Falkland Islands Fisheries Department

RV Castelo
Research Cruise ZDLT1-10-2009

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Falkland Islands Fisheries
Research Cruise Report ZDLT1-10-2009

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1.0 Introduction

In October 2009, a research cruise was undertaken in the south-western parts of the Falkland Islands shelf and shelf break using the chartered research vessel RV Castelo. The primary objective of the cruise was to estimate the biomass of hoki returning to their feeding grounds after spawning. The cruise's secondary objective was to use a swept area method to calculate the standing fishable biomass of commercial species in the areas, namely *Patagonotothen ramsayi* (rockcod), *Micromesistius australis* (southern blue whiting), *Genypterus blacodes* (kingclip), *Salilota australis* (red cod) and *Loligo gahi*.

1.1 Cruise Objectives

- To examine distribution, biology and biomass of hoki during their post-spawning migrations to Falkland waters.
- To examine distribution, biology and biomass of other commercial species in the survey area.
- To carry out oceanographic survey of the area studied.

1.2 Cruise Plan and Key Dates

The vessel departed Stanley on the afternoon of 17 October, and in the evening conducted its first trawl and oceanographic stations to the east of Lively Island. The following thirteen days of the research cruise were dedicated to a biomass trawl survey of the south-western part of FICZ. The vessel started the survey from the eastern grid squares XVAK and XVAL, then proceeded fishing in western grid squares and finished the survey in the southern grid squares XUAE and XUAF. Every day, two grid squares of the survey were fished. In each grid square, two trawls were made at random locations, usually one in shallower and one in deeper waters. During the last two days of the survey, four plankton tows were performed just after the dusk, at depths of the main backscattering layer (80-100 m) and above it (25-30 m).

After finishing the biomass survey on 29 October, the vessel moved to a deepwater area of the Falkland Trough to the south of Beauchene Island. Three deepwater trawls were conducted at depths of 550, 650 and 900 m on 30 October, studying distribution and abundance of deepwater fauna with grenadiers *Macrourus carinatus* being the dominating species.

To compare the demographic structure of juvenile toothfish inhabiting deepwater and shelf regions, three trawls were conducted at 250-350 m depths to the southeast of Beauchene Island on 31 October. A good collection of genetic and otolith samples of toothfish were collected from both regions.

On 1 November, two shallow water trawls (65-70 m depth) were conducted in one of the potential *Loligo* spawning grounds between East Falkland and Sea Lion Islands. Mature and spawning squid of the spring-spawning cohort together with juvenile squid of the autumn-spawning cohort were sampled.

The RV Castelo returned to Stanley on the morning of 2 November. Despite strong winds and rough seas encountered during nine out of sixteen days of the cruise, only a half day was lost due to bad weather.

Figure 1 illustrates the positions of trawl, CTD and plankton stations respectively.

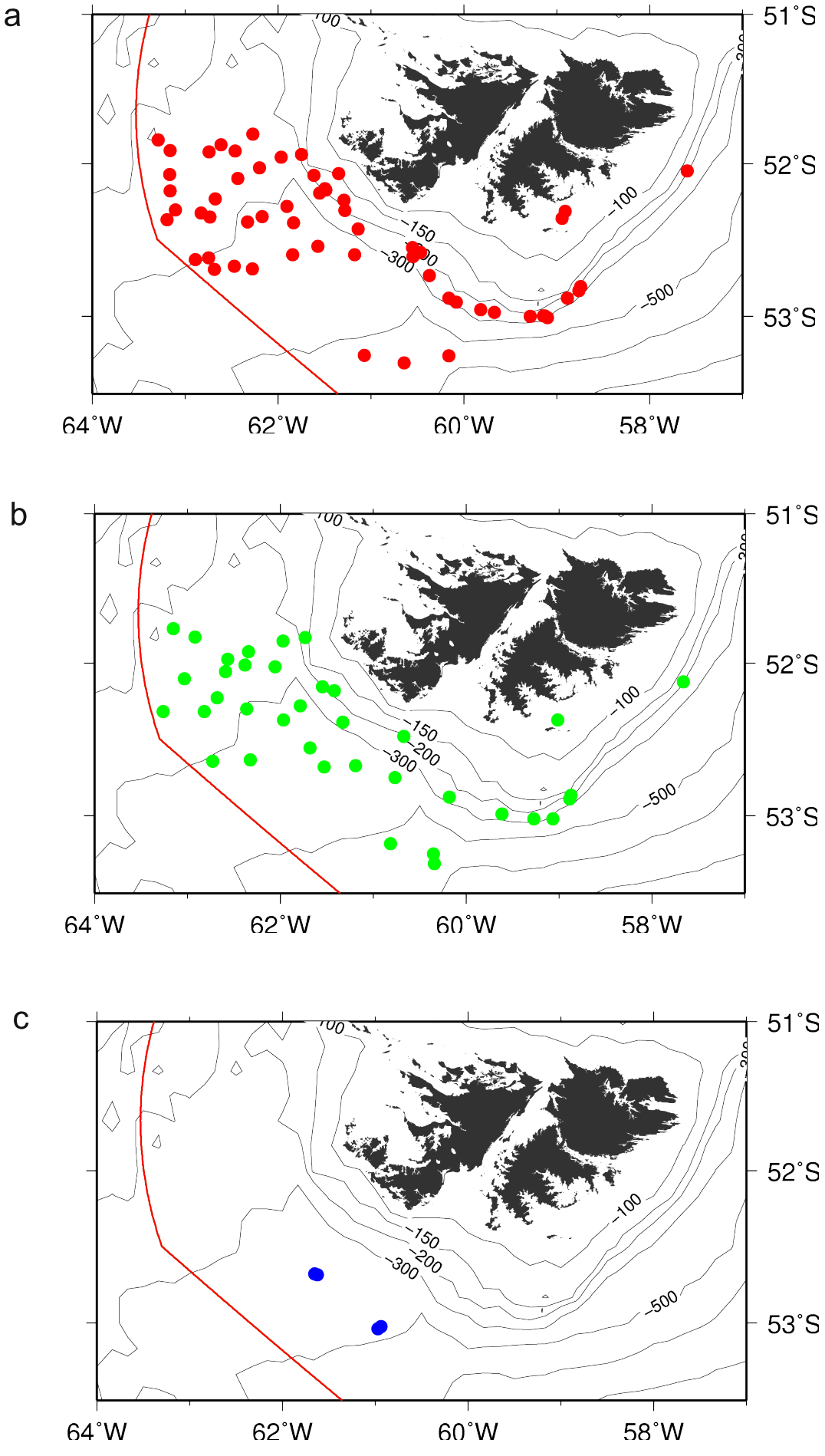

Figure 1: Maps illustrating the positions of trawl stations (a), oceanographic stations (b) and plankton stations (c)

1.3 Vessel Characteristics

Table 1: Vessel Characteristics

Callsign	ZDLT1
Length	67.78
GRT	1,321
NRT	474
Crew	30

1.4 Personnel and responsibilities

The following staff participated in the cruise:

Dr Alexander Arkhipkin	Chief Scientist
Dr Paul Brickle	Trawl/plankton surveys
Dr Vlad Laptikhovsky	Trawl/Oceanographic surveys
Joost Pompert	Trawl survey
Zhanna Shcherbich	Trawl survey
Helen Ake	Trawl survey

Additionally, a fisheries consultant, Cpt. Len Featherstone also participated to provide advice to the RV Castelo's Captain on the use of our trawl gear and Isaac-Kidd mid water trawl.

1.5 Equipment used

1.5.1 Trawling

At all trawl stations, a standard bottom trawl equipped with polyvalent trawl doors until Station 299, after which Oval-Foil Doors were used. A 40-mm codend liner was used . The trawl was equipped with MarPort ITI sensors. The typical vertical opening of the trawl was between 3.3 and 4.5 m.

1.5.2 Oceanography

The oceanographic equipment used on ZDLT1-10-2009 was the same as was used on previous surveys and included.

1. CTD SBE-25 with Sea Tech fluorometer and an oxygen sensor

1.6 Trawl stations and biological sampling.

During the ZDLT1-10-2009 research cruise the station numbers ranged from 252 to 350 (Table 2). The catches at all stations were weighed using an electronic marine adjusted balance (POLS, min 10 g, and max 80 kg).

Finfish and skates were measured (L_T, L_{PA} and W_D) to the nearest centimetre below and the sex and stage of maturity were recorded for all specimens sampled. Individual weights were recorded to the nearest gram using a POLS balance. New Marel balances were also tested with pleasing results.

Cephalopods were analysed for DML, sex, maturity and weight, with statoliths extracted from sub samples.

Table 2: Trawl, oceanographic and plankton stations conducted on ZDLT1-10-2009

Station	Activity	Time	Latitude		Longitude		Date	Depth (m)	Duration (min)
252	B	16.54	52	2.80	57	35.70	17/10/2009	203	111
253	C	19.35	52	7.40	57	39.60	17/10/2009	203	45
254	B	6.55	52	48.40	58	44.70	18/10/2009	204	85
255	C	8.50	52	52.10	58	52.30	18/10/2009	167	10
256	B	9.30	52	50.02	58	45.69	18/10/2009	180	80
257	B	13.05	52	59.92	59	8.50	18/10/2009	240	90
258	C	14.50	53	1.19	59	16.15	18/10/2009	335	10
259	B	15.15	52	59.95	59	17.06	18/10/2009	210	105
260	B	6.55	52	57.48	59	49.28	19/10/2009	256	100
261	C	8.45	52	59.24	59	36.77	19/10/2009	249	10
262	B	9.15	52	58.46	59	40.16	19/10/2009	210	90
263	B	12.55	52	54.45	60	4.89	19/10/2009	248	105
264	C	14.55	52	52.85	60	10.77	19/10/2009	211	10
265	B	15.20	52	52.96	60	9.81	19/10/2009	210	100
266	B	6.55	52	44.03	60	22.42	20/10/2009	250	85
267	B	9.15	52	35.14	60	27.89	20/10/2009	204	90
268	B	14.30	52	36.58	60	32.86	20/10/2009	252	105
269	B	17.00	52	33.24	60	33.18	20/10/2009	206	95
270	C	18.55	52	28.90	60	40.21	20/10/2009	205	7
271	B	6.55	52	25.89	61	8.17	21/10/2009	258	95
272	C	9.45	52	23.37	61	19.64	21/10/2009	253	9
273	B	10.20	52	18.49	61	17.00	21/10/2009	204	110
274	B	13.30	52	10.44	61	29.28	21/10/2009	230	55
275	B	16.00	52	14.53	61	17.29	21/10/2009	175	100
276	C	17.50	52	10.98	61	25.19	21/10/2009	179	8
277	B	18.20	52	9.83	61	29.76	21/10/2009	217	95
278	B	6.55	51	56.41	61	44.96	22/10/2009	174	135
279	C	8.45	51	49.75	61	44.02	22/10/2009	163	8
280	B	11.16	51	57.47	61	58.03	22/10/2009	225	106
281	C	13.05	51	51.20	61	58.40	22/10/2009	212	7
282	B	14.35	51	48.24	62	16.18	22/10/2009	268	97
283	C	16.20	51	55.43	62	20.47	22/10/2009	260	10
284	B	17.06	51	54.87	62	27.67	22/10/2009	241	99
285	B	6.55	51	52.44	62	36.97	23/10/2009	229	95
286	C	8.45	51	58.51	62	34.14	23/10/2009	243	80
287	B	9.35	51	55.25	62	44.51	23/10/2009	226	100
288	C	11.29	51	49.65	62	55.15	23/10/2009	218	8
289	B	15.10	51	54.67	63	9.73	23/10/2009	214	90
290	B	18.20	51	50.45	63	17.51	23/10/2009	200	95
291	C	20.06	51	46.16	63	9.15	23/10/2009	200	8
292	B	7.00	52	10.85	63	9.61	24/10/2009	236	95
293	C	8.50	52	6.14	63	2.06	24/10/2009	233	8
294	B	9.35	52	4.24	63	9.89	24/10/2009	223	110
295	B	12.45	52	37.09	62	44.79	24/10/2009	240	105
296	C	14.39	52	3.39	62	35.41	24/10/2009	249	9
297	C	16.10	52	13.73	62	40.98	24/10/2009	262	10
298	B	16.25	52	13.84	62	40.57	24/10/2009	262	100
299	B	6.55	52	5.78	62	25.93	25/10/2009	262	95
300	C	8.36	52	0.74	62	22.80	25/10/2009	259	12
301	B	9.30	52	1.58	62	12.05	25/10/2009	280	95
302	C	11.15	52	1.47	62	3.36	25/10/2009	288	11
303	B	13.10	52	4.59	61	36.73	25/10/2009	185	90
304	C	14.52	52	9.36	61	32.75	25/10/2009	231	9
305	B	15.35	52	11.71	61	33.21	25/10/2009	265	90
306	B	6.55	52	23.40	61	49.86	26/10/2009	319	90
307	C	8.45	52	16.91	61	47.02	26/10/2009	325	11
308	B	9.25	52	16.84	61	54.22	26/10/2009	308	90
309	C	11.12	52	22.44	61	57.86	26/10/2009	308	12
310	B	12.45	52	20.86	62	10.34	26/10/2009	302	100
311	B	14.50	52	23.08	62	19.70	26/10/2009	293	115
312	C	16.55	52	18.19	62	21.62	26/10/2009	289	11
313	B	6.55	52	21.11	62	44.11	27/10/2009	272	110
314	C	9.34	52	19.24	62	49.12	27/10/2009	267	9
315	B	9.50	52	19.46	62	49.65	27/10/2009	265	100
316	B	13.05	52	22.20	63	11.75	27/10/2009	252	95
317	B	14.50	52	18.30	63	6.23	27/10/2009	255	95
318	C	16.35	52	19.24	63	15.77	27/10/2009	254	10
319	B	6.55	52	37.78	62	53.51	28/10/2009	298	95
320	C	8.38	52	38.75	62	43.62	28/10/2009	305	12
321	B	9.15	52	41.62	62	41.11	28/10/2009	315	95
322	B	13.05	52	40.40	62	28.39	28/10/2009	329	110
323	C	15.00	52	38.24	62	19.54	28/10/2009	319	12
324	B	15.40	52	41.51	62	16.55	28/10/2009	328	100
325	I	21.05	52	41.24	61	37.37	28/10/2009	353	35
326	I	21.45	52	40.83	61	39.07	28/10/2009	354	32
327	B	6.55	52	35.90	61	50.50	29/10/2009	334	100
328	C	8.40	52	33.43	61	40.88	29/10/2009	334	15
329	B	9.20	52	32.66	61	34.35	29/10/2009	345	100
330	C	12.16	52	41.00	61	31.59	29/10/2009	355	12
331	B	13.15	52	3.91	61	20.80	29/10/2009	361	90
332	C	14.54	52	40.49	61	11.57	29/10/2009	355	12
333	B	15.40	52	35.86	61	10.56	29/10/2009	373	105
334	C	18.35	52	45.07	60	46.04	29/10/2009	402	15
335	I	21.20	53	1.40	60	56.31	29/10/2009	445	35
336	I	22.01	53	2.17	60	58.16	29/10/2009	450	27
337	B	6.55	53	15.20	61	4.21	30/10/2009	545	170
338	C	9.52	53	10.87	60	48.92	30/10/2009	535	18
339	B	11.10	53	18.12	60	38.49	30/10/2009	693	150
340	C	14.20	53	14.74	60	21.20	30/10/2009	732	25
341	B	15.20	53	15.36	60	9.81	30/10/2009	760	185
342	C	18.55	53	18.52	60	20.50	30/10/2009	895	30
343	B	6.55	52	59.89	59	7.63	31/10/2009	292	165
344	C	9.48	52	53.38	58	53.16	31/10/2009	283	12
345	B	10.05	52	52.98	58	53.15	31/10/2009	239	160
346	C	14.00	53	1.20	59	3.99	31/10/2009	363	12
347	B	15.00	53	0.48	59	5.90	31/10/2009	350	155
348	B	15.15	52	21.64	58	56.55	01/11/2009	74	55
349	C	16.15	52	22.50	59	0.98	01/11/2009	72	6
350	B	16.55	52	18.77	58	54.43	01/11/2009	69	55

