Scientific Report

Fisheries Research Cruise ZDLH1-02-2007

Fisheries Department
Falkland Islands Government

Scientific Report

Fisheries Research Cruise

ZDLH1-02-2007

FPRV Dorada

2nd February – 14th February 2007

Fisheries Department
Falkland Islands Government
Stanley
Falkland Islands

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Summary

The cruise ZDLH1-02-2007 was undertaken on the northern and north-eastern shelf and shelf break of the Falkland Islands. The main tasks were to examine the distribution and biology of skates on the northern shelf in order to help design future swept area stock assessments for the skate fishery in the Falkland Islands; to tag skates for migration and age validation studies and to continue oceanographic studies of the Falkland Islands' Shelf.

After departure in the evening of 2nd of February, the vessel proceeded to the southern most transect (R5) of Region 2. Three transects (R3-R5) in the eastern part of Region 2 were made between the 3rd and 5th of February. After receiving a gale warning on the evening of the 5th February the vessel moved to the shallow waters of region 1, where the following four days were spent trawling for *Psammobatis* skates and *Loligo*. Strong south-westerly winds did not allow the vessel to proceed to the western part of the Region 2 until the 10th February, and the survey of the 'ray box' was completed only on the 13th of February. The last day of the cruise was spent in shallow waters to the northeast of the East Falkland, fishing for shallow water skates and *Loligo*. The Dorada arrived to Stanley in the morning of the 15th of February. No days were lost due to bad weather, however strong winds prevented work in an exposed part of Region 3, so this part of the survey was abandoned.

During the cruise a total of 36 trawl stations and 38 oceanographic stations were conducted. The cruise yielded a total catch of 41,134 kg comprising over 100 species. In terms of catch the most abundant species were *Patagonotothen ramsayi* and hoki *Macruronus magellanicus* and they accounted for 77% of the total catch. The period of the cruise coincided with an increase in the intensity of the Falkland Current which resulted in negative temperature anomalies over the Falkland Islands' Shelf. Also in this period there was an inflow of relatively warm waters on the north-western shelf. This feature was present in waters deeper that 100 m and shifted south-east bringing with it the first wave of *Illex argentinus.*

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1.0 Introduction

In February 2007, a research cruise was undertaken in the north and north-eastern parts of the Falkland Islands Shelf using the Research and Patrol vessel *Dorada*. Figure 1 illustrates the sampling locations undertaken during the cruise. The primary objective of the cruise was to examine the biology and distribution of skates on the northern shelf.

1.1 Cruise Objectives

The cruise objectives were to:

1. To examine the distribution and biology of skates on the northern shelf. This survey was used to help design future swept area method stock assessments for the skate fishery in the Falkland Islands.
2. To tag skates for migration and age validation studies.
3. To continue oceanographic studies of the Falkland shelf.

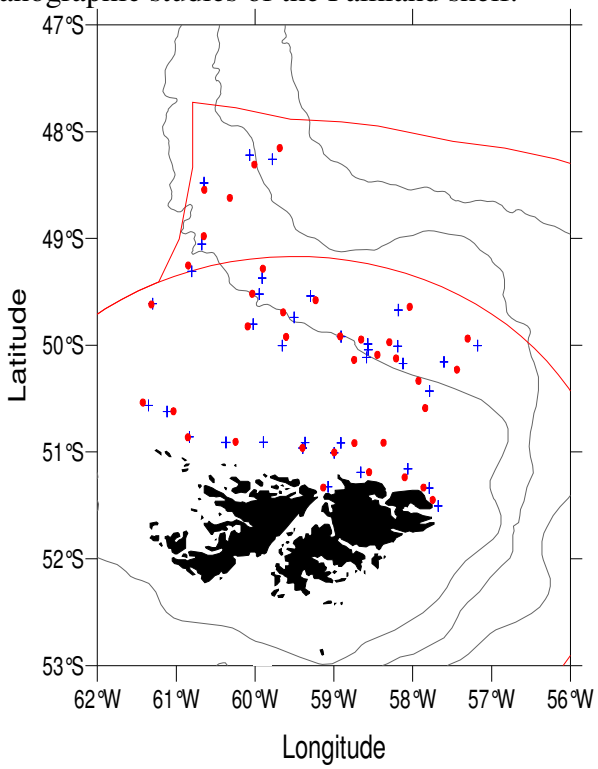


Figure 1: Location of sampling stations undertaken on research cruise ZDLH1-02-2006 between 2nd and 14th February 2007

1.2 Cruise plan and key dates

The vessel departed Stanley in the evening of 2 February, and proceeded to the southern most transect (R5) of Region 2 ('ray' box). Three transects (R3-R5) in the eastern part of the Region 2 were made between 3 and 5 February. After receiving a gale warning in the evening of 5 February, the vessel moved to shallow waters of the region 1, where the following four days were spent trawling for *Psammobatis* skates and *Loligo*. Strong south-westerly winds did not allow the vessel to proceed to the western part of the Region 2 until 10 February, and the survey of the 'ray box' was completed only on 13 February. The last day of the cruise was spent in shallow waters to the northeast of the East Falkland, fishing for shallow water skates and *Loligo*. The Dorada arrived to Stanley in the morning of 15 February. No days were lost of bad

weather, however strong winds prevented to work in an exposed part of the Region 3, so it was abandoned from the survey.

1.3 Vessel Characteristics

The cruise was conducted on the RV *Dorada*, which is registered in the Falkland Islands. The *Dorada's* characteristics are shown in table 1.

Table 1: Vessel characteristics

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

1.4 Personnel and responsibilities

The following staff participated in the cruise:

Dr. Alexander Arkhipkin	Chief Scientist
Dr. Paul Brickle	Trawl/Oceanographic survey
Joost Pompert	Trawl/Oceanographic survey
Ester Sancho	Trawl survey
Pablo Reyes	Trawl survey
Katja Janzen	Trawl survey
Dr. Matthias Stehmann	Taxonomy/Trawl survey
Haseeb Randhawa	Parasite/Trawl Survey

1.5 Equipment used

1.5.1 Acoustics

The acoustic equipment was similar to that used on previous research cruises and included:

1. Simrad EK500 scientific echo-sounder with hull mounted split transducers at 38 kHz and 120 kHz; and
2. SonarData Echolog_EK v1.50 (data acquisition and Echo View (post processing) software.

The EK500 had a ping interval of approximately 2 seconds. The calibration of the EK500 was not carried out during this research cruise. All data were logged with an expanded bottom echogram of approximately 15 m range, starting at 10 m above the substrate. The range of the echogram was automatically adjusted to cover the entire water column.

1.5.2 Trawling

At all trawl stations, a standard bottom trawl equipped with polyvalent trawl doors, tickler chain and a 40-mm codend liner were used. The trawl was equipped with SIMRAD ITI sensors. The typical vertical opening of the trawl was between 6 and 10 m.

1.5.3 Oceanographic

The oceanographic equipment used on ZDLH1-02-2007 was the same as was used on previous surveys and included.

1. CTD SBE-25 with Sea Tech fluorometer and an oxygen sensor; and
2. Thermosalinometer SBE45.

1.6 Acoustic surveying

During the survey acoustic data were logged over the entire trip. The data were archived in SonarData EK5 format on a PC in the dry lab running the SonarData Echolog 500.

1.7 Trawl stations and biological sampling

During the ZDLH1-02-2007 research cruise the station numbers ranged from 2693 to 2766 (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 rajids were measured (total, pre-anal and disc width) to the nearest centimetre below and sex and stage of maturity were recorded for all specimens sampled. Individual weights were measured to the nearest gram using a POLS balance or, for larger specimens, to the nearest 20 grams using the Scanvaegt balances.

