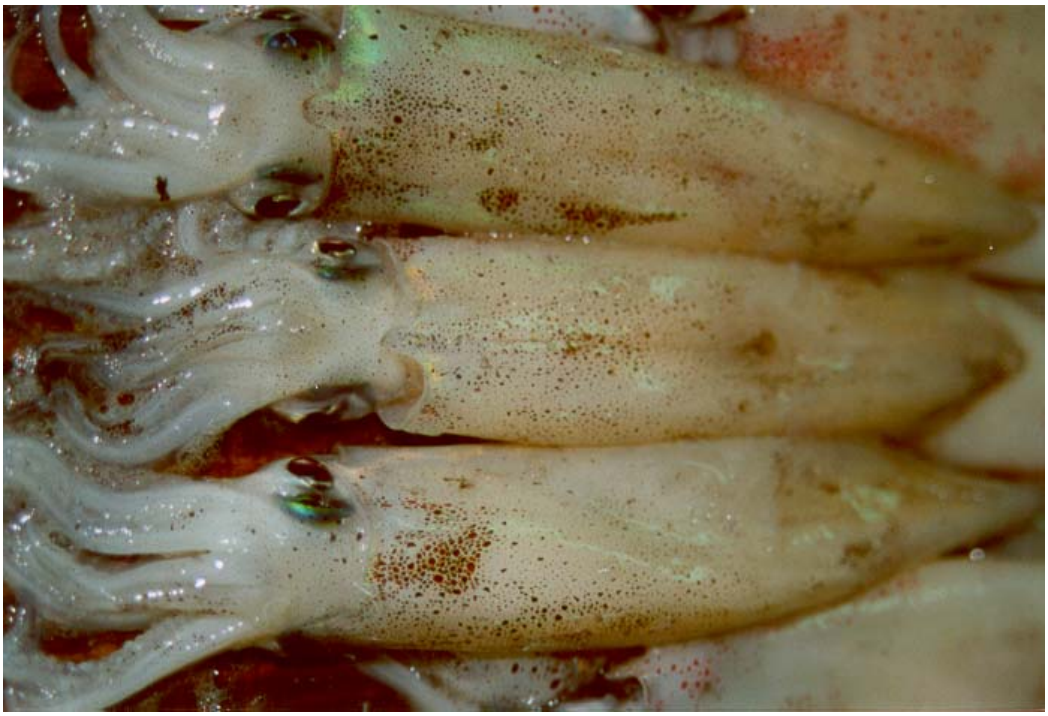
Scientific Report

Fisheries Research Cruise ZDLH1-02-2005



Fisheries Department

Falkland Islands Government

Scientific Report

Fisheries Research Cruise

ZDLH1-02-2005

FPRV Dorada

10 February to 24 February 2005

Fisheries Department

Falkland Islands Government

Stanley

Falkland Islands

Participating scientific staff (alphabetical)	Principal author of section
Dr. Alexander Arkhipkin	
Dr. Vlad Laptikhovsky	3
Dr. Lianos Triantafillos	1, 2, 4 scientific editor
Sam Clarke	
Nina Baumgartner	
Teresa Athayde	

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Joost Pompert produced Figures 13, 16, 18, 20, 22, 24 and 26.

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1. Introduction

In February 2005, a research cruise was undertaken around the wider shelf and continental waters of the Falkland Islands using the Falkland Islands Research and Patrol Vessel *Dorada* (Fig. 1). The primary objective of this research cruise was to examine the distribution and abundance of the first cohort of *Loligo gahi* throughout these waters. Acoustic data were collected concurrently with the trawling data. The following report summarises the research activities and results of this research cruise.

1.1 Cruise objectives

The four objectives of the research cruise were to:

1. conduct a bottom trawl survey to identify the distribution and abundance of *Loligo gahi* (mostly first cohort) during its feeding period, and other commercial species during February;
2. study oceanographic conditions over the survey area;
3. collect routine biological samples of most commercially important species;
4. collect *ad hoc* acoustic data along the track of the trawl survey.

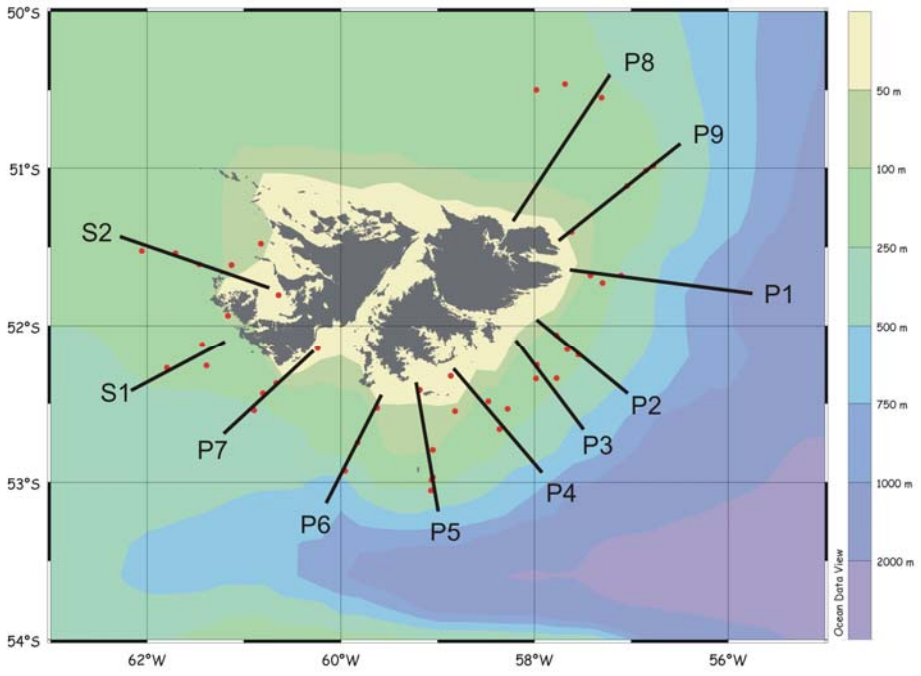

Figure 1. Location of the main transects undertaken on the research cruise ZDLH1-02-2005 between 10th and 24th February, 2005.

1.2 Cruise plan and key dates

The trawl survey consisted of eleven transects located primarily in the south and east of the Falkland Islands (within the "*Loligo* box"), where the largest concentrations of *Loligo gahi* are found (Fig. 1). Each transect typically consisted of trawls at depths of <100 m, ~100-200 m, and >200 m. The duration of the trawl varied between 30-220 minutes, depending on the amount of lobster krill expected and the type of bottom encountered. All trawls were carried out in the daytime. An oceanographic station was usually conducted prior to, or immediately after, each trawl. Sometimes, additional oceanographic stations would be carried at depths > 500 m. Two very shallow (<50m) trawls were carried out on the western part of the continental shelf (near S2 transect). The cruise departed from Stanley on the 10th February, 2005 and was completed by the 24th February, 2005. In total, 13 days were spent at sea with 43 trawls and 59 CTD stations completed. No days were lost to bad weather and on February 17th, Teresa was transferred from the MV *Capricorn* to the R/PV *Dorada*.

1.3 Vessel characteristics

The cruise was conducted on board the R/PV *Dorada*, which is registered in the Falkland Islands. The characteristics of this vessel are shown in Table 1.

Table 1. Characteristics of the Fisheries Protection and Research Vessel Dorada.

Callsign	*ZDLH1*
Length	76 m
GRT	2360 t
NRT	708 t
Crew	16 people

1.4 Personnel and responsibilities

The following personnel participated in the cruise:

Dr. Alexander Arkhipkin	Chief Scientist	
Dr. Vlad Laptikhovsky	Oceanography	
Dr. Lianos Triantafillos	Fisheries Biologist/ Acoustic survey	
Sam Clarke	Fisheries Biologist	
Nina Baumgartner	Fisheries Biologist	
Teresa Athayde	Fisheries Biologist	(17th – 24th February)

1.5 Equipment used

Acoustics

The acoustic instrumentation was similar to that used in previous surveys. This included:

1. Simrad EK500 echo-sounder with hull mounted split transducers operating at 38 kHz and 120 kHz; and

2. SonarData Echolog_EK v1.50 (data acquisition) and EchoView v3.1 (post-processing) software.

The EK500 was triggered with a ping interval of approximately 2 seconds. Triggering was synchronised with the Furuno Doppler log to reduce acoustic interference. Data was logged with SonarData Echolog and processed with Echoview. The calibration of the EK500 was not carried out on this research cruise because it was recently calibrated by BAS scientists in January, 2005. All data were logged with an expanded bottom echogram of ~15 m range, starting 10 m above the detected bottom. The range of the echogram was automatically adjusted to cover the entire water column.

Trawling

All trawl stations used an ENGEL semi-pelagic trawl with a 40.2 m headline and a 38.7 m footrope equipped with rockhoppers. The trawl was equipped with SIMRAD ITI sensors and the doors were Super-V style, weighing 1200 kg and with an area of 6 m^2. The typical vertical opening of the trawl was between 10 and 15 m when fishing either semi-pelagically or near the bottom. The cod-end mesh size was 95 mm, with a 40 mm cod-end liner.

Oceanographic

The oceanographic equipment was similar to that used in previous surveys. This included:

1. CTD SBE 25 with oxygen sensor and SeaTech fluorometer; and

2. Thermosalinometer SBE45.

2. Sampling

2.1 Acoustic surveying

Acoustic data were logged along the entire cruise track. These data were archived in the SonarData EK5 format on a PC running SonarData Echolog500. Future comparisons of the acoustic data with the trawl catch will help characterise the acoustic properties of *Loligo gahi*, as well as other major commercial species.

2.2 Trawl stations and biological sampling

On this research cruise, trawl station numbers ranged from to 1957 to 2055 (Table 2). Catches at all stations were weighed using an electronic, marine adjusted balance (POLS, min 10g, and max 80kg). Commercial finfish species were measured (total or pre-anal length) to the nearest centimetre below and both sex and stage of maturity were recorded for all sampled specimens. Individual weight was measured to the nearest gram using the POLS balance (min. 1gram, max. 13kg) or, for larger specimens, to the nearest 20 grams using the Scanvaegt balances. The diet composition of some species was also recorded.

Table 2. Dates, locations, modal depths and duration of oceanographic (CTD) and trawl (TRAWL) stations carried out during the research cruise ZDLH1-02-2005 undertaken from the 10th to 24th February, 2005.

Station	Activity	Date	Start Time	Start Latitude	Start Longitude	Start Depth (m)	Duration (min)
1956	CTD	08-Feb	07:03	50°37.3	57°14.4	303	12
1957	TRAWL	08-Feb	08:35	50°33	57°18.4	300	187
1958	CTD	08-Feb	13:06	50°27.9	57°40.5	215	9
1959	TRAWL	08-Feb	13:25	50°27.7	57°41	216	98
1960	TRAWL	08-Feb	15:54	50°29.9	57°58.9	132	161
1961	CTD	08-Feb	20:58	50°57.3	57°40.8	122	6
1962	CTD	08-Feb	23:00	51°10.7	59°0.91	81	6
1963	CTD	09-Feb	07:06	51°24.9	57°36.9	63	4
1964	TRAWL	09-Feb	08:00	51°24.3	57°37.1	61	66
1965	CTD	09-Feb	11:48	51°7	57°2.08	114	6
1966	TRAWL	09-Feb	12:20	51°6.8	57°2.6	113	96
1967	CTD	09-Feb	15:12	51°0.9	56°51	202	9
1968	TRAWL	09-Feb	15:27	51°0.8	56°50.8	210	118
1969	TRAWL	09-Feb	18:28	50°59.2	56°46.3	306	30
1970	CTD	09-Feb	20:02	51°0.6	56°47.4	288	12
1971	CTD	09-Feb	21:34	50°54.9	56°28.7	478	22
1972	CTD	10-Feb	06:02	51°39.5	57°45.4	18	3
1973	CTD	10-Feb	06:58	51°41.9	57°33.1	96	6
1974	TRAWL	10-Feb	08:56	51°40.8	57°25.2	133	96
1975	CTD	10-Feb	14:49	51°44	57°22.2	186	9
1976	TRAWL	10-Feb	15:54	51°43.7	57°17.7	225	100
1977	TRAWL	10-Feb	18:14	51°40.8	57°6.2	311	112
1978	CTD	10-Feb	20:32	51°43.9	57°7.4	295	11
1979	CTD	10-Feb	22:04	51°48.9	56°41.1	498	19
1980	CTD	11-Feb	00:04	51°46.05	56°10.1	985	34
1981	CTD	11-Feb	02:24	51°45	56°37	1107	35
1982	CTD	11-Feb	08:42	52°16.6	56°7.1	496	7
1983	CTD	11-Feb	09:34	52°16.6	57°7.1	496	18
1984	CTD	11-Feb	11:34	52°6.5	57°30.7	287	12
1985	TRAWL	11-Feb	12:38	52°11.5	57°32.7	315	109
1986	TRAWL	11-Feb	15:58	52°9.3	57°39.7	218	178
1987	CTD	11-Feb	21:20	52°3.4	57°37.4	174	7
1988	CTD	11-Feb	22:03	52°2	57°43.6	128	6
1989	TRAWL	12-Feb	07:00	52°3.6	57°46.4	125	121

Table 2 (cont.). Dates, locations, start depths and duration of oceanographic (CTD) and trawl (TRAWL) stations carried out during the research cruise ZDLH1-02-2005 undertaken from the 10th to 24th February, 2005.