1.7 Swept Area Biomass Estimations

For each species being assessed density was calculated as kg/km^2 for each trawl station by using the ship's speed and duration and either trawl horizontal opening or trawl door spread. It was considered that trawl horizontal opening was more appropriate for *Loligo gahi* and *Patagonotothen ramsayi*. On the contrary, door spread was considered more appropriate for the larger finfish species being assessed namely *Macruronus magellanicus*, *Salilota australis*, *Micromesistius australis* and *Genypterus blacodes*. A conservative vulnerability coefficient of 1.0 was assigned to all of the species assessed due to the lack of data on catchability of the trawl.

Positions were assigned to the mean position between the trawl start and end positions and a calculated density values were assigned to them. These data were then gridded in Surfer V 8.02 using the Kriging Algorithm with a 23 km search ellipse (23 km X 23 km). A blanking file was created in order to select the survey area and a contour map of iso-densities was created. The total fishable biomass was calculated using the 'Grid Volume Computations' facility within Surfer resulting in three estimates determined by the Trapezoidal Rule, Simpson's Rule and Simpson's 3/8 Rule.

2.0 Oceanography

2.1 Methods

A logging CTDO (SBE-25, Sea-Bird Electronics Inc., Bellevue, USA) was deployed from the surface to 1-20 m above the bottom to obtain profiles of temperature (ºC), salinity (PSU), and dissolved oxygen (ml l-1). The CTD was deployed for the first one minute at about 8-10 m depth to allow polarizing of the oxygen sensor. It was then retrieved to 1 m depth and deployed again to the bottom. The speed of deployment was c. 1m/s and was monitored by use of wire counter. Temperature was measured directly whereas the other variables were calculated using Seasoft v.4.326 software (Sea-Bird Electronics Inc.) from the following measured parameters: pressure (db), conductivity (S/m), oxygen current (µA) and oxygen temperature (ºC). The CTDO sensors were calibrated annually by Sea-Bird Electronics Inc. For each station, vertical profiles of temperature, salinity and density were constructed using the Seasoft software. Profiles for each transect and iso-surfaces were constructed using the VG griding method including in the Ocean Data View package v. 3.4.4-2009 (Schlitzer 2009).

Oceanographic data were collected at 37 oceanographic stations. These stations were conducted either before or after each trawl, or randomly. Stations were situated on the southwest Falkland shelf between 72 and 895 m (Figure 2).

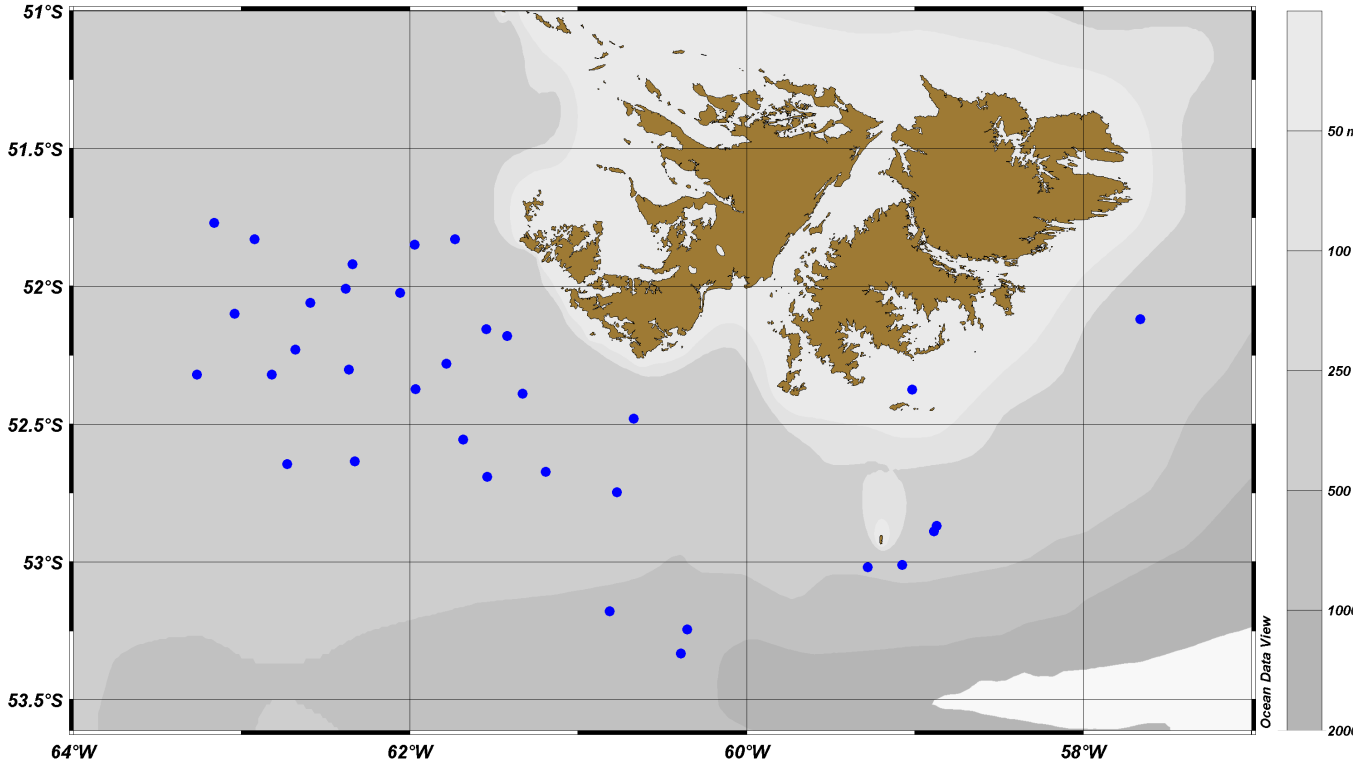

Figure 2: Oceanographic stations conducted on ZDLT1-10-2009

2.2 Results

The survey was aimed to assess the oceanographic situation over the southwest Falkland shelf and to reveal environmental factors influencing arrival and distribution of spring hoki foraging aggregations. Surface temperatures ranged from 5.26º to 6.21ºC, surface salinity from 33.58 to 34.03 psu, and densities from 26.41 to 26.87 kg/m3. T-S curves are shown on Figure 3.

The period was characterised by an ongoing negative surface temperature anomaly (Figure 4) that has persisted in the region over last two years.

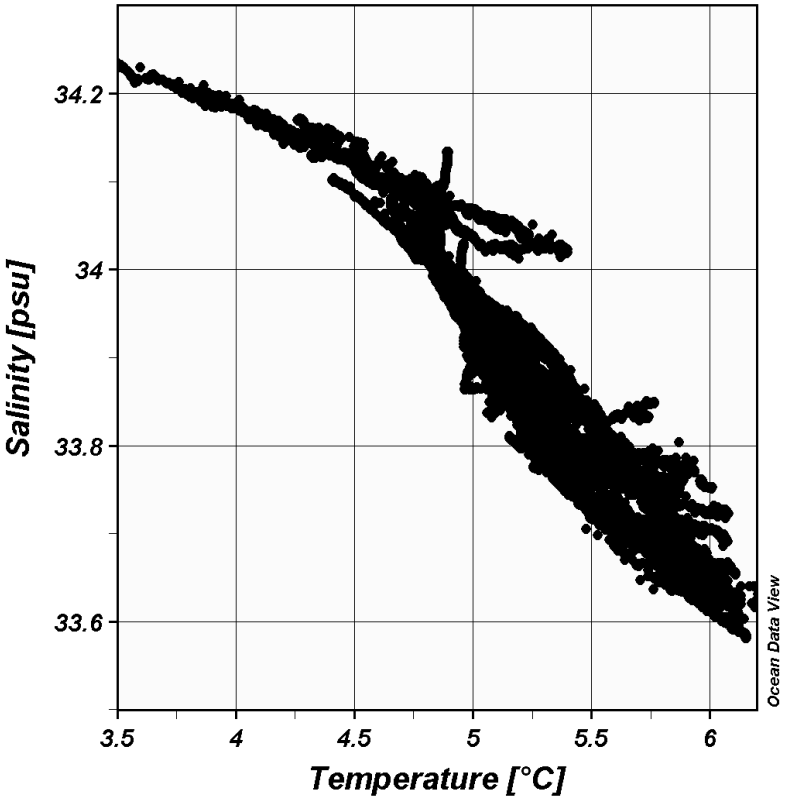

Figure 3: T-S Curve of water masses encountered during ZDLT1-10-2009

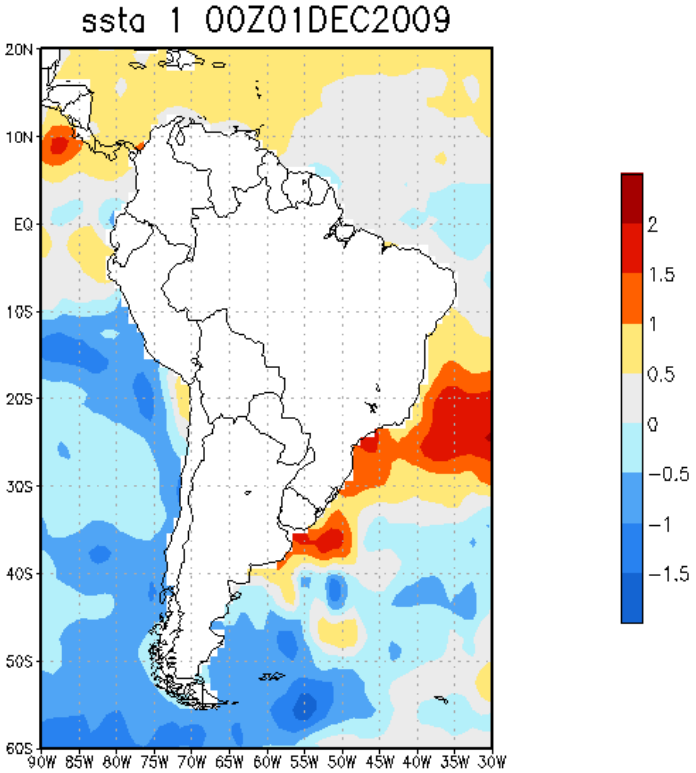

Figure 4: SST anomaly distribution in October 2009 (NOAA data)