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

Table 2: Trawl and Oceanographic stations conducted during ZDLH1-02-2007 (B = bottom trawl; C = CTD)

Station	Activity	Time	Start Latitiude		Start Longitude		Depth (m)	Duration
2693	C	8.47	50	35.3	57	50.5	133	7
2694	B	9.55	50	25.7	57	47.2	214	91
2695	C	12.05	50	20	57	55.6	216	9
2696	B	13.49	50	9.4	57	36.2	309	108
2697	C	16.01	50	13.7	57	26.3	330	14
2698	B	17.49	50	0.2	57	10.6	367	101
2699	C	19.47	49	56.27	57	18.19	341	14
2700	B	8.24	50	6.9	58	35.1	156	120
2701	C	10.22	50	8.25	58	44.55	150	8
2702	B	11.33	50	2.6	58	33.85	212	105
2703	C	13.44	50	5.4	58	26.9	212	10
2704	B	17.25	49	40.3	58	10.9	337	105
2705	C	19.34	49	38.43	58	2.28	337	13
2706	C	7.00	49	34.7	59	13.9	360	14
2707	B	8.32	49	32.3	59	17.8	370	115
2708	B	12.07	49	44.4	59	30.3	220	104
2709	C	14.15	49	41.5	59	38.6	205	10
2710	B	17.34	50	0.2	59	39.3	157	91
2711	C	19.25	49	55.3	59	36.4	160	8
2712	C	8.03	50	57.7	59	23.9	125	6
2713	B	8.13	50	57.7	59	23.7	124	93
2714	B	16.26	51	19.5	59	4.4	32	52
2715	C	17.31	51	20	59	8.1	34	4
2716	C	8.39	51	0.2	58	59.7	128	7
2717	B	8.50	51	0.5	58	59.8	126	61
2718	C	11.34	50	54.98	58	44.36	133	5
2719	B	11.45	50	54.8	58	54.6	134	63
2720	C	15.02	50	54.8	58	22.2	131	7
2721	B	15.11	50	54.7	59	21.9	131	61

Station	Activity	Time	Start Latitiude		Start Longitude		Depth (m)	Duration
2722	B	18.28	51	11.4	58	39.5	70	53
2723	C	19.38	51	11.3	58	33.2	65	2
2724	B	14.11	50	54.5	59	53.5	130	65
2725	C	15.42	52	57.5	59	56.5	123	7
2726	B	17.49	50	54.6	60	22.2	125	61
2727	C	19.11	50	54.3	60	14.8	127	5
2728	C	8.00	50	51.7	60	51.1	112	6
2729	B	8.13	50	51.4	60	49.9	110	62
2730	B	11.07	50	37.2	61	6.9	139	61
2731	C	12.29	50	37.1	61	2.1	138	6
2732	B	17.35	50	33.9	61	21	153	63
2733	C	19.19	50	32.2	61	25.4	160	7
2734	C	7.32	49	37.1	61	18.9	153	8
2735	B	8.01	49	36.7	61	17.9	153	58
2736	B	13.25	49	18.5	60	48.1	168	66
2737	C	14.50	49	15.2	60	50.9	167	9
2738	B	17.09	49	3.2	60	40.5	204	62
2739	C	18.37	48	58.7	60	39	215	8
2740	C	7.32	48	37.2	60	19.2	352	16
2741	B	10.33	48	28.8	60	38.8	262	77
2742	C	12.05	48	32.7	60	38.6	258	12
2743	B	15.20	48	13.2	60	4.1	483	114
2744	B	18.46	48	15.5	59	46.7	573	115
2745	C	21.02	48	9.2	59	41.2	634	22
2746	C	23.10	48	18.5	60	0.5	484	18
2747	B	9.26	49	22.3	59	54.6	288	100
2748	C	11.29	49	17	59	54	313	12
2749	B	13.29	49	31.2	59	56.7	223	82
2750	C	16.14	49	31.1	60	2.1	196	9
2751	B	18.25	49	48.1	60	1.4	161	65
2752	C	20.40	49	49.4	60	5.6	161	6
2753	C	7.33	49	55	58	55.2	225	10
2754	B	8.19	49	55.1	58	54.5	228	63
2755	B	11.15	49	59.3	58	34.1	255	68
2756	C	12.39	49	56.8	58	39.2	268	15
2757	B	14.37	50	0.5	58	11.4	286	69
2758	C	16.02	49	58.3	58	17.8	291	13
2759	B	17.34	50	10.3	58	7.4	245	65
2760	C	19.01	50	7.4	58	12.65	248	9
2761	C	7.29	51	14.2	58	6.1	75	6
2762	B	8.09	51	9.4	58	3.6	80	53
2763	B	12.30	51	20.2	57	47.4	60	55
2764	C	13.41	51	20	57	51.8	57	4
2765	B	15.18	51	30.3	57	40.6	39	52
2766	C	16.28	51	26.9	57	44.8	40	4

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 the polarisation of the oxygen sensor. It was then retrieved to 1 m depth and deployed again either to depth of about 1000 m or to approximately 10 m from the bottom. The speed of deployment was c. 1m/s and was monitored by the use of a 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 temperature (ºC). The CTDO sensors are 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 included in the Ocean Data View package v. 3.0-2005 (Schlitzer 2005).

2.2 Results

Oceanographic data were collected at 38 oceanographic stations. These stations were made either before or after each trawl (Figure 2).

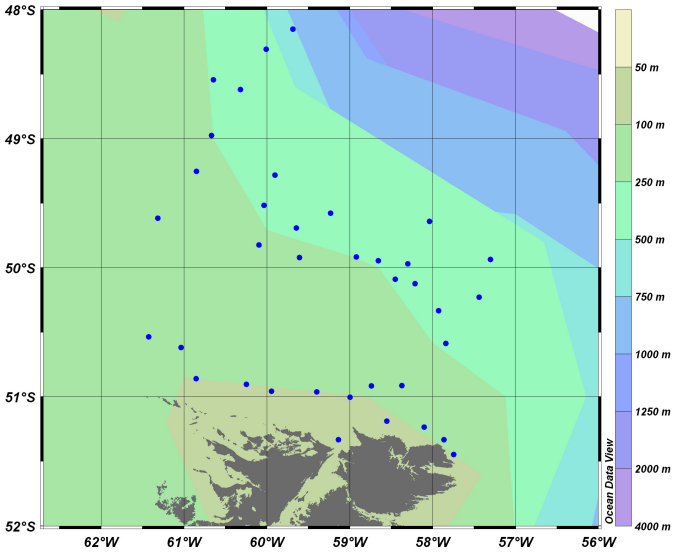


Figure 2: Oceanographic stations conducted during ZDLH1-02-2007

The survey aimed to assess oceanographic situation over the ray/skate fishing grounds at the beginning of both *Illex* and *Loligo* squid seasons. Stations were situated on the northern Falkland shelf between 34 and 640 m.

Temperatures ranged from 3.64º to 10.83ºC, salinity from 33.57 to 34.19 psu, and densities from 25.80 to 27.18 kg/m^3. Analysis of T-S curves demonstrated the presence of two major water masses with some possible transient modifications. One of them, the left cluster of data points, was present shallower than 400 m, the other

one, the right cluster of data points (the Falkland Current) were deeper and further offshore than 480-640 m (Figure 3).

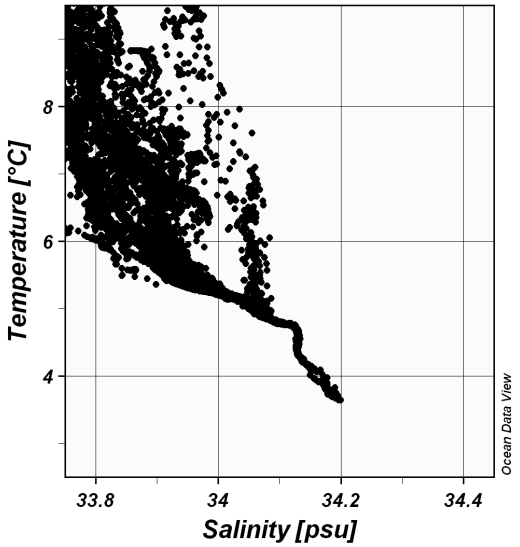


Figure 3: T – S curves of water masses encountered during ZDLH1-02-2007

The period of the cruise coincided with an increased intensity of the Falkland Current, which provoked negative temperature anomalies over the Falkland shelf and adjacent slope waters (Figure 4 and 5).

