Cruise Report ZDLT1-02-2010

Rock cod Biomass Survey

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Directorate of Natural Resources
Fisheries Department
Stanley
Falkland Islands

Falkland Islands Fisheries
Research Cruise Report ZDLT1-02-2010

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Contents

1.0 Introduction

A research cruise was undertaken by 6 FIFD personnel on board the RV Castelo between 30th of January and the 22nd of February. The main aim of the cruise was to estimate the biomass of rock cod present on their feeding grounds in the western, northern and north western parts of the FICZ. The other objectives included a thorough oceanographic survey in order to help explain the distribution of biomass of rock cod and the other commercial species encountered.

1.1 Cruise Objectives

- To examine the distribution, biology and biomass of rock cod (*Patagonotothen ramsayi*) on their feeding grounds.
- To examine the distribution, biology and biomass of other commercial species in the survey area.
- To carry out a thorough oceanographic survey of the area studied.

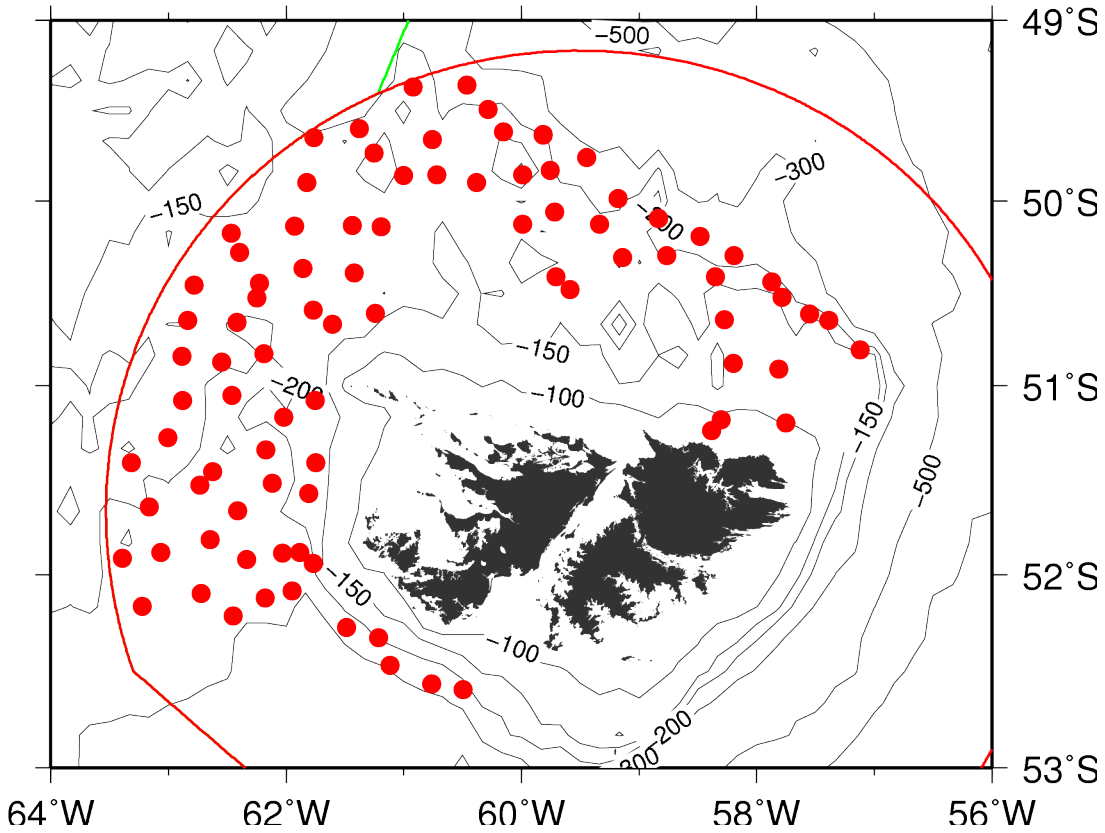
1.2 Cruise Plan and Key Dates

The vessel departed Port William at 1810 on the 30th January and navigated over night towards XUAG for the first trawl and CTD. The first CTD was deployed at 0700 but there were problems with the oceanographic winch caused by the rollers seizing. Other issues with the CTD communication cable caused further delays in the oceanographic survey. These were remedied by having the PV Protegat deliver their cable on the 2nd February. For the rest of the period the RV Castelo conducted 4 – 5 bottom trawls per day. Only one day of bad weather interrupted the programme resulting in only one trawl being conducted that day. The trawl was damaged on three occasions and had to be repaired each time. These trawls were not used in the biomass estimation. The third trawl of the day on the 19th February (501) was badly damaged when it came fast on the bottom at 1410 after about 10 minutes after shooting. The vessel remained stationary as the net was hauled. After approximately 10 minutes of hauling the net, it became clear that something was very wrong. Half the net was onboard but the lengthening piece and codend were left in the water, being dragged by one of the net's strengthen ropes. After some careful manoeuvring the crew managed to get it onboard. It was thought that the port door hit a reef. Dragging the doors up then ripped the net from the baiting, belly and the selvedge down to the lengthening piece. The panels on the baiting, belly and selvedge were replaced with material on board meaning we were able to continue fishing the following day.

The rest of the cruise continued without incident and we retuned to Stanley on the 22nd February.

Figure 1 illustrates the positions of the trawl and oceanographic stations respectively.

a



b

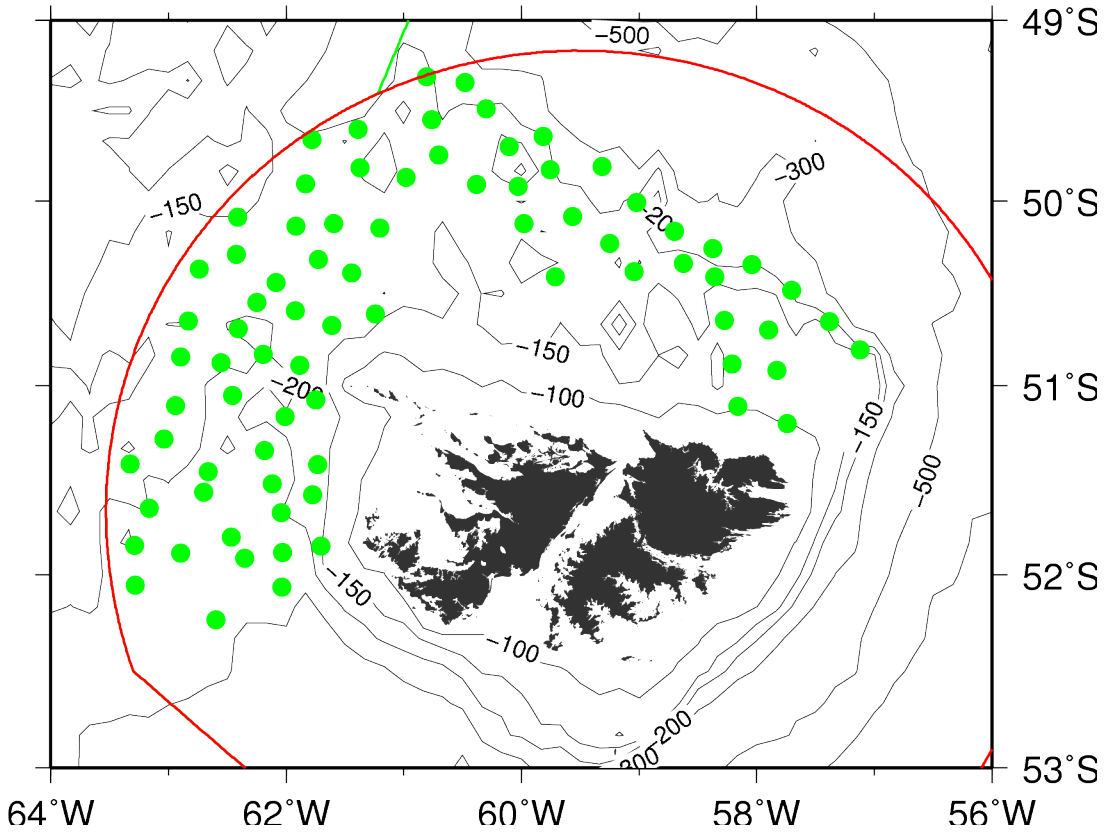


Figure 1: Maps illustrating the postions of trawl stations (a) and oceanographic stations (b).

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 Fisheries Department staff participated in the cruise:

Dr Paul Brickle	Chief Scientist
Dr Vladimir Laptikhovsky	Trawl/Oceanographic surveys
Dr Pia Schuchert	Trawl survey
Helen Ake	Trawl survey/data management
Andy Black	Trawl survey
Lars Jurgens	Trawl survey

1.5 Equipment used

1.5.1 Trawling

At all trawl stations, a standard bottom trawl equipped with Oval-Foil Doors was used. The cod end contained a 40-mm liner and the trawl was equipped with MarPort ITI sensors. The typical vertical opening was between 3.2 and 4.9 m.

1.5.2 Oceanography

The oceanographic equipment used on ZDLT1-02-2010 was the same as was used on previous surveys and included:

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

1.6 Trawl stations and biological sampling

During the ZDLT1-02-2010 cruise the station numbers ranged from 351 to 517 (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 WD) to the nearest cm below and the sex and stage of maturity were recorded for all specimens sampled. Individual weights were recorded with POLS and Meral balances.

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

Table 2: Trawl and oceanographic stations conducted on ZDLT1-02-2010

Station	Activity	Date	Time	Latitude		Longitude		Depth (m)	Duration (min)
351	B	31/01/2010	7.50	52	35.80	60	29.8	234	100
352	B	31/01/2010	11.00	52	34.10	60	45.8	285	100
353	B	31/01/2010	14.00	52	28.30	61	7	289	102
354	B	31/01/2010	16.20	52	19.60	61	12.8	199	105
355	B	01/02/2010	6.55	52	16.50	61	29.1	257	95
356	B	01/02/2010	9.45	52	5.00	61	57	292	95
357	C	01/02/2010	11.25	52	3.79	62	2.26	291	15
358	B	01/02/2010	12.15	52	7.26	62	10.66	252	95
359	B	01/02/2010	14.35	52	12.89	62	26.84	272	95
360	C	01/02/2010	16.20	52	14.17	62	35.82	270	10
361	B	01/02/2010	17.30	52	5.89	62	43.35	244	100
362	B	02/02/2010	6.50	52	9.78	63	13.24	230	100
363	C	02/02/2010	9.00	52	3.24	63	16.8	217	15
364	B	02/02/2010	10.15	51	54.75	63	23.55	202	90
365	C	02/02/2010	11.53	51	50.79	63	17.35	203	7
366	B	02/02/2010	12.50	51	53.01	63	3.8	212	90
367	C	02/02/2010	14.27	51	53.15	62	53.75	216	10
368	B	02/02/2010	15.30	51	48.83	62	38.67	222	90
369	C	02/02/2010	17.10	51	48.18	62	27.81	233	10
370	C	02/02/2010	18.35	51	54.78	62	20.97	257	10
371	B	03/02/2010	6.55	51	55.09	62	20.03	258	100
372	C	03/02/2010	9.15	51	52.91	62	1.76	240	10
373	B	03/02/2010	9.30	51	53.17	62	1.76	242	100
374	B	03/02/2010	12.20	51	56.48	61	46.25	185	95
375	C	03/02/2010	14.27	51	50.94	61	42.19	160	5
376	C	03/02/2010	16.44	51	34.78	61	46.57	156	6
377	B	03/02/2010	17.00	51	34.35	61	48.43	162	90
378	C	04/02/2010	6.31	51	31.35	62	6.87	230	10
379	B	04/02/2010	6.45	51	31.03	62	7.18	234	105
380	C	04/02/2010	9.53	51	40.34	62	2.52	234	10
381	B	04/02/2010	10.10	51	39.80	62	24.51	234	95
382	C	04/02/2010	12.46	51	33.93	62	41.99	202	8
383	B	04/02/2010	13.10	51	31.72	62	43.92	198	95
384	C	04/02/2010	16.02	51	39.07	63	9.7	191	8
385	B	04/02/2010	16.15	51	38.52	63	9.78	190	95
386	C	04/02/2010	19.00	51	24.92	63	19.5	165	6
387	B	05/02/2010	6.55	51	24.51	63	18.7	165	95
388	C	05/02/2010	9.18	51	16.92	63	2.16	170	6
389	B	05/02/2010	9.30	51	16.63	63	0.18	170	90
390	C	05/02/2010	12.27	51	27.46	62	39.52	193	7
391	B	05/02/2010	12.50	51	27.46	62	37.53	195	110
392	C	05/02/2010	15.49	51	20.66	62	10.85	216	8
393	B	05/02/2010	16.00	51	20.41	62	10.24	217	95
394	C	05/02/2010	18.51	51	25.19	61	43.75	157	5
395	B	06/02/2010	6.55	51	24.50	61	44.94	177	95
396	C	06/02/2010	10.00	51	4.48	61	44.87	177	6
397	B	06/02/2010	10.15	51	4.67	61	45.07	180	100
398	C	06/02/2010	13.03	51	9.83	62	0.61	199	7
399	B	06/02/2010	13.20	51	10.02	62	1.18	199	90
400	C	06/02/2010	16.20	51	2.96	62	27.42	185	7
401	B	06/02/2010	16.30	51	3.09	62	27.55	184	90