Station	Activity	Date	Start Time	Start Latitude	Start Longitude	Start Depth (m)	Duration (min)
1990	CTD	12-Feb	10:20	52°14.8	58°6.5	109	5
1991	TRAWL	12-Feb	11:14	52°15.3	57°58.5	134	96
1992	CTD	12-Feb	13:19	52°20.2	58°0.5	196	8
1993	TRAWL	12-Feb	13:35	52°20.6	57°59	214	220
1994	TRAWL	12-Feb	17:40	52°20.4	57°46.3	301	109
1995	CTD	12-Feb	19:47	52°24.4	57°55.2	295	12
1996	CTD	12-Feb	22:07	52°46	57°32	522	19
1997	CTD	13-Feb	00:58	53°0.4	58°8.3	546	21
1998	CTD	13-Feb	07:36	52°40.1	58°24.3	300	12
1999	TRAWL	13-Feb	07:58	52°39.9	58°21.6	313	87
2000	TRAWL	13-Feb	10:30	52°32.1	58°16.6	227	96
2001	CTD	13-Feb	12:51	52°33.9	58°29.7	184	8
2002	CTD	13-Feb	13:38	52°28.1	58°34.7	117	6
2003	TRAWL	13-Feb	14:27	52°29.3	58°28.6	131	96
2004	TRAWL	14-Feb	08:23	52°24.9	59°11	59	
2005	CTD	14-Feb	10:44	52°24.9	59°12.7	62	3
2006	CTD	14-Feb	12:19	52°19.4	58°51.3	72	4
2007	TRAWL	14-Feb	12:49	52°19.6	58°51.9	75	56
2008	TRAWL	14-Feb	16:32	52°33	58°49.2	92	86
2009	CTD	14-Feb	19:01	52°31.1	59°12	59	4
2010	CTD	14-Feb	21:18	52°48.1	59°5.1	102	7
2011	TRAWL	15-Feb	08:10	52°47.7	59°2.9	109	61
2012	CTD	15-Feb	10:24	52°58.6	59°5.2	199	9
2013	CTD	15-Feb	10:50	52°59.5	59°3	313	53
2014	TRAWL	15-Feb	11:17	52°59.2	59°3.7	263	100
2015	TRAWL	15-Feb	13:41	53°3.1	59°4.1	440	139
2016	CTD	15-Feb	17:42	53°4.6	59°4.2	507	19
2017	CTD	15-Feb	19:11	53°15.1	59°1.8	660	26
2018	CTD	15-Feb	20:07	53°18.7	59°1.2	962	36
2019	CTD	16-Feb	01:42	53°8.7	60°1.6	500	19
2020	CTD	16-Feb	07:30	52°58.4	59°56.8	290	13
2021	TRAWL	16-Feb	08:00	52°58.1	59°2.9	325	110
2022	CTD	16-Feb	10:41	52°55.4	59°35.3	202	8
2023	TRAWL	16-Feb	11:05	52°55.7	59°57.4	246	92
2024	TRAWL	16-Feb	14:30	52°45	59°49.6	162	97
2025	CTD	16-Feb	17:00	52°37.7	59°46.8	120	6
2026	TRAWL	16-Feb	17:55	52°31.8	59°37.5	101	60
2027	CTD	16-Feb	19:22	52°29.4	59°31.5	89	4
2028	CTD	17-Feb	07:00	52°11.2	60°17	75	6
2029	TRAWL	17-Feb	08:04	52°8.9	60°14.4	62	56
2030	CTD	17-Feb	10:51	52°20.3	60°40.9	122	5
2031	TRAWL	17-Feb	12:12	52°22.3	60°39.9	143	88
2032	TRAWL	17-Feb	14:07	52°26.1	60°48.2	191	95
2033	TRAWL	17-Feb	16:17	52°32.6	60°53.8	273	75
2034	CTD	17-Feb	18:39	52°27.1	60°47.8	204	8
2035	CTD	17-Feb	19:33	52°34	60°54.2	289	12
2036	CTD	17-Feb	23:26	52°22.8	62°1.9	296	13
2037	CTD	18-Feb	07:03	52°16.9	61°44.3	315	19
2038	TRAWL	18-Feb	08:07	52°16.5	61°47.8	306	100
2039	CTD	18-Feb	10:55	52°14.6	61°19.9	176	8
2040	TRAWL	18-Feb	11:27	52°15.6	61°23.3	205	67
2041	TRAWL	18-Feb	14:31	52°7.3	61°25.8	161	96

Table 2 (cont.). Dates, locations, start depths and duration of oceanographic (CTD) and trawl (TRAWL) stations carried out during the research cruise ZDLH1-02-2005 undertaken from the 10th to 24th February, 2005.

Station	Activity	Date	Start Time	Start Latitude	Start Longitude	Start Depth (m)	Duration (min)
2042	CTD	18-Feb	17:09	51°58.3	61°14.6	111	8
2043	TRAWL	18-Feb	18:26	51°56.1	61°10	87	54
2044	CTD	18-Feb	19:45	51°58.3	61°6.5	79	5
2045	CTD	19-Feb	07:00	51°31	62°2.1	212	10
2046	TRAWL	19-Feb	07:55	51°31.5	62°3.3	214	97
2047	CTD	19-Feb	10:38	51°32.8	61°39.2	140	7
2048	TRAWL	19-Feb	11:02	51°32.4	61°42.4	147	56
2049	CTD	19-Feb	13:24	51°33.9	61°24	95	5
2050	TRAWL	19-Feb	14:05	51°36.6	61°27.7	103	57
2051	TRAWL	19-Feb	16:06	51°36.8	61°7.6	75	50
2052	CTD	19-Feb	17:19	51°39.8	61°5.6	67	5
2053	CTD	20-Feb	09:31	51°48.3	60°38.6	46	4
2054	TRAWL	20-Feb	09:39	51°48.3	60°38.5	46	61
2055	TRAWL	20-Feb	12:40	51°28.8	60°49.4	70	54
2056	CTD	20-Feb	13:53	51°26.3	60°52.6	72	4
2057	CTD	20-Feb	17:18	51°23.7	60°24.3	25	4

2.3 Length-frequency sampling

For each trawl, 200 (or the entire catch if the catch was less than 200 individuals) *Loligo gahi* were randomly selected and their dorsal mantle length (nearest mm), sex and maturity stage measured. After the measuring was completed, the combined weight of all these squid was weighed to the nearest 0.1 gram.

2.4 Statolith sampling

Statoliths were collected on both a random and non-random basis. For the former, approximately 50 squid were randomly selected from the 200 individuals sampled for length frequency. On average, a random sample of statoliths was collected every second or third trawl. For the latter, the statoliths of any squid deemed interesting (e.g. any individual greater than 25cm or sexually mature female) were collected on an *ad-hoc* basis.

For both types of collections, the statoliths were removed with fine forceps, placed in labelled waterproof paper and stored in a vial filled with 70% ethanol.

3. Oceanographic methods

3.1 Oceanographic sampling

A logging CTD (SBE-25, Sea-Bird Electronics Inc., Bellevue, USA) was used to obtain profiles of temperature (ºC), salinity (PSU), and dissolved oxygen (ml l^{-1}) at 59 oceanographic stations (Table 2; Fig. 2). The CTD was deployed for one minute at each station to a depth of between 8-10 m, to allow the oxygen sensor to polarise. It was then winched up to a depth of one metre and deployed to either a depth about 10-20 m above the sea bottom (shelf and continental slope) or down to 1000 m in the open sea. The speed of deployment was approximately 1m/s and was monitored by wire counter. Temperature was measured directly, whereas the other variables were calculated using the Seasoft v.4.326 software (Sea-Bird Electronics Inc.) and the following measured parameters: pressure (db), conductivity (S/m), oxygen current (µA) and oxygen temperature (ºC). The Seasoft v.4.326 software was also used to construct vertical profiles of temperature, salinity and density of each station while the VG griding method in the Ocean Data View package v. 5.2-2000 (Schlitzer 2000) was used to construct profiles and iso-surfaces for each transect. To ensure profiles were consistent between years, all sensors were calibrated on an annual basis by Sea-Bird Electronics Inc., Bellevue, USA.

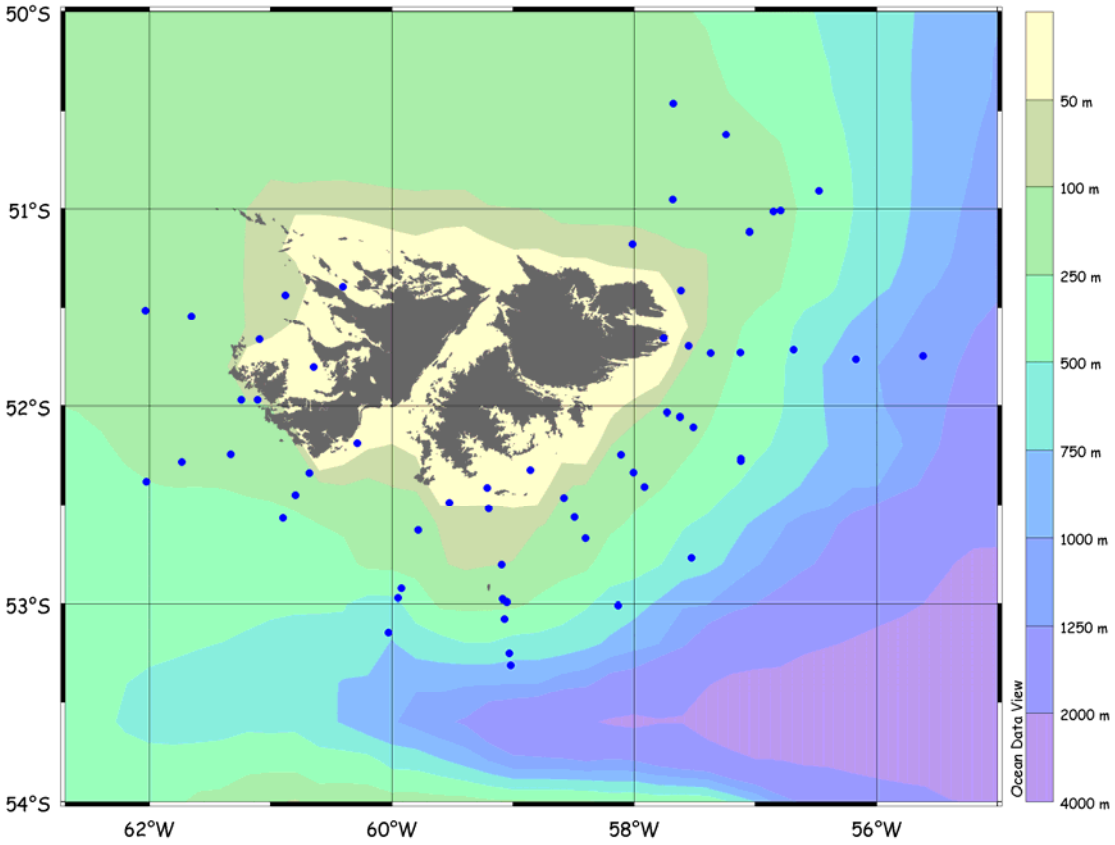

Figure 2. Location of oceanographic stations conducted on the research cruise ZDLH1-02-2005 undertaken between the 10th and 24th February, 2005.

3.2 Results

The 59 CTD stations were located primarily in the central and southern parts of the Falkland shelf, including the "*Loligo* box" and adjacent waters (Fig. 2). Temperatures at these stations ranged between 2.5 and 12.5ºC, salinity from 33.5 to 34.4 psu, and densities from 25.6 to 27.4 kg/m^3. No oxygen data were available for this year because the oxygen sensor was not calibrated. Comparisons of this year's oceanographic features were made with the previous 5 years (Fig. 3A & 3B). These comparisons revealed that the temperature profile at transect P1 was consistent with those of to February 2003 and 2004, while temperatures encountered at transect P5 were the warmest since 2000 (Fig. 3B).

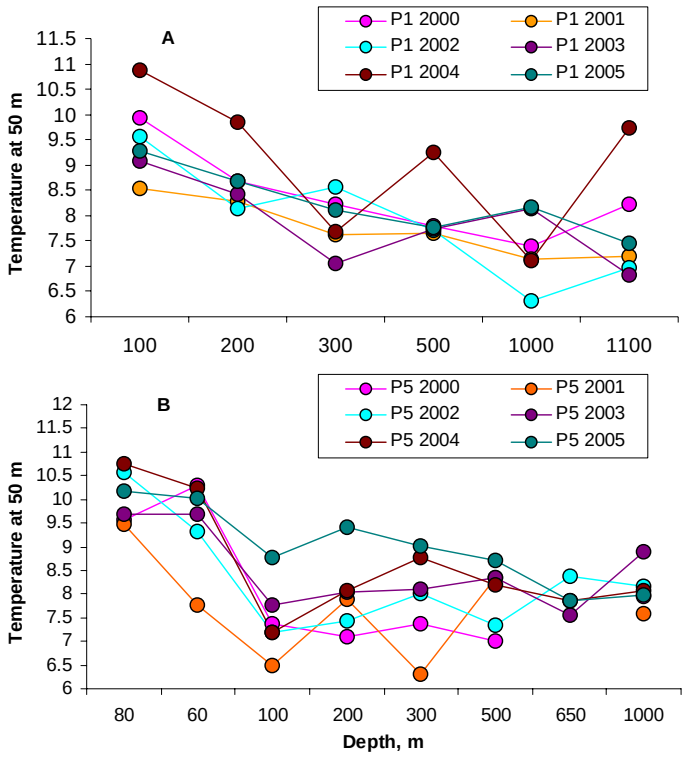

Figure 3. Temperature at the horizon of 50 m in February on P1 (A) and P5 (B) transects

The maximum abundance of chlorophyll "a" (coinciding presumably with the highest phytoplankton abundance) was located alongside the inshore border of the main (eastern) branch of the Falkland Current and south of the Falkland Sound (Fig 4). The lowest levels of chlorophyll "a" were found in an area to the west of the Falkland Islands. Low levels of chlorophyll "a" were also found in the shallow waters from Lively Island to Sea Lion Island, down to Beauchene Island (Fig 4).