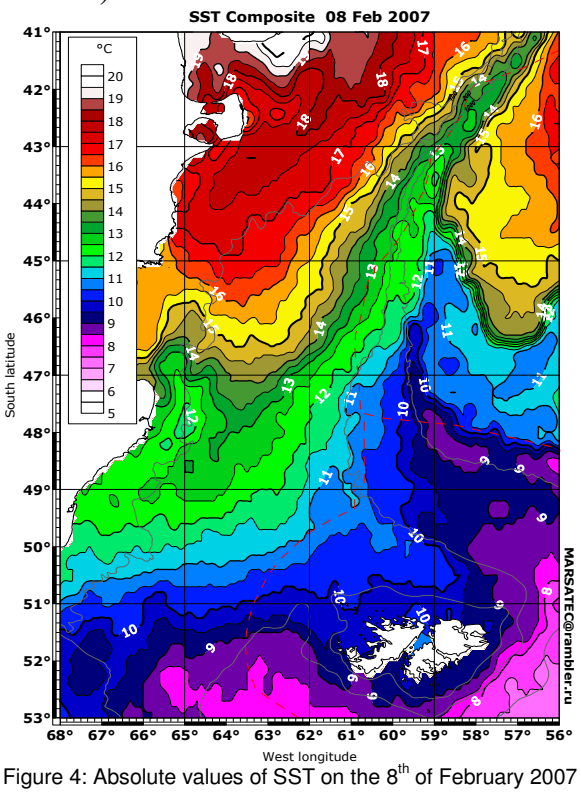


Figure 4: Absolute values of SST on the 8th of February 2007

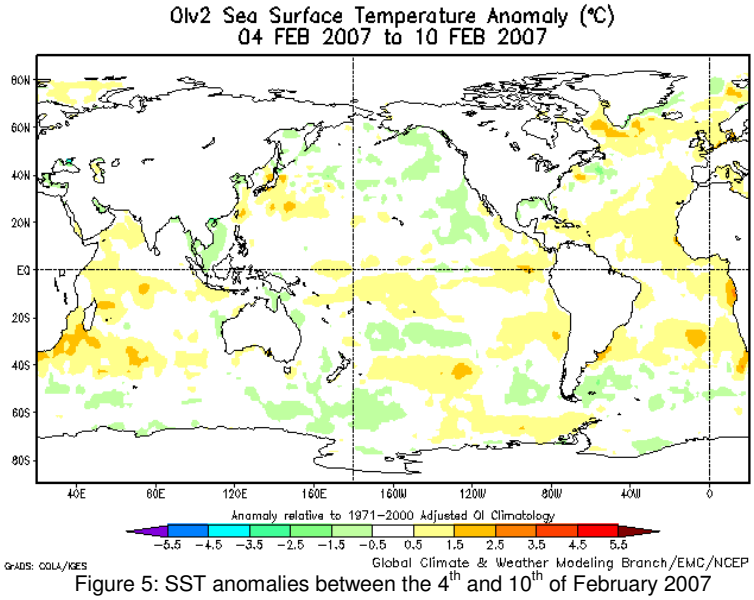
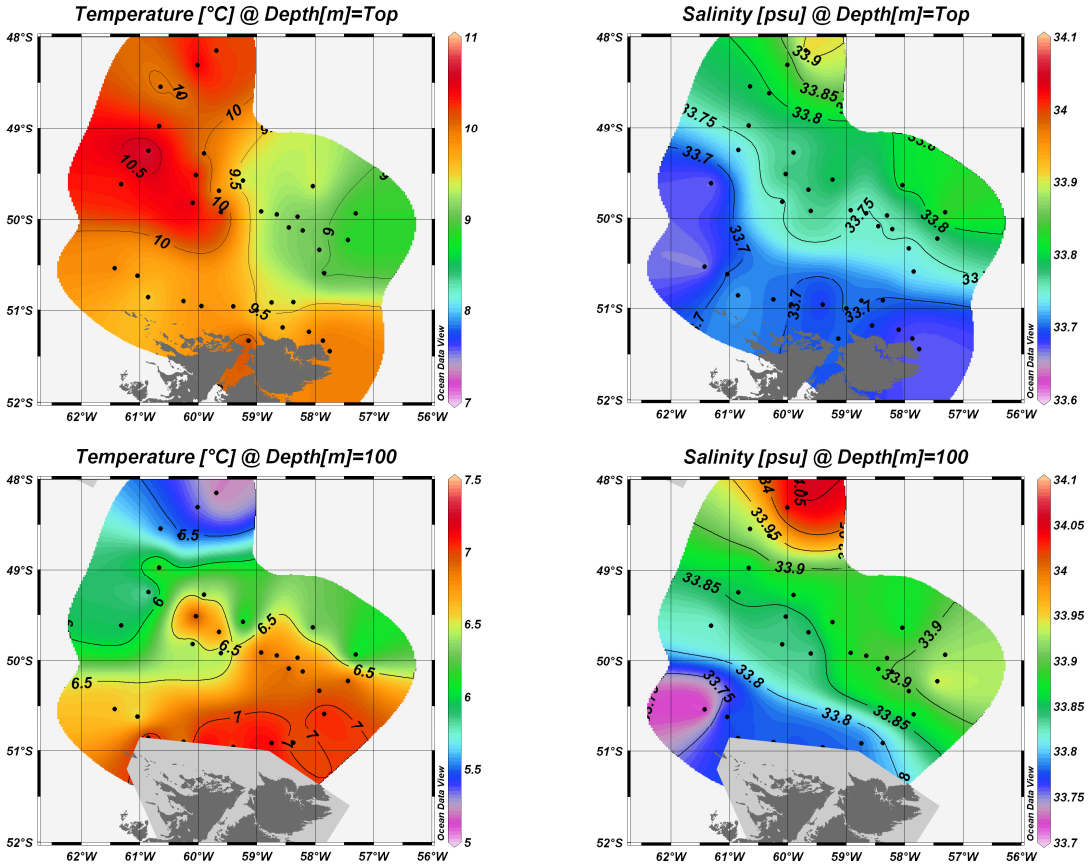


Figure 5: SST anomalies between the 4th and 10th of February 2007

The period was also characterised by an inflow of relatively warm waters on the northwest shelf (Figure 6). These waters formed a warm eddy, which was centred at about 49°S, 61°W on the 8th of February. This eddy penetrated deeper than 100 meters and gradually shifted southeast.

The northeast part of the survey area was dominated by the cold and saline waters of the Falkland Current.



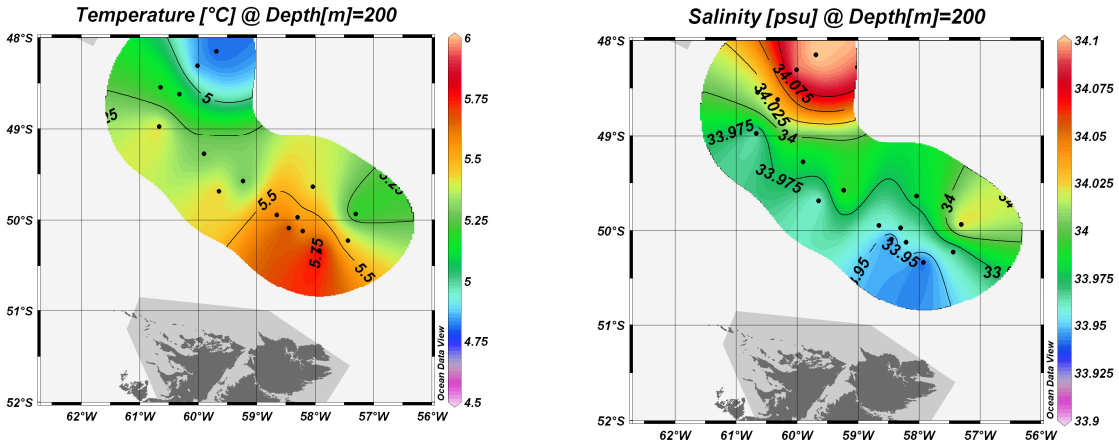


Figure 6: Distribution of temperature and salinity on the northern Falkland shelf in February 2007

3.0 Biological Sampling

3.1 Catch and by-catch

Trawling was conducted on 36 stations in the northern parts of the Falkland Islands' shelf. Trawling time on horizon (seabed) varied between 28 and 65 minutes, with an average time on horizon of 40.83 minutes.