Station	Activity	Date	Time	Latitude		Longitude		Depth (m)	Duration (min)
402	C	06/02/2010	19.20	51	6.38	62	56.39	166	6
403	B	07/02/2010	6.50	51	4.60	62	52.63	167	100
404	C	07/02/2010	9.54	50	50.67	62	53.62	155	6
405	B	07/02/2010	10.05	50	50.39	62	52.94	156	95
406	C	07/02/2010	12.23	50	52.49	62	33.06	173	6
407	B	07/02/2010	12.30	50	52.22	62	32.83	173	95
408	C	07/02/2010	14.59	50	49.80	62	11.63	185	6
409	B	07/02/2010	15.10	50	49.63	62	11.38	185	95
410	C	08/02/2010	6.33	50	53.31	61	53.06	170	6
411	B	08/02/2010	6.45	51	52.93	61	53.1	169	95
412	C	08/02/2010	9.37	50	40.54	61	36.58	167	6
413	B	08/02/2010	9.45	50	40.08	61	36.25	167	95
414	C	08/02/2010	12.20	50	36.69	61	14.49	150	300
415	B	08/02/2010	12.30	50	36.58	61	14.53	150	90
416	B	08/02/2010	16.40	50	35.43	61	46.04	180	90
417	C	08/02/2010	18.22	50	35.67	61	55.14	185	7
418	C	08/02/2010	19.52	50	33.01	62	14.81	127	5
419	B	09/02/2010	7.10	50	31.56	62	14.83	154	95
420	C	09/02/2010	9.36	50	41.48	62	24.25	171	7
421	B	09/02/2010	9.50	50	39.50	62	25.1	167	95
422	C	09/02/2010	12.44	50	38.95	62	49.88	150	5
423	B	09/02/2010	12.55	50	38.72	62	50.07	151	95
424	B	09/02/2010	15.20	50	27.30	62	47	146	90
425	C	09/02/2010	16.58	50	22.14	62	44.17	146	6
426	B	10/02/2010	17.20	50	16.78	62	23.79	145	95
427	C	10/02/2010	20.51	50	17.30	62	25.22	150	5
428	B	11/02/2010	5.30	50	26.64	62	13.69	159	90
429	C	11/02/2010	7.09	50	26.48	62	4.98	161	6
430	B	11/02/2010	8.10	50	21.85	61	51.46	160	95
431	C	11/02/2010	9.52	50	19.05	61	43.46	161	5
432	C	11/02/2010	11.10	50	23.30	61	26.4	163	6
433	B	11/02/2010	11.25	50	23.34	61	25.29	162	95
434	C	11/02/2010	14.45	50	8.82	61	12.07	157	5
435	B	11/02/2010	14.35	50	8.33	61	11.35	158	90
436	B	11/02/2010	18.15	50	7.94	61	26.28	157	90
437	C	11/02/2010	19.58	50	7.33	61	35.78	156	5
438	C	12/02/2010	5.19	50	8.11	61	54.88	157	6
439	B	12/02/2010	5.30	50	8.16	61	55.64	156	90
440	B	12/02/2010	8.35	50	10.53	62	27.8	145	90
441	C	12/02/2010	10.14	50	5.17	62	24.78	146	5
442	C	12/02/2010	12.38	49	54.26	61	50.11	156	6
443	B	12/02/2010	12.45	49	53.77	61	49.38	157	100
444	C	12/02/2010	15.28	49	39.58	61	46.7	156	5
445	B	12/02/2010	15.35	49	38.98	61	45.78	156	90
446	C	12/02/2010	18.04	49	36.20	61	23.19	158	7
447	B	12/02/2010	18.15	49	35.98	61	22.76	158	90
448	B	13/02/2010	6.45	49	43.99	61	15.14	161	100
449	C	13/02/2010	8.29	49	48.96	61	22.23	158	6
450	B	13/02/2010	9.35	49	51.56	61	0.12	165	90
451	C	13/02/2010	11.16	49	52.19	60	58.86	164	6
452	B	13/02/2010	12.25	49	51.26	60	43.04	164	90

Station	Activity	Date	Time	Latitude		Longitude		Depth (m)	Duration (min)
453	C	13/02/2010	14.04	49	44.82	60	42.18	165	7
454	B	13/02/2010	14.45	49	39.67	60	45.39	167	90
455	C	13/02/2010	16.26	49	33.01	60	45.61	171	6
456	B	14/02/2010	6.50	49	22.18	60	55.23	168	85
457	C	14/02/2010	8.29	49	18.87	60	48.46	174	6
458	C	14/02/2010	10.04	49	20.74	60	28.76	197	8
459	B	14/02/2010	10.15	49	21.52	60	27.76	196	95
460	C	14/02/2010	12.35	49	29.51	60	17.99	185	7
461	B	14/02/2010	12.50	49	29.76	60	16.89	186	90
462	B	14/02/2010	15.15	49	37.09	60	9.26	170	90
463	C	14/02/2010	16.54	49	42.03	60	6.34	171	7
464	C	14/02/2010	18.24	49	38.50	59	48.89	196	7
465	B	15/02/2010	6.50	49	38.15	59	48.88	197	95
466	B	15/02/2010	9.35	49	38.03	59	49.02	198	95
467	C	15/02/2010	12.07	49	49.56	59	45.15	169	7
468	B	15/02/2010	12.20	49	49.81	59	45.24	169	90
469	B	15/02/2010	15.00	49	51.20	59	59.3	165	90
470	C	15/02/2010	16.38	49	55.18	60	1.77	165	6
471	C	15/02/2010	18.19	49	54.50	60	22.77	164	6
472	B	16/02/2010	5.55	49	53.75	60	22.89	163	90
473	C	16/02/2010	10.08	50	7.33	59	58.74	162	6
474	B	16/02/2010	10.20	50	7.57	59	59.19	162	95
475	B	16/02/2010	13.25	50	3.55	59	42.97	160	90
476	C	16/02/2010	15.03	50	5.07	59	33.86	158	6
477	C	16/02/2010	17.21	50	24.67	59	42.57	150	6
478	B	16/02/2010	17.30	50	24.74	59	42.38	150	50
479	B	16/02/2010	19.15	50	28.89	59	35.16	148	100
480	B	17/02/2010	5.50	49	45.64	59	26.83	231	95
481	C	17/02/2010	7.31	49	48.58	59	18.72	238	9
482	B	17/02/2010	8.45	49	59.09	59	10.64	165	95
483	C	17/02/2010	10.34	50	0.28	59	1.22	164	7
484	B	17/02/2010	11.55	50	7.53	59	20.1	155	100
485	C	17/02/2010	13.41	50	13.71	59	15.01	150	6
486	B	17/02/2010	14.25	50	18.33	59	8.51	149	90
487	C	17/02/2010	16.01	50	22.91	59	2.62	148	6
488	B	17/02/2010	17.15	50	17.77	58	46	145	90
489	C	17/02/2010	18.53	50	20.26	58	37.39	142	5
490	B	18/02/2010	6.45	50	5.69	58	50.25	152	100
491	C	18/02/2010	8.32	50	9.82	58	41.88	150	5
492	B	18/02/2010	9.30	50	11.57	58	28.98	158	90
493	C	18/02/2010	11.08	50	15.37	58	22.36	141	6
494	B	18/02/2010	12.00	50	17.68	58	11.68	140	95
495	C	18/02/2010	13.45	50	20.66	58	2.43	149	5
496	C	18/02/2010	15.19	50	24.62	58	21.23	141	5
497	B	18/02/2010	15.30	50	24.55	58	21.01	141	90
498	B	19/02/2010	6.55	50	26.28	57	52.22	160	100
499	C	19/02/2010	8.45	50	29.08	57	42.36	180	8
500	B	19/02/2010	9.15	50	31.33	57	47.25	140	90
501	B	19/02/2010	13.45	50	36.70	57	32.91	137	100
502	C	20/02/2010	7.01	50	54.98	57	49.78	131	5
503	C	20/02/2010	8.35	50	52.84	58	12.47	134	5

Station	Activity	Date	Time	Latitude		Longitude		Depth (m)	Duration (min)
504	B	20/02/2010	8.50	50	52.67	58	11.93	135	85
505	C	20/02/2010	12.01	50	38.75	58	16.36	138	5
506	B	20/02/2010	12.10	50	38.58	58	16.33	136	85
507	B	20/02/2010	15.20	50	54.51	57	48.85	130	90
508	C	20/02/2010	17.52	50	42.00	57	53.91	138	6
509	C	20/02/2010	19.58	50	39.17	57	23	136	5
510	B	20/02/2010	20.05	50	38.80	57	23.15	136	90
511	C	21/02/2010	6.57	50	48.42	57	7.28	132	5
512	B	21/02/2010	7.05	50	48.33	57	7.11	132	90
513	C	21/02/2010	12.06	51	11.94	57	44.54	103	4
514	B	21/02/2010	12.15	51	11.80	57	45.22	103	85
515	C	21/02/2010	14.51	51	6.48	58	9.6	84	3
516	B	21/02/2010	15.45	51	10.90	58	18.27	88	80
517	B	21/02/2010	18.05	51	14.21	58	23.1	65	80

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 *Patagonotothen ramsayi* and *Loligo gahi*. 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 catchability coefficient of 1.0 was assigned to all of the species assessed due to the lack of data on the catchablilty of the trawl.

Positions were assigned to the mean position between the trawl start and end positions and a calculated density value was 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.

As the first season *Loligo gahi* pre-recruit occurred simultaneously and contiguously the aim was to merge the two data sets in order to arrive at a fuller biomass estimate of rock cod in the fishery. The biomass estimate for the combined surveys will be reported in a separate rock rod stock assessment document.

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 for the polarisation of the oxygen sensor. It was then retrieved to 1 m depth and deployed again either to depth of about 640 m or to the bottom whichever was shallower. The speed of deployment was c. 1m/s and was monitored by the use of a wire counter. 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 gridding method included in the Ocean Data View package v. 3.4.3-2009 (Schlitzer 2009).

Oceanographic data were collected at 78 oceanographic stations. These stations were conducted either before or after each trawl (Figure 2).

