274 kg/h) was higher than in the February 2024 groundfish survey (178 kg/h). However, CPUE still is below average (361 kg/h) amongst February groundfish surveys since 2010. Consistent with previous February groundfish surveys, denser aggregations of rock cod were located mainly along the west in the FICZ. Most individuals were in resting or immature maturity stages, as spawning occurs in autumn on the Argentine Shelf at 42°S, at the end of autumn and in part of winter at the shelf break in Falkland Islands waters, and in spring at the Burdwood Bank (Ekau 1982; Brickle et al. 2006).

Common hake was the second highest catch (17 t) during the survey. Catch proportion (22%) and CPUE (202 kg/h) were the highest amongst February groundfish surveys since 2010. Accordingly, the highest densities of common hake were observed during the February 2025 groundfish survey, in particular through the north-west. Common hake starts its migration to the Falkland shelf with the Argentine inflow, and use this area as feeding ground (Arkhipkin et al. 2003). A pattern of the maturity status of common hake in Falkland Islands waters was described by Arkhipkin et al. (2015): "The post-spawning period runs from March to June, while the resting/feeding period occurs from July to November. The spawning period, when the majority of fish was absent from Falklands waters, was from December to February". This may explain why ripe or running females were not common during February surveys, despite some ripe males were reported. Contrasting maturity patterns observed across February surveys may be due to alterations in reproductive phenology associated with environmental variability (Pörtner & Farrell 2008; Alix et al. 2020; Elisio et al. 2020), or may be an artefact caused by the misidentification of maturity stages, which requires further examination and detailed description of the eight-stage maturity scale used at FIFD. Common hake was in the range of sizes between 30 cm and 90 cm total length during the February groundfish surveys in 2010 and 2011. However, individuals were smaller in most February surveys from 2015 to 2025, with the largest individuals reaching up to 80 cm. The migrating stock of common hake into Falkland Islands waters was mostly comprised of relatively small animals (<40 cm total length) during February 2025.

The Argentine shortfin squid was the third highest catch (13 t; 17%) during the survey. This is the fourth highest CPUE (154 kg/h) of Argentine shortfin squid during February groundfish surveys since 2010, and it was above the average CPUE (111 kg/h) of the time series. Relatively high abundance may reflect early migration to the north-west in the FICZ as it was observed in the February 2015 (Gras et al. 2015), February 2018–2021 (Gras et al. 2018; Arkhipkin et al. 2019; Randhawa et al. 2020b; Trevizan et al. 2021), and February 2024 groundfish surveys (Ramos et al. 2024a), with most individuals >20 cm mantle length.

Southern blue whiting was the fourth highest catch (8.2 t; 10%) during the survey, although over half of its catch (4.8 t) was taken in one station to the north-east. This is the highest CPUE (98 kg/h) of southern blue whiting during February groundfish surveys since 2010. Catch, catch proportion and CPUE have increased for third consecutive year. This species is demersal-pelagic (Froese & Pauly 2024), and it must be noted that the groundfish survey may represent a portion of the stock that was collected near the seabed. Aggregations occurred around the 200 m isobath, and in deeper stations. Immature individuals and at resting maturity were common during the survey, which is consistent with the reproductive timing of this species in Falkland Islands waters, i.e., spawning occurs during September and October to the south of West Falkland (Macchi et al. 2005; Arkhipkin et al. 2022). The majority of individuals were larger (>25 cm length) compared with previous February groundfish surveys.

Banded whiptail grenadier was the fifth highest catch (4.1 t; 5%) during the survey. CPUE (49 kg/h) was below average (56 kg/h) amongst February groundfish surveys since 2010. Denser aggregations occurred at stations deeper than 200 m to the south-west in the FICZ, consistent with patterns of distribution observed in previous February groundfish surveys. The maturity stages and the length frequency distributions seem to be consistent across February groundfish surveys.