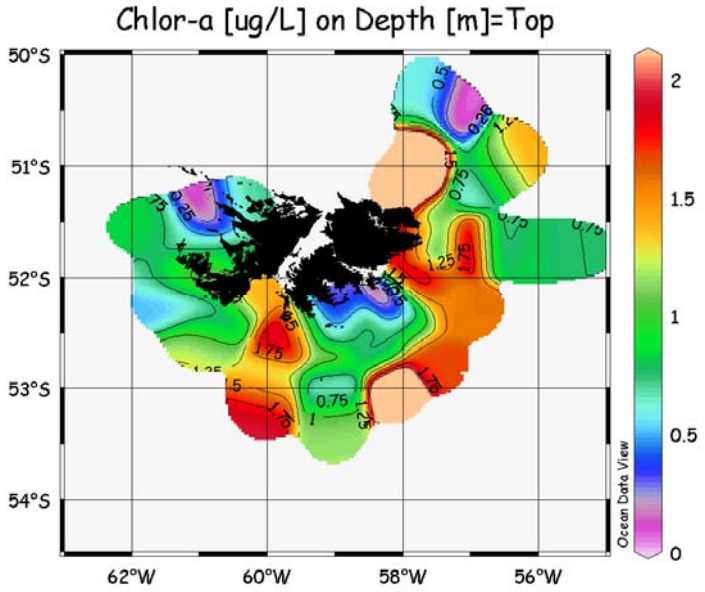

Figure 4. Iso-surface of chlorophyll "a" at the surface during research cruise ZDLH1-02-2005

The spatial distribution of temperature and salinity at the different horizons are shown in Fig. 5, while the vertical profiles of temperature, and salinity of each oceanographic transect are displayed in Figs 6-11.

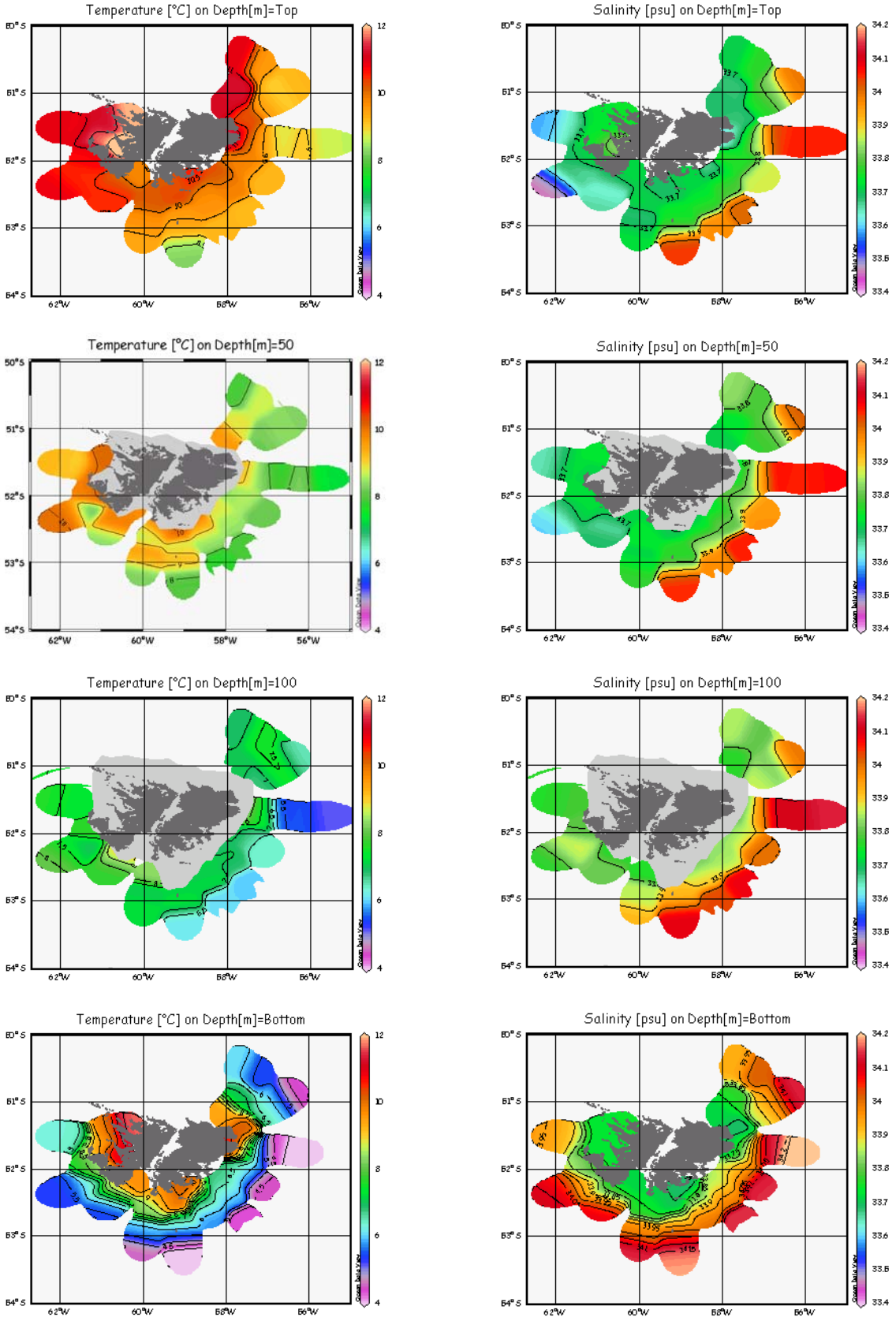

Figure 5. Iso-surface of temperature and salinity at the different horizons during research cruise ZDLH1-02-2005.

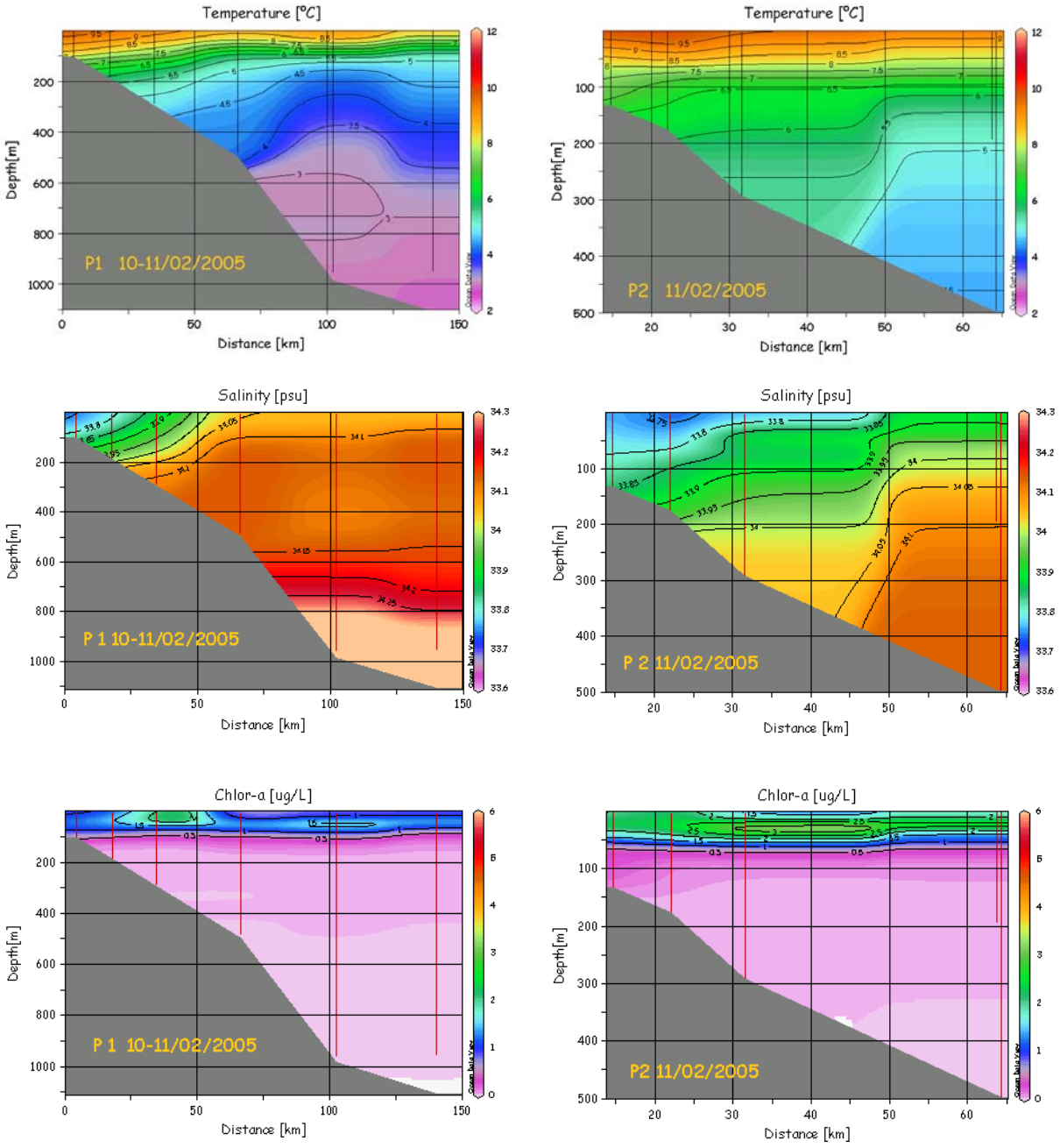

Figure 6. Contoured vertical sections for transect P1 and P2.

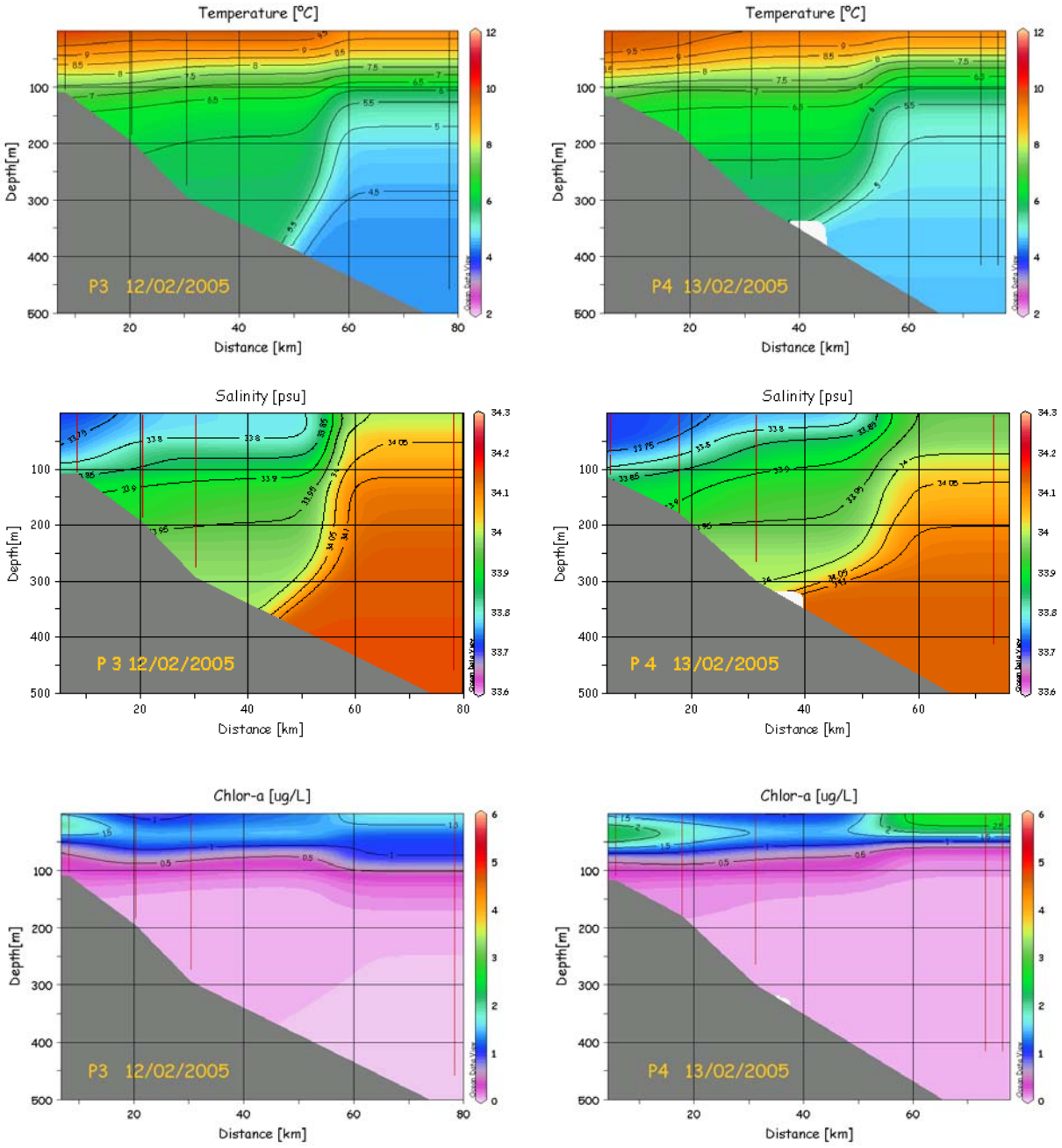

Figure 7. Contoured vertical sections for transect P3 and P4.