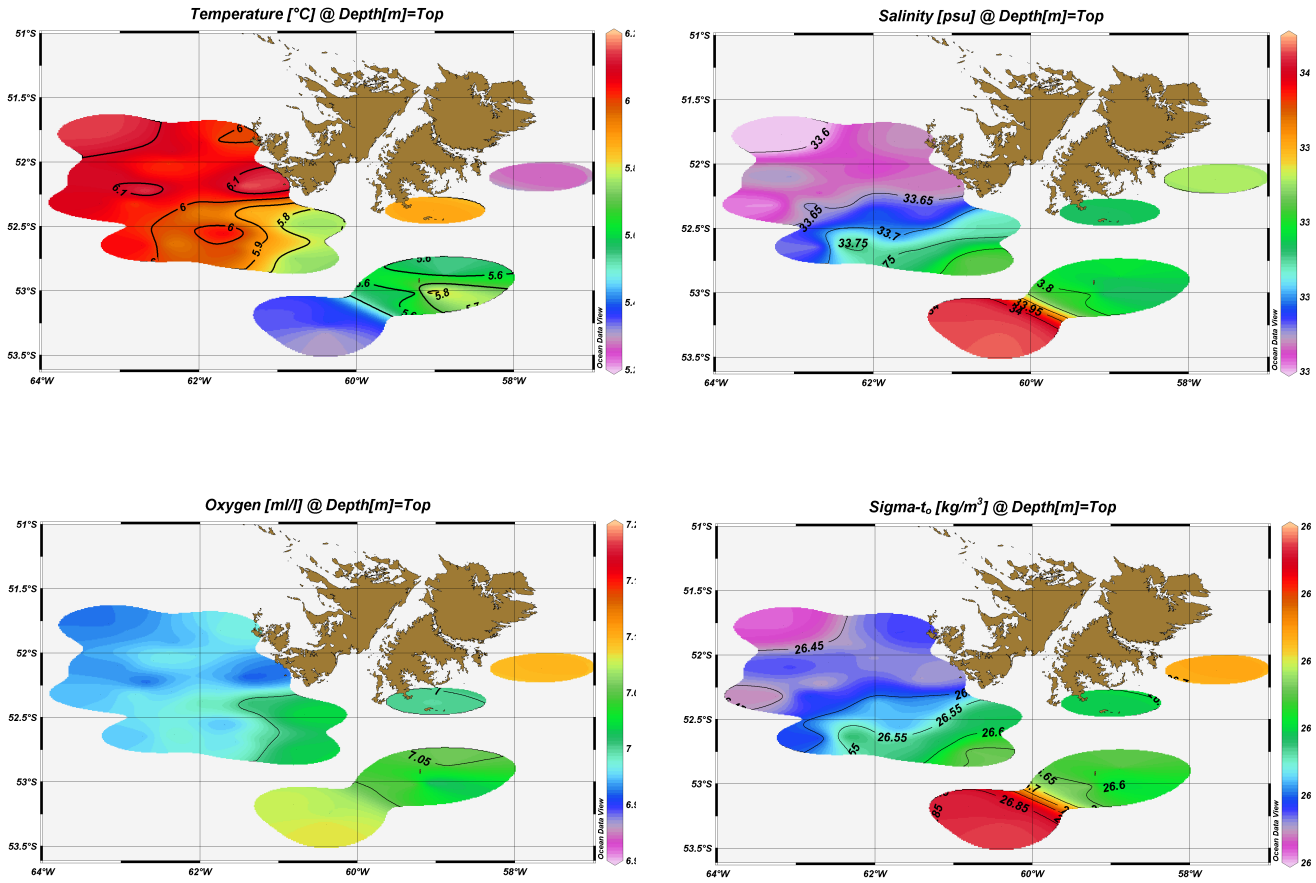

Figure 5: Distribution of temperature, salinity, oxygen, and density over the southwest Falkland shelf in October 2009

As usual on the Falkland's shelf during October, the western part of the shelf (west of 61°W) was occupied by relatively warm, low saline and oxygen-poor waters of the Argentinean drift. Figure 5 illustrates the distribution of temperature, salinity, oxygen and density in the survey area. The rest of the area was under the impact of the cold Falkland Current with its adjacent gyres and eddies. The oceanographic transect alongside the shelf edge between 200 and 300 m (Figure 6) demonstrated that the waters of Argentinean drift did not penetrate deeper than about 70 m (Figure 7). Colder and more saline waters of the western branch of the Falkland Current was situated underneath this water layer around the frontal zone that was situated more or less along 61°W (Figure 7).

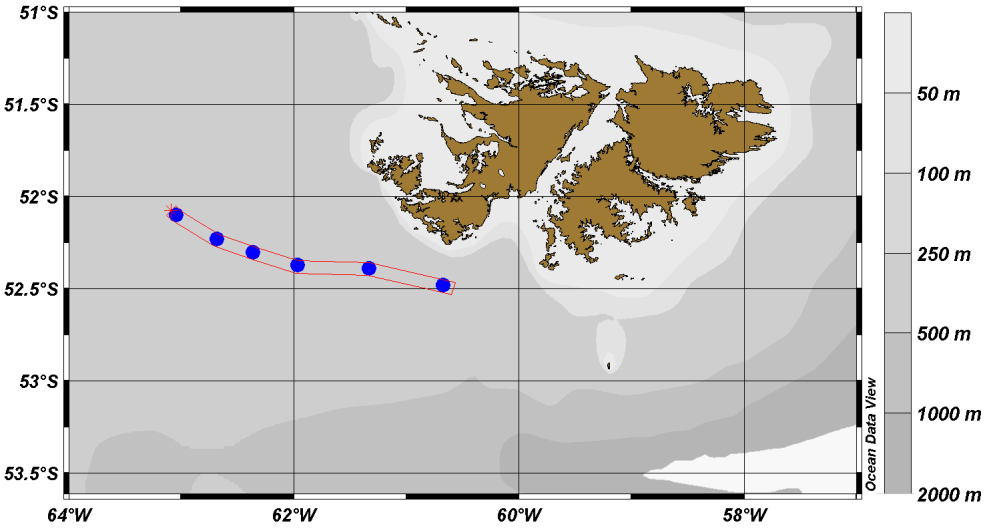

Figure 6: Position of the oceanographic transect

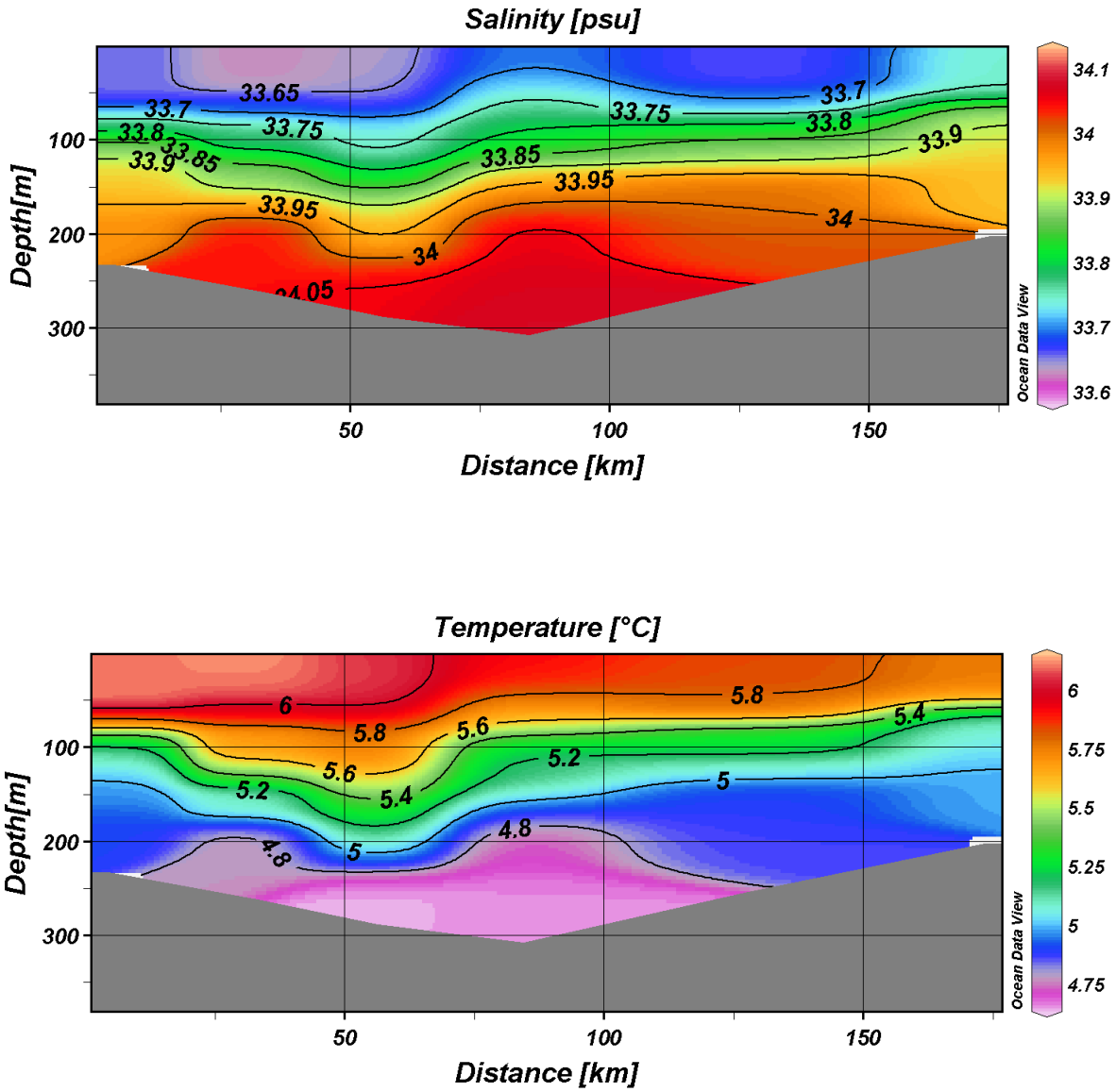

Figure 7: Temperature and salinity at the transect along the southwest Falkland shelf edge

3.0 Biological Sampling

3.1 Catch and by-catch

Bottom trawling was conducted at 58 stations and comprised 1 initial 'test' trawl (station 252), 52 survey trawls, 3 deepwater trawls, and two shallow inshore trawls. Seabed trawling times during the survey was aimed to be 60 minutes, with the deepwater stations aimed to be 120 minutes. The shallow inshore trawls lasted 30 minutes.

During the cruise a total of 66,175kg was caught comprising over 117 species (Table 3). In terms of weight, the greatest catches were the red cod (*Salilota australis*), rockcod (*Patagonotothen ramsayi*), hoki (*Macruronus magellanicus*), and grenadier (*Macrourus carinatus*), together amounting to over 75% of the total catch.