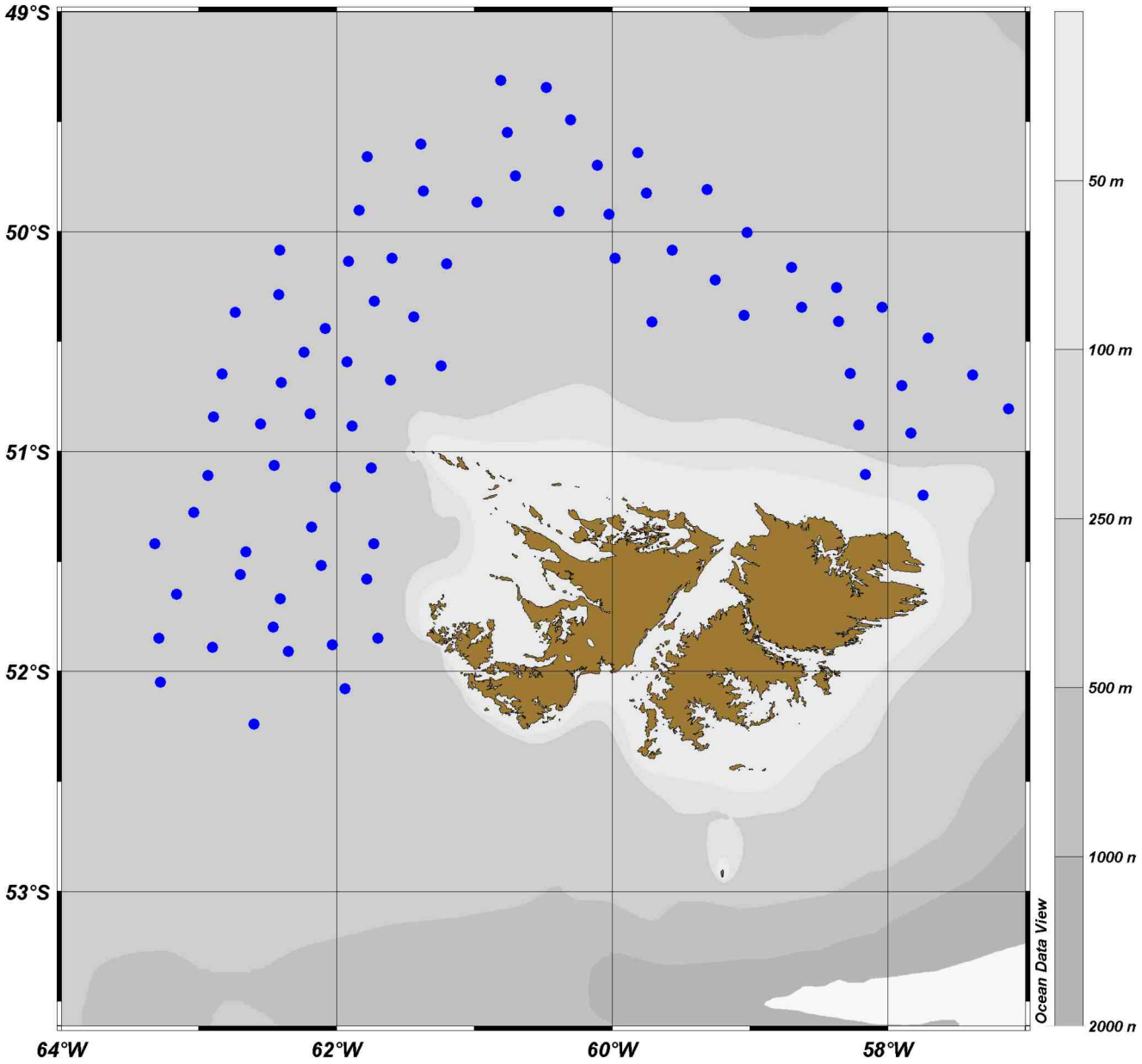


Figure 2: Oceanographic stations conducted on ZDLT1-02-2010

2.2 Results

The survey aimed to assess the oceanographic situation over the northern and western parts of the Falkland shelf and to reveal environmental factors influencing distribution and biology of the Falkland rock cod, *Patagonotothen ramsayi*. Surface temperatures ranged from 7.30ºC to 10.85 ºC, surface salinity from 33.49 to 33.92 psu, and densities from 25.73 to 26.52 kg/m3. T-S curves are shown in Figure 3. The oceanographic situation was characterized by an unusually strong development of the western branch of the Falkland Current that is seen by the distribution of isohalines 33.90-33.95 (Figure 4). The same isohalines north of the islands denote a border of the main eastern branch of the Falkland Current.

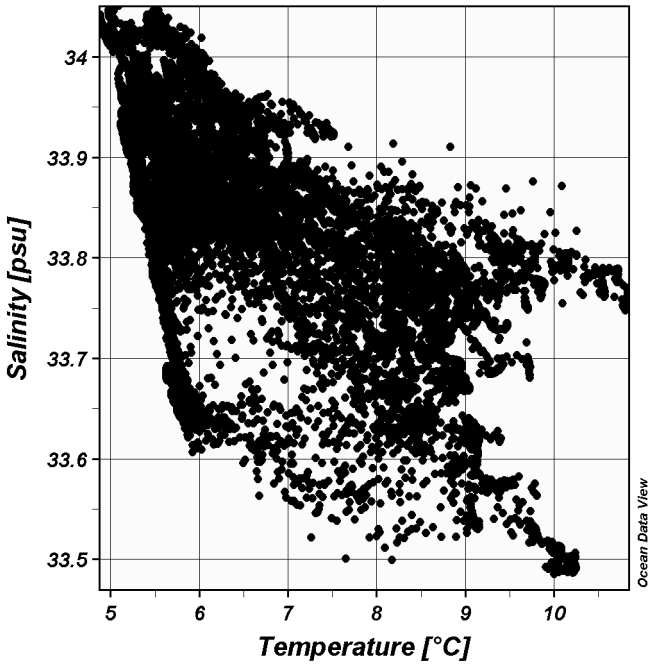


Figure 3: T-S curves encountered on the Falklands shelf on ZDLT1-02-2010

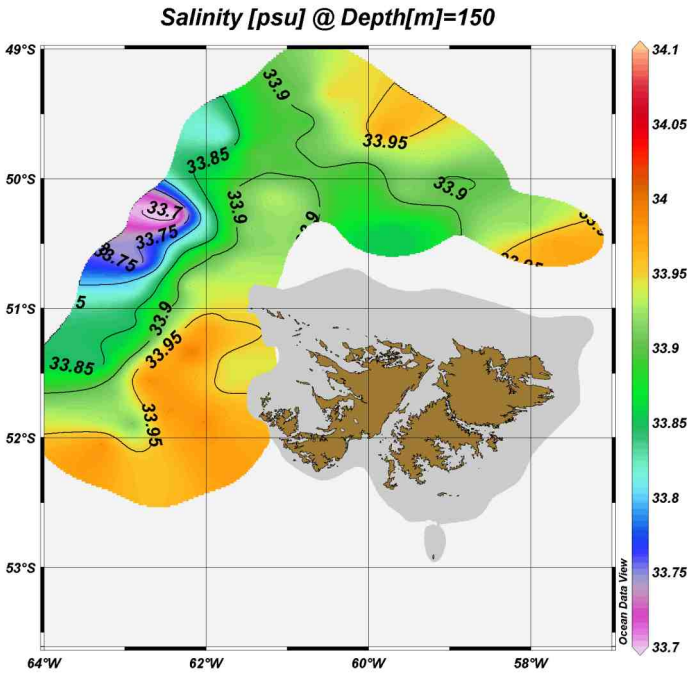


Figure 4: Distribution of salinity at a horizon of 150 m on ZDLT1-02-2010

There were two zones of maximum water productivity. The first was situated along the border between the western branch of the Falkland Current and waters of the Argentine drift (Figures 5 and 6). The second zone occurred north of the islands and was situated between a warm water eddy and a cold water inflow of the main branch of the Falkland Current (Figures 6 and 7).

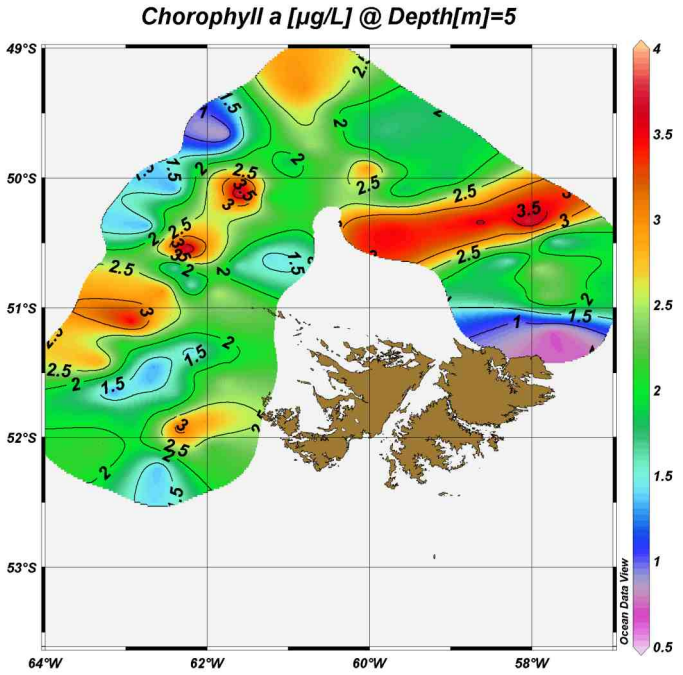


Figure 5: Distribution of chlorophyll a at the surface during ZDLT1-02-2010

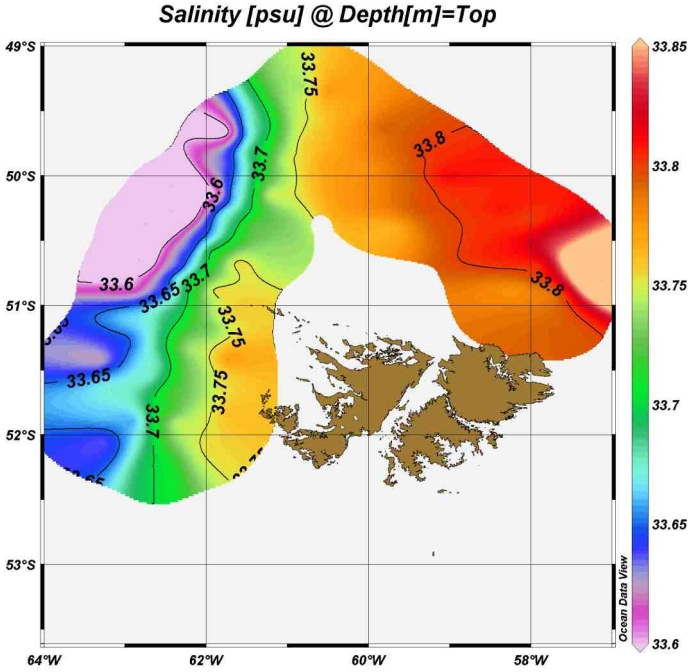


Figure 6: Distribution of salinity at the surface during ZDLT1-02-2010

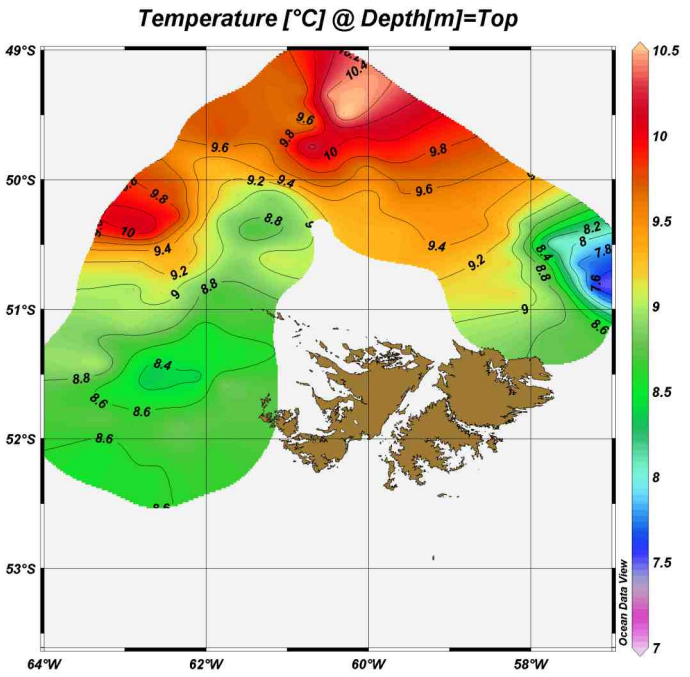


Figure 7: Surface temperature during ZDLT1-02-2010

The distribution of the bottom salinity and temperature is shown on Figures 8 and 9. An intensification of the Falkland Current provoked negative mean monthly temperature anomalies compared to the period 1971-2000, which are shown in Figure 10.