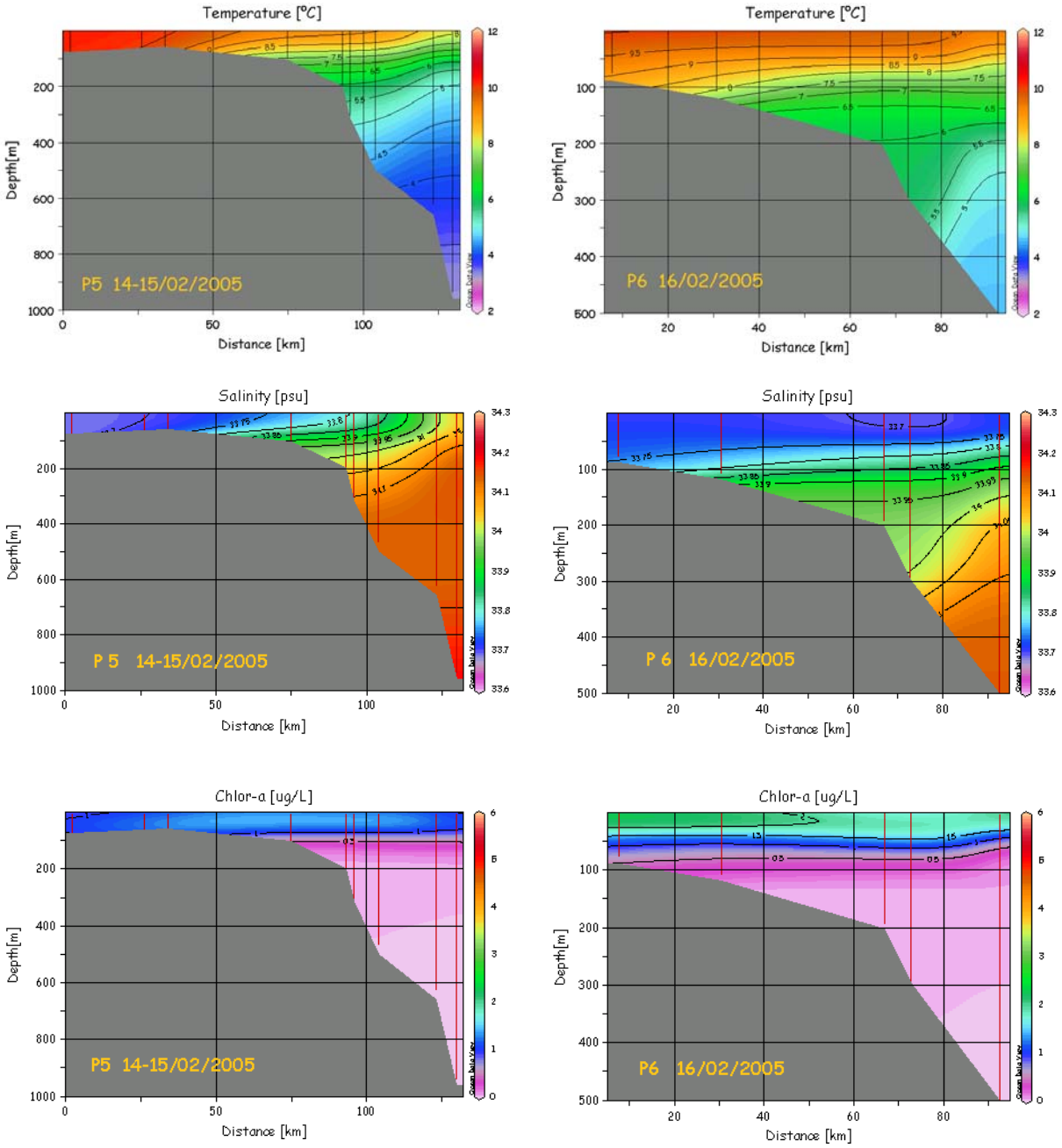

Figure 8. Contoured vertical sections for transect P5 and P6.

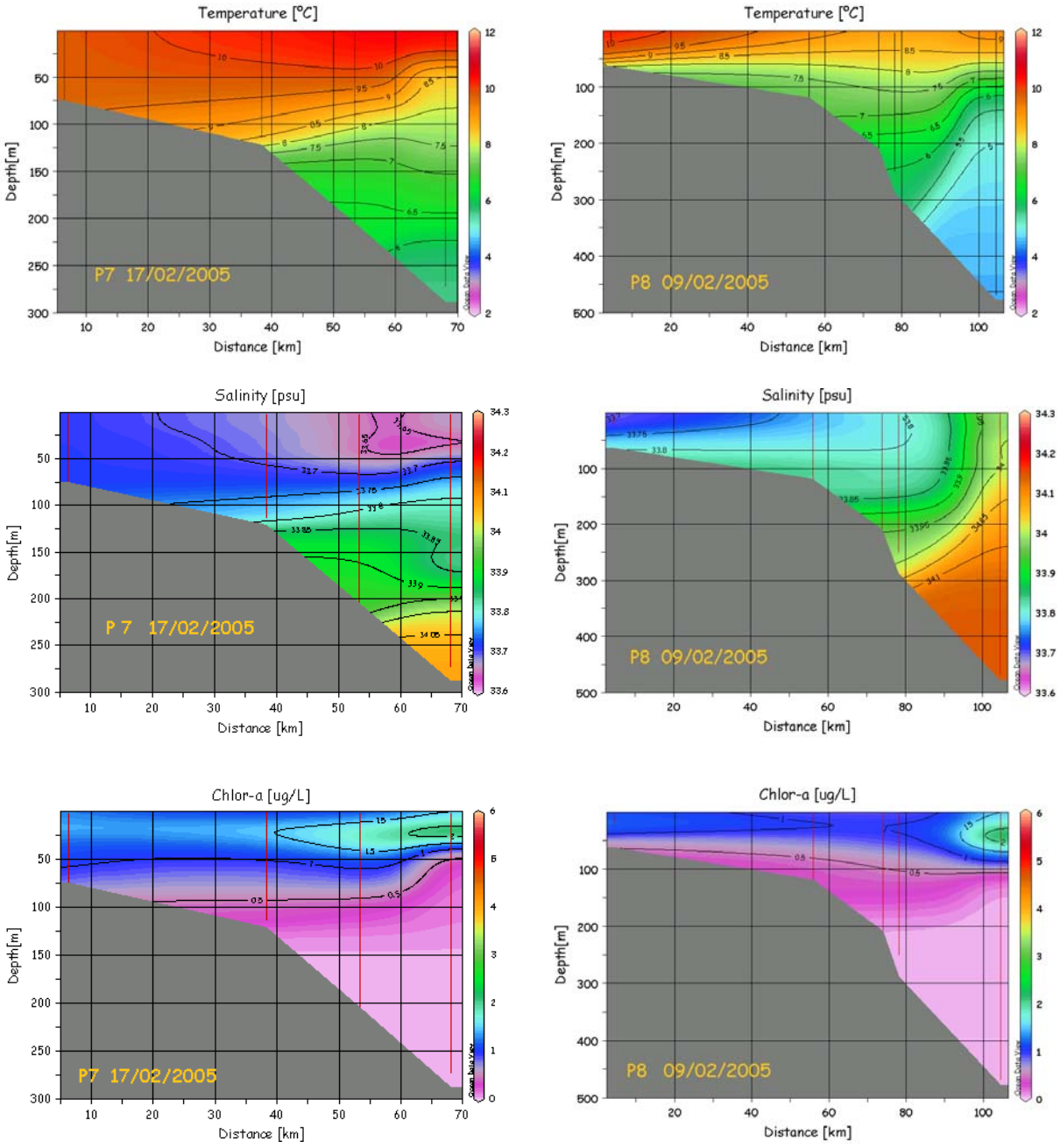

Figure 9. Contoured vertical sections for transect P7 and P8.

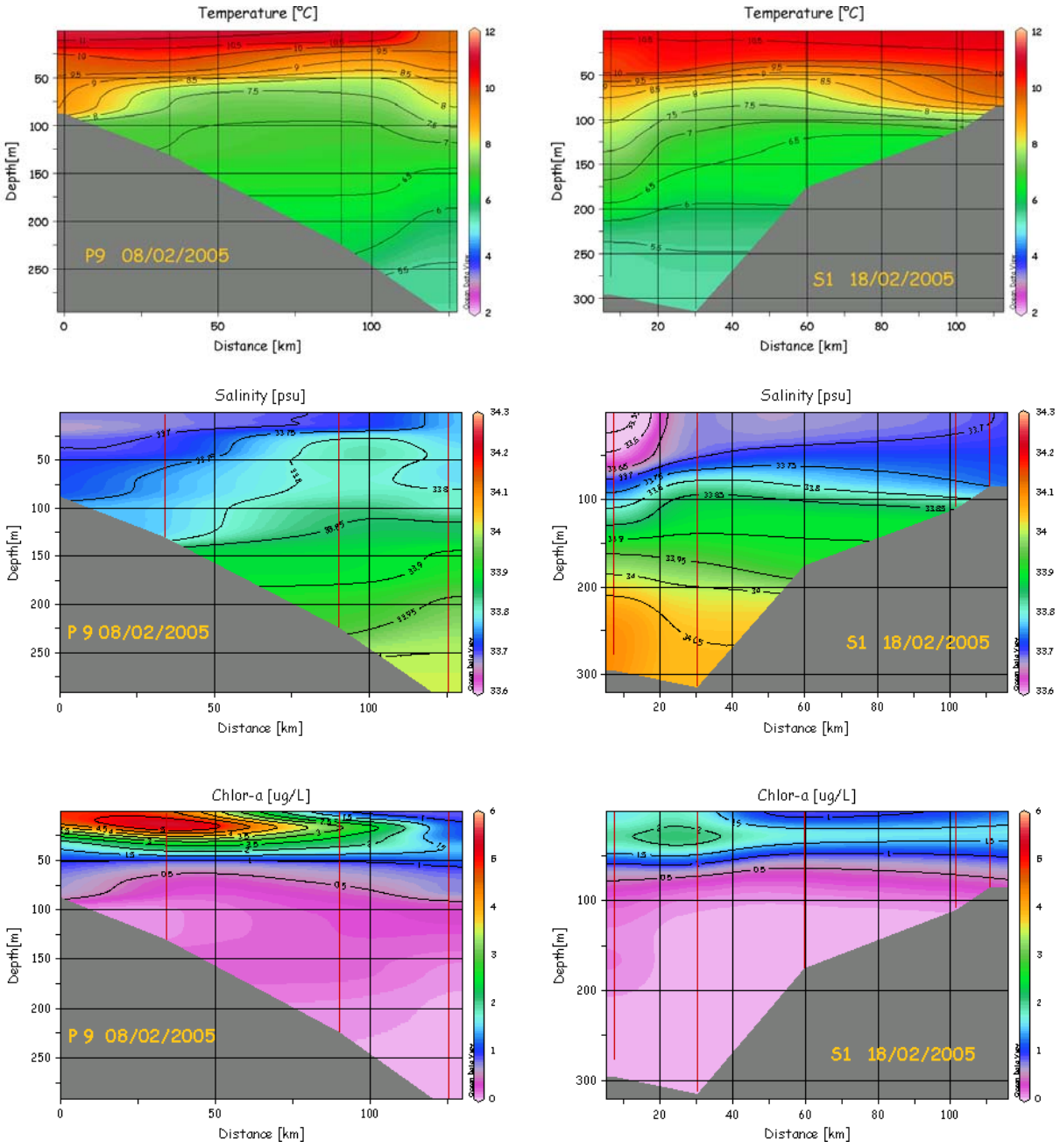

Figure 10. Contoured vertical sections for transect P9 and S1.

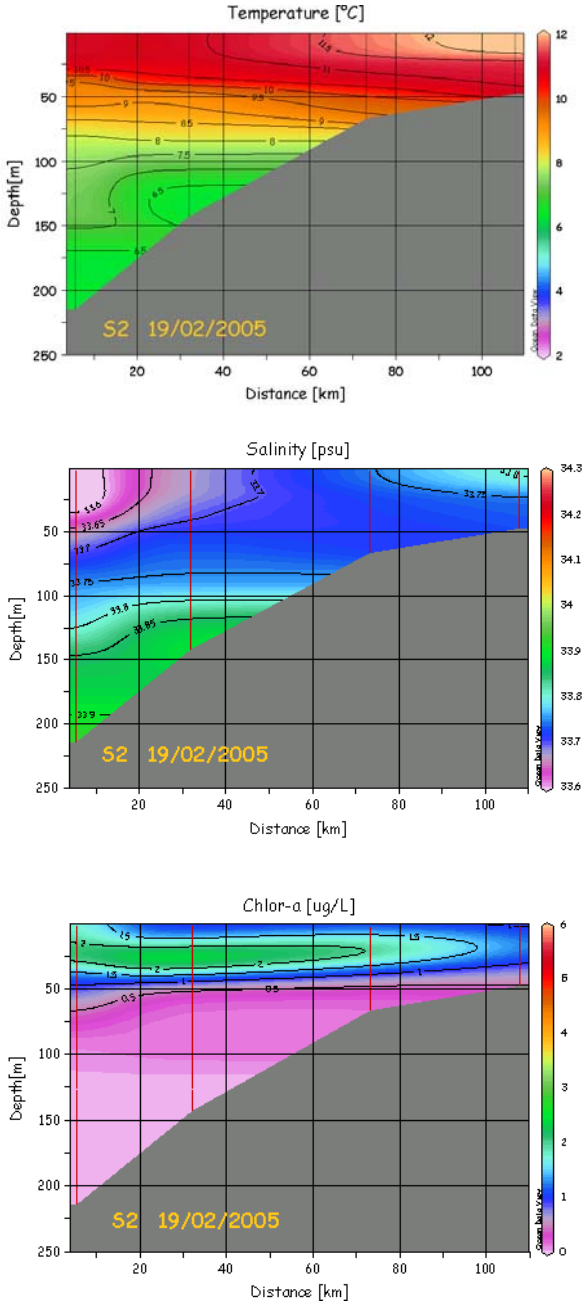

Figure 11. Contoured vertical sections for transect S2.