Table 3: Total catch of all trawl stations during research cruise ZDLT1-10-2009

Species Code	Species name	Total Catch (kg)	Total Sampled (kg)	Total Discarded (kg)	Proportion (%)
BAC	*Salilota australis*	16,214.476	1,508.340	510.490	24.50%
PAR	*Patagonotothen ramsayi*	11,844.570	773.885	5,663.330	17.90%
WHI	*Macruronus magellanicus*	11,521.580	2,712.620	1,426.080	17.41%
GRC	*Macrourus carinatus*	10,569.276	1,524.301	882.550	15.97%
GRF	*Coelorhynchus fasciatus*	3,155.783	57.483	3,147.930	4.77%
BLU	*Micromesistius australis*	2,971.250	543.320	2,068.710	4.49%
KIN	*Genypterus blacodes*	1,760.180	775.590	6.920	2.66%
LOL	*Loligo gahi*	1,220.285	401.011	86.270	1.84%
RGR	*Bathyraja griseocauda*	1,069.028	1,069.028	3.558	1.62%
PEN	Pennatulacea	992.000	0.000	992.000	1.50%
CGO	*Cottoperca gobio*	803.876	0.126	803.140	1.21%
RFL	*Dipturus chilensis*	759.581	759.581	1.650	1.15%
TOO	*Dissostichus eleginoides*	683.928	627.082	11.010	1.03%
MUG	*Munida gregaria*	629.244	1.440	627.744	0.95%
EEL	*Iluocoetes fimbriatus*	240.985	0.005	240.980	0.36%
RBR	*Bathyraja brachyurops*	223.776	223.736	5.066	0.34%
PYM	*Physiculus marginatus*	188.042	35.952	154.561	0.28%
PAT	*Merluccius australis*	187.183	183.573	0.000	0.28%
RAL	*Bathyraja albomaculata*	123.763	123.763	14.712	0.19%
RBZ	*Bathyraja cousseauae*	115.340	115.340	4.208	0.17%
ING	*Moroteuthis ingens*	111.208	6.152	108.878	0.17%
RMU	*Bathyraja multispinis*	96.740	96.740	0.750	0.15%
RSC	*Bathyraja scaphiops*	81.754	81.678	3.375	0.12%
NED	*Neolithodes diomedeae*	72.080	72.080	0.000	0.11%
DGH	*Schroederichthys bivius*	69.863	0.000	69.863	0.11%
SPN	Porifera	62.090	0.000	62.090	0.09%
ANR	*Antimora rostrata*	40.026	39.590	35.756	0.06%
HAK	*Merluccius hubbsi*	34.664	30.984	2.560	0.05%
RPA	*Bathyraja papilionifera*	31.490	31.490	0.000	0.05%
WRM	*Chaetopterus variopedeatus*	29.770	0.000	29.770	0.04%
NEM	*Neophyrnichthys marmoratus*	22.612	5.850	22.612	0.03%
DGS	*Squalus acanthias*	17.114	0.980	17.114	0.03%
RDA	*Dipturus argentinensis*	15.380	15.380	0.000	0.02%
MUL	*Eleginops maclovinus*	15.007	15.007	15.000	0.02%

Species Code	Species name	Total Catch (kg)	Total Sampled (kg)	Total Discarded (kg)	Proportion (%)
MUU	*Munida subrugosa*	14.868	0.623	14.805	0.02%
SAR	*Sprattus fuegensis*	13.350	6.080	13.100	0.02%
ALG	Algae	12.770	0.000	12.770	0.02%
STA	*Sterechinus agassizi*	11.557	0.000	11.557	0.02%
RMG	*Bathyraja magellanica*	10.860	10.860	10.860	0.02%
MED	Medusae.	10.657	0.000	10.657	0.02%
AST	Asteroidea	10.467	0.000	10.467	0.02%
BEJ	*Benthoctopus sp.cf.januarii*	7.949	7.949	0.000	0.01%
RMC	*Bathyraja macloviana*	7.525	7.525	0.000	0.01%
RDO	*Raja doellojuradoi*	7.091	7.021	7.083	0.01%
ANM	Anemone	7.032	0.000	7.032	0.01%
ZYP	*Zygochlamys patagonica*	6.580	0.000	6.580	0.01%
RED	*Sebastes oculatus*	6.270	0.000	0.000	0.01%
GOC	*Gorgonocephalas chilensis*	5.743	0.000	5.743	0.01%
ANT	Anthozoa	5.600	0.000	5.600	0.01%
POA	*Porania antarctica*	5.247	0.000	5.247	0.01%
COT	*Cottunculus granulosus*	5.063	0.779	4.284	0.01%
FUM	*Fusitriton m. magellanicus*	4.995	0.000	4.995	0.01%
CAS	*Campylonotus semistriatus*	4.422	4.254	0.168	0.01%
BEE	*Benthoctopus eureka*	3.762	3.762	0.000	0.01%
ICA	*Icichthys australis*	3.130	3.130	0.000	<0.01%
PES	*Peltarion spinosulum*	2.673	0.000	2.673	<0.01%
MAM	*Mancopsetta milfordi*	2.540	2.540	0.000	<0.01%
AUC	*Austrocidaris canaliculata*	2.308	0.000	2.108	<0.01%
COS	*Coryphaenoides subserrulatus*	2.258	2.258	0.000	<0.01%
MAR	*Martialia hyadesi*	2.175	0.185	1.990	<0.01%
PTE	*Patagonotothen tessellata*	1.910	1.910	0.000	<0.01%
FLX	*Flabellum spp.*	1.875	0.270	1.605	<0.01%
RPX	*Psammobatis spp.*	1.780	1.780	1.780	<0.01%
LEE	*Lepidion ensiferus*	1.708	1.700	0.000	<0.01%
ASA	*Astrotoma agassizii*	1.380	0.000	1.380	<0.01%
ADA	*Adelomelon ancilla*	1.368	0.000	1.368	<0.01%
WLK	Whelks	1.300	0.000	1.300	<0.01%
SHT	Mixed invertebrates	1.090	0.000	1.090	<0.01%
OCM	*Octopus megalocyathus*	1.000	1.000	0.000	<0.01%
SQT	Ascidiacea	0.961	0.000	0.961	<0.01%
PSM	*Pseudocyttus maculatus*	0.933	0.933	0.313	<0.01%
COL	*Cosmasterias lurida*	0.933	0.000	0.933	<0.01%
GRH	*Macrourus holotrachys*	0.820	0.820	0.820	<0.01%
ALN	*Allocyttus niger*	0.644	0.644	0.000	<0.01%
ALP	*Alepocephalus productus*	0.590	0.590	0.000	<0.01%
BUT	*Stromateus brasiliensis*	0.555	0.000	0.555	<0.01%
BRP	Brachiopoda	0.500	0.000	0.500	<0.01%
ACP	*Acanthephyra pelagica*	0.460	0.460	0.000	<0.01%
CHE	*Champsocephalus esox*	0.380	0.380	0.000	<0.01%
SUN	*Labidaster radiosus*	0.346	0.000	0.346	<0.01%
EUO	*Eurypodius longirostris*	0.326	0.000	0.326	<0.01%
UCH	Sea urchin	0.290	0.000	0.290	<0.01%
ECC	*Echiodon cryomargarites*	0.250	0.250	0.000	<0.01%
NOC	*Notacanthus chemnitzi*	0.230	0.230	0.000	<0.01%
THB	*Thymops birsteini*	0.205	0.113	0.205	<0.01%

Species Code	Species name	Total Catch (kg)	Total Sampled (kg)	Total Discarded (kg)	Proportion (%)
MMA	*Mancopsetta maculata*	0.180	0.180	0.000	<0.01%
PSR	*Psolas regularis*	0.170	0.000	0.170	<0.01%
GYN	*Gymnoscopelus nicholsi*	0.154	0.076	0.078	<0.01%
PGR	*Paradiplospinus gracilis*	0.135	0.135	0.000	<0.01%
CAZ	*Calyptraster sp.*	0.130	0.000	0.130	<0.01%
OCC	Octocorals	0.130	0.000	0.130	<0.01%
ODM	*Odontocymbiola magellanica*	0.113	0.000	0.113	<0.01%
TED	*Terebratella dorsata*	0.103	0.000	0.103	<0.01%
ZOX	Zoarcidae	0.094	0.000	0.094	<0.01%
BAL	*Bathydomus longisetosus*	0.093	0.000	0.093	<0.01%
NUD	Nudibranchia	0.076	0.000	0.076	<0.01%
AUX	*Austrocidaris sp.*	0.073	0.000	0.073	<0.01%
EUL	*Eurypodius latreillei*	0.073	0.000	0.068	<0.01%
PAA	*Pandalopsis ampla*	0.070	0.070	0.000	<0.01%
NEH	*Neomena herwigi*	0.068	0.000	0.068	<0.01%
MXX	Myctophidae	0.060	0.000	0.060	<0.01%
ELC	*Electrona carlsbergi*	0.059	0.000	0.059	<0.01%
COG	*Patagonotothen guntheri*	0.058	0.058	0.000	<0.01%
OPH	Ophiuroidea	0.048	0.000	0.048	<0.01%
SRP	*Semirossia patagonica*	0.042	0.042	0.000	<0.01%
COK	*Coelorinchus kaiyomaru*	0.040	0.040	0.000	<0.01%
MUO	*Muraenolepis orangiensis*	0.040	0.000	0.040	<0.01%
XXX	Unidentified animal	0.038	0.038	0.000	<0.01%
LIR	*Limopsis marionensis*	0.034	0.000	0.034	<0.01%
PSG	*Pseudoechinus magellanicus*	0.021	0.000	0.021	<0.01%
MEL	Melanocetidae	0.020	0.000	0.020	<0.01%
PYX	Pycnogonida	0.018	0.000	0.018	<0.01%
NEC	*Neorossia caroli*	0.014	0.014	0.000	<0.01%
TRX	*Trophon sp.*	0.011	0.000	0.011	<0.01%
PAE	*Patagonotothen elegans*	0.010	0.010	0.000	<0.01%
MUN	*Munida spp.*	0.001	0.000	0.001	<0.01%
SER	*Serolis spp.*	0.001	0.000	0.001	<0.01%
Totals		**66,174.847**	**11,900.816**	**17,171.677**	

3.0 *Loligo gahi*

Patagonian squid *Loligo gahi* was present at almost all stations of the survey (Figure 8). The abundance of squid was the greatest in the western part of the *Loligo* box at 200 m depth (St. 269, 149kg/hr). Overall, the abundance was greater in the eastern part of the survey area than in the western part. High catches of *Loligo* were also taken in one of their supposed spawning grounds in shallow waters (70-80 m depths) between East Falkland and Sea Lion Islands (20-80 kg/hr).

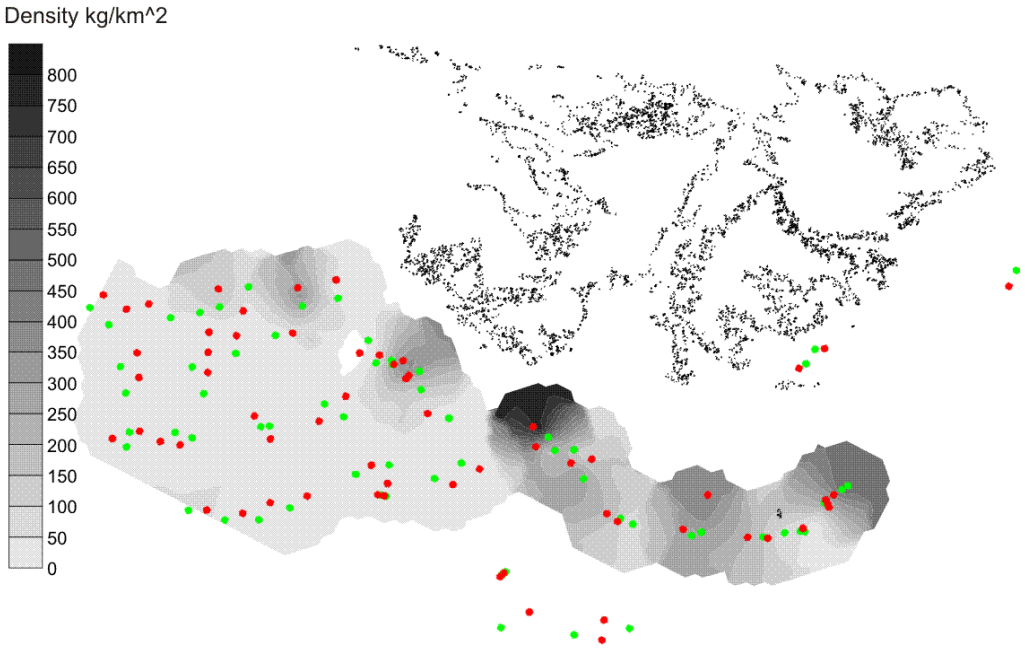

Figure 8: The distribution of density of *Loligo gahi* calculated during ZDLT1-10-2009

Almost all squid caught in deepwater (>150 m) belonged to the spring-spawning cohort (SSC) except for small immature squid of the autumn-spawning cohort (ASC). Most of the SSC squid were mature. In shallow waters, the juvenile and immature ASC cohort was present in significant numbers.