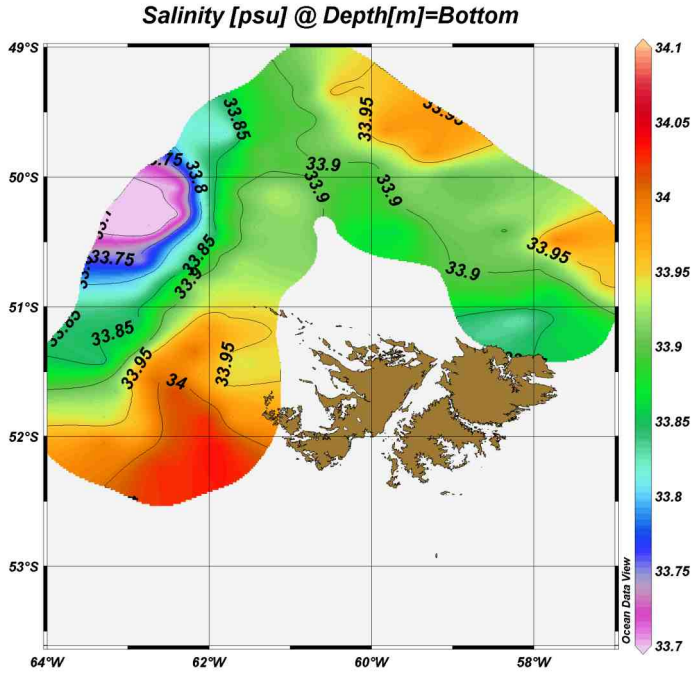


Figure 8: Distribution of salinity at near bottom layers during ZDLT1-02-2010

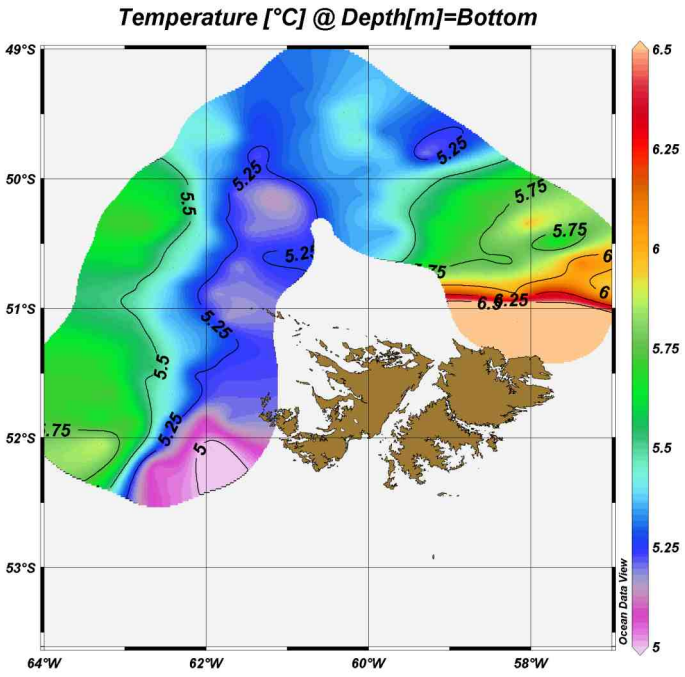


Figure 9: Distribution of temperature in near bottom layers during ZDLT1-02-2010

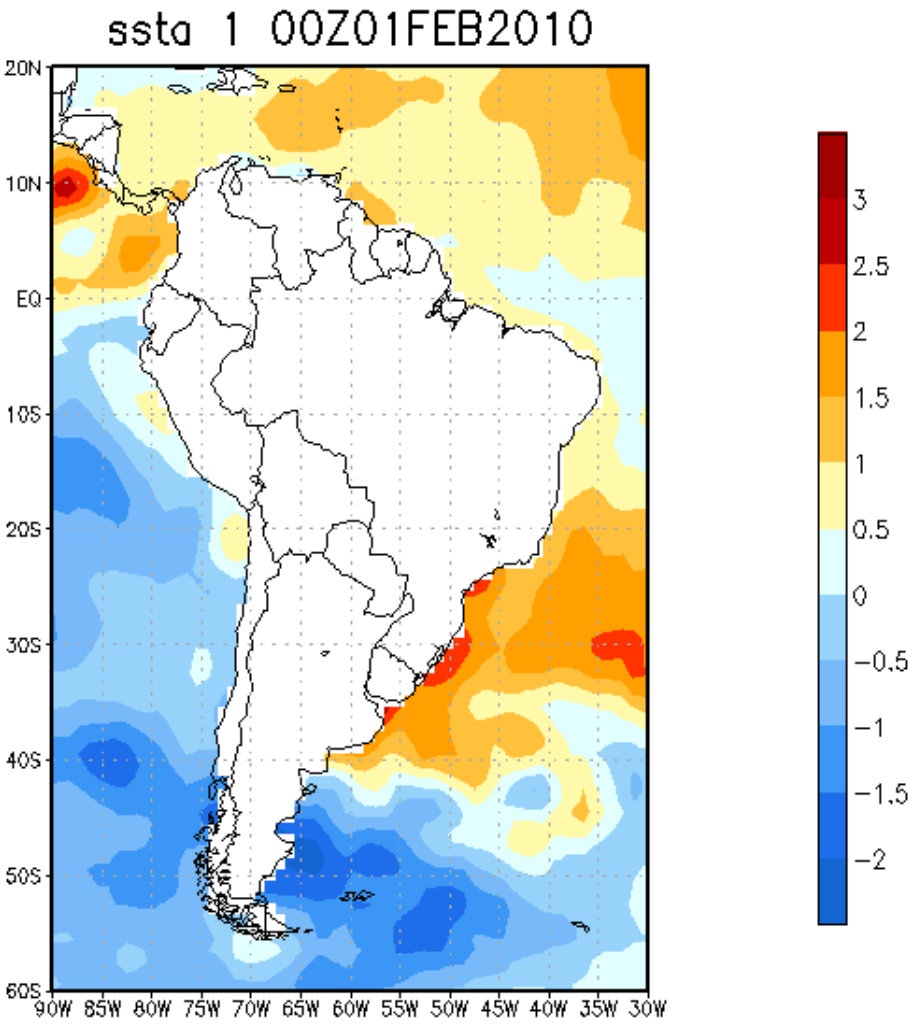


Figure 10: Sea surface temperature anomalies during February 2010

3.0 Biological Sampling

3.1 Catch and by-catch

Bottom trawling was conducted at 90 stations. However, three trawls (Stations 465, 478, and 501) were not used in the biomass estimates as they were damaged and were aborted early. The bottom time was c. 60 minutes with the exception of the aborted trawls.

During the cruise a total of 206,633 kg was caught comprising over 129 species (Table 3). In terms of catch weight, the most abundant species were rock cod (*Patagonotothen ramsayi*), hoki (*Macruronus magellanicus*), red cod (*Salilota australis*), grenadier (*Coelorhynchus fasciatus*) and southern blue whiting (*Micromesistius australis*). Together these amounted to 89% of the total cruise catch.

Table 3: Total catch of all trawl stations during research cruise ZDLT1-02-2010

Species code	Species name	Catch (kg)	Sample (kg)	Discard (kg)	Prportion (%)
PAR	*Patagonotothen ramsayi*	108222.838	1666.406	49488.088	52.374
WHI	*Macruronus magellanicus*	50171.833	5732.277	431.010	24.281
BAC	*Salilota australis*	13427.475	2252.824	291.047	6.498
GRF	*Coelorhynchus fasciatus*	8047.080	37.950	8047.080	3.894
BLU	*Micromesistius australis*	4223.674	596.439	1096.047	2.044
SAR	*Sprattus fuegensis*	3759.672	13.470	3579.672	1.819
LOL	*Loligo gahi*	3386.691	300.252	267.000	1.639
KIN	*Genypterus blacodes*	3064.020	2777.500	20.000	1.483
CGO	*Cottoperca gobio*	1915.388	0.000	1915.388	0.927
BUT	*Stromateus brasiliensis*	1324.110	0.000	1324.110	0.641
HAK	*Merluccius hubbsi*	1308.490	1256.020	0.000	0.633
TOO	*Dissostichus eleginoides*	1232.139	1232.039	44.510	0.596
RBR	*Bathyraja brachyurops*	1027.572	1027.572	11.194	0.497
ILL	*Illex argentinus*	873.843	390.591	29.392	0.423
PAT	*Merluccius australis*	821.568	821.560	0.000	0.398
MED	*Medusae sp.*	660.560	0.000	660.560	0.320
RED	*Sebastes oculatus*	643.432	57.504	110.472	0.311
RGR	*Bathyraja griseocauda*	557.410	541.360	0.484	0.270
ING	*Moroteuthis ingens*	404.366	2.520	404.363	0.196
PRX	*Paragorgia sp.*	229.700	0.120	229.580	0.111
RFL	*Dipturus chilensis*	178.247	178.239	0.000	0.086
DGH	*Schroederichthys bivius*	175.897	0.000	175.892	0.085
DGS	*Squalus acanthias*	98.240	25.190	98.240	0.048
RAL	*Bathyraja albomaculata*	94.055	93.299	3.243	0.046
PTE	*Patagonotothen tessellata*	91.686	0.000	91.686	0.044
SPN	Porifera	78.409	0.000	78.409	0.038
RBZ	*Bathyraja cousseauae*	70.680	70.680	0.660	0.034
PYM	*Physiculus marginatus*	68.147	3.860	64.287	0.033
RMC	*Bathyraja macloviana*	62.477	62.477	4.597	0.030
EEL	*Iluocoetes fimbriatus*	56.610	0.000	56.610	0.027
RSC	*Bathyraja scaphiops*	45.388	45.388	1.430	0.022
RDA	*Dipturus argentinensis*	32.560	32.560	0.000	0.016
RPX	*Psammobatis spp.*	28.852	28.302	22.849	0.014
GOC	*Gorgonocephalas chilensis*	26.178	0.000	26.178	0.013
RMU	*Bathyraja multispinis*	23.997	23.997	0.000	0.012
GOR	*Gorgonacea*	22.226	3.307	18.689	0.011
COP	*Congiopodus peruvianus*	18.684	0.000	18.684	0.009
NEM	*Neophyrnichthys marmoratus*	17.460	0.000	16.460	0.008
GYN	*Gymnoscopelus nicholsi*	13.076	0.000	12.474	0.006
FUM	*Fusitriton m. magellanicus*	9.911	0.000	9.911	0.005
STA	*Sterechinus agassizi*	9.774	0.000	9.774	0.005
RDO	*Raja doellojuradoi*	7.566	7.566	5.542	0.004
BEE	*Benthoctopus eureka*	7.557	7.557	0.000	0.004
SHT	Mixed invertebrates	7.210	0.000	6.850	0.003
ASA	*Astrotoma agassizii*	6.197	0.000	6.197	0.003
SQT	Ascidiacea	5.762	0.000	5.762	0.003
RMG	*Bathyraja magellanica*	5.400	5.400	0.000	0.003
AUC	*Austrocidaris canaliculata*	3.988	0.000	3.988	0.002
OCM	*Enteroctopus megalocyathus*	3.920	3.920	0.000	0.002
ANT	Anthozoa	3.779	0.000	3.779	0.002
ANM	Anemone	3.683	0.000	3.683	0.002