4. Biological sampling

4.1 Catch and by-catch

Trawling was conducted at 43 stations, most of which were located in previously establish transects (P1 to P9 and S1 to S2). The towing time at the trawl horizon varied between 30 and 220 minutes, with an average bottom time of 94 minutes. The locations and depths of these trawls are shown in Fig. 12.

A total of 28,731.073 kg, consisting of over 70 species was caught. Of this, 3,668.501 kg was sampled (Table 3). In terms of weight, the greatest overall catch was hoki *Macruronus magellanicus*, followed by Patagonian squid *Loligo gahi*, southern blue whiting *Micromesistius australis* and the lobster krill *Munida gregaria*. These four species accounted for over 90% of the total catch. Significant catches of grenadier *Macrourus carinatus*, rock cod *Patagonotothen ramsayi*, geater hooked squid *Moroteuthis ingens* and grenadier *Coelorhynchus fasciatus* were also taken.

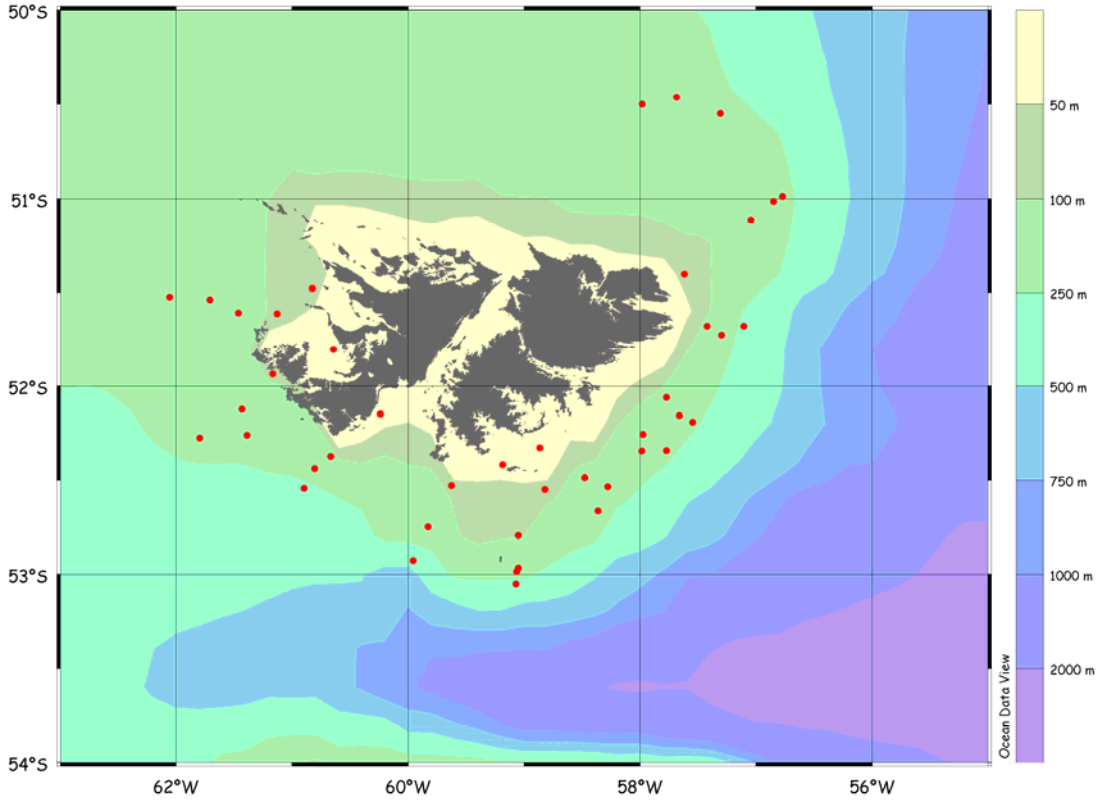

Figure 12. Location and depth (m) of semi-pelagic trawl stations conducted during the research cruise ZDLH1-02-2005 undertaken from the 10th to 24th February, 2005.

Table 3. Total catch of semi-pelagic stations 1957-2055 during the research cruise ZDLH1-02-2005 undertaken from the 10th to 24th February, 2005.

Species Code	***Species name***	***Catch (kg)***	***Sampled (kg)***	***Discarded (kg)***	***Proportion (%)***
WHI	*Macruronus magellanicus*	20,654.201	1,581.131	20,602.301	71.89%
LOL	*Loligo gahi*	3,058.347	211.035	3,056.907	10.64%
BLU	*Micromesistius australis*	1,153.485	587.753	1,153.340	4.01%
MUG	*Munida gregaria*	1,106.178	5.019	1,106.178	3.85%
GRC	*Macrourus carinatus*	666.290	193.892	645.920	2.32%
PAR	*Patagonotothen ramsayi*	663.937	206.436	663.264	2.31%
ING	*Moroteuthis ingens*	469.065	403.186	469.065	1.63%
GRF	*Coelorhynchus fasciatus*	353.578	2.507	353.578	1.23%
TOO	*Dissostichus eleginoides*	70.998	70.643	31.454	0.25%
POR	*Lamna nasus*	57.000	57.000	0.000	0.20%
BAC	*Salilota australis*	55.757	53.720	55.757	0.19%
COX	*Notothenid spp.*	52.826	6.420	52.826	0.18%
CGO	*Cottoperca gobio*	51.982	44.563	51.982	0.18%
RBZ	Unidentified ray #3	32.319	32.319	32.319	0.11%
KIN	*Genypterus blacodes*	28.582	28.582	15.955	0.10%
DGH	*Schroederichthys bivius*	26.784	26.784	26.784	0.09%
ILL	*Illex argentinus*	24.366	24.366	24.366	0.08%
CHE	*Champsocephalus esox*	21.158	12.453	10.605	0.07%
RBR	*Bathyraja brachyurops*	19.106	14.398	19.106	0.07%
PAT	*Merluccius australis*	16.864	16.864	11.876	0.06%
RAL	*Bathyraja albomaculata*	14.933	14.933	14.933	0.05%
MED	*Medusae sp.*	12.301	0.000	12.301	0.04%
RGR	*Bathyraja griseocauda*	11.643	11.643	11.643	0.04%
DGS	*Squalus acanthias*	11.109	11.109	11.109	0.04%
MUU	*Munida subrugosa*	10.751	0.543	10.751	0.04%
HAK	*Merluccius hubbsi*	9.197	9.197	4.665	0.03%
ALF	*Allothunnus fallai*	7.440	7.440	0.000	0.03%
RPX	*Psammobatis spp.*	6.947	6.947	6.947	0.02%
ALG	Algae	5.767	0.000	5.767	0.02%
SPN	Sponges	5.753	0.000	5.753	0.02%
RFL	*Raja flavirostris*	5.616	5.616	5.616	0.02%
BUT	*Stromateus brasiliensis*	5.088	5.088	5.088	0.02%
UCH	Sea urchin	4.317	0.000	4.317	0.02%
OCM	*Octopus megalocyathus*	4.316	0.000	4.136	0.02%
RDO	*Raja doellojuradoi*	3.631	3.631	3.631	0.01%
RMC	*Bathyraja macloviana*	3.630	3.630	3.630	0.01%
PYM	*Physiculus marginatus*	3.258	1.707	3.258	0.01%
PTE	*Patagonotothen tessellata*	2.793	0.000	2.793	0.01%
EEL	*Iluocoetes fimbriatus*	2.571	2.571	0.000	0.01%
MAN	*Mancopsetta sp.*	2.545	2.545	0.000	0.01%
AST	Asteroidea	1.985	0.057	1.985	0.01%
BEE	*Benthoctopus eureka*	1.818	1.818	1.818	0.01%
OPH	*Ophiuroidea*	1.713	0.000	1.713	0.01%
ANM	Anemone	1.676	0.000	1.676	0.01%
NEM	*Neophyrnichthys marmoratus*	1.272	0.407	1.272	<0.01%
SQT	Ascidiacea	1.190	0.000	1.190	<0.01%
GYN	*Gymnoscopelus nicholsi*	0.468	0.000	0.468	<0.01%
EUL	*Eurypodius latreillei*	0.450	0.000	0.450	<0.01%
COT	*Cottunculus granulosus*	0.438	0.000	0.438	<0.01%
ANT	Anthozoa	0.390	0.000	0.390	<0.01%
SUN	Sunstar	0.350	0.000	0.350	<0.01%

Table 3 (cont.). Total catch of semi-pelagic stations 1957-2055 during the research cruise ZDLH1-02-2005 undertaken from the 10th to 24th February, 2005.

Species Code	***Species name***	***Catch (kg)***	***Sampled (kg)***	***Discarded (kg)***	***Proportion (%)***
MMA	*Mancopsetta maculata*	0.347	0.000	0.347	<0.01%
MYA	*Myxine australis*	0.322	0.000	0.322	<0.01%
SEP	*Seriolella porosa*	0.272	0.272	0.272	<0.01%
MUO	*Muraenolepis orangiensis*	0.267	0.000	0.267	<0.01%
WLK	Whelks	0.253	0.000	0.253	<0.01%
COG	*Patagonotothen guntheri*	0.244	0.244	0.244	<0.01%
CAS	*Campylonotus semistriatus*	0.222	0.000	0.222	<0.01%
MYX	*Myxine spp.*	0.164	0.000	0.164	<0.01%
NUD	Nudibranchia	0.155	0.000	0.155	<0.01%
ELU	*Euphausia lucens*	0.149	0.000	0.149	<0.01%
SCA	Scallop	0.133	0.000	0.133	<0.01%
XXX	Unidentified animal	0.113	0.000	0.113	<0.01%
ZYP	*Zygochlamys patagonica*	0.084	0.000	0.084	<0.01%
PES	*Peltarion spinosulum*	0.071	0.000	0.071	<0.01%
MUN	*Munida spp.*	0.044	0.000	0.044	<0.01%
SAR	*Sprattus fuegensis*	0.025	0.022	0.003	<0.01%
SRP	*Semirossia patagonica*	0.010	0.010	0.010	<0.01%
MXX	*Myctophid species.*	0.010	0.000	0.010	<0.01%
CRU	Crustacea	0.009	0.000	0.009	<0.01%
Total		**28,731.073**	**3,668.501**	**28,514.543**	**100.00%**

4.1.1 Loligo gahi

The abundance of *Loligo gahi* was unevenly distributed with respect to depth. High abundances were encountered at depths of up to 150 m, while comparatively few *Loligo* were caught in waters deeper than 200 metres (Fig. 13). The only exception was the 310 kg caught in 246 metres at station 2023 (Fig. 13). The highest catch of 620 kg was landed at station 2055, in a region where there is no commercial fishing for this species (Fig. 13). Depth related differences in abundances were also found between the sexes. Males outnumbered females by a ratio of 1.5 to 1 in waters shallower than 100 m, while the opposite was true in deeper waters.

Maturity state also seemed to vary with depth (Fig. 14). While most of the squid caught on this cruise were immature (i.e. stages 1 to 3), some stations found in waters < 100 m (e.g. stations 2043 and 2054) had a relatively high proportion of sexually mature females. Such a large proportion of mature female is uncommon at this time of the year. There are two plausible explanations for this finding. Either these mature females belong to the previous cohort (i.e. second cohort of 2004) or they have matured quicker than normal. The latter is supported by the warmer than average water temperatures found in this survey (see Fig. 3). One simple way to conclude which of these explanations is correct is to determine the age of these mature females.