During the cruise a total of 41,137 kg was caught comprising over 100 species (Table 3). In terms of weight, the greatest catches were the Patagonian rockcod (*Patagonotothen ramsayi*) and hoki (*Macruronus magellanicus*). These two species accounted for over 77% of the catch in terms of weight.

Table 3: Total catch of trawl stations during research cruise ZDLH1-02-2007

Species Code	*Species name*	***Total Catch (kg)***	***Total Sampled (kg)***	***Total Discarded (kg)***	***Proportion (%)***
PAR	*Patagonotothen ramsayi*	20,733.530	0.000	20,733.530	50.36%
WHI	*Macruronus magellanicus*	11,108.075	1,976.570	11,041.955	26.98%
SHT	Mixed invertebrates	1,349.570	0.000	1,349.570	3.28%
RGR	*Bathyraja griseocauda*	1,328.791	1,328.791	1,328.791	3.23%
RBR	*Bathyraja brachyurops*	722.484	722.484	722.484	1.75%
ING	*Moroteuthis ingens*	537.141	0.736	537.141	1.30%
GRC	*Macrourus carinatus*	465.380	76.890	465.380	1.13%
SPN	Sponges	463.581	0.000	463.581	1.13%
RAL	*Bathyraja albomaculata*	458.060	458.060	458.060	1.11%
LOL	*Loligo gahi*	349.929	90.570	289.519	0.85%
BAC	*Salilota australis*	302.899	260.869	301.205	0.74%
UCH	Sea urchin	299.675	0.000	299.675	0.73%
COT	*Cottunculus granulosus*	209.080	0.000	209.080	0.51%
RBZ	*Bathyraja cousseauae*	186.643	186.643	186.643	0.45%
RMC	*Bathyraja macloviana*	182.164	182.164	182.164	0.44%
RSC	*Bathyraja scaphiops*	174.997	174.997	174.997	0.43%
EEL	*Iluocoetes fimbriatus*	158.103	12.300	158.103	0.38%
CGO	*Cottoperca gobio*	137.807	0.000	137.807	0.33%
TOO	*Dissostichus eleginoides*	130.639	122.539	5.480	0.32%
DGH	*Schroederichthys bivius*	121.783	21.848	121.783	0.30%
BLU	*Micromesistius australis*	121.506	94.042	121.491	0.30%
ILL	*Illex argentinus*	112.521	40.728	93.951	0.27%
KIN	*Genypterus blacodes*	107.619	107.619	0.000	0.26%
RFL	*Raja flavirostris*	100.555	100.555	100.555	0.24%
RPX	*Psammobatis spp.*	96.094	96.094	0.000	0.23%
SQT	Ascidiacea	96.049	0.000	96.049	0.23%
RMU	*Bathyraja multispinis*	95.906	95.906	95.906	0.23%
BUT	*Stromateus brasiliensis*	89.545	0.000	89.545	0.22%
AST	Asteroidea	86.677	0.000	86.677	0.21%
RAY	Ray spp.	85.200	85.200	0.000	0.21%
HAK	*Merluccius hubbsi*	84.970	69.610	9.890	0.21%
MED	Medusae	73.620	0.000	73.620	0.18%
RDO	*Raja doellojuradoi*	71.086	71.086	71.086	0.17%
BEE	*Benthoctopus eureka*	60.989	0.622	15.400	0.15%
MUG	*Munida gregaria*	55.252	0.000	55.252	0.13%
RMG	*Bathyraja magellanica*	44.312	44.312	44.312	0.11%

STE	*Sterechinus sp.*	43.760	0.000	43.760	0.11%
MUU	*Munida subrugosa*	35.344	0.000	35.344	0.09%
ANM	Anemone	33.599	0.000	33.599	0.08%
BEJ	*Benthoctopus sp. cf. januarii*	26.593	0.000	3.960	0.06%
WLK	Whelks	24.196	0.000	24.196	0.06%
DGS	*Squalus acanthias*	23.013	21.213	23.013	0.06%
PTE	*Patagonotothen tessellata*	17.922	0.000	17.922	0.04%
ANT	Anthozoa	16.663	0.000	16.663	0.04%
GYM	*Gymnoscopelus spp.*	12.214	0.000	12.028	0.03%
PYM	*Physiculus marginatus*	11.801	0.000	11.801	0.03%
PAT	*Merluccius australis*	10.220	6.900	3.210	0.02%
PMX	*Protomictophum spp.*	10.064	0.000	10.064	0.02%
RPN	*Psammobatis normani*	9.490	9.490	0.000	0.02%
NED	*Neolithodes diomedeae*	9.350	0.000	9.350	0.02%
GOC	*Gorgonocephalas chilensis*	8.180	0.000	8.180	0.02%
CHE	*Champsocephalus esox*	6.748	6.723	0.025	0.02%
THB	*Thymops birsteini*	5.599	0.000	0.896	0.01%
CAS	*Campylonotus semistriatus*	5.562	0.000	0.179	0.01%
OCM	*Octopus megalocyathus*	5.303	0.000	0.296	0.01%
GRF	*Coelorhynchus fasciatus*	4.903	0.402	4.903	0.01%
RED	*Sebastes oculatus*	4.765	0.460	4.765	0.01%
SAT	*Salpa thomsoni*	4.200	0.000	4.200	0.01%
HOL	Holothuroidea	4.063	0.000	4.063	0.01%
MUO	*Muraenolepis orangiensis*	3.899	3.587	3.899	0.01%
NEM	*Neophyrnichthys marmoratus*	3.011	0.091	2.920	0.01%
MMA	*Mancopsetta maculata*	2.606	1.817	2.606	0.01%
COP	*Congiopodus peruvianus*	2.480	0.000	2.480	0.01%
GRX	*Coelorhynchus sp. cf. braueri*	1.880	1.880	0.000	<0.01%
PES	*Peltarion spinosulum*	1.745	0.000	1.745	<0.01%
MUR	Ribbed mussel	1.280	0.000	1.280	<0.01%
GYN	*Gymnoscopelus nicholsi*	1.256	0.000	1.256	<0.01%
EUO	*Eurypodius longirostris*	1.185	0.000	1.185	<0.01%
ADA	*Adelomelon ancilla*	1.040	0.000	1.040	<0.01%
BIV	Bivalve	0.970	0.000	0.970	<0.01%
SYB	*Symbolophorus boops*	0.930	0.000	0.930	<0.01%
ZOX	Zoarcidae	0.927	0.927	0.539	<0.01%
MUS	Smooth mussel	0.881	0.031	0.850	<0.01%
ANN	Annelida	0.682	0.000	0.682	<0.01%
MYA	*Myxine australis*	0.603	0.000	0.603	<0.01%
PAW	*Patagonotothen wiltoni*	0.564	0.564	0.564	<0.01%
ZYP	*Zygochlamys patagonica*	0.508	0.000	0.508	<0.01%
MAM	*Mancopsetta milfordi*	0.473	0.473	0.473	<0.01%
EUL	*Eurypodius latreillei*	0.449	0.219	0.230	<0.01%
NUD	Nudibranchia	0.428	0.000	0.428	<0.01%
XXX	Unidentified animal	0.416	0.031	0.343	<0.01%
PAA	*Pandalopsis ampla*	0.353	0.000	0.000	<0.01%
WRM	Worm cases	0.345	0.000	0.345	<0.01%
GON	*Gonatus antarcticus*	0.324	0.324	0.324	<0.01%
AUC	*Austrocidaris canaliculata*	0.316	0.000	0.316	<0.01%
PAG	*Paralomis granulosa*	0.300	0.000	0.300	<0.01%
BRY	Bryozoa	0.260	0.000	0.260	<0.01%
EUP	Euphausidae	0.245	0.000	0.245	<0.01%
MXX	Myctophidae	0.212	0.000	0.212	<0.01%
BRP	Brachiopods	0.181	0.000	0.181	<0.01%