Red cod catch (3.2 t), catch proportion (4%), and CPUE (38 kg/h) were the lowest for this species amongst February groundfish surveys since 2010. A survey conducted in late September 2022 found low biomass of spawning red cod, and concluded that this stock has decreased in the Falkland Islands fishing area (Arkhipkin et al. 2022), which is consistent with low CPUE in recent years calculated from commercial fishery data (Ramos & Winter 2022b). Red cod had a patchy distribution in the survey area and higher densities were observed to the south-west. Previous February groundfish surveys had a broader distribution and with higher densities either to the west near the limit of the FICZ (i.e., 2011, 2015–2017; Arkhipkin et al. 2011; Gras et al. 2015, 2016, 2017b) or in random areas along the west (i.e., 2010, 2018–2024; Brickle & Laptikhovsky 2010; Gras et al. 2018; Arkhipkin et al. 2019; Randhawa et al. 2020b; Trevizan et al. 2021, 2022, 2023; Ramos et al. 2024a). Females in resting maturity stage are consistent across February surveys, which suggests that red cod uses Falkland Islands waters mainly as feeding grounds this time of the year, whereas spawning occurs between August and October to the south and south-west of West Falkland (Arkhipkin et al. 2010; Brickle et al. 2011). For the third consecutive year, the length-group of <20 cm total length animals was represented in lower numbers, likely a sign of poor recruitment.

Patagonian squid CPUE (31 kg/h) was below the CPUE average (49 kg/h) amongst February groundfish surveys since 2010, contrasting with the February 2024 groundfish survey, when CPUE was the highest (97 kg/h) in the time series. Consistent with the February 2021 to February 2024 groundfish surveys, the Patagonian squid was distributed across the survey area, with the largest densities found to the south-west. As in previous February groundfish surveys, most individuals were young or immature, but modal lengths in 2025 were slightly smaller than in previous years (i.e., 2017, 2020, 2022–2024; Gras et al. 2017b; Randhawa et al. 2020b; Lee et al. 2022; Trevizan et al. 2023; Ramos et al. 2024a).

Kingclip catch (2.4 t) and CPUE (29 kg/h) were the lowest amongst February groundfish surveys since 2010, consistent with low abundances since 2015 (García 2024). Kingclip catch distribution was scattered across the survey area, as in previous February groundfish surveys, and higher densities were observed to south-west in the FICZ. Resting individuals are mainly present this time of the year in Falkland Islands, and in small numbers given that most of the kingclip stock moves out of Falkland Islands waters from January through March to spawn (Arkhipkin et al. 2012). Larger females seemed more common in February 2025 compared with previous years (i.e., 2017, 2020, 2022–2024; Gras et al. 2017b; Randhawa et al. 2020b; Lee et al. 2022; Trevizan et al. 2023; Ramos et al. 2024a). Ridge scaled rattail is occasionally caught in February groundfish surveys. However, catch (78 t), catch proportion (1.4%), and CPUE (13 kg/h) were above average amongst February groundfish surveys since 2010, and increased for the fourth consecutive year.

Hoki catch (824 kg), catch proportion (1%), and CPUE (10 kg/h) were the lowest amongst February groundfish surveys since 2010. CPUE of hoki in the February 2025 groundfish survey decreased for the fourth consecutive year. As this species is demersal-pelagic (Froese & Pauly 2024), the groundfish survey may represent a portion of the stock that was collected near the seabed. Denser aggregations occurred to the south-west in the FICZ, at stations deeper than 200 m; this pattern has been observed in February groundfish surveys since 2019 (Arkhipkin et al. 2019; Randhawa et al. 2020b; Trevizan et al. 2021, 2022, 2023; Ramos et al. 2024a), a pattern that is contrasting with that observed earlier in the time series (Brickle & Laptikhovsky 2010; Arkhipkin et al. 2011; Gras et al. 2016, 2018). Post-spawning (recovering spent and resting maturity stages) hoki are common during February in Falkland Islands waters. However, a high proportion of early developing individuals were also reported during the February 2025 groundfish survey, consistent with the patterns observed during the February 2024 groundfish survey (Ramos et al. 2024a). Spawning occurs during winter outside of Falkland Islands waters, and part of the hoki population migrates in spring to feeding grounds in the slope areas of the Falkland Current Front (west in the FICZ) (Brickle et al. 2009; Arkhipkin et al. 2012). Length frequency distributions showed relatively similar patterns compared with the February 2024 groundfish survey (Ramos et al. 2024a), although larger animals within the smaller length-group were more common compared with the February 2024 groundfish survey.