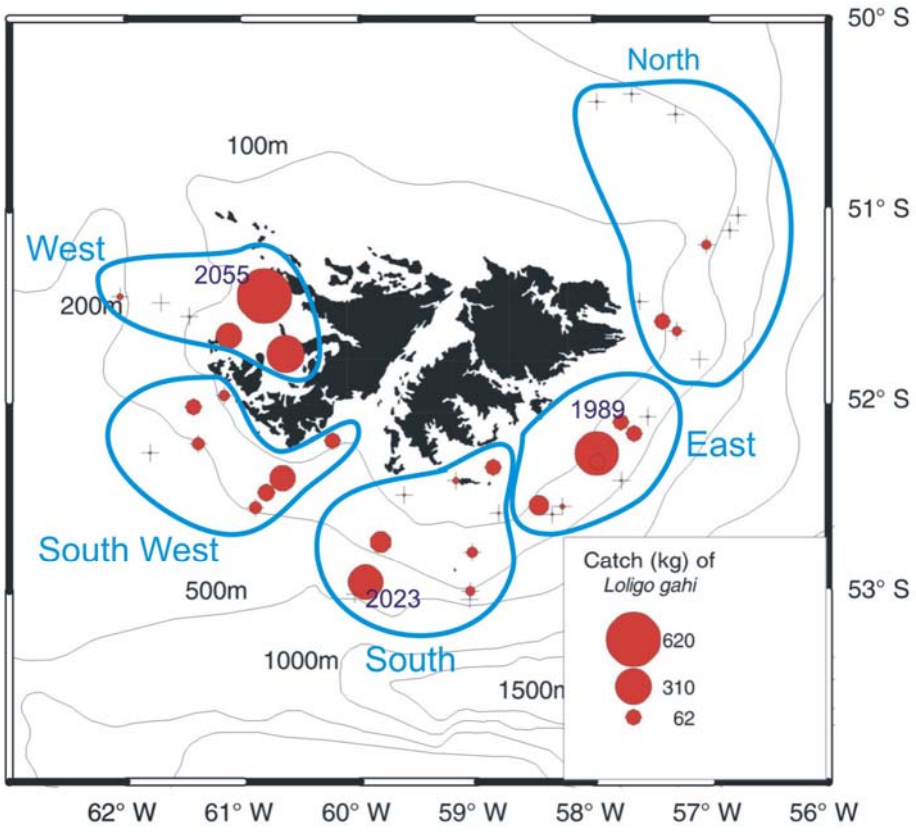

Figure 13. Results from the trawl survey done on the research cruise ZDLH1-02-2005, showing the weight of Loligo gahi *caught. Station numbers and regions mentioned in the text are shown in blue and cyan, respectively.*

The size structure of squid taken from waters shallower than 100 m was very different to that taken from waters deeper than 200 m. In the shallow waters, both males and females had a mode of about 8 or 9cm cm and few squid were greater than 10 cm in mantle length. In comparison, the squid were much bigger in deeper waters. Here, modal mantle length for both males and females was about 11.5 cm (Fig, 14) and a large proportion of individual were greater than 11 cm in mantle length. Based on these results, there was a general trend of increasing size from shallow, inshore waters to deep, offshore waters.

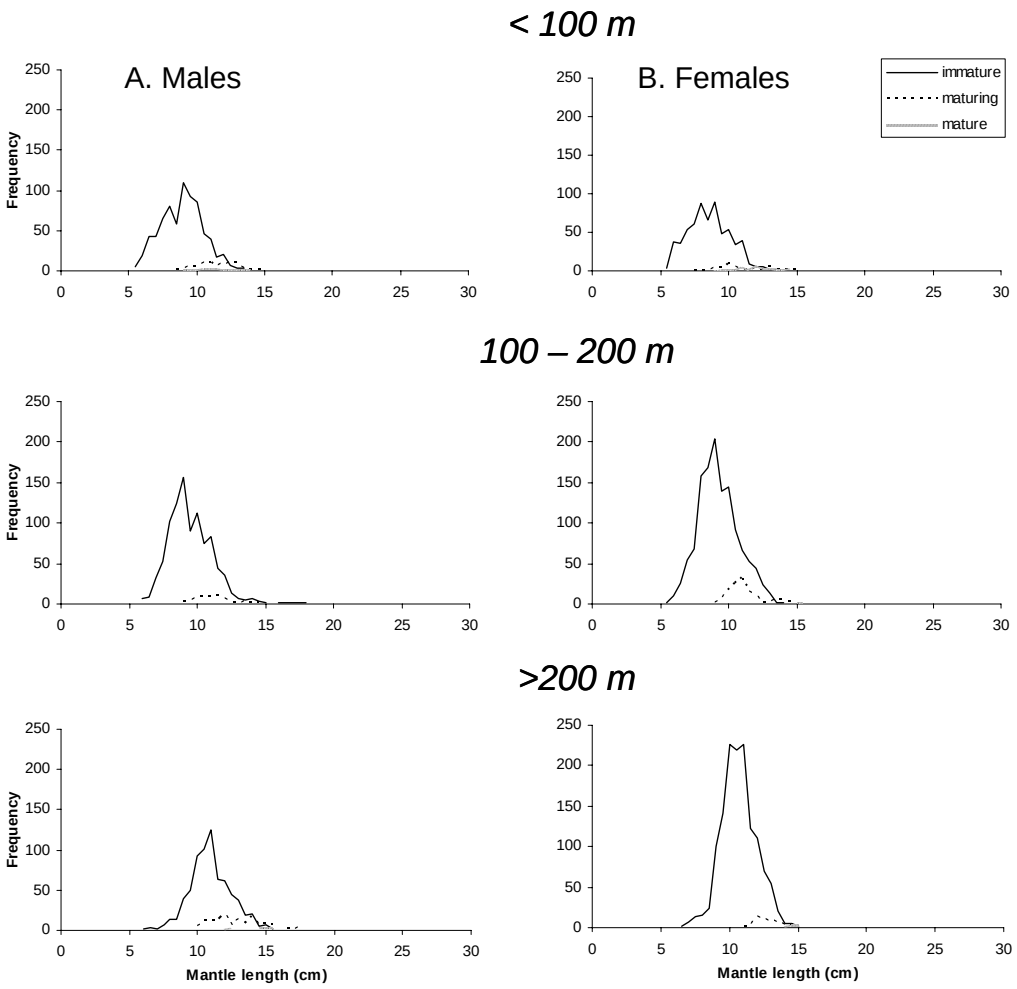

Figure 14. Length frequency distributions of (A) male and(B) female Loligo gahi *caught at different depths in the waters around the Falkland Islands during the research cruise ZDLH1-02-2005.*

Length frequency distribution for males and females of different maturities were also analysed separately for 5 different regions. These regions were North, East and South, South West and West Falkland Islands and are displayed in Fig. 15. Based on the length frequency distributions, it seems that there were two groups of animals encountered on this research cruise. One group, consisting of squid from the North and West, had an indistinct mode (aside from the relatively clear mode of 8 cm for females from the North) of approximately 7-8.5 cm. The other group, consisting of larger squid from the East, South and South West, has a much more prominent mode at around 10cm. It is not known why the squid from the North and West have a less pronounced mode than those found elsewhere, but it could be due to mixing of squid from different environmental conditions.

Also noteworthy is the relatively high proportion of maturing females found in the South West compared to the other regions.

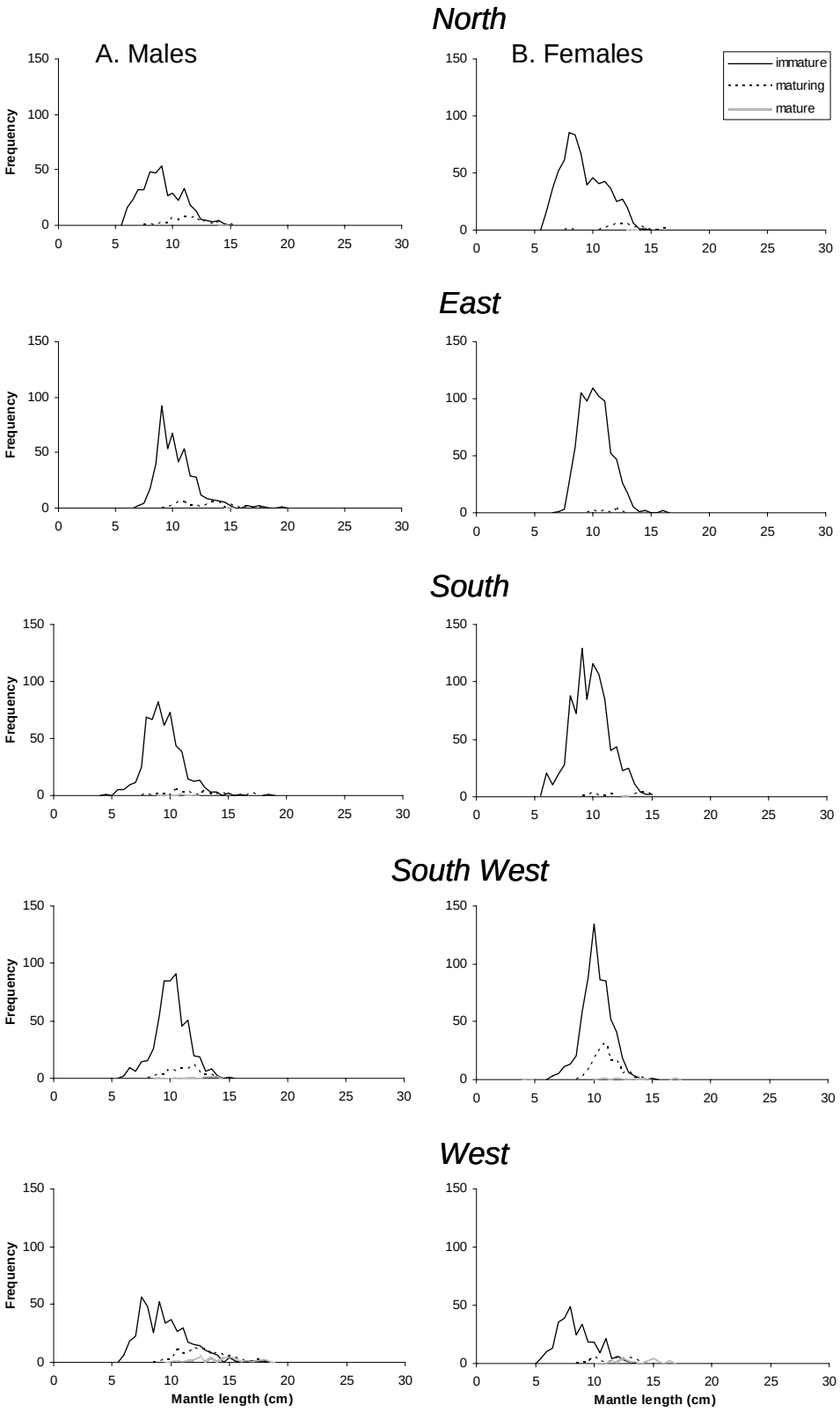

Figure 15. Length frequency distributions of (A) male and(B) female Loligo gahi *caught in different regions around the Falkland Islands during the research cruise ZDLH1-02-2005.*

4.1.2 Macruronus magellanicus

Hoki were taken from throughout the sampling area, except in waters shallower than 113 m (Fig. 16). In total, 20,654.2 kg of hoki were caught in the survey, with most (75%) of the catch landed at station 1960. This trawl station was located to the north of the islands in 300 m of water (Fig. 16). Pre-anal length ranged between 16 to 40 cm for males (mean length = 26.66 cm, SD = 4.73; Fig. 17 A) and 17 and 47 cm for females (mean length = 28.27 cm, SD = 4.94; Fig. 17 B). Negligible differences were found in length frequency distributions between stations. A total of 1639 animals were sampled, of which 1009 were females and 630 were males. No juveniles were caught. Of the females sampled, 88% were immature (stages I and II) and 11% were in post spawning stages 7 and 8 (Fig. 17 B). Most of the post spawning females were collected from stations 1957, 1977, 2014, 2031 and 2033 (Fig. 16). With the exception of station 2031, which is found in waters only 143 m deep, all of these stations are found in deeper waters (> than 273 m; Fig. 16). No hydrated oocytes were recovered from any females. The maturity state of males was almost identical to that found in females. Of the 630 males sampled, 89% were immature (stages I and II) and 8 % were in post spawning condition (Fig. 17 A).