Species code	Species name	Catch (kg)	Sample (kg)	Discard (kg)	Prportion (%)
COL	*Cosmasterias lurida*	3.579	3.271	3.444	0.002
PMC	*Protomictophum choriodon*	3.458	0.000	3.458	0.002
AST	Asteroidea	3.361	0.000	3.361	0.002
ALC	Alcyoniina	3.150	1.792	1.358	0.002
POA	*Porania antarctica*	2.669	0.000	2.669	0.001
BRY	Bryozoa	2.648	0.000	2.648	0.001
GRC	*Macrourus carinatus*	2.618	1.360	0.000	0.001
CHE	*Champsocephalus esox*	2.592	2.591	0.000	0.001
ZYP	*Zygochlamys patagonica*	2.373	0.000	2.373	0.001
CAM	*Cataetyx messieri*	2.270	0.000	2.270	0.001
ADA	*Adelomelon ancilla*	2.230	0.000	2.230	0.001
BEJ	*Benthoctopus sp.cf.januarii*	2.010	2.010	0.000	0.001
SEP	*Seriolella porosa*	2.004	0.000	0.580	0.001
MUG	*Munida gregaria*	1.930	0.709	1.221	0.001
FLX	*Flabellum spp.*	1.528	0.000	1.528	0.001
CEX	*Ceramaster sp.*	1.477	0.000	1.477	0.001
MUU	*Munida subrugosa*	1.442	0.000	1.442	0.001
TRP	*Tripilaster philippi*	1.313	0.000	1.313	0.001
CTA	*Ctenodiscus australis*	1.146	0.175	0.971	0.001
SRP	*Semirossia patagonica*	1.035	0.387	0.648	0.001
CAZ	*Calyptraster sp.*	1.012	0.000	1.012	<0.001
LIA	*Lithodes antarcticus*	0.663	0.000	0.663	<0.001
MYA	*Myxine australis*	0.620	0.000	0.620	<0.001
WRM	*Chaetopterus variopedeatus*	0.589	0.000	0.589	<0.001
COG	*Patagonotothen guntheri*	0.537	0.459	0.078	<0.001
ISO	Isopoda	0.409	0.000	0.409	<0.001
PES	*Peltarion spinosulum*	0.384	0.000	0.384	<0.001
UCH	Sea urchin	0.360	0.000	0.360	<0.001
MAV	*Magellania venosa*	0.351	0.000	0.351	<0.001
MUO	*Muraenolepis orangiensis*	0.297	0.297	0.000	<0.001
HYD	Hydrozoa	0.290	0.000	0.290	<0.001
SOR	*Solaster regularis*	0.285	0.000	0.285	<0.001
EUO	*Eurypodius longirostris*	0.259	0.000	0.259	<0.001
OPH	Ophiuroidea	0.234	0.000	0.234	<0.001
EUL	*Eurypodius latreillei*	0.220	0.000	0.220	<0.001
BRP	*Brachiopod spp.*	0.219	0.000	0.219	<0.001
SUN	*Labidaster radiosus*	0.208	0.000	0.208	<0.001
OPL	*Ophiuroglypha lymanii*	0.196	0.000	0.196	<0.001
GON	*Gonatus antarcticus*	0.191	0.000	0.191	<0.001
OPV	*Ophiacanta vivipara*	0.175	0.000	0.175	<0.001
OOX	*Odontaster sp.*	0.169	0.000	0.169	<0.001
PYX	Pycnogonida	0.119	0.049	0.070	<0.001
COT	*Cottunculus granulosus*	0.106	0.000	0.106	<0.001
BAO	*Bathybiaster loripes*	0.099	0.000	0.099	<0.001
BAL	*Bathydomus longisetosus*	0.095	0.000	0.095	<0.001
CAS	*Campylonotus semistriatus*	0.091	0.000	0.091	<0.001
HEX	*Henricia sp.*	0.090	0.000	0.090	<0.001
NUD	Nudibranchia	0.079	0.009	0.070	<0.001
TED	*Terebratella dorsata*	0.077	0.000	0.077	<0.001
WLK	Whelks	0.070	0.000	0.070	<0.001
LAP	*Lamillaria patagonica*	0.064	0.012	0.064	<0.001

Species code	Species name	Catch (kg)	Sample (kg)	Discard (kg)	Prportion (%)
POL	Polychaeta	0.063	0.000	0.063	<0.001
SYD	*Sympagurus dimorphus*	0.054	0.000	0.054	<0.001
XXX	Unidentified animal	0.046	0.000	0.046	<0.001
MAU	*Maurolicus muelleri*	0.040	0.000	0.040	<0.001
HOL	Holothuroidea	0.033	0.000	0.033	<0.001
THN	*Thysanopsetta naresi*	0.032	0.032	0.000	<0.001
AGO	*Agonopsis chilensis*	0.030	0.000	0.030	<0.001
ODM	*Odontocymbiola magellanica*	0.030	0.000	0.030	<0.001
LEA	*Lepas australis*	0.022	0.000	0.022	<0.001
AUL	*Austrolycus laticinctus*	0.020	0.000	0.020	<0.001
CRY	*Crossaster sp.*	0.018	0.000	0.018	<0.001
NUH	*Nuttallochiton hyadesi*	0.017	0.000	0.017	<0.001
OPI	*Ophioplocus incipiens*	0.013	0.000	0.013	<0.001
DOX	*Doris sp.*	0.012	0.000	0.012	<0.001
PAM	*Pagurus comptus*	0.012	0.000	0.012	<0.001
LIR	*Limopsis marionensis*	0.010	0.000	0.010	<0.001
NEH	*Neomena herwigi*	0.010	0.000	0.010	<0.001
STS	*Stereomastis suhmi*	0.010	0.000	0.010	<0.001
TRX	*Trophon sp.*	0.010	0.000	0.010	<0.001
ACS	*Acanthoserolis schythei*	0.009	0.001	0.008	<0.001
LAM	*Lampanyctus macdonaldi*	0.008	0.000	0.008	<0.001
ANX	*Anasterias sp.*	0.005	0.000	0.005	<0.001
OPS	*Ophiactis asperula*	0.004	0.000	0.004	<0.001
ICA	*Icichthys australis*	0.002	0.000	0.002	<0.001
PIR	Pirapulidae	0.002	0.000	0.002	<0.001
ASF	*Asterina finbriata*	0.001	0.000	0.001	<0.001
PSG	*Pseudoechinus magellanicus*	0.001	0.000	0.001	<0.001
	Total	**206633.382**	**19311.300**	**68737.087**	

4.0 Rock cod - *Patagonotothen ramsayi*

Rock cod was the most abundant species and represented 52.4% (108.2 t) of the total catch. Its catches ranged from 0.9 to 16.3 t, mean 1.2 t. A total of 10,093 fish were sampled (including length frequencies of discarded fish).

Shallow waters (<100 m depth) were outside of the scope of this survey. Three control hauls that were conducted in shallow waters demonstrated that this depth range was mostly inhabited by juvenile fish of 6-14 cm TL and rock cod abundance was very low (1-3 kg/haul). At shelf break (140 - 300 m) there was no obvious relation between fish size and depth, but a weak positive trend (Spearman r=0.29, P=0.0116 (Figure 11)). Large fish were concentrated in a relatively restricted area west of West Falkland (Figure 12 and 14), and it was exactly the area where the species is targeted by finfish fleet (Figure 13).

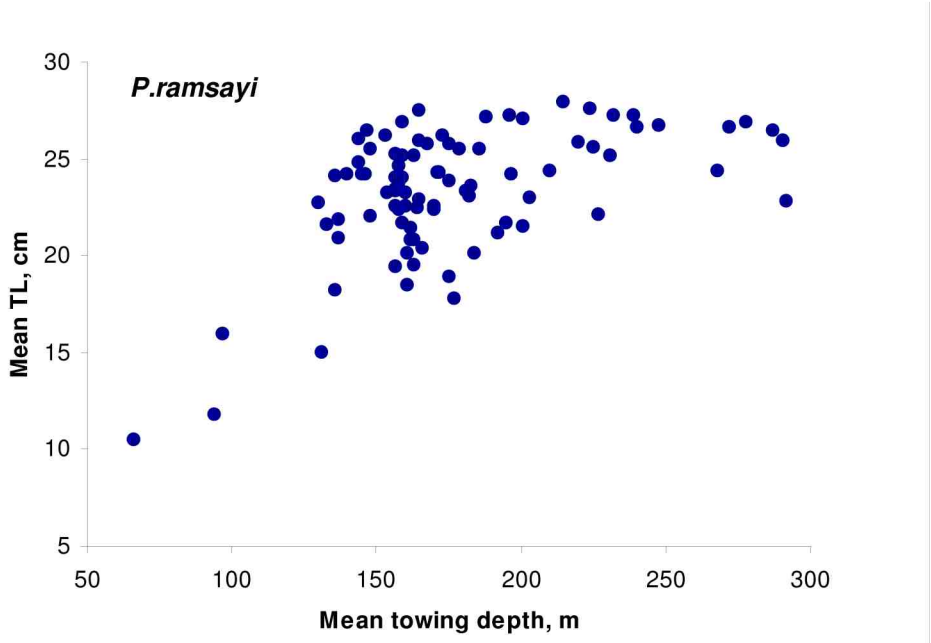


Figure 11: Correlation analysis between trawl depth and L_T for Patagonotothen ramsayi during ZDLT1-02-2010

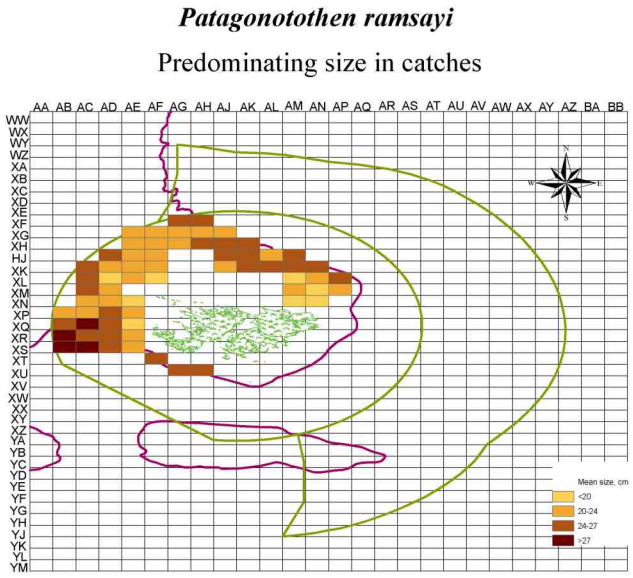


Figure 12: Mean size of Patagonotothen ramsayi (L_T) per grid square during ZDLT1-02-2010

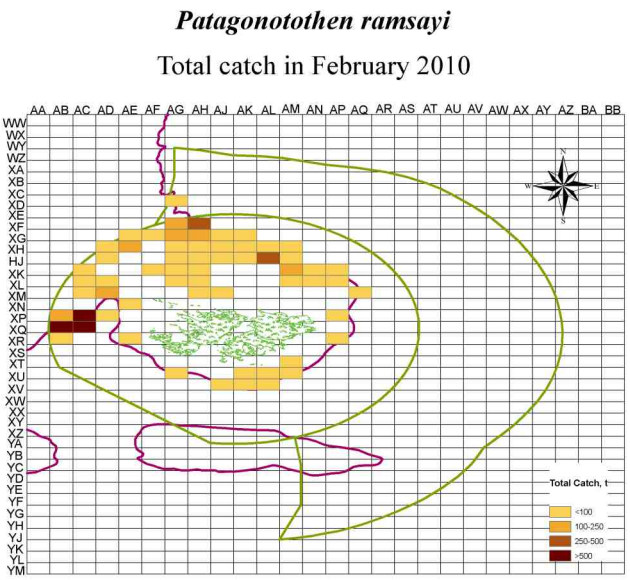


Figure 13: Total of Patagonotothen ramsayi (mt) per grid square during ZDLT1-02-2010

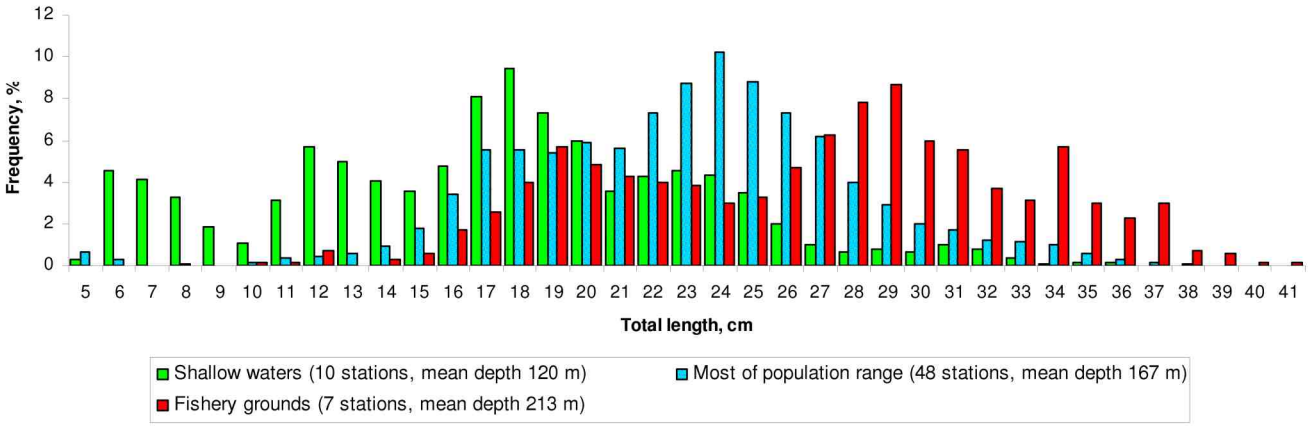


Figure 14: Length frequency distributions of Patagonotothen ramsayi at different depth distributions during ZDLT1-02-2010

Fish size in catches varied from 5 to 41 cm with most being between 16 and 28 cm L_T (Figure 15). Sex ratio was close to equality (Female: Male = 1.075: 1). The population was represented mostly by immature fish at Stage I and resting fish at Stage II (Figure 16). However, some spawning fish were encountered (four females and one male).