Patagonian toothfish catch (728 kg), catch proportion (1 %), and CPUE (9 kg/h) were the fourth highest amongst February groundfish surveys since 2010. Patagonian toothfish were caught through the survey area, although most individuals (relatively small and immature) were mostly caught at stations deeper than 200 m to the south-west in the FICZ. However, adult Patagonian toothfish are caught mainly using longline; therefore, the information provided in this report is not representative of the adult portion of the Patagonian toothfish population. Southern hake was a minor catch (320 kg; 0.3%) during the survey. CPUE (4 kg/h) increased for the third consecutive year since the February 2022 groundfish survey. Catch and abundance patterns of southern hake should be taken with caution given that this species is often misidentified as common hake *M. hubbsi*. Butterfish catch (61 kg), catch proportion (0.07%), and CPUE (0.7 kg/h) had a decrease compared with the February 2024 groundfish survey, and CPUE was the third lowest amongst February groundfish surveys since 2010. Driftfish catch (4 kg), catch proportion (0.01%), and CPUE (0.05 kg/h) was the third lowest amongst February groundfish surveys since 2010, decreasing for second consecutive year.

No incidental bycatches, nor mortalities, of pinnipeds occurred during the February 2025 groundfish survey. However, pinnipeds have entered the net in rare occasions during previous groundfish surveys, resulting in one mortality in the February 2016 groundfish survey, and 12 mortalities in the July 2022–2024 groundfish surveys. These 13 mortalities represent 4% of the overall reported pinniped incidental mortalities in Falkland Islands commercial fisheries, and only 1% of the mortalities during the groundfish surveys were comprised by females (V. Iriarte, FIFD Bycatch Mitigation Officer, *pers. comm.*). The pinniped incidental mortalities occurred mostly in the first trawl station of the day. It is presumed that the pinnipeds were attracted by the CTD and then aggregated astern during the shooting of the net that took place just before the sunrise (while it was still dark), with some pinnipeds entering the net.

6. Conclusions

1. The most abundant species during the February 2025 groundfish survey were rock cod (29%), common hake (22%), Argentine shortfin squid (17%), and southern blue whiting (10%).
2. CPUE of butterfish, driftfish, hoki, kingclip, and red cod decreased compared with previous February groundfish surveys, with hoki and kingclip having the lowest CPUE amongst February groundfish surveys since 2010.
3. CPUE of banded whiptail grenadier, common hake, ridge scaled rattail, rock cod, southern blue whiting, southern hake, and Patagonian toothfish increased compared with previous February groundfish surveys, with common hake and southern blue whiting having the highest CPUE amongst February groundfish surveys since 2010.
4. CPUE of the Argentine shortfin squid and the Patagonian squid decreased from the February 2024 groundfish survey; in particular, the Patagonian squid saw a considerable decrease in CPUE.
5. CPUE of each skate species was below average amongst February groundfish surveys since 2010, and the CPUE of six species of skates were the lowest amongst February groundfish surveys since 2010, i.e., starry skate, grey-tailed skate, Falkland skate, Magellanic skate, sand ray, and roughskin skate. Some skate species caught in Falkland Islands waters are classified as endangered (i.e., grey-tailed skate), vulnerable (i.e., white spotted skate), or near threatened (i.e., blonde skate, Falkland skate, and multispine skate) by The International Union for Conservation of Nature (IUCN).
6. CPUE of catfish and dogfish were the lowest amongst February groundfish surveys since 2010, and dogfish is classified as vulnerable by the IUCN.
7. There were no incidental bycatches, nor mortalities, of pinnipeds during the survey.
8. Temperature was lower to the north-east and to the south-west. Chlorophyll concentration was higher in the surface, and along the north. Overall, oxygen, salinity, and density were higher to the north-east and to the south-west.

7. Recommendations

Abundance and conservation

1. The CPUE declining patterns observed for some commercial finfish species such as hoki, kingclip, and red cod highlight the need of measures to protect and/or recover these stocks.
2. Rock cod, southern blue whiting, and southern hake continue showing signs of slow recovery but still at low CPUE levels. Measures should be implemented to protect and recover these stocks to sustainable levels, and abundance should be monitored over the following years from fisheries dependent and independent sources of data.
3. CPUE of common hake in the February 2025 groundfish survey was the highest for this species amongst February groundfish surveys, which may be an early signal of high catches of this species in the finfish fishery during 2025. However, the effect of the high abundance of common hake and its predatory capacity should also be discussed at FIFD to anticipate its effects on other commercial species and the fisheries they sustain.
4. Relatively low abundance of the Patagonian squid in February 2025 may be a sign of poor commercial catches of this species during the first fishing season, unless migration into the finfish fishing area and into the ‘Loligo box’ increase its abundance. Further studies are required to better understand the drivers of Patagonian squid distribution and abundance in the FICZ/FOCZ.
5. CPUE declining trends of dogfish, catshark, and several species of skates in February groundfish surveys, as well as the generally low productivity of Chondrichthyes, and the poor conservation status of some of these species according to the IUCN red list pinpoint the need for research to better understand their distribution, abundance, biology, and the effects of the fisheries and environmental variability on their populations.