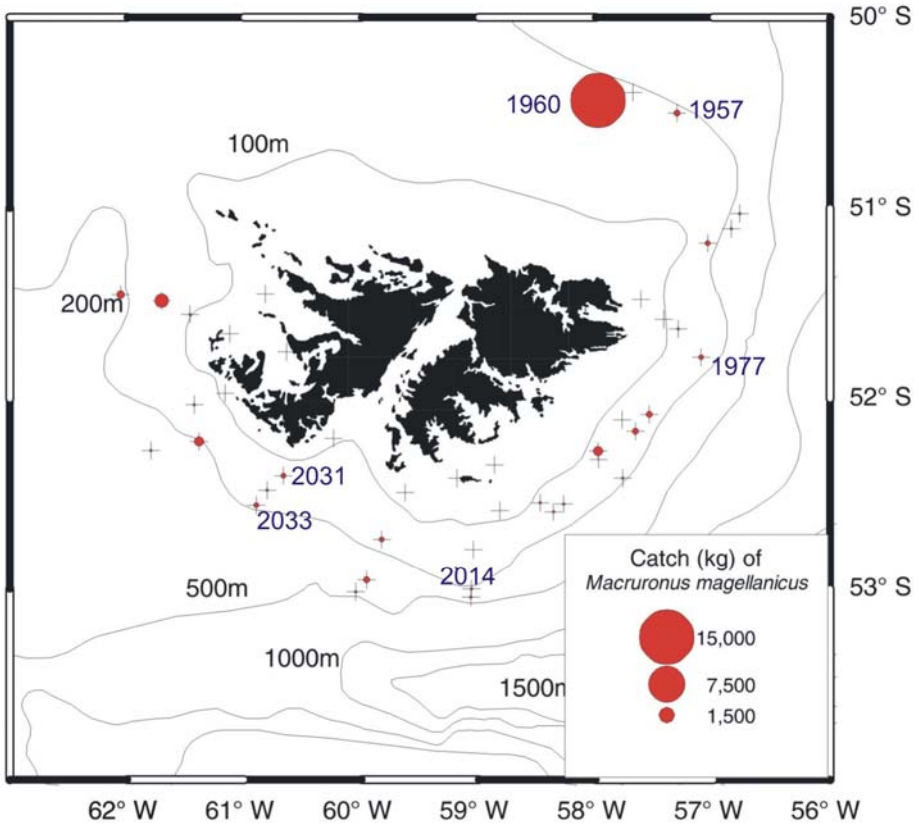

Figure 16. Results from the trawl survey done on the research cruise ZDLH1-02-2005, showing the weight of Macruronus magellanicus *caught. Station numbers mentioned in the text are shown in blue.*

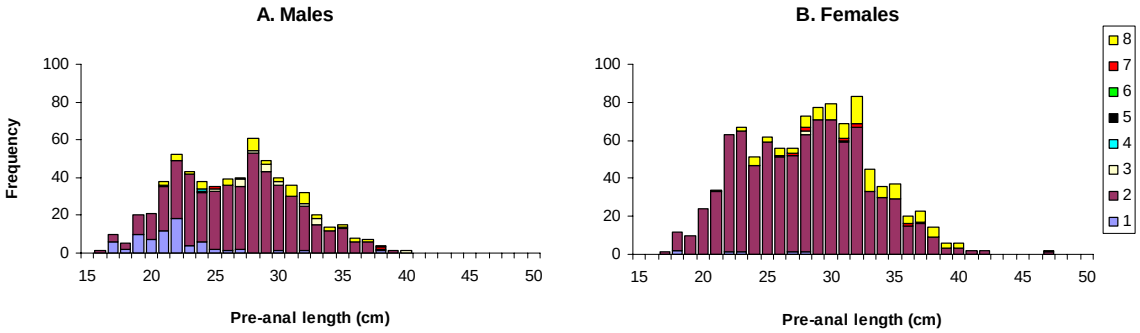

Figure 17. Length frequency distributions of (A) male and(B) female Macruronus magellanicus *caught during the research cruise ZDLH1-02-2005.*

4.1.3 Micromesistius australis australis

Southern blue whiting were taken from throughout the sampling area, except in the shallow waters immediately south of the Falkland Islands (Fig. 18). While southern blue whiting were caught in depths ranging from 75 to 440 m, most were taken in waters between 132 and 325 metres deep. A total of 675 fish were sampled, of which 50.4 % were female, 42.8 % were male and 6.8 % were classified as juvenile. Males landed ranged from 19-60 cm and had a unimodal size distribution around the mode of 52 cm (Fig. 19 A). In comparison, females were slightly larger, ranging from 14-69 cm and having a modal size of 56 cm (Fig. 19 B). Over 83% of the females caught were immature (stages I and II), with another 16.2 % in post spawning condition (stages 7 and 8; Fig. 19 B). A large proportion of the post spawning females were collected from stations 2033 and 2038, which are found in the south west in waters deeper than 300 m in depth (Fig. 18). The maturity state of males was almost identical to that of females, except that fewer males were found (8 %) in post spawning condition (Fig. 19 A).

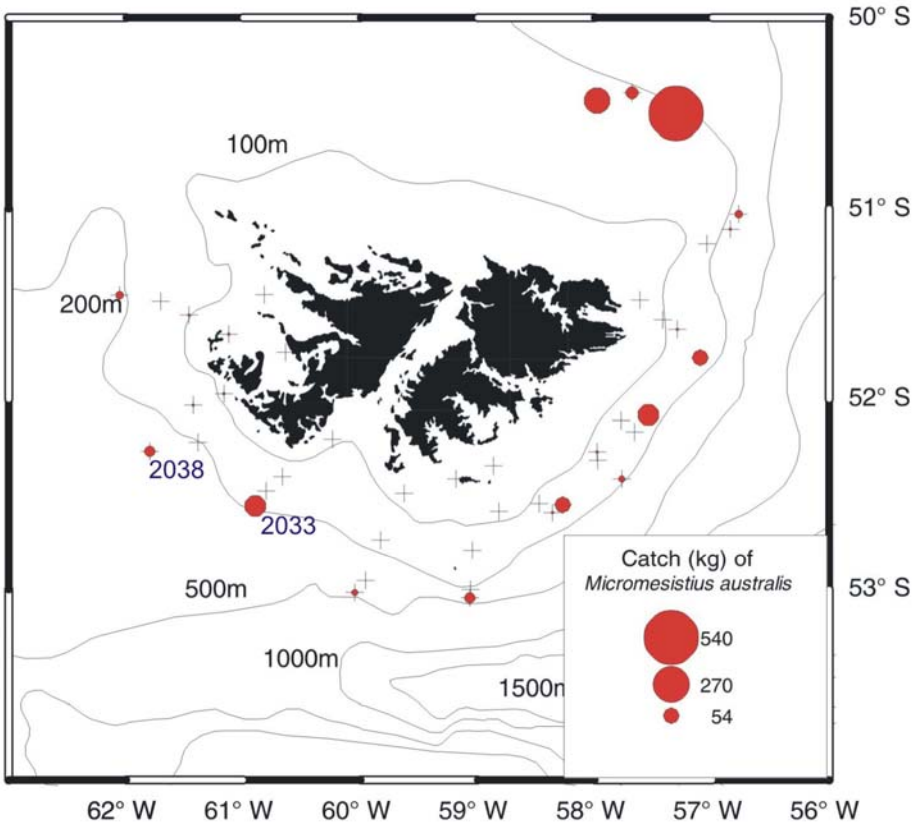

Figure 18. Results from the trawl survey done on the research cruise ZDLH1-02-2005, showing the weight of Micromesistius australis australis *caught. Station numbers mentioned in the text are shown in blue.*

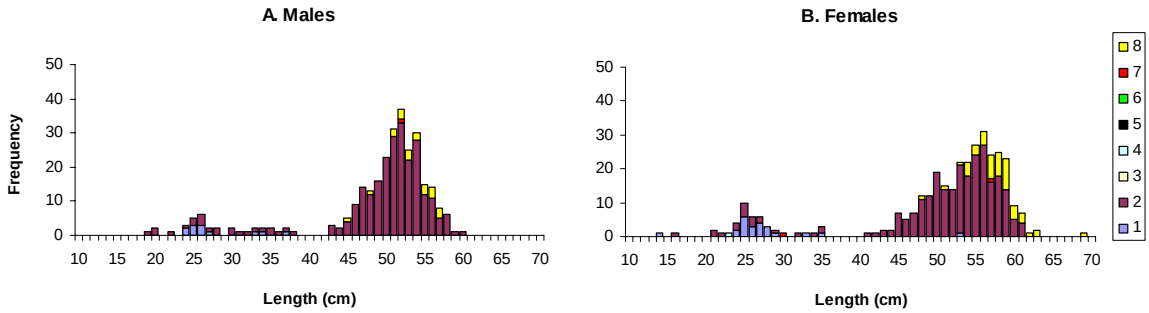

Figure 19. Length frequency distributions of (A) male and(B) female Micromesistius australis australis *caught during the research cruise ZDLH1-02-2005.*

4.1.4 Munida gregaria

Lobster krill were most abundant in shallow waters (i.e. < 100 metres) to the west and the south of the islands (Fig. 20).The largest catch of 320 kg was taken at station 2026 after only an hour of trawling. Another 300 kg was landed nearby at station 2029 in even less time. The sex of approximately 100 individual was assessed at 5 stations (2004, 2026, 2029, 2051 and 2054). At the shallowest of these stations (station 2029), males outnumbered females by a ratio of 5 to 4. Elsewhere, females outnumbered males, sometimes by as much as four to one (e.g. station 2029).The carapace length of males ranged from 20 to 35 mm and had a unimodal size distribution around the mode of 30 mm, which was larger than the range of 18-32 mm and modal size of 27 mm for females (Fig. 21).

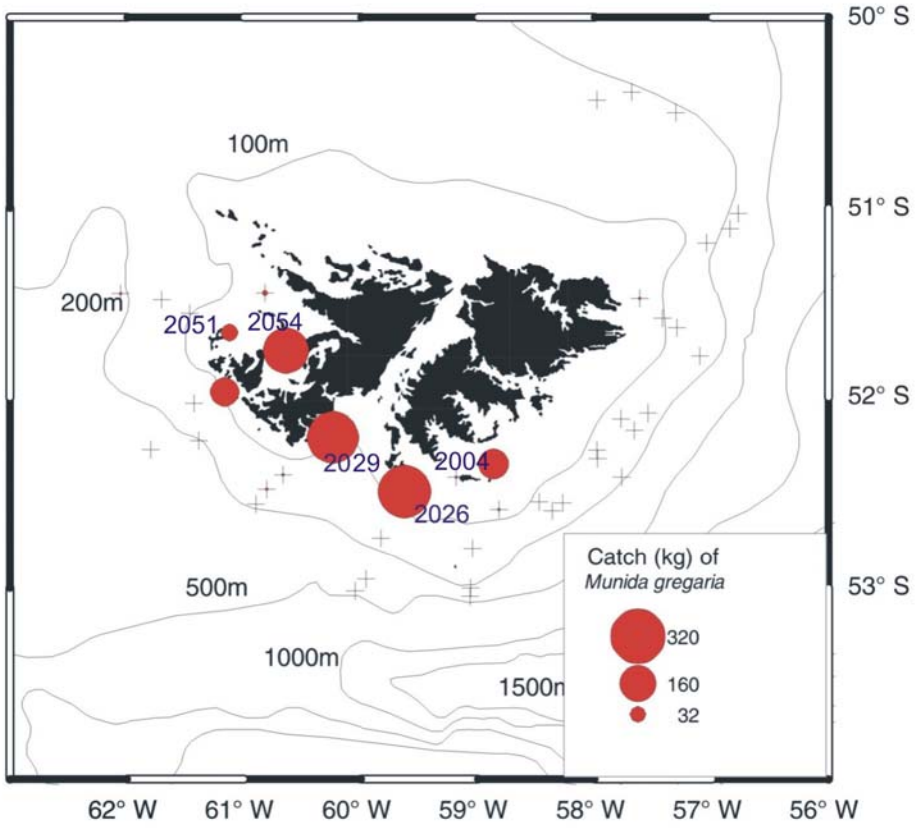

Figure 20. Results from the trawl survey done on the research cruise ZDLH1-02-2005, showing the weight of Munida gregaria *caught. Station numbers mentioned in the text are shown in blue.*

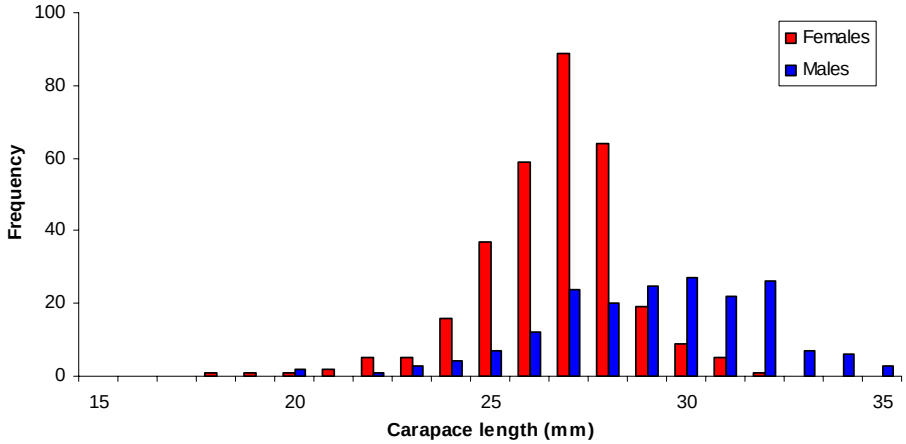

Figure 21. Length frequency distributions of Munida gregaria *caught during the research cruise ZDLH1-02-2005.*

4.1.5 Macrourus carinatus

All *Macrourus carinatus* were caught to the south or east of East Falkland Islands, with the exception of station 2038, which was found in the south west of West Falklands (Fig, 22). Most were taken in deeper waters, with the highest catch taken in the south (station 2015) at a depth of 350 metres (Fig, 22). The shallowest depth at which this species was found was 133 m (station 1974). The next shallowest depth was 218 m (station 1986; Fig, 22). A total of 133 *Macruronus magellanicus* were sampled, of which most were females. Males landed ranged from 13-25 cm pre-anal length and had a unimodal size distribution around the mode of 19 cm (Fig. 23 A). In comparison, females were slightly larger, ranging from 14-29 cm and having a modal size of 23 cm (Fig. 23 B).Of the 98 females sampled, 83 were in pre-spawning condition (at maturity stages III to V; Fig. 23 B). A similar proportion (73.4%) of males was in pre-spawning condition (at maturity stages III to V; Fig. 23 A). Only three post-spawning animals were caught. Two were landed at stations 2000 and another at station 2015.