Length-frequency distributions and maturities of males and females were analysed separately for depth ranges less and more than 250 m, and for two regions, Western region (to the west of 61°W) and Eastern region (to the east of 61°W). Additionally, size composition of squid in shallow waters was also analyzed.

In the Western region, large mature squid with modal mantle length of 14-15 cm were predominant in catches. Modal length of males was almost the same as that of females, however their maximum sizes were larger. The proportion of mature squid at depths >250 m was greater than at depths <250 m. Females were predominant in sex ratios (Figure 9).

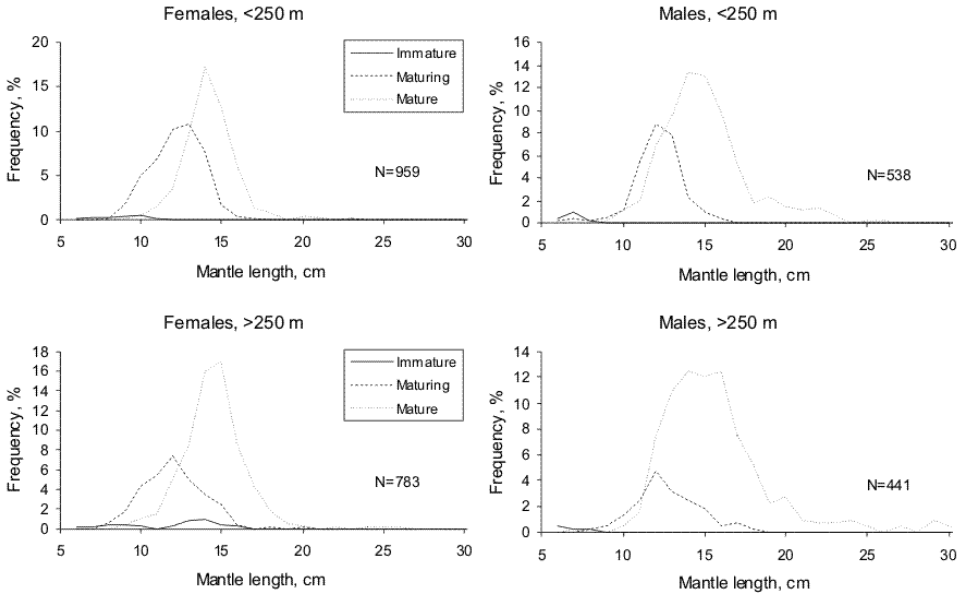

Figure 9: Length frequency distributions of females and males of *Loligo gahi* at different depths in the western region

In the Eastern region, size ranges and modal lengths of both males and females were quite similar to those observed in the Western region. The maturity trend was also similar with a greater proportion of mature squid in deeper waters. Comparing to the Western region, more immature ASC squid were encountered at depths <250 m. Sex ratios showed greater prevalence of females in the Eastern region

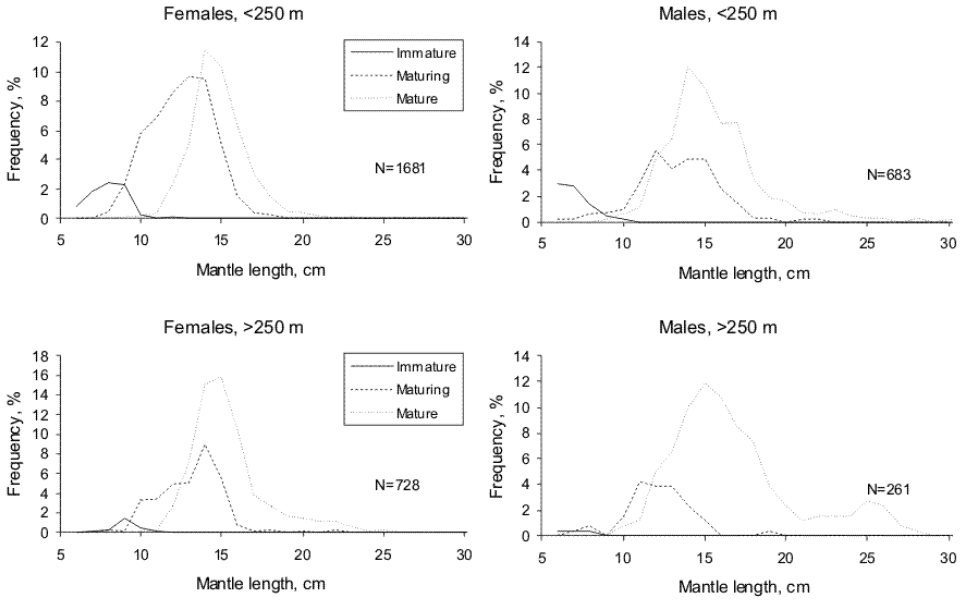

Figure 10: Length frequency distributions of females and males of *Loligo gahi* at different depths in the eastern region

A mixture of the ASC and SSC squid was observed in shallow waters to the north of Sea Lion Islands. Mature squid belonged to SSC, whereas juvenile and immature squid belonged to ASC. Surprisingly, modal sizes of mature SSC squid were much smaller (11-12 cm ML) than those observed in deep waters (15-16 cm ML). Only a few large mature specimens were caught in shallow waters (Figure 11).

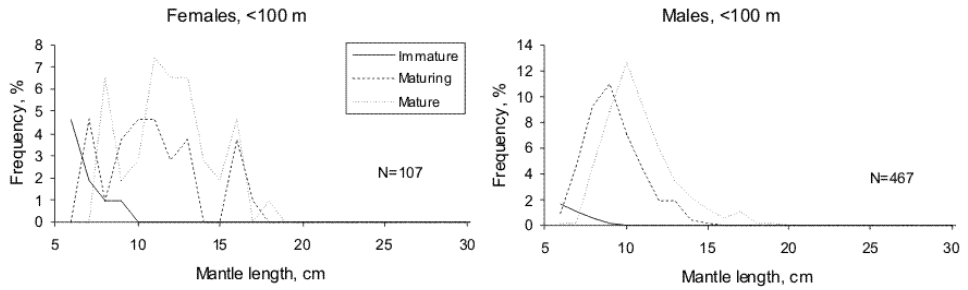

Figure 11: Length frequency distributions of females and males of *Loligo gahi* in shallow waters between East Falkland and Sea Lion Islands

The presence of large and mature females with ready to spawn gonads in deepwater far from the Falkland coasts raised a question about possible spawning of at least a part of the SSC squid at depths more than 250 m. Possible indirect confirmation of this phenomenon is their almost total absence in shallow waters, where a majority of spawning SSC squid were much smaller (11-12 cm) than in deeper waters (15-16 cm). However, none of the *Loligo* paralarvae have been caught in our plankton tows offshore of the Falkland Islands. The question about possible additional spawning of *Loligo* in deepwater needs further investigations, perhaps with the use of ROVs.

It is notable that the large SSC squid were present almost everywhere in the south-western part of FICZ outside the *Loligo* box. Their aggregations were mostly dispersed and therefore non-attractive to target commercially. However, the total estimate of the standing biomass during the survey (>3,400 mt) reveals that a significant proportion of the spawning stock biomass may occur outside the *Loligo* box and needs to be taken into account during SSB estimation after the second fishing season.

Table 4: Biomass Estimates of *Loligo gahi* calculated from the survey ZDLT1-10-2009

Volume Method	Biomass Estimate (mt)
Trapezoidal Rule:	3,447.71
Simpson's Rule:	3,443.03
Simpson's 3/8 Rule:	3,440.97

4.0 *Macruronus magellanicus* – hoki

Macruronus magellanicus was the 3rd most abundant species in terms of total weight (11,521 kg) and caught in 54 of the 58 bottom trawls during the survey. CPUEs ranged from 1.11 – 2784 kg/hr (mean = 196.91 ± 452.66). Figure 12 illustrates the distribution of density (kg/km^2) of hoki encountered during the survey. The greatest densities were encountered to the south west of Cape Meredith and to the south of Beauchêne Island.

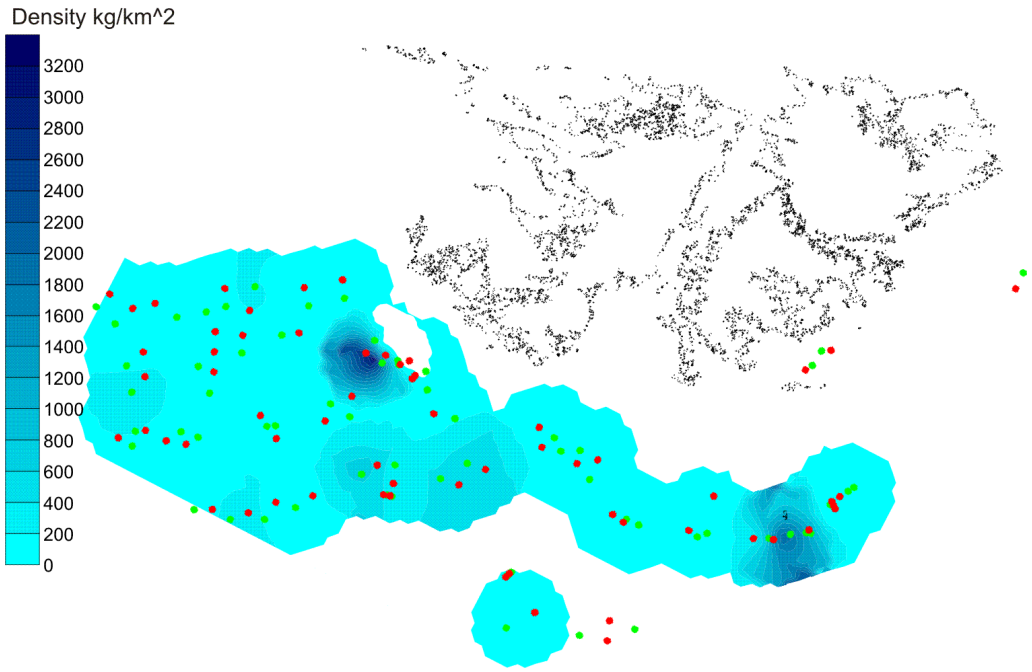

Figure 12: The distribution of density of *Macruronus magellanicus* calculated during ZDLT1-10-2009

A total of 4,106 individual hoki were sampled for length frequency analysis and for otoliths for trace elemental analyses. Of these 4,081 were used in the maturity and length frequency analyses. Hoki ranged in length from 7 to 47 cm L_{PA} (mean = 24.72 ± 7.06) (Figure 13).

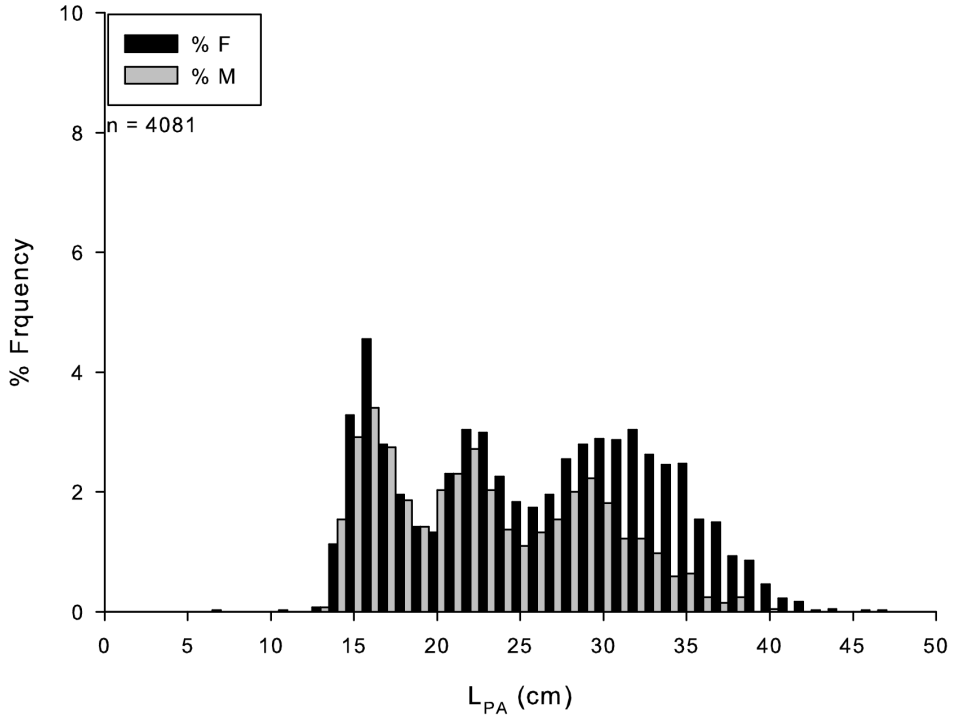

Figure 13: Length frequency distribution for *Macruronus magellanicus* sampled on ZDLT1-10-2009

Maturity stages ranged from I through to VIII with most animals in stages I, II, III, VII and VIII. The latter two stages are testament to individuals returning from their spawning grounds (Figure 14).