6. Implementation of the seal exclusion device (SED) during groundfish surveys may have significant effects on the composition and volume of the catch, and as a consequence, on abundance calculations and spatial patterns of the abundance. The use of the SED may limit our capacity to produce the only fisheries independent indices of abundance in Falkland Islands waters, which are also required for the calculation of Total Allowable Catch (TAC) according to the ICES category 3 advice rule (ICES 2012, 2018), currently implemented at FIFD. Therefore, the use of the SED during the groundfish surveys is not advised without scientific evidence of its effect on the catch, and also considering the small proportion of pinniped mortalities during the surveys (4% of the reported pinnipeds mortalities in commercial fisheries), and the low proportion of females in the survey mortalities (1%). As an alternative to prevent pinnipeds incidental bycatches, steaming for 1–2 nm at full speed (approximately 11 knots) after the CTD station may allow the vessel to leave the pinnipeds behind, reducing their presence during net shooting (Iriarte et al. 2020).

Scientific protocols

7. The eight-stage maturity scale for finfish species used at FIFD (Brickle et al. 2005, modified from Nikolsky 1963) is a broad maturity scale. A detailed description of this scale is recommended for each individual species according to their gonads' macroscopic features validated with histology. This should facilitate the identification of maturity stages for each species and minimize subjectivity in the interpretation of the scale by different scientific staff. The ongoing finfish gonad histology project that started during the February 2024 groundfish survey should facilitate the identification of maturity stages for each species.
8. Notes from the February 2024 groundfish survey have proved useful to differentiate common hake *M. hubbsi* from southern hake *M. australis* (Soeth 2024b), and it is encouraged to continue its use during surveys and during observer trips.
9. Non-random samples, including juvenile Patagonian toothfish, must be searched for, and collected, at the belt before the catch is weighed. Non-random samples are important to complete the length-age curve, whereas juvenile Patagonian toothfish are sometimes overlooked amongst the rock cod catch, missing crucial data of the early life stage of that species.
10. An R code and a guide (Ramos 2025) were produced to facilitate the detection and correction of groundfish survey data errors. The use of these tools is encouraged to optimize time for data correction and for the production of the survey related reports.

Technical - Deck

11. Oceanographic data provides valuable insights towards understanding the distribution, abundance, and other demographic patterns of the stocks, and should be recorded and described in every survey report. In this survey, chlorophyll data were not recorded in 8 CTD stations due to unknown issues. The CTD should be serviced regularly to ensure correct functioning, and tested before the survey. In addition, spare accessories in working condition should be in stock at FIFD.
12. It was noted that the FIFD bottom trawl net is deteriorated; arrangements are being made to repair the net in Spain after the second fishing season of 2025.
13. The plastic and metallic cases for the net sensor must be used through the entire survey to protect the net sensors.
14. The net must be cleaned thoroughly after each trawl to prevent having animals from a previous trawl, which affects the spatial distribution and abundance of the catch, and the patterns of the samples' biological characteristics.

Technical – Factory and laboratory

15. The white boxes provided by the vessel to weight the catch were useful given the characteristics of the factory, and because it was possible to stack these boxes. However, the boxes should have small holes at the corners of the bottom allowing the water to drain but at the same time

preventing losing small individuals. The white boxes also should be of the same model, i.e., same dimension and weight.

16. Additional lights, and lifted sampling benches, would facilitate the processing of samples.
17. Excessive noise in the factory and in the laboratory complicated the communication for the scientific staff. Most of this noise was due to the fishing crew banging metallic boxes while packing the catch, due to the engine, and due to the winches operating and the fishing gear moving on deck. This issue was already raised to the fishing company, and pertinent improvements will be made if possible.
18. The identification of maturity stages of some species (e.g., butterfish) may require the use of a stereomicroscope or magnifying glasses. Pertinent arrangements should be made to facilitate the use of this equipment at sea if possible.
19. The laboratory was adequate although it's necessary to have a dehumidifier on at all times.