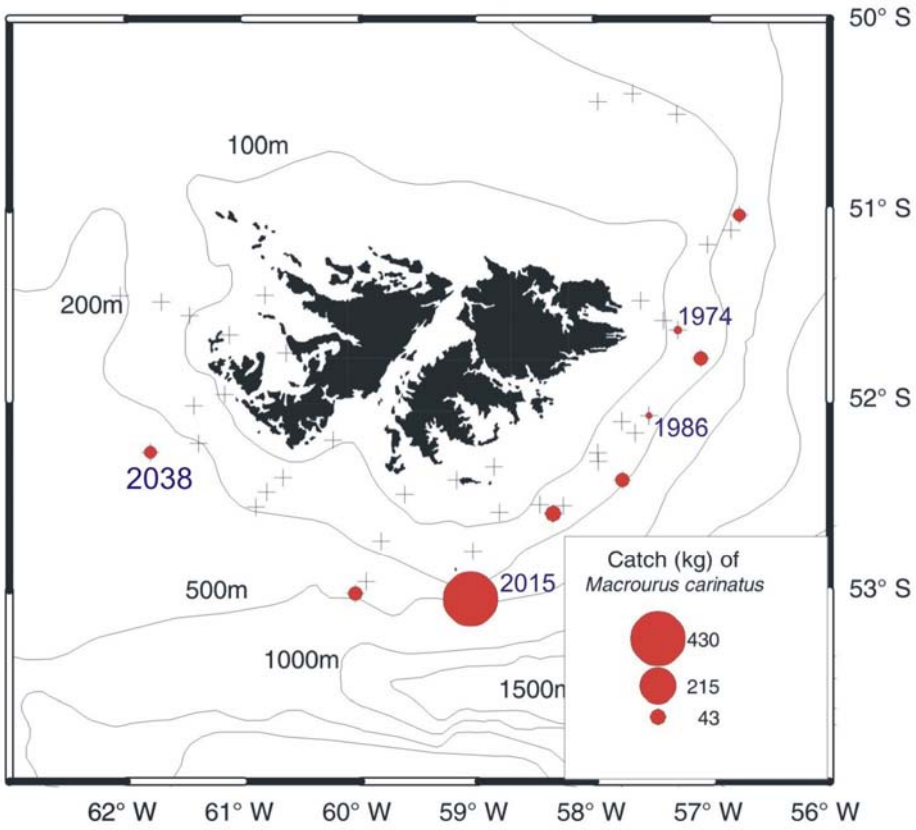

Figure 22. Results from the trawl survey done on the research cruise ZDLH1-02-2005, showing the weight of Macrourus carinatus *caught. Station numbers mentioned in the text are shown in blue.*

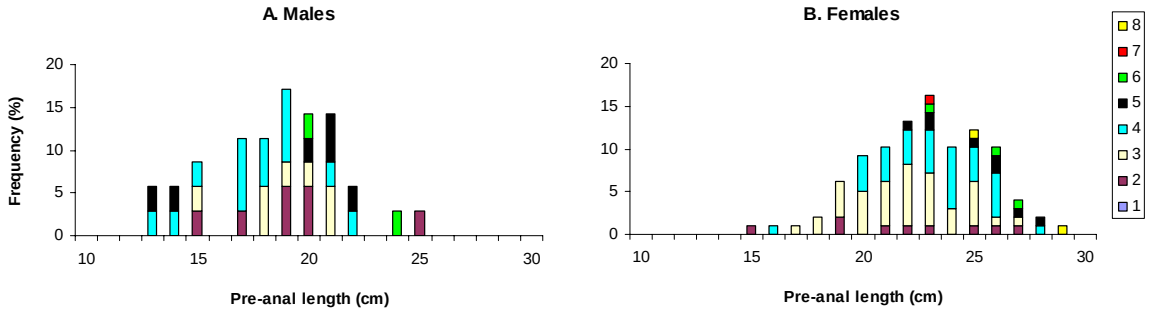

Figure 23. Length frequency distributions of (A) male and(B) female Macrourus carinatus *caught during the research cruise ZDLH1-02-2005.*

4.1.6 Patagonotothen ramsayi

Rock cod were caught at every station except for the two stations situated to the immediate east of Sea Lion Islands (stations 2004 and 2026; Fig. 24). High catches of between 50 and 73 kg were encountered in to the west and east of the Falklands in waters ranging from 200 to 300 m deep (Fig. 24). Elsewhere, catches were consistent, varying between 10 and 50 kg per trawl (Fig. 24). Of the 2049 rock cod sampled, 707 were females, 717 were males and 625 were juvenile. Length ranged between 11 and 46 cm for females, 13 to 39 cm for males and 7 to 23 cm for juveniles (Fig. 25). Both females and males had a unimodal size distribution around the mode of 23 cm, while for juveniles, the mode was around 13 cm (Fig. 25). All the juveniles were caught at 5 stations. These were 1974, 1991, 2003, 2043 and 2050. The depths of these stations ranged from 87 to 134 metres. The largest rock cod were caught in the west at stations 2033, 2038 and 2040. Negligible differences were found in length frequency distributions between sexes and stations. Of the 707 females, 92% were immature (stages I and II), with another 7.5% in post spawning condition (stages 7 and 8; Fig. 25 B). No hydrated oocytes were recovered from any females. The maturity state of males was almost identical to that found in females. Of the 630 males sampled, 89% were immature (stages I and II) and 8 % were in post spawning condition (Fig. 25 A).

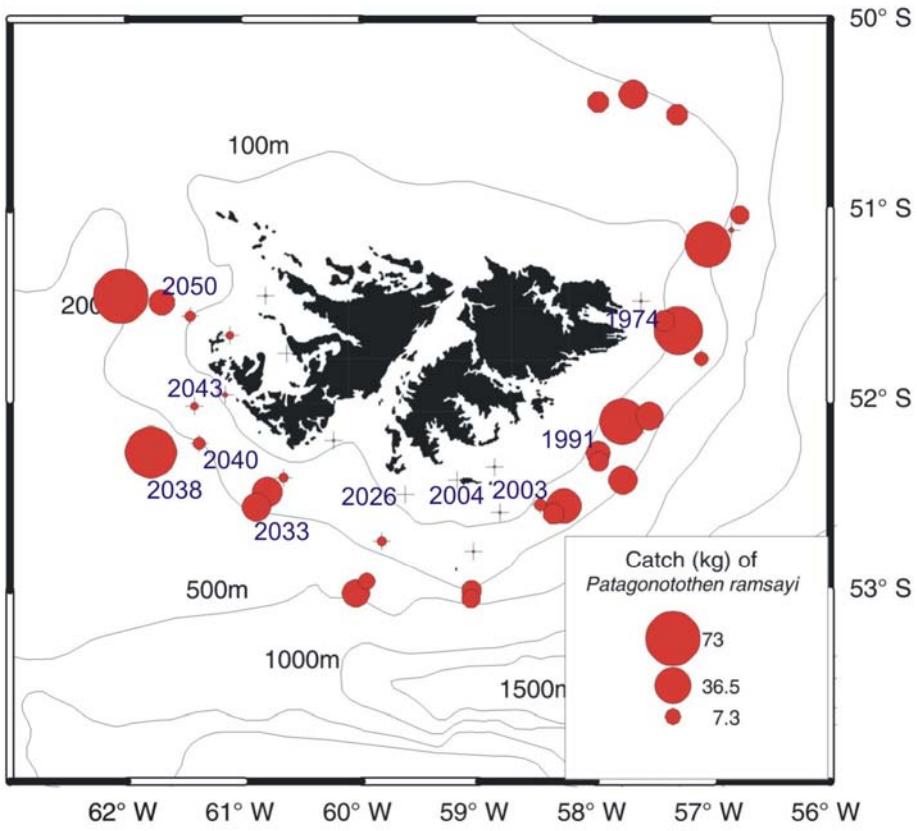

Figure 24. Results from the trawl survey done on the research cruise ZDLH1-02-2005, showing the weight of Patagonotothen ramsayi *caught. Station numbers mentioned in the text are shown in blue.*

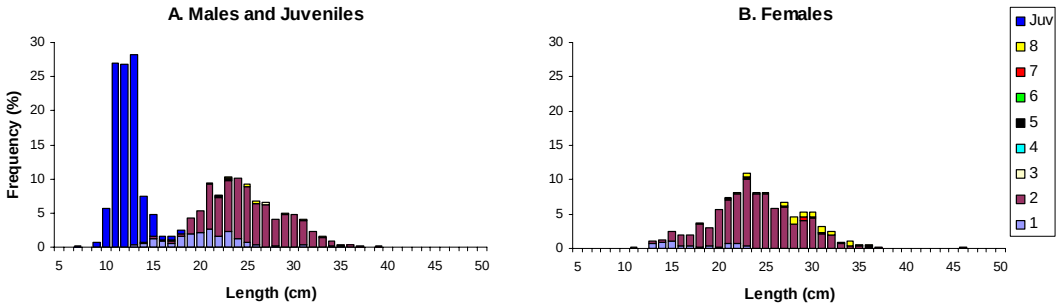

Figure 25. Length frequency distributions of (A) male, juveniles and(B) female Patagonotothen ramsayi *caught during the research cruise ZDLH1-02-2005.*

4.1.7 Moroteuthis ingens

Although *Moroteuthis ingens* was distributed throughout the survey area (Fig. 26), catch was dependent on depth. Individuals were caught at every station deeper than 100 metres, but at only one station in waters less than 100 metres (station 2051; Fig. 26). The highest catches (over 50 kg) were taken in the South West at stations 2023, 2033 and 2046, all of which are located in waters deeper than 214 metres. Over half the 874 males caught were sexually mature (stage IV or V), with only a small proportion (13.2%) of immature (stage 1 and 2) males found (Fig. 27 A). In marked contrast, over 90% of the 571 females sampled were immature, with no stage V landed (Fig. 27 B). No spent animals were found. Males ranged from 12 to 34.5 cm (mean of 23.7 cm) and females from 12 to 44 cm (mean of 24.5 cm). Only one juvenile was caught, and it was 4.5 cm in length (this individual is not shown in Fig 27).

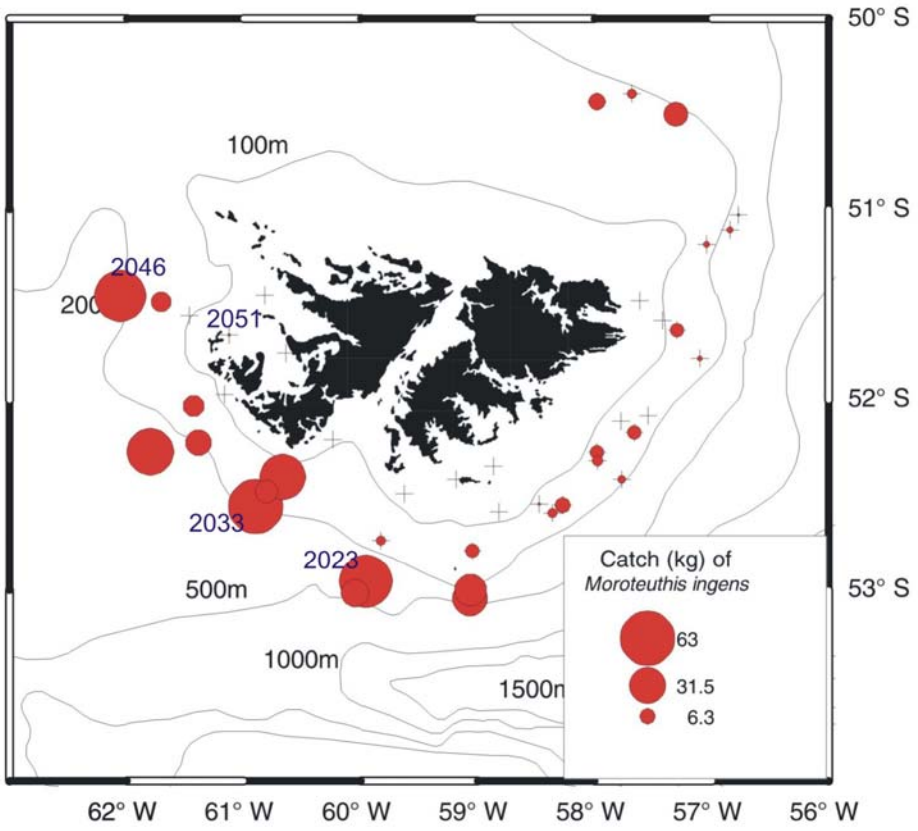

Figure 26. Results from the trawl survey done on the research cruise ZDLH1-02-2005, showing the weight of Moroteuthis ingens *caught. Station numbers mentioned in the text are shown in blue.*

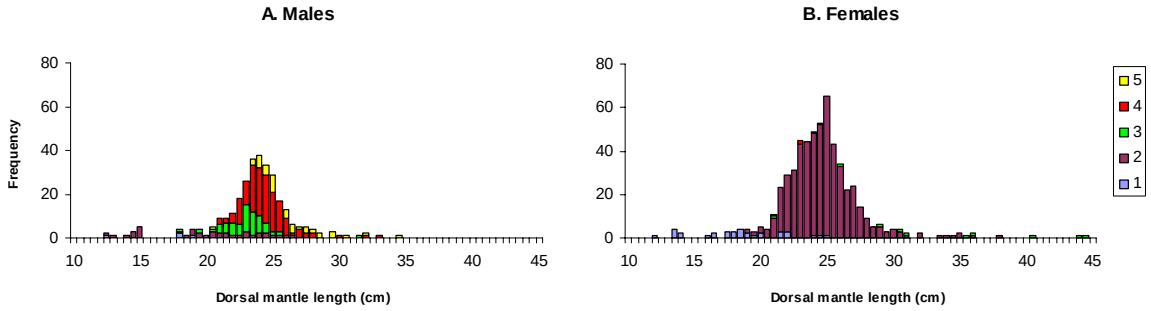

Figure 27. Length frequency distributions of (A) male and(B) female Moroteuthis ingens *caught during the research cruise ZDLH1-02-2005.*