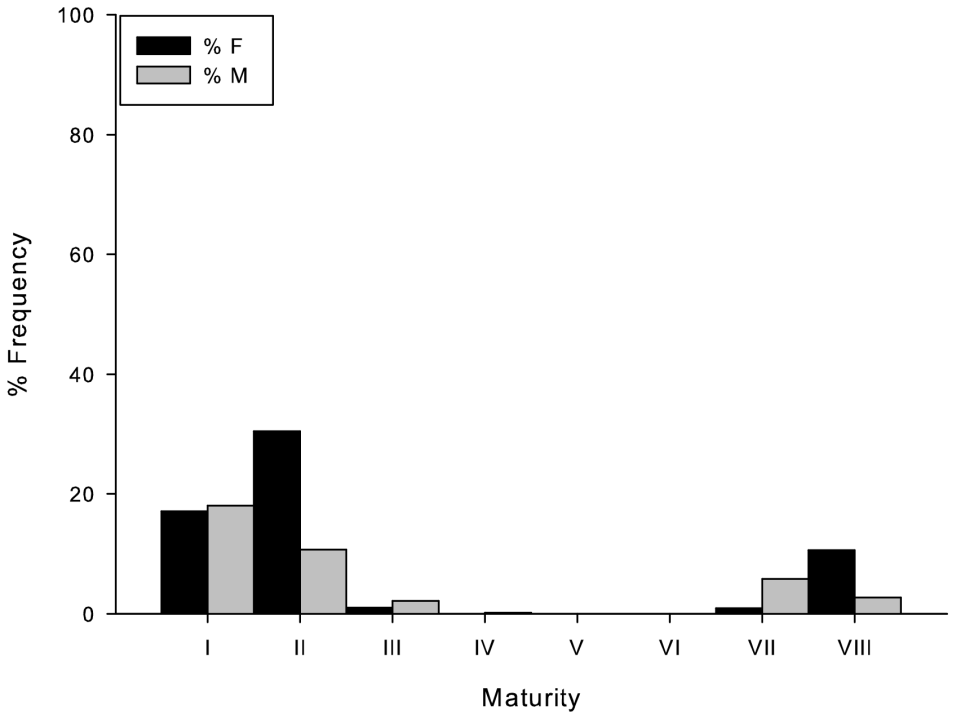

Figure 14: Maturity distribution for *Macruronus magellanicus* sampled on ZDLT1-10-2009

Table 5 illustrates the fishable biomass calculated during the cruise.

Table 5: Biomass Estimates of *Macruronus magellanicus* calculated from the survey ZDLT1-10-2009

Volume Method	Biomass Estimate (mt)
Trapezoidal Rule:	6398.57
Simpson's Rule:	6403.66
Simpson's 3/8 Rule:	6384.09

5.0 Red cod – *Salilota australis*

Red cod was the most abundant species on the cruise in terms of catch (16,214 kg) and it was caught in 52 of the 58 bottom trawls. CPUEs ranged between 0.14 and 13715.840 kg/hr (mean = 318.64 ± 1901.29). Figure 15 illustrates the distribution of red cod encountered during the survey. The greatest density of red cod was encountered on their spawning grounds to the west of New Island.

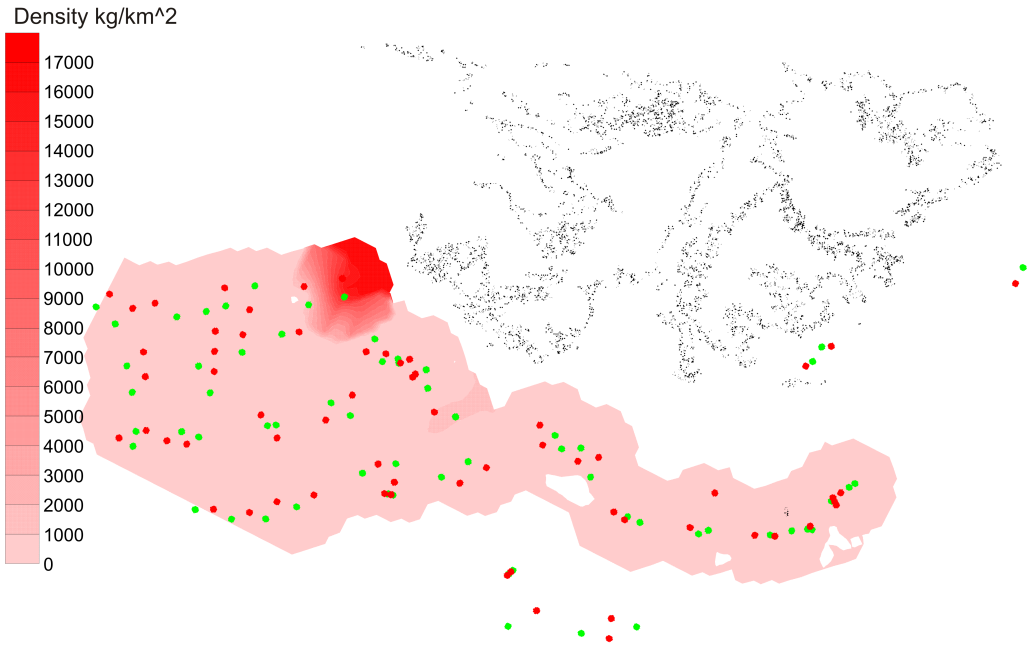

Figure 15: The distribution of density of *Salilota australis* calculated during ZDLT1-10-2009

A total of 3,097 individual red cod were sampled for biological analyses. Of these 2937 were used in length frequency and maturity analyses. During the cruise red cod ranged between 13 and 82 cm LT (mean = 33.62 ± 12.93) (Figure 16). Many smaller red cod were found on this cruise indicating a good recruitment.

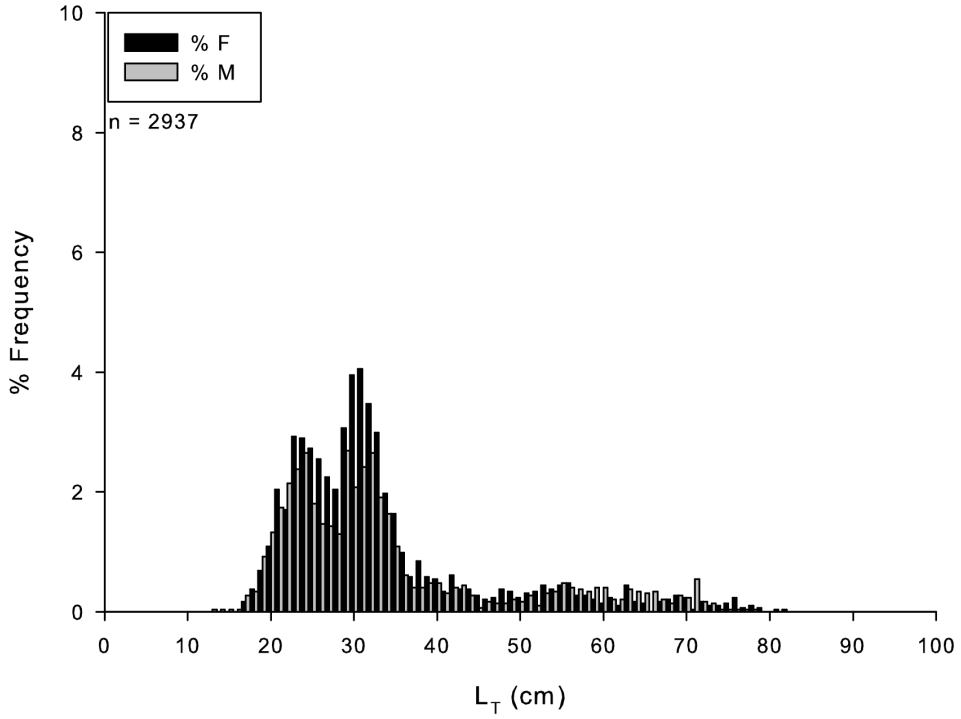

Figure 15: Length frequency distribution *Salilota australis* sampled during ZDLT1-10-2009

Maturities ranged between I and VIII with the majority in stage I and II due to the numbers of juveniles caught outside of the spawning area. A number of spawning and post spawning animals were encountered on spawning grounds to the west of New Island (Figure 17).

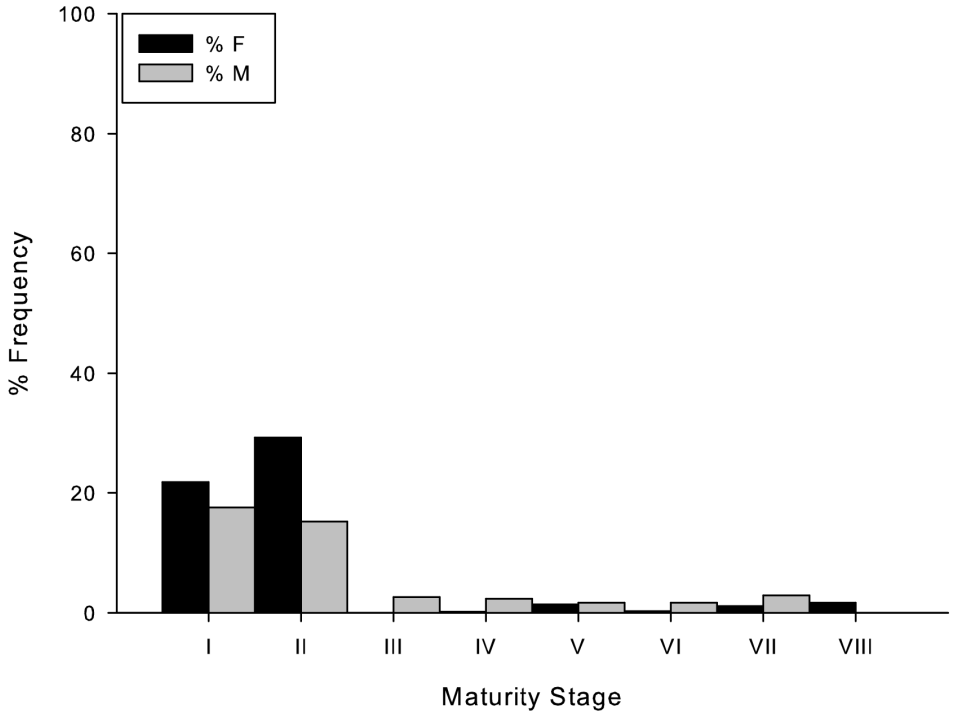

Figure 17: Maturity distribution for *Salilota australis* sampled on ZDLT1-10-2009

Table 6 illustrates the fishable biomass calculated during the cruise.

Table 6: Biomass Estimates of *Salilota australis* calclated from the survey ZDLT1-10-2009

Volume Method	Biomass Estimate (mt)
Trapezoidal Rule:	18019.22
Simpson's Rule:	18006.28
Simpson's 3/8 Rule:	18146.34

6.0 Kingclip – *Genypterus blacodes*

Also common on the south Falkland shelf and representing 2.7% of the total catch (41 of 58 hauls) was the kingclip. CPUEs ranged from 0.85 to 904 kg/hr (mean 42.0 kg/hr) with the maximum abundance found southwest of West Falkland (St. 271). Figure 18 illustrates the distribution of kingclip density over the survey area.