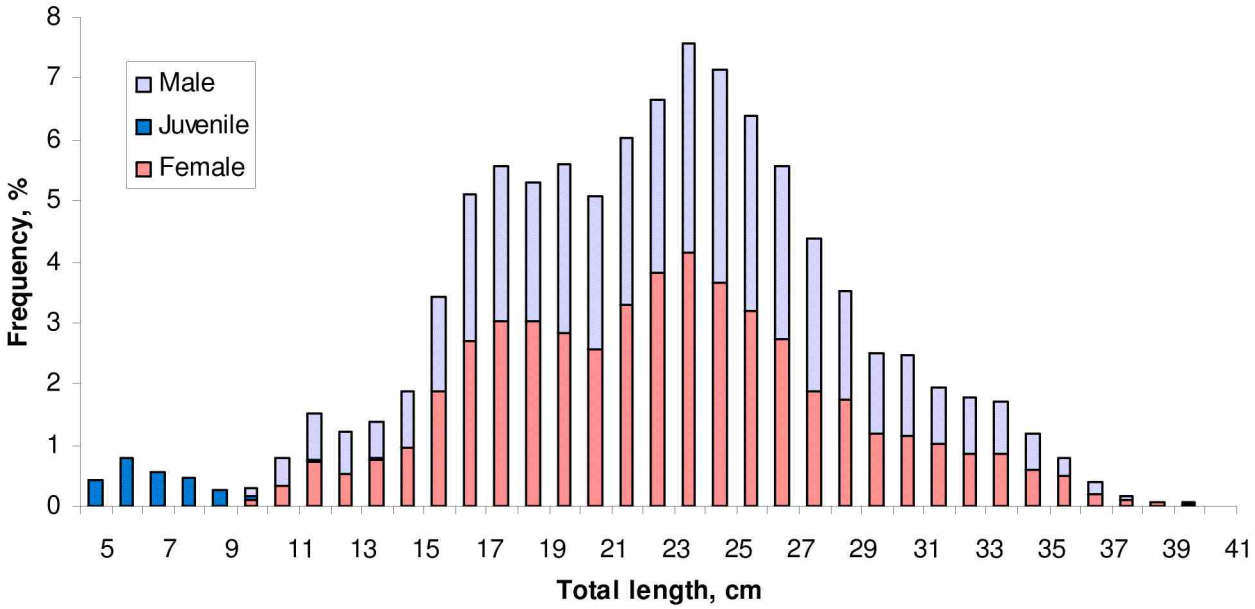


Figure 15: Combined length frequency distribution of Patagonotothen ramsayi during ZDLT1-02-2010

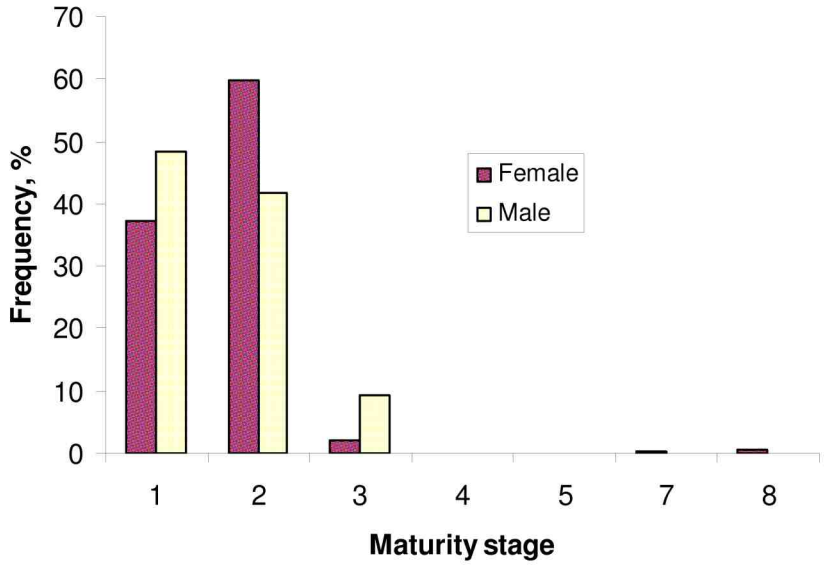


Figure 16: Maturity distribution of Patagonotothen ramsayi during ZDLT1-02-2010

The minimum stock biomass in the studied area was estimated at 410,091 t ± 116,606 t (294-526 thousand mt) (GS+ software with Kriging method applied, radius search of 23 km, no anisotropy, K=1). Surfer, with the same parameters applied, produced an estimation of 443,382-445,056 t (Fig. 17).

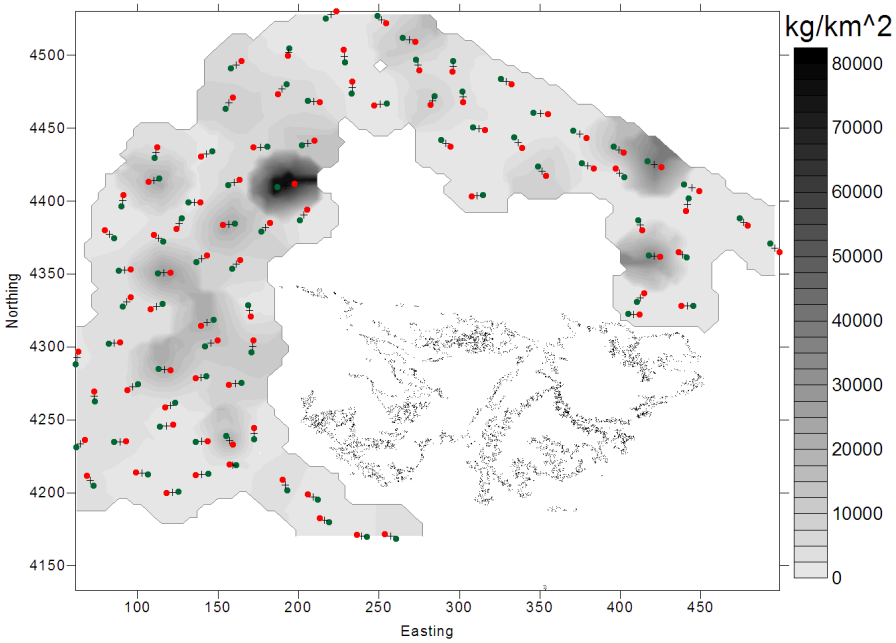


Figure 17: The distribution of density of Patagonotothen ramsayi during ZDLT1-02-2010

5.0 Patagonian long finned squid - *Loligo gahi*

The catch of *Loligo gahi* was 3.3 mt, which represented 1.6% of the total catch but it was the most sampled species on the cruise (a total of 13,547 individuals sampled).

Shallow waters (<100 m) were populated by relatively large squid. The smallest squid were found between 120 and 160 m, then squid size gradually increased with depth illustrating an ontogenetic foraging migration down the slope (Figure 18). Generally squid size varied between 4 and 19.5 cm, both males and females were mostly between 7-9.5 cm ML (Figure 19). Most of the squid population were immature, at stages I and II, although some maturing and mature animals were occasionally encountered (Figure 20). Mature females represented 0.18% of the total sample, mature males represented 0.23%.

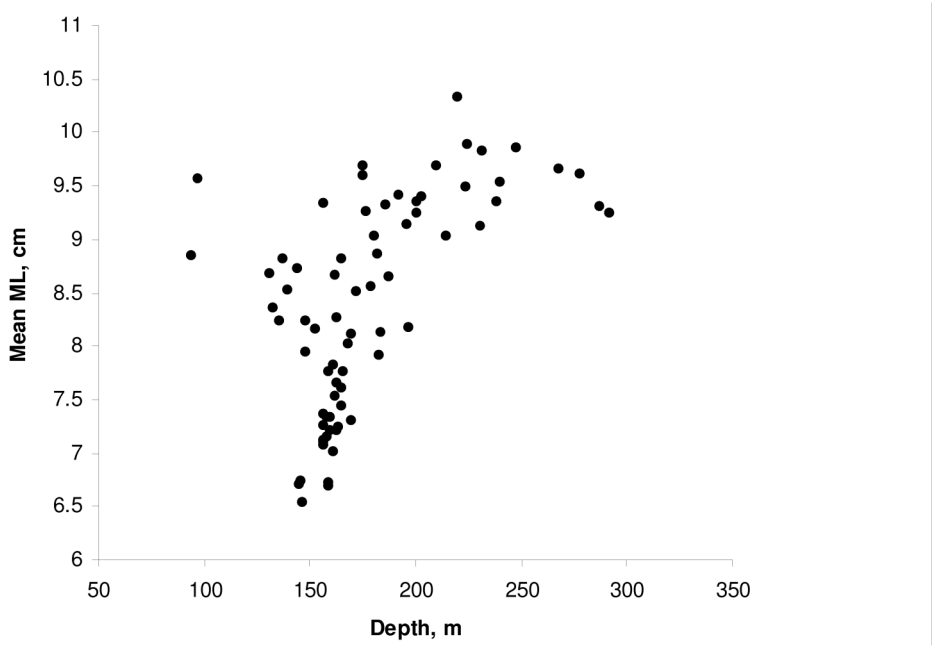


Figure 18: Correlation analysis between trawl depth and ML for Loligo gahi during ZDLT1-02-2010

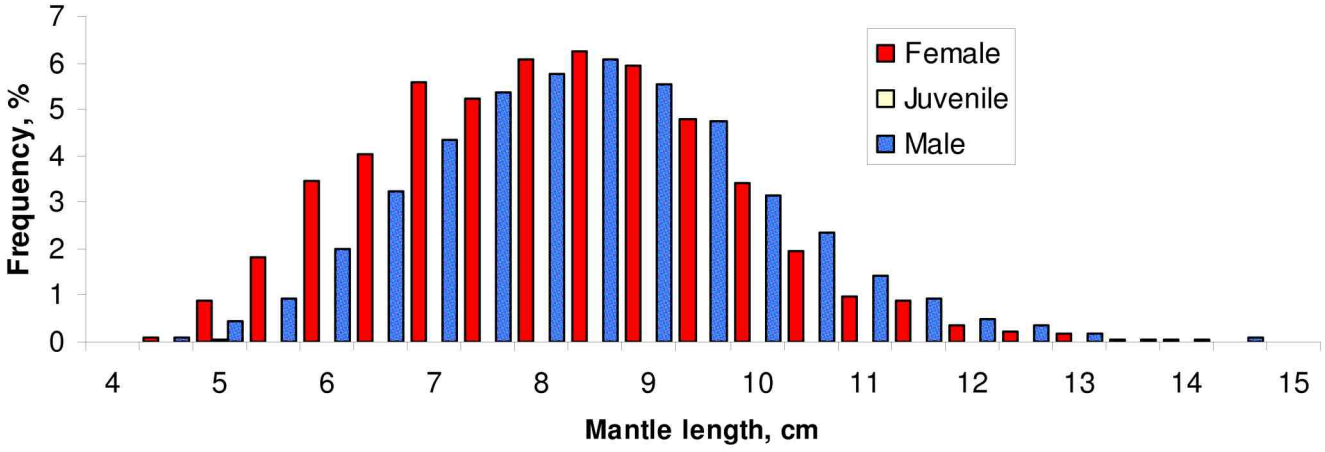


Figure 19: Combined length frequency distribution of Loligo gahi during ZDLT1-02-2010