CAM	*Cataetyx messieri*	0.133	0.000	0.050	<0.01%
ALG	Algae	0.100	0.000	0.100	<0.01%
STS	*Stereomastis suhmi*	0.090	0.000	0.090	<0.01%
PMB	*Protomictophum bolini*	0.081	0.081	0.000	<0.01%
COX	*Notothenid spp.*	0.063	0.063	0.000	<0.01%
OCT	Unidentified octopus	0.057	0.057	0.000	<0.01%
NEC	*Neorossia caroli*	0.052	0.052	0.000	<0.01%
COL	*Cosmasterias lurida*	0.047	0.000	0.047	<0.01%
LYB	*Lycenchelys bachmanni*	0.046	0.025	0.021	<0.01%
MUN	*Munida spp.*	0.033	0.000	0.033	<0.01%
SEP	*Seriolella porosa*	0.030	0.030	0.000	<0.01%
POL	Polychaeta	0.025	0.000	0.025	<0.01%
SAL	*Salpa sp.*	0.015	0.000	0.005	<0.01%
LMK	*Laemonema kongi*	0.010	0.000	0.010	<0.01%
PYX	Pycnogonida	0.001	0.000	0.001	<0.01%
HYD	Hydrozoa	0.001	0.000	0.001	<0.01%
		41,167.317	**6,476.675**		

3.2 Patagonian longfin squid – Loligo gahi

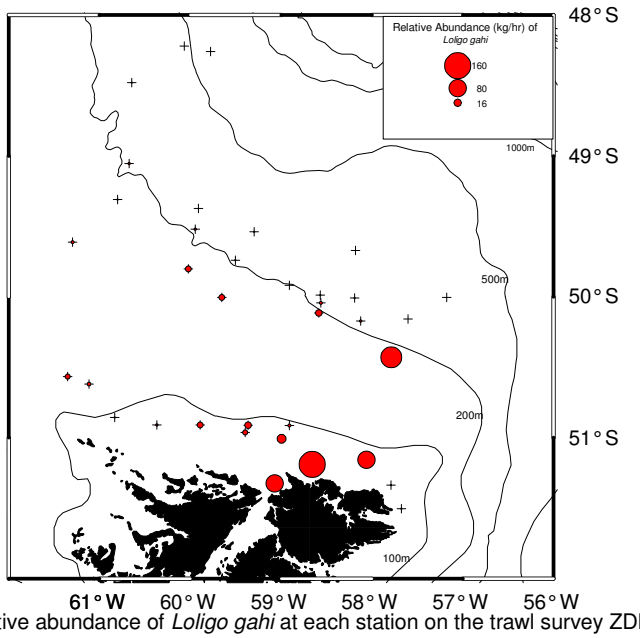


Figure 7: Relative abundance of *Loligo gahi* at each station on the trawl survey ZDLH1-02-2007

The Patagonian squid *Loligo gahi* was only abundant in the eastern part of FICZ during the survey, both in shallow waters and on the shelf break (Figure 7). The largest catch was observed on the shelf break to the northeast of the Islands at a depth of ~200 m (112 kg per 1 hr trawl). High catches of *Loligo gahi* were also taken from shallow waters (<100 m depths) just to the north of east Falkland (40-80 kg per 0.5 hr trawl).

All of the squid caught belonged to the autumn-spawning cohort (ASC). Most of them were immature with only a few maturing and mature males caught in the eastern part of FICZ.

Length-frequency distributions and maturities of male and female were analysed separately for depth ranges less and more than 130 m, and for two regions, the Western region (to the west of 60°W) and the Eastern region (to the east of 60°W). Both regions were outside the *Loligo* box.

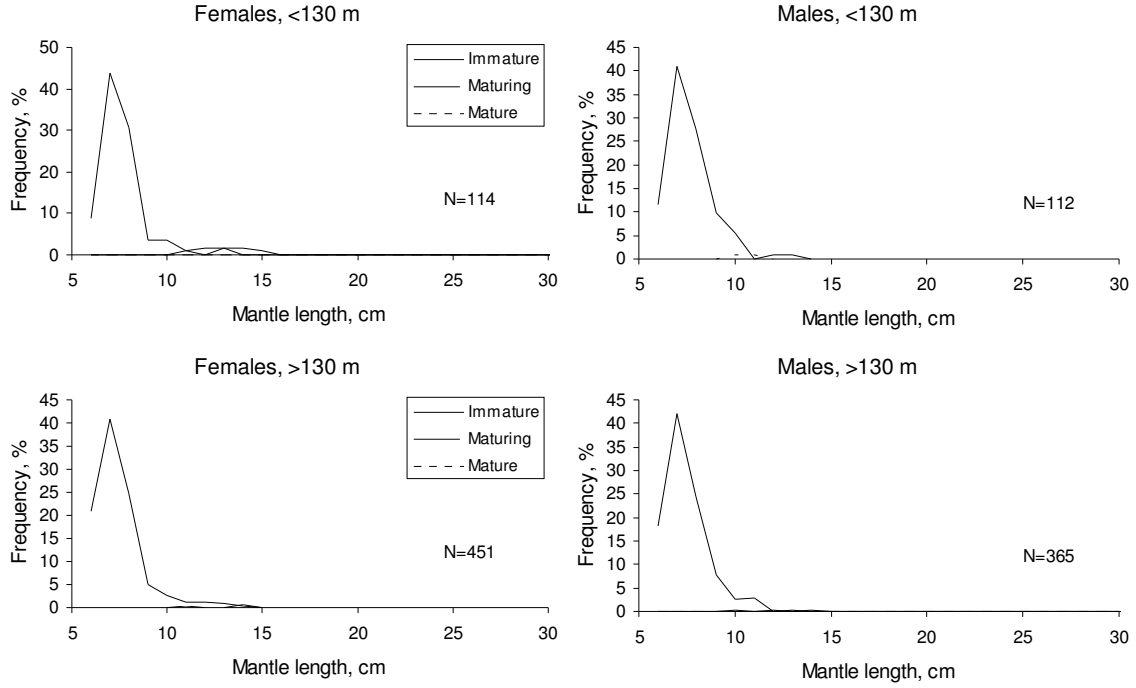


Figure 8: Length frequency distributions of male and female *Loligo gahi* at different depths in the western region

In the Western region, small immature squid with a modal mantle length of 6-7 cm were predominant in catches, both in shallow and deep waters of the shelf. Sex ratios were equal in shallow waters, whereas females were slightly more common in deep waters (1.2:1) (Figure 8).