Safety

20. Given the configuration of the F/V Argos Vigo, it is necessary to walk along the deck to go to the factory and laboratory, raising safety concerns. Therefore, it was agreed that the scientific staff must use helmet and safety boots, and will not walk along the deck during manoeuvres.
21. Jiggers were in close proximity to the F/V Argos Vigo during one day of the survey, with some of them steaming across in front of the survey vessel while we were trawling. During the survey, we were informed about the collision of some jiggers, and it was brought to our attention that jiggers occasionally leave the bridge unattended and with unresponsive radio communication; this is a major safety hazard that should be addressed.

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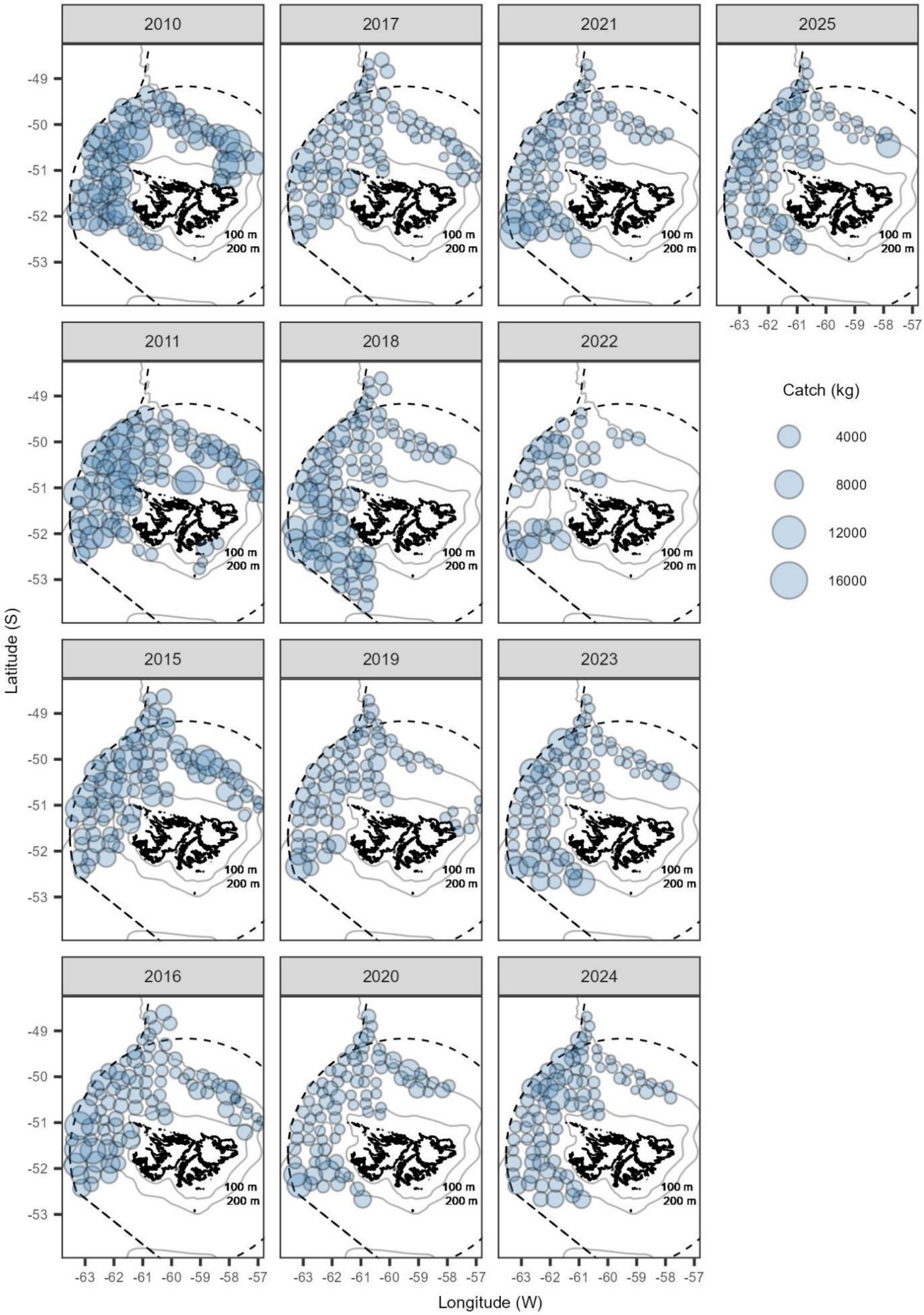
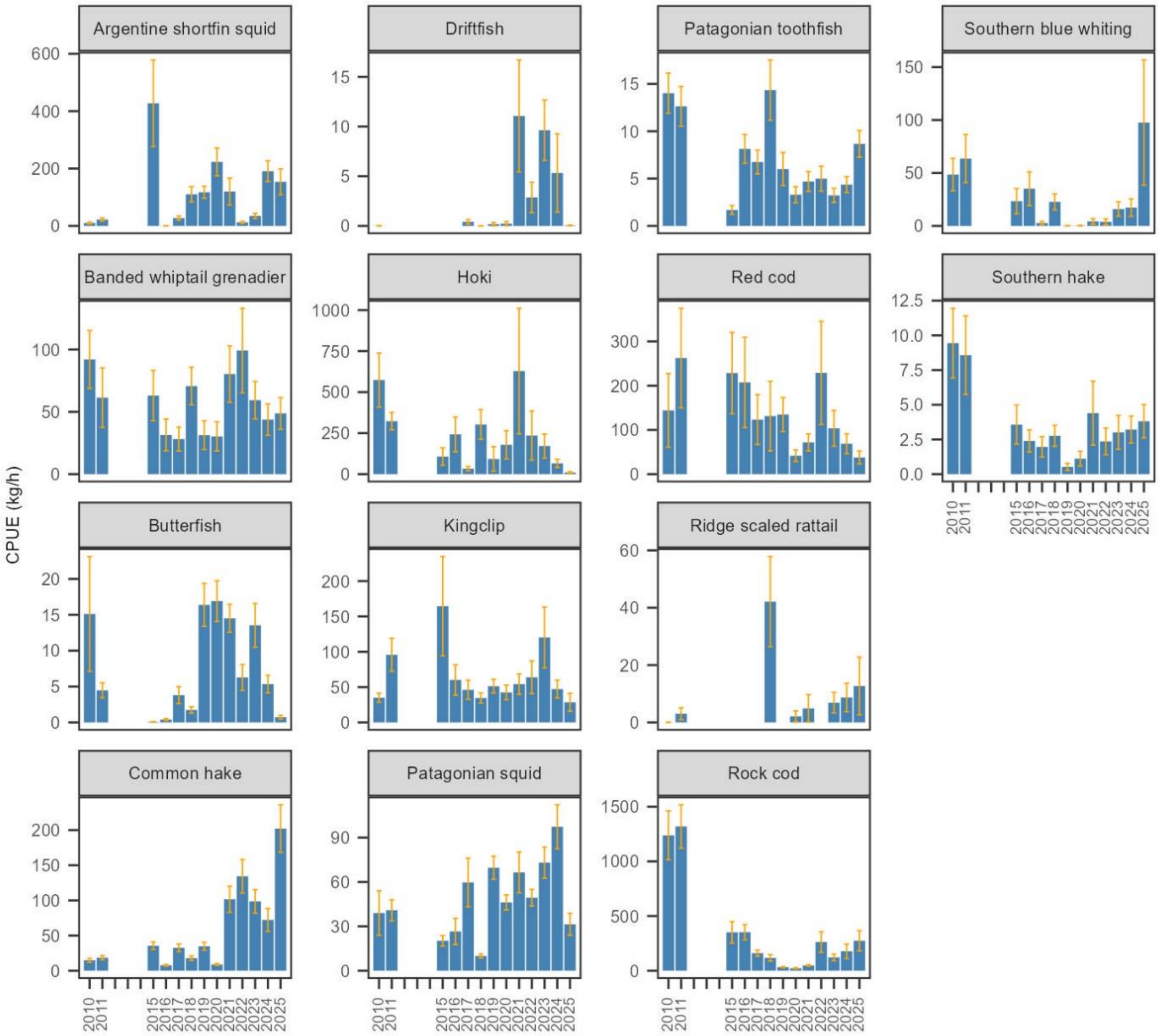
Appendix I. Total catch per station during February groundfish surveys.



Appendix II. CPUE ± SE of main finfish and squid species during February groundfish surveys.



Appendix III. CPUE ± SE of main skate and shark species during February groundfish surveys.