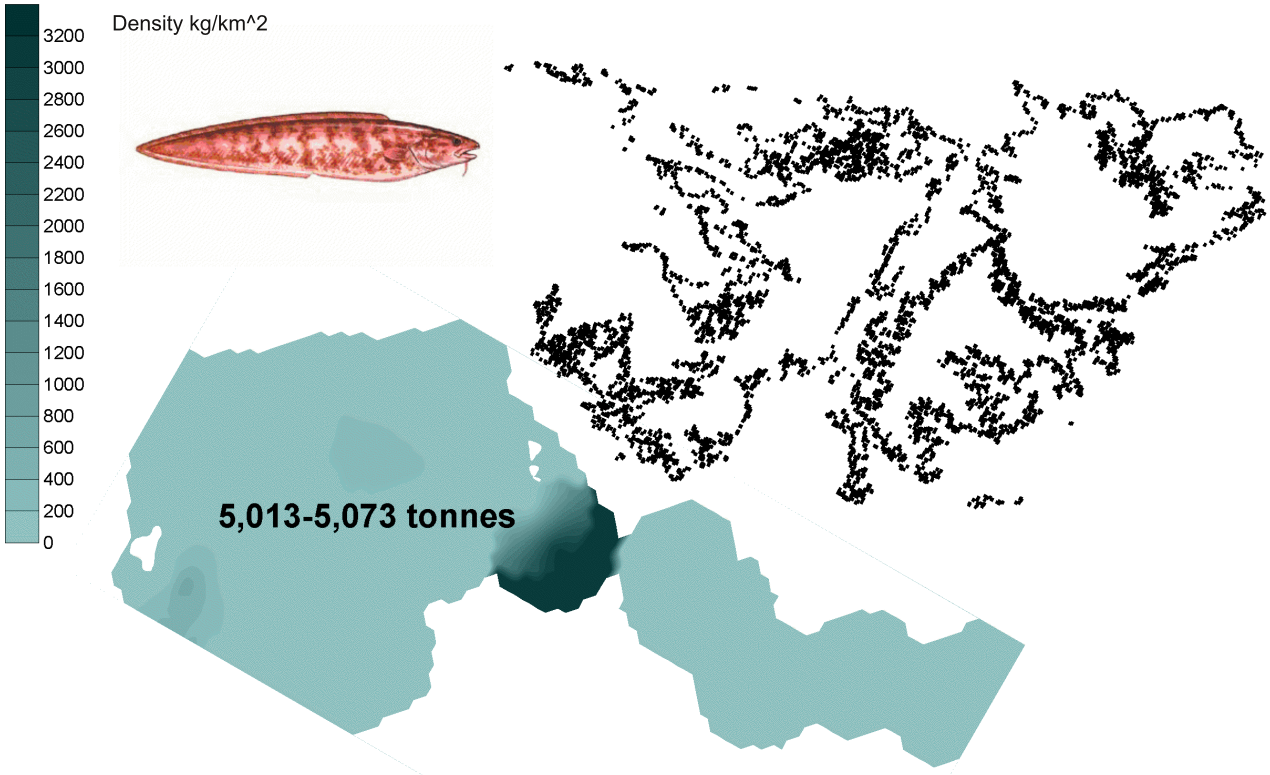

Figure 18: The distribution of density of *Genypterus blacodes* calculated during ZDLT1-10-2009

A total of 444 fish of 40-116 cm LT were sampled. Most of these (60.1%) were females. The size distribution was polymodal with two predominating size groups of 55-62 cm and 84-100 cm LT (Figure 19). Fish were immature and resting, mostly at maturity stages I and II (Figure 20). A few animals were post spawning.

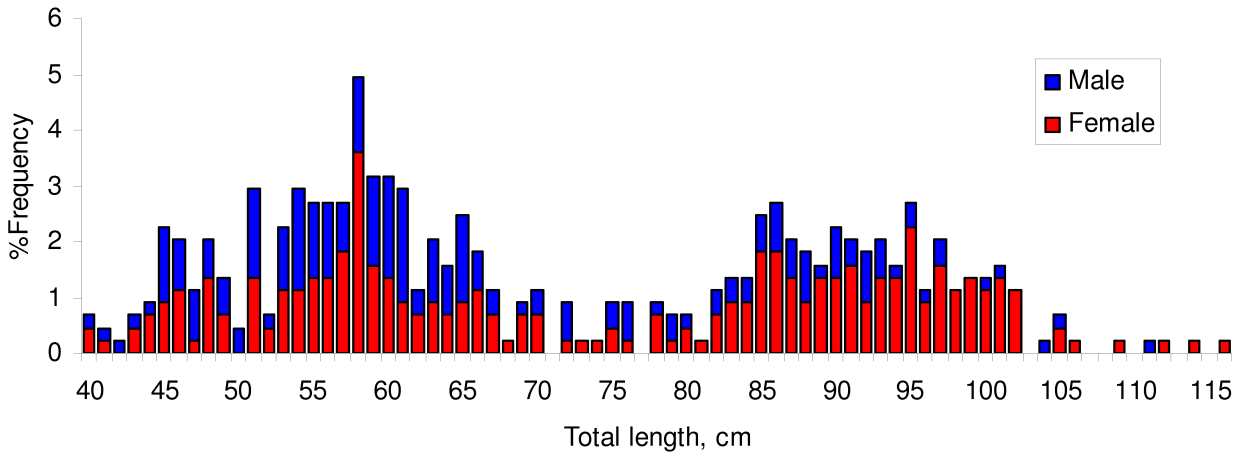

Figure 19: Length frequency distribution *Genypterus blacodes* sampled during ZDLT1-10-2009

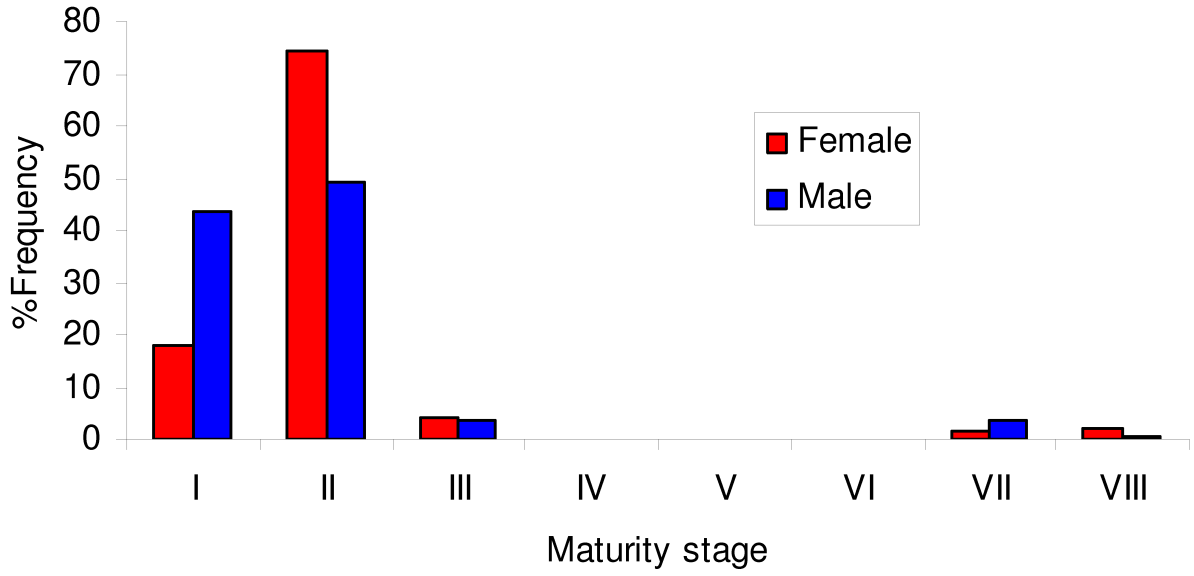

Figure 20: Maturity distribution for *Genypterus blacodes* sampled on ZDLT1-10-2009

Table 7 illustrates the fishable biomass calculated during the cruise.

Table 7: Biomass Estimates of *Genypterus blacodes* calculated from the survey ZDLT1-10-2009

Volume Method	Biomass Estimate (mt)
Trapezoidal Rule:	5073.53
Simpson's Rule:	5013.32
Simpson's 3/8 Rule:	5062.47

7.0 Blue whiting – *Micromesistius australis*

Blue whiting was common and abundant in trawl catches and was caught in 43 of the 58 hauls, representing 4.5% of the total catch. CPUEs ranged from 0.75 to 432 kg/hr (mean 37.3 kg/hr). The species did not form important aggregations; distribution of abundance is illustrated in Figure 21.

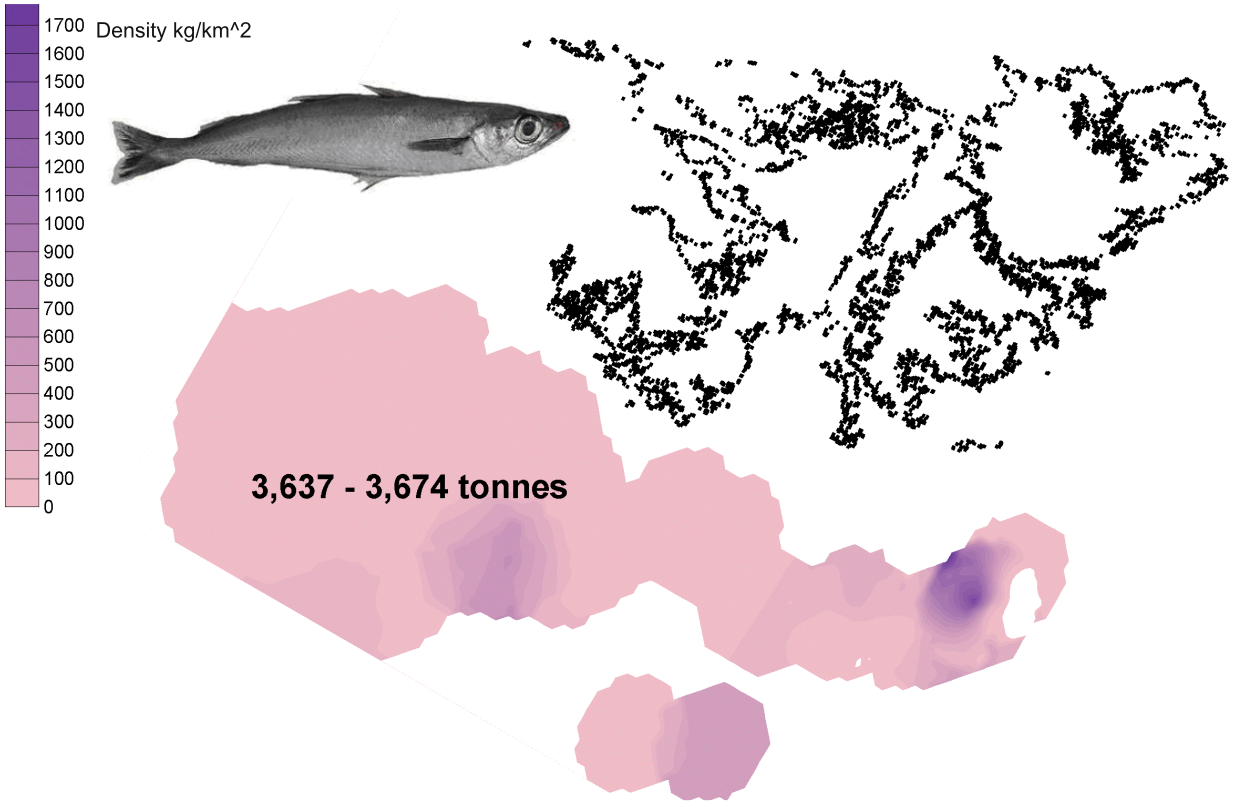

Figure 21: The distribution of density of *Micromesistius australis* calculated during ZDLT1-10-2009

A total of 898 fish of 8-65 cm L_T were sampled. Most of population was represented by juvenile fish of 19-23 cm L_T (presumably 1 y.o). The second important size group was of 26-29 cm L_T (2 y.o.). The remaining size distribution of blue whiting was polymodal (Figure 22).

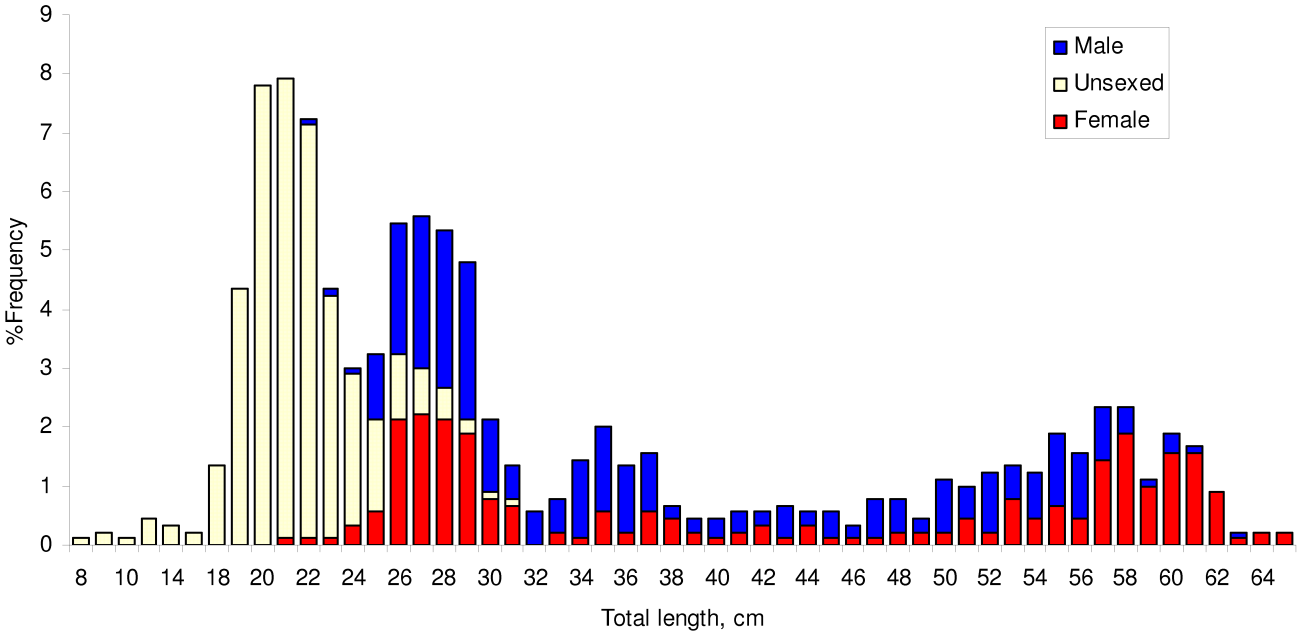

Figure 22: Length frequency distribution *Micromesistius australis* sampled during ZDLT1-10-2009

Males slightly predominated in catches (53.7%). Adult fish had just finished spawning and most of males still had sperm in their testes and were assigned to either stages IV or VII (Figure 23).