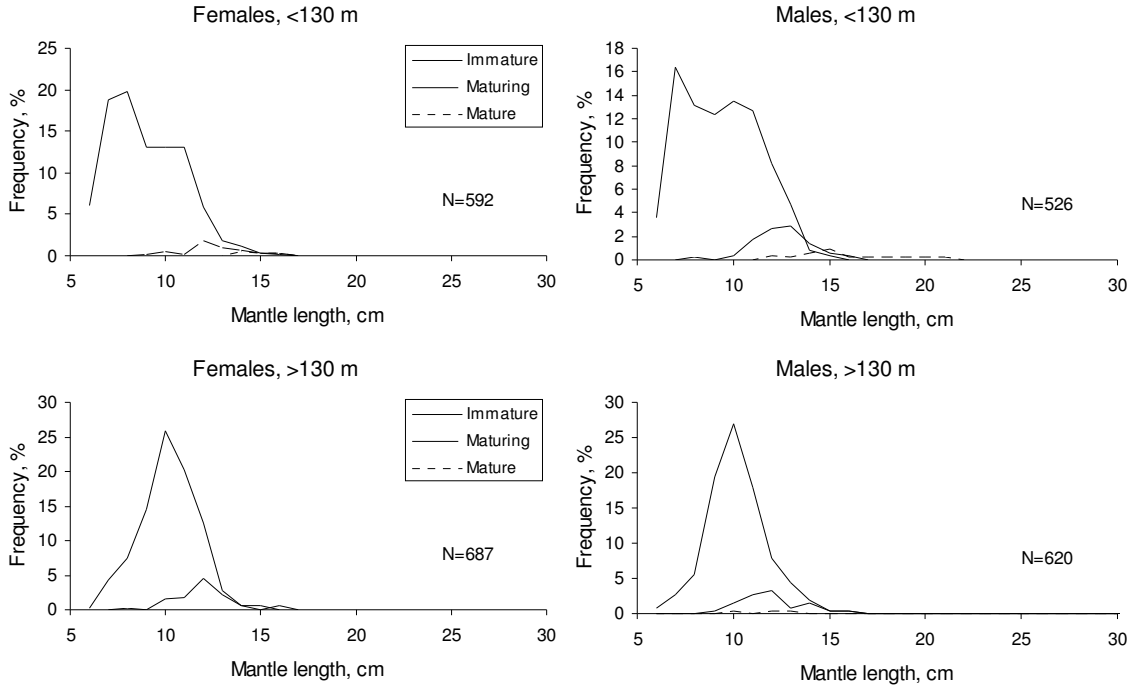


Figure 9: Length frequency distribution of male and female *Loligo gahi* at different depths in the eastern region

In the eastern region, small immature squid of 6-7 cm ML were encountered mainly in shallow waters (<130 m depths). With them was another group of larger immature squid still belonging to autumn-spawning cohort (10-12 cm ML). The latter group of squid was predominant in deep water of the shelf break, where some squid were already at maturity stage 3 (females) and 4-5 (males). Sex ratios were equal for both depth ranges (Figure 9).

It seems that negative anomalies in water temperatures observed in austral summer of 2007 caused a delay in squid migrations from their shallow water nursery grounds to their deepwater feeding grounds near the shelf break. This is why relatively big squid (10-12 cm ML) were still in shallow water during the survey period, whereas in usual years these squid are normally already on their feeding grounds. Significant catches of small immature squid (6-7 cm ML) in shallow waters indicated that the abundance of the autumn-spawning cohort in 2007 was at a high level, at least in the northern part of FICZ.

3.3 Argentine short fin squid – Illex argentinus

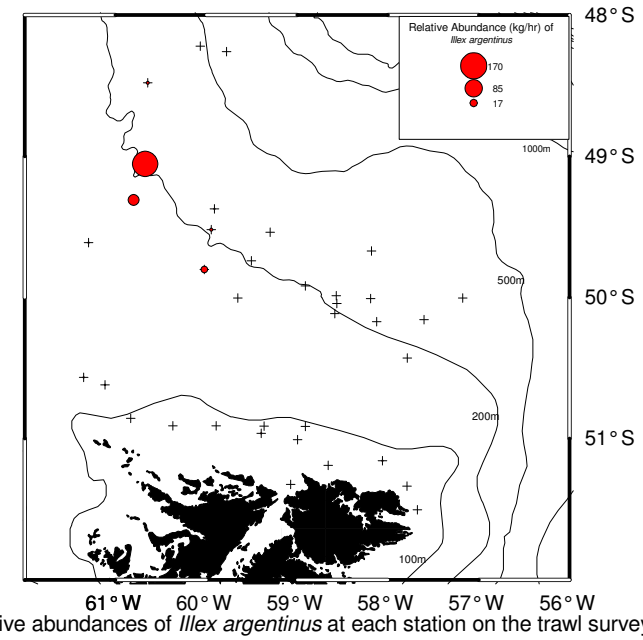


Figure 10: Relative abundances of *Illex argentinus* at each station on the trawl survey ZDLH1-02-2007

A total of 112.5 kg of *I. argentinus* were caught during the cruise. The greatest abundances were found in the northwest of the FICZ in approximately 200 m of water. These aggregations were associated with the warmer waters on the north-western part of the shelf where thy formed an eddy which was centred at approximately 49°S, 61°W on the 8th of January (see oceanography section). During the cruse CPUEs ranged from 0.14 to 162.36 kg/hr (mean = 20.42 ± 48.36).

A total of 304 individual *I. argentinus* were sampled for length frequency and statolith and their sizes ranged from 16 to 35.5 cm DML (mean = 18.96 ± 1.52). Figure 11 illustrates the length frequency distribution of male and females.

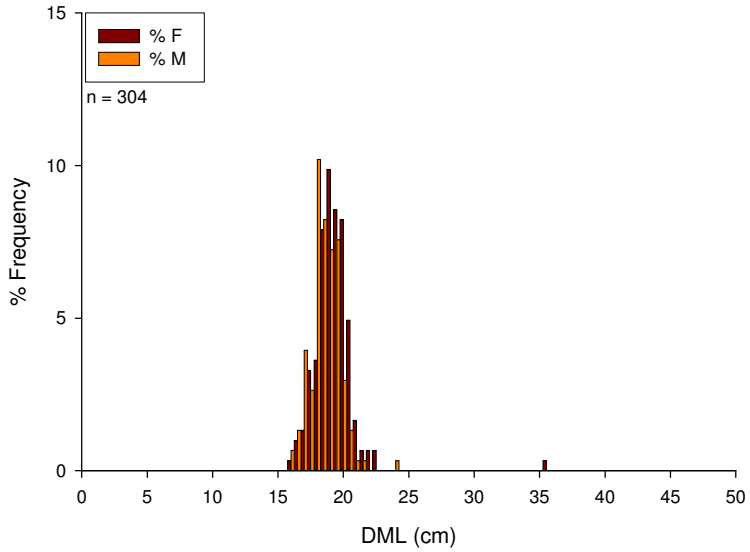


Figure 11: Length frequency distribution of male and female *Illex argentinus* sampled on ZDLH1-02-2007

As expected for this time of the year maturities were made up of mostly II for both sexes with fewer individuals in stages III, IV and V (Figure 12).