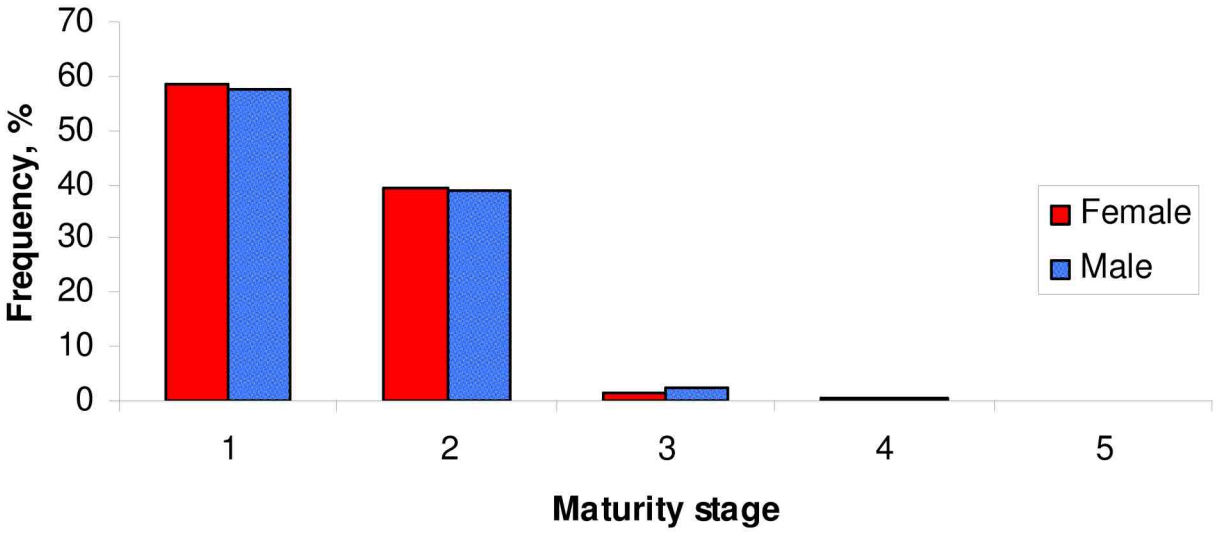


Figure 20: Maturity distribution of Loligo gahi during ZDLT1-02-2010

The minimum stock biomass in the area studied was estimated at 14,839 t ± 9,748 (5-23 thousand mt) (GS+ software with Kriging method applied, radius search of 23 km, no anisotropy, K=1). Surfer, with the same parameters, produced an estimation of 15,198-15,217 t (Figure 21).

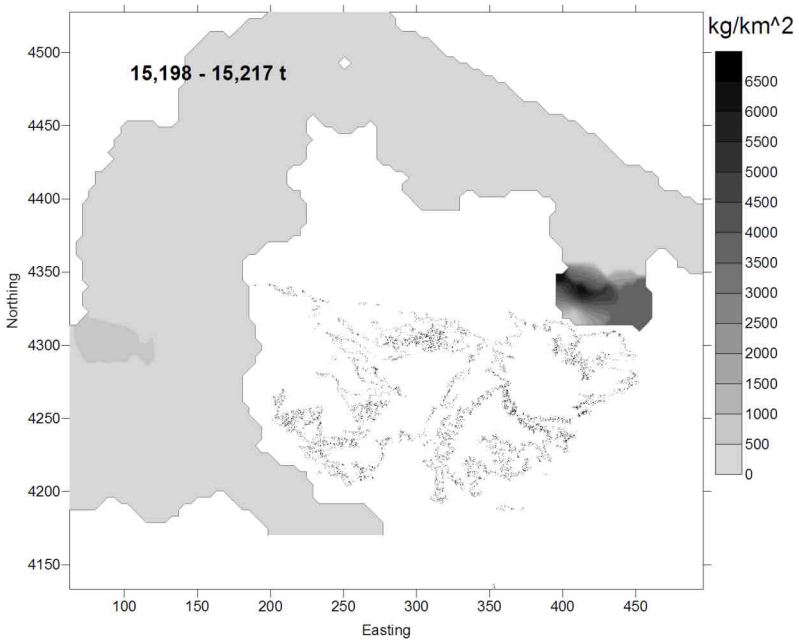


Figure 21: The distribution of density of Loligo gahi during ZDLT1-02-2010

6.0 Hoki – *Macruronus magellanicus*

Hoki was the 3rd most abundant species in terms of total weight (50,171 kg) and was caught in 85 of the 90 trawls conducted during the survey. CPUEs ranged from 0 to 10,358 kg/hr (mean = 582.02 ± 1545.04). Figure 22 illustrates the distribution of hoki density (kg/km2). The greatest densities were encountered in the north east of the survey area. The total fishable biomass of hoki calculated for the survey area was between 40,484 – 40,692 mt.

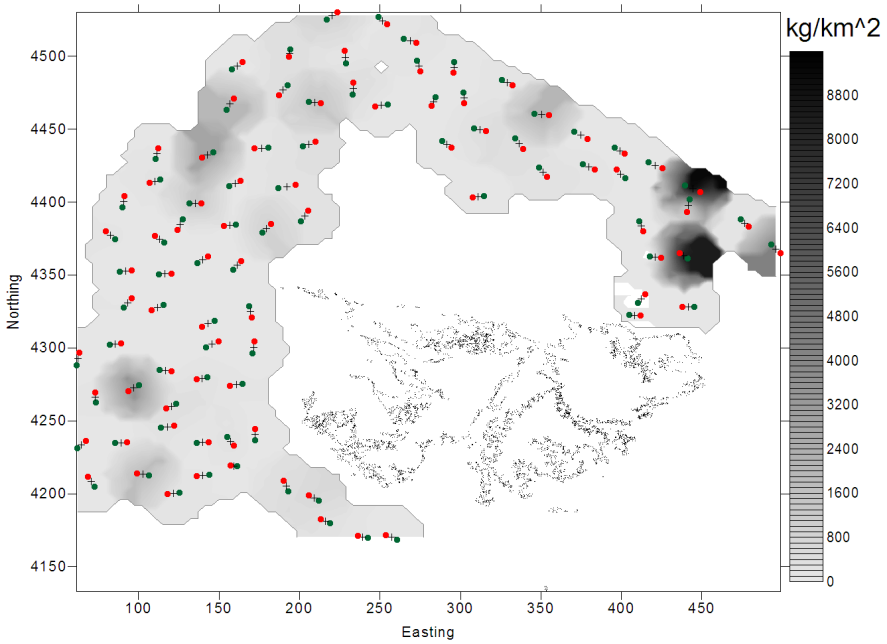


Figure 22: The distribution of density of Macrurounus magellanicus during ZDLT1-02-2010

A total of 5,906 individual hoki were sampled for length frequency analysis and otoliths for trace element analyses. Hoki ranged in length from 12 – 45 cm L_{PA} (mean = 4.78 ± 4.78) (Figure 23).

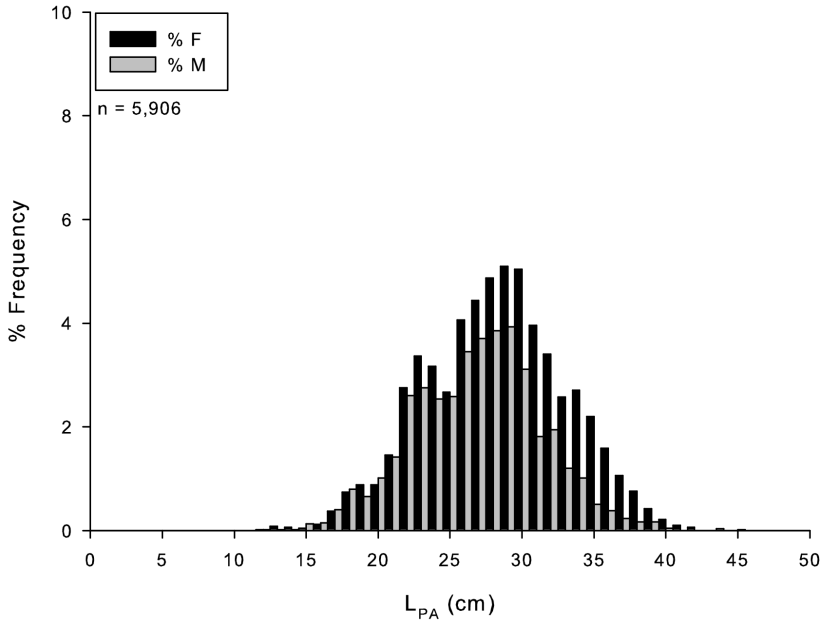


Figure 23: Length frequency distribution of Macrurounus magellanicus sampled during ZDLT1-02-2010

Maturity stages ranged from I through to VII with most individuals sampled in stages I, II and IV. A small number of individuals were found in the post spawning stages, VII and VIII (Figure 24).

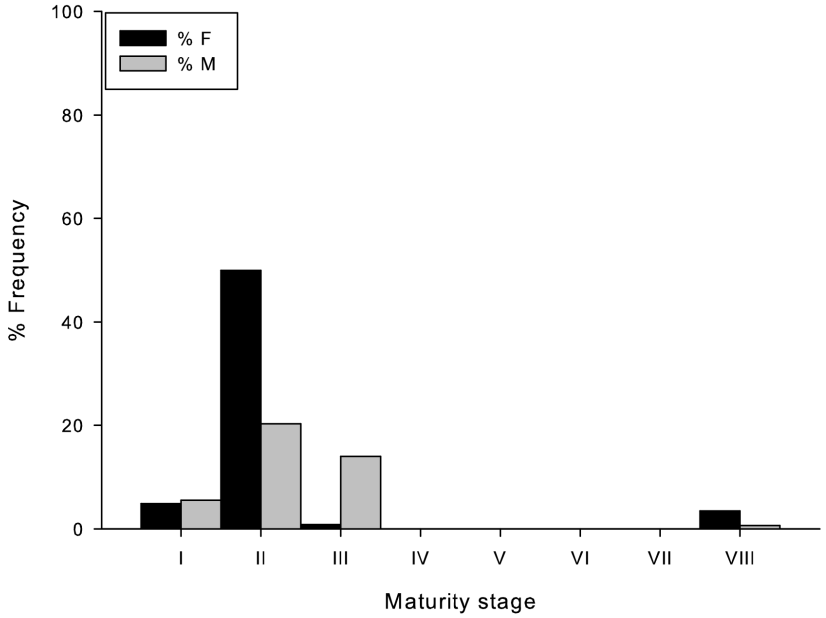


Figure 24: Maturity distribution of Macrurounus magellanicus sampled during ZDLT1-02-2010

7.0 Kingclip – *Genypterus blacodes*

Kingclip were caught in 80 of the 90 bottom trawls conducted during the cruise ZDLT1-02-2010. CPUEs ranged between 0 – 330.62 kg/hr (mean = 34.85 ± 59.56). Figure 25 illustrates the distribution of density (kg/km^2) of kingclip encountered during the cruise. The greatest densities were encountered in the north and western parts of the survey area. The total fishable biomass calculated for the survey area was between 2,426 – 2,436 mt.