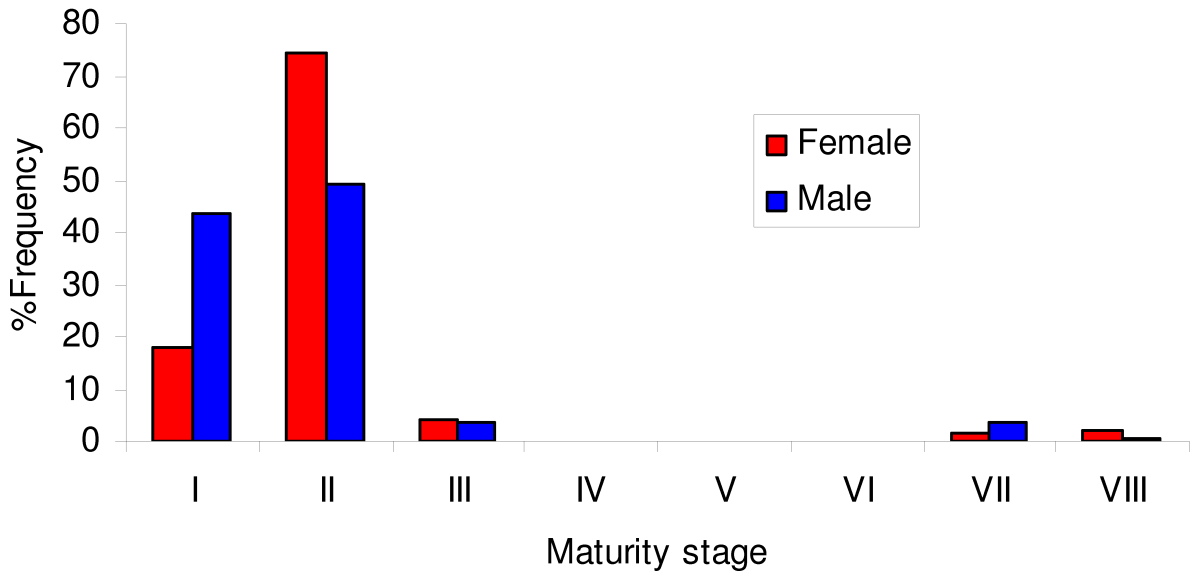

Figure 23: Maturity distribution for *Micromesistius australis* sampled on ZDLT1-10-2009

Table 8 illustrates the fishable biomass calculated during the cruise.

Table 8: Biomass Estimates of *Micromesistius australis* calculated from the survey ZDLT1-10-2009

Volume Method	Biomass Estimate (mt)
Trapezoidal Rule:	3640.09
Simpson's Rule:	3674.41
Simpson's 3/8 Rule:	3637.60

8.0 Rock cod – *Patagonotothen ramsayi*

Rock cod was caught in 54 of the 58 trawl stations and represented 17.9% of the total catch and thus the second most abundant species after red cod. CPUEs ranged from 0.9 to 2,844.9 kg/hr (mean = 208.3 kg). Figure 24 illustrates the distribution of rock cod density caught on the cruise. The maximum fishable biomass was found south of the Falkland Islands.

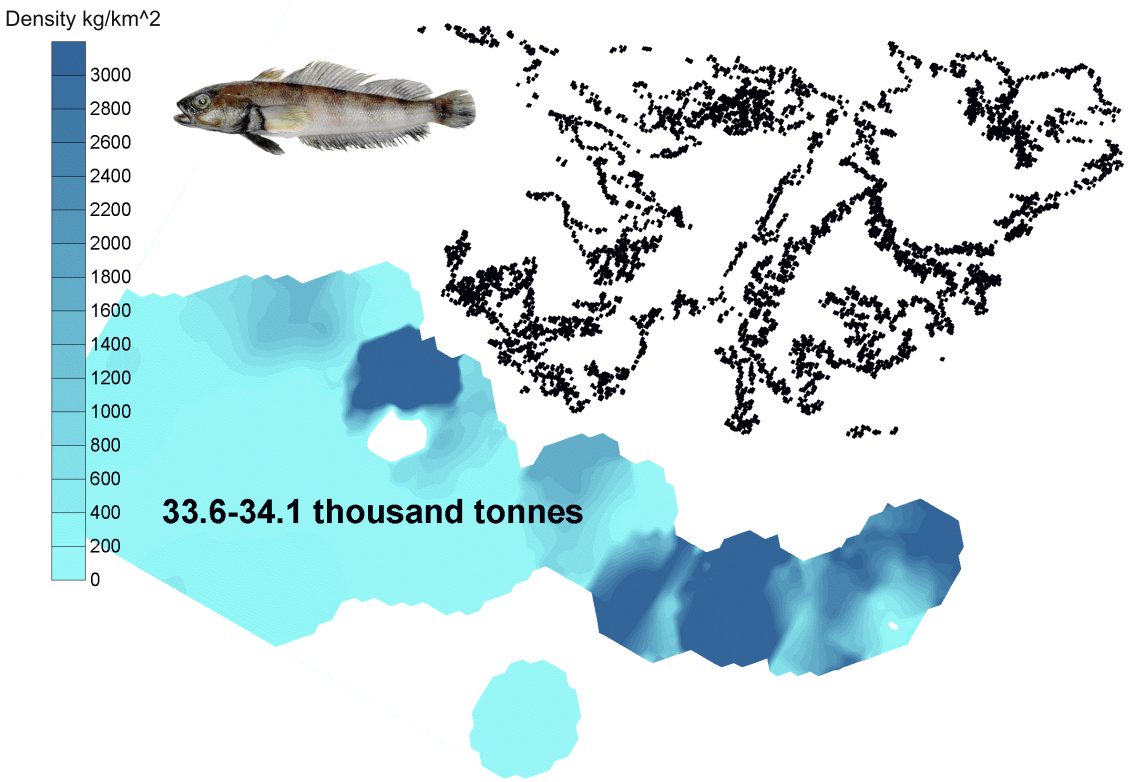

Figure 24: The distribution of density of *Patagonotothen ramsayi* calculated during ZDLT1-10-2009

A total of 2,364 individuals of rock cod were sampled. They ranged in length from 8 to 40 cm (mean 24.7 cm) and showed two indistinct modes at about 14-18 cm and 26-30 cm (Figure 25). Sex ratio was about equal, females represented 50.7% of the population.

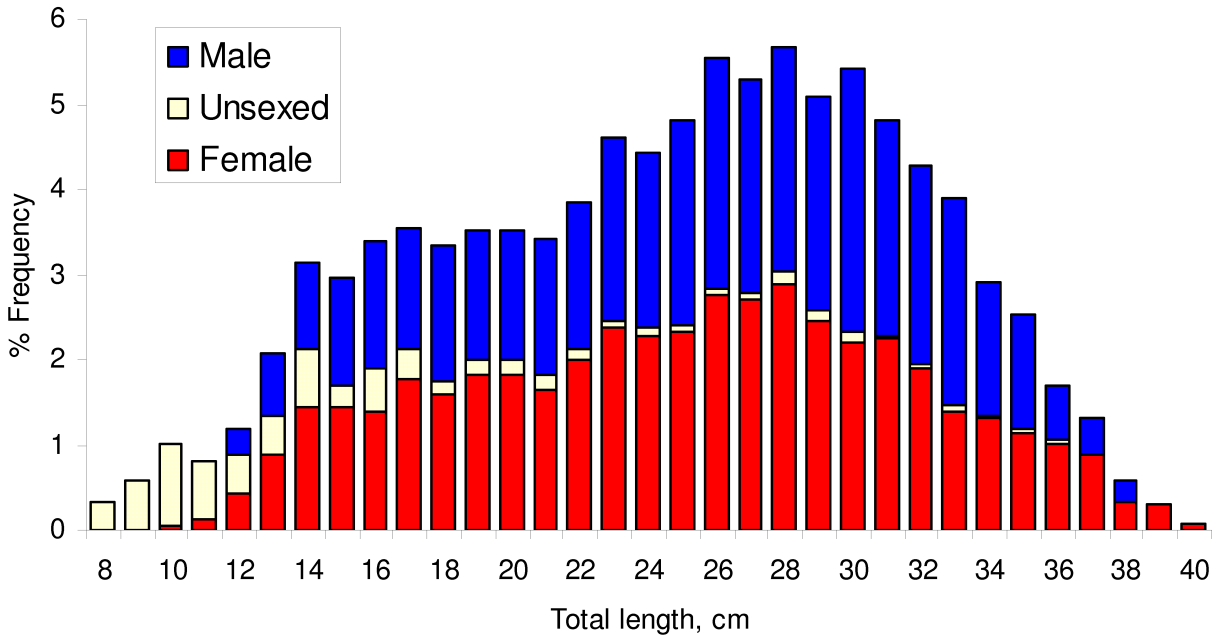

Figure 25: Length frequency distribution *Patagonotothen ramsayi* sampled during ZDLT1-10-2009

Fish were resting and recovering after their winter spawning, most adults were at stages VIII and II (Figure 26). However, a small number fish were found still spawning (one running female and three males) or just spent (4.4% of population).

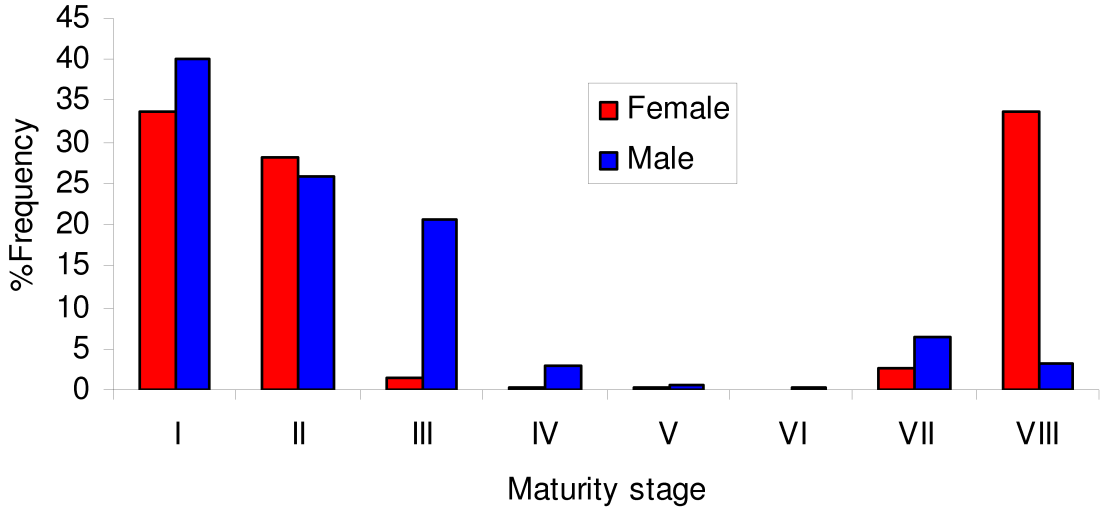

Figure 26: Maturity distribution for *Patagonothen ramsayi* sampled on ZDLT1-10-2009

Table 9 illustrates the fishable biomass calculated during the cruise.

Table 9: Biomass Estimates of *Patagonotothen ramsayi* calculated from the survey ZDLT1-10-2009

Volume Method	Biomass Estimate (mt)
Trapezoidal Rule:	33858.82
Simpson's Rule:	34059.69
Simpson's 3/8 Rule:	33627.65