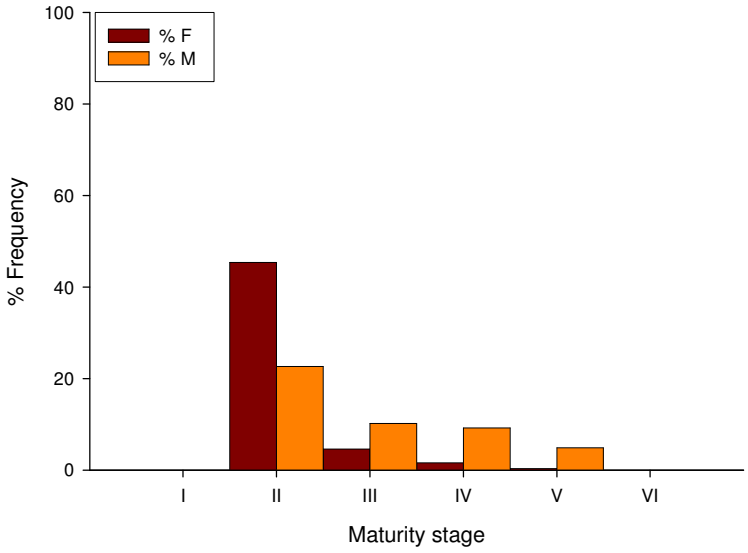


Figure 12: Maturity stages of male and female *Illex argentinus* sampled on ZDLH1-02-2007

3.4 Hoki – Macruronus magellanicus

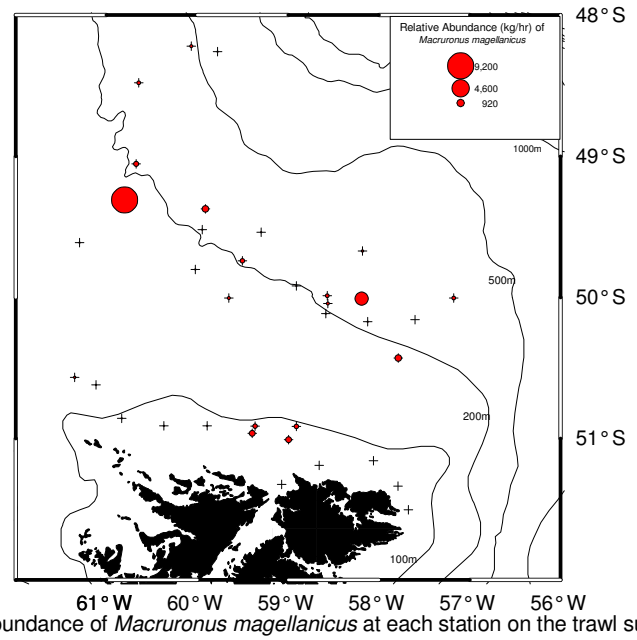


Figure 13: Relative abundance of *Macruronus magellanicus* at each station on the trawl survey ZDLH1-02-2007

Hoki was the second most abundant species caught on the cruise and was caught on 30 of the 36 trawl stations conducted. The largest catches were encountered along the 200 m isobath with the largest catch (4,556 kg) in the north of the zone at 168 m depth (Figure 13). CPUEs ranged from 2 to 9,112 kg/hr (mean = 617.76 ± 1,690.25).

A total of 2,437 individual hoki were sampled for length frequency analysis during the cruise. Hoki ranged in size from 16 to 40 cm L_{PA} (mean = 26.07 ± 4.71) and had a bimodal distribution (Figure 14).

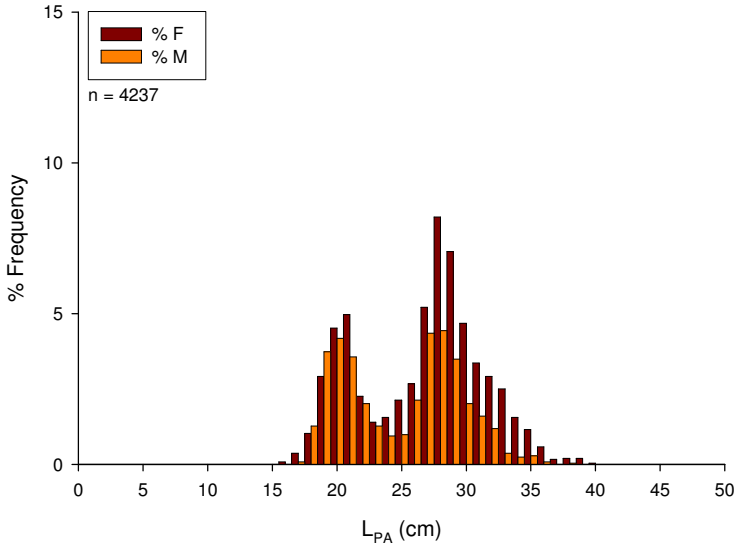


Figure 14: Length frequency composition of male and female *Macruronus magellanicus* sampled on ZDLH1-02-2007

Maturities over the period of the cruise were mainly I, II and III with a very few females in maturity stage VIII (Figure 15).

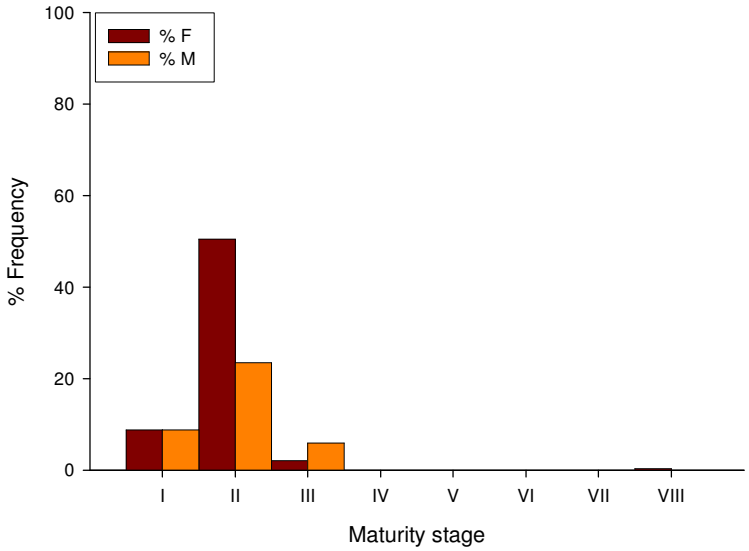


Figure 15: Maturity stages for male and female *Macruronus magellanicus* sampled on ZDLH1-02-2007

3.5 Red cod – Salilota australis

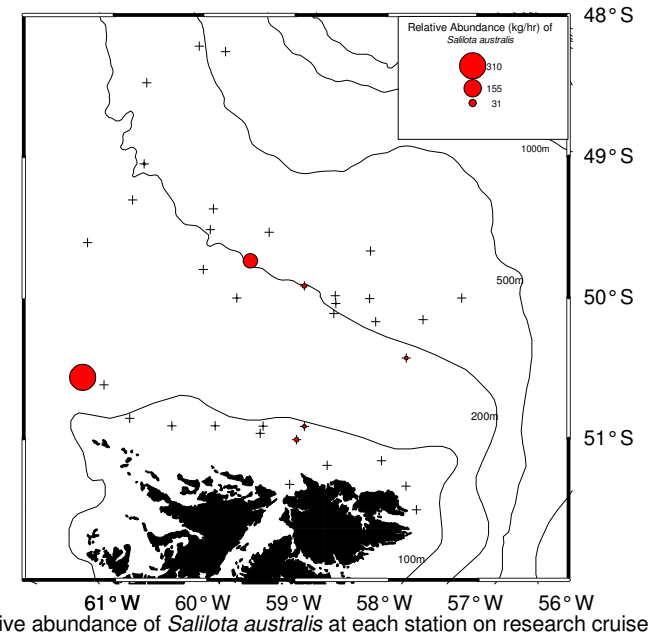


Figure 16: Relative abundance of *Salilota australis* at each station on research cruise ZDLH1-02-2007

Salilota australis was caught on 13 of the 36 trawl stations conducted and was the 11th most abundant species, in terms of weight, encountered during the cruise. The largest catches (152 kg) were found to the north west of the Jason Island group in 153 m water depth and to the north of the Islands (113 kg) at 220 m (Figure 16). CPUEs ranged from 0.44 to 304.55 kg/hr (mean = 36.92 ± 85.55).

A total of 310 individual red cod were sampled for length frequency analysis during the cruise. Gonads for histology and otoliths for age and growth studies were removed from subsamples of these individuals. *Salilota australis* ranged in size from 16 to 66 cm L_T (mean = 37.68 ± 9.80) and was tri-modal in their length distribution (Figure 17).

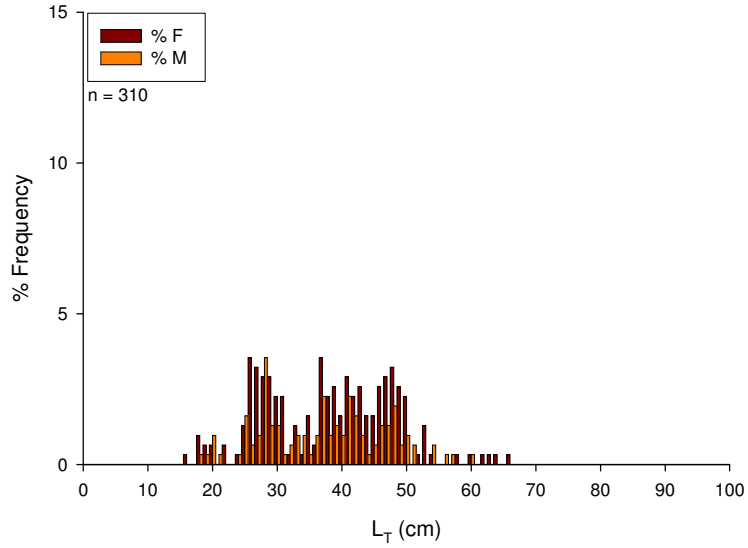


Figure 17: Length frequency distribution of *Salilota australis*

Most of the red cod sampled were at their resting stage (II) with fewer numbers at III. Red cod spawn in October and there were still a couple of animals at spent recovering stage (VIII) (Figure 18).

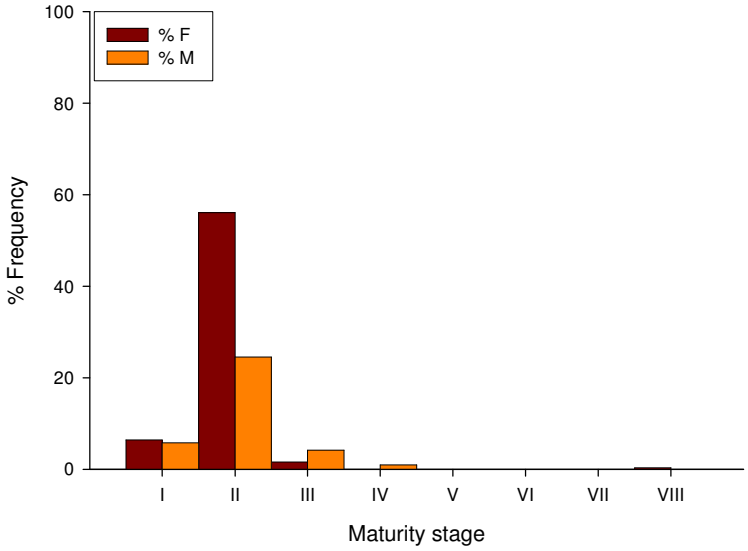


Figure 18: Distribution of maturity stages of male and female *Salilota australis* sampled on ZDLH1-02-2007

3.6 Kingclip – Genypterus blacodes

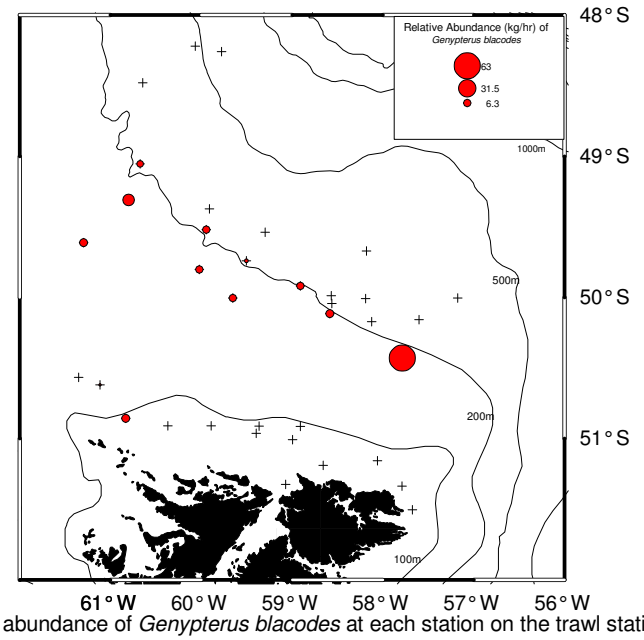


Figure 19: Relative abundance of *Genypterus blacodes* at each station on the trawl station ZDLH1-02-2007

Genypterus blacodes was caught on 12 of the 36 trawl stations conducted on the cruise and in terms of weight it was 23rd most abundant species. The largest catches were found on the shelf and shelf break (Figure 19). CPUEs ranged from 0.70 to 62.05 kg/hr (mean = 11.33 ± 16.34).

During the cruise 81 individuals were sampled for length frequency analyses and otoliths. Kingclip ranged from 46 to 87 cm L_T (mean = 66.79 ± 7.94). Figure 20 illustrates their length frequency distribution.

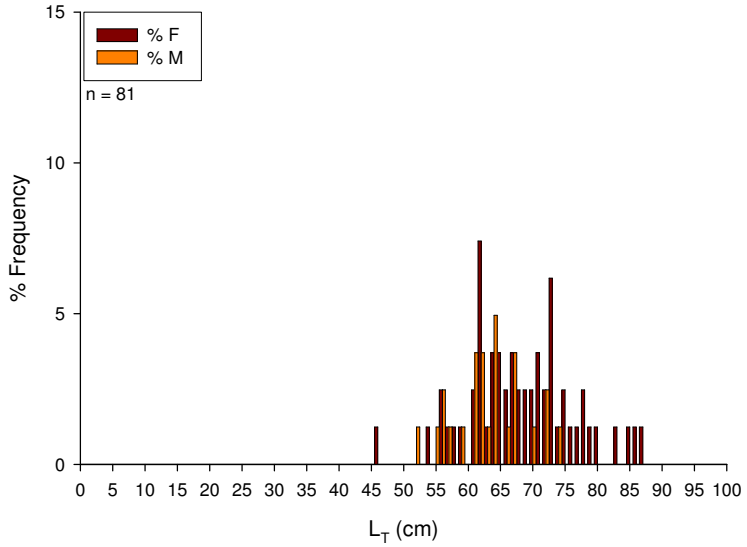


Figure 20: Length frequency distribution of male and female *Genypterus balcodes* sampled on ZDLH1-02-2007

As expected for this time of the year almost all kingclip sampled were at maturity stage II with few numbers at I and III (Figure 21).

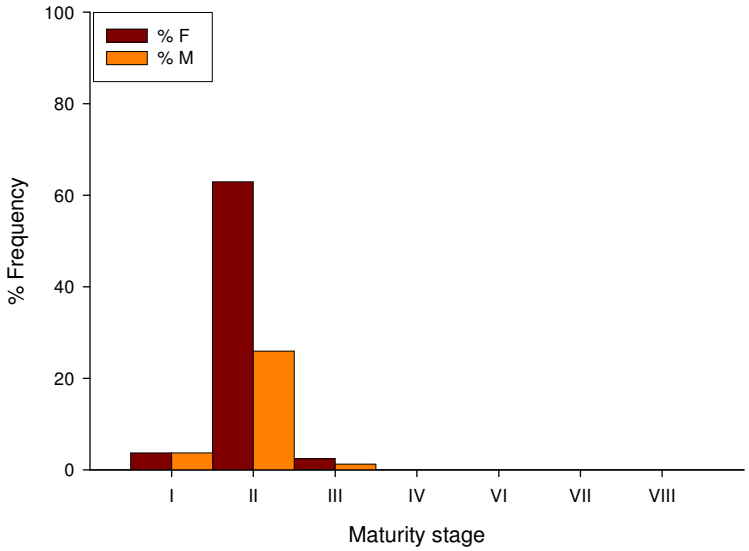


Figure 21: Maturity stages of male and female *Genypterus blacodes* sampled on ZDLH1-02-2007

3.7 Sothern blue whiting – Micromesistius australis