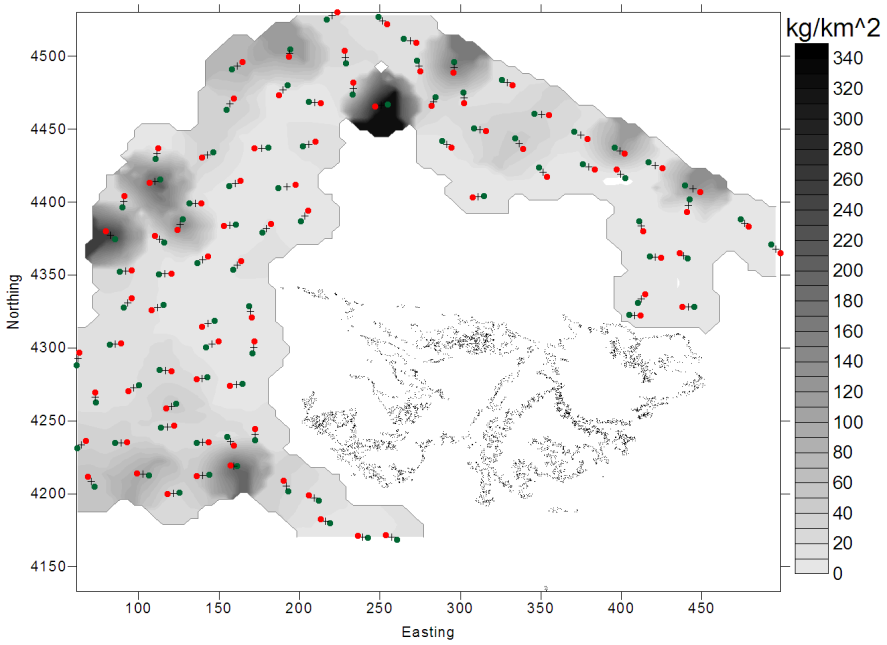


Figure 25: The distribution of density of Genypterus blacodes during ZDLT1-02-2010

A total of 1,922 individual kingclip were sampled for length frequency and otoliths. Kingclip ranged in length from 32 – 126 cm L_T (mean = 64.81 ± 14.52) and their length frequency exhibited a bimodal distribution (Figure 26).

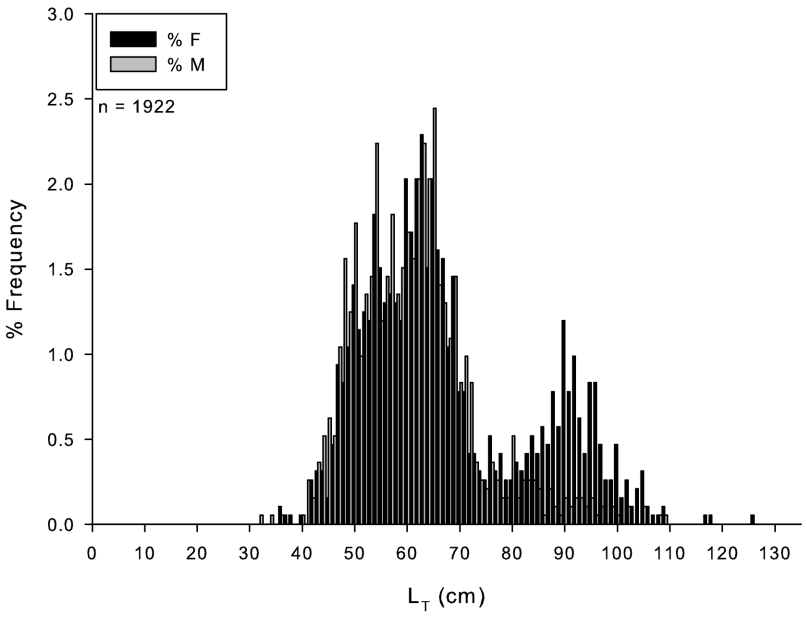


Figure 26: Length frequency distribution of Genypterus blacodes sampled during ZDLT1-02-2010

The majority of individuals encountered were in maturity stages I, II and III. However, some individuals were found in a spawning and pre-spawning condition, which was surprising as spawning animals are rare in the Falkland Islands (Figure 27). A number of ovaries were collected and fixed in 10% buffered formol saline for fecundity studies.

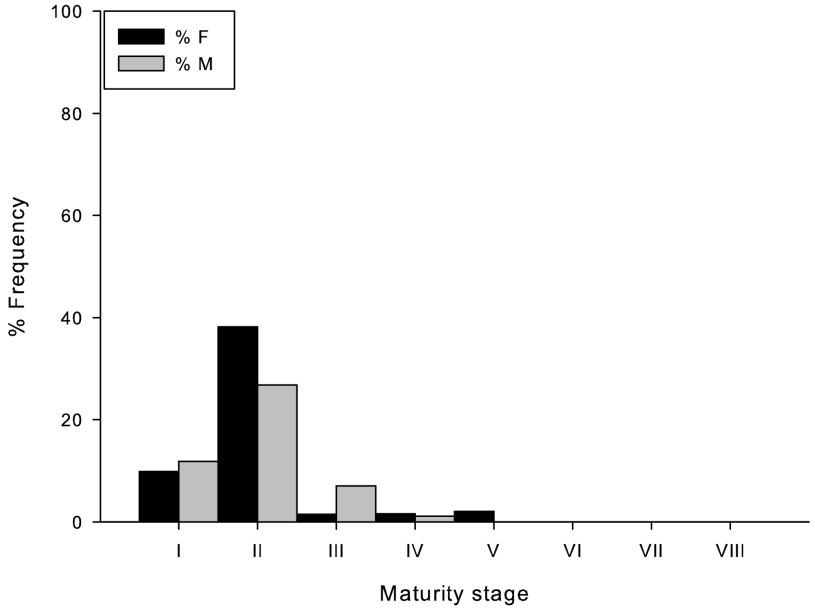


Figure 27: Maturity distribution of Genypterus blacodes sampled during ZDLT1-02-2010

8.0 Red cod – *Salilota australis*

Red cod were caught in 71 of the 90 trawl stations conducted during ZDLT1-02-2010. CPUEs ranged between 0 – 6984.60 kg/hr (mean = 145.54 ± 778.71). Figure 28 illustrates the distribution of density (kg/km2) of red cod encountered during the survey. The greatest densities were encountered to the south west of New Island. The total fishable biomass calculated for the survey area was between 11,111 – 11,186 mt.

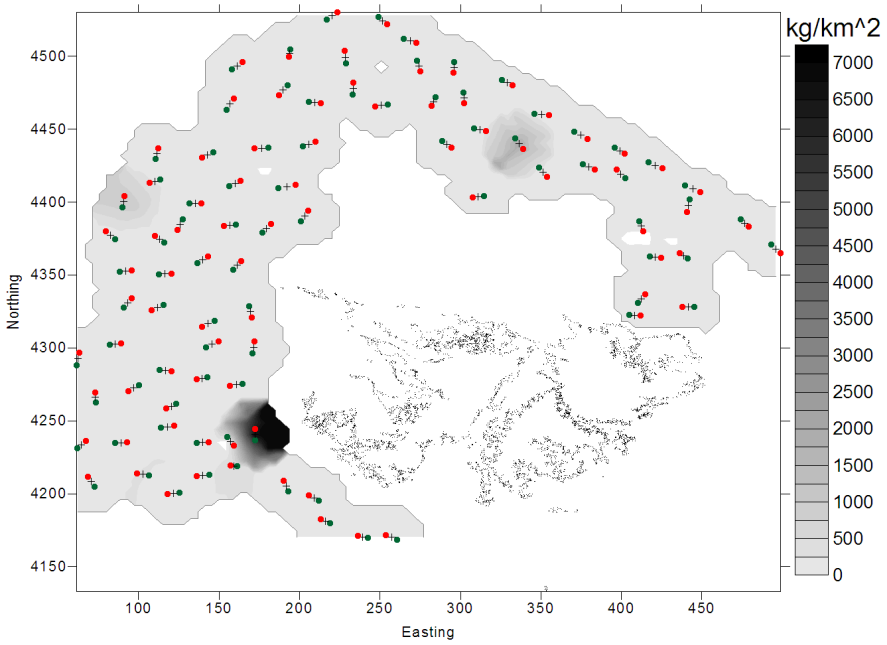


Figure 28: The distribution of density of Salilota australis during ZDLT1-02-2010

A total of 3308 individual red cod were sampled for length frequency analysis. Individuals sampled ranged between 13 – 85 cm L_T (mean = 36.51 ± 13.36) Figure 29.

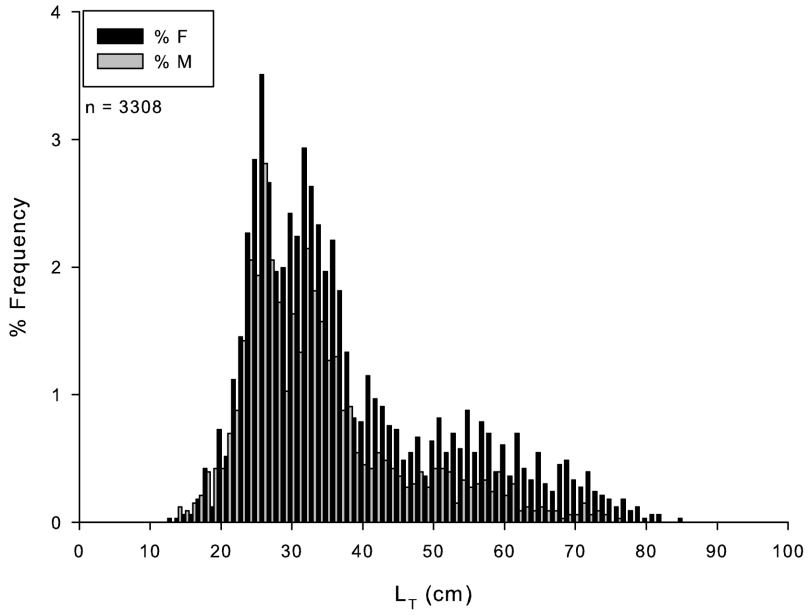


Figure 29: Length frequency distribution of Salilota australis sampled during ZDLT1-02-2010

As expected for this time of the year most animals sampled were in maturity stages I, II and III with fewer animals in the post spawning stages (Figure 30).

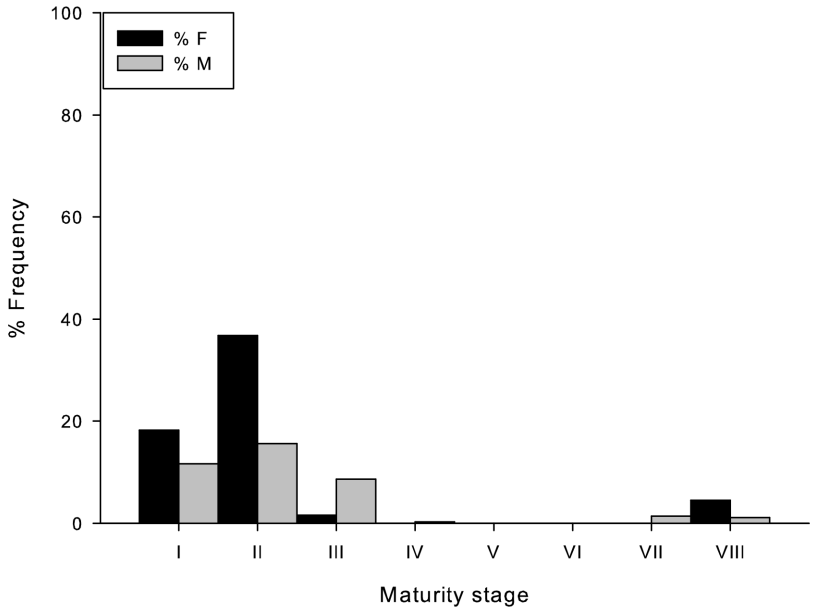


Figure 30: Maturity distribution of Salilota australis sampled during ZDLT1-02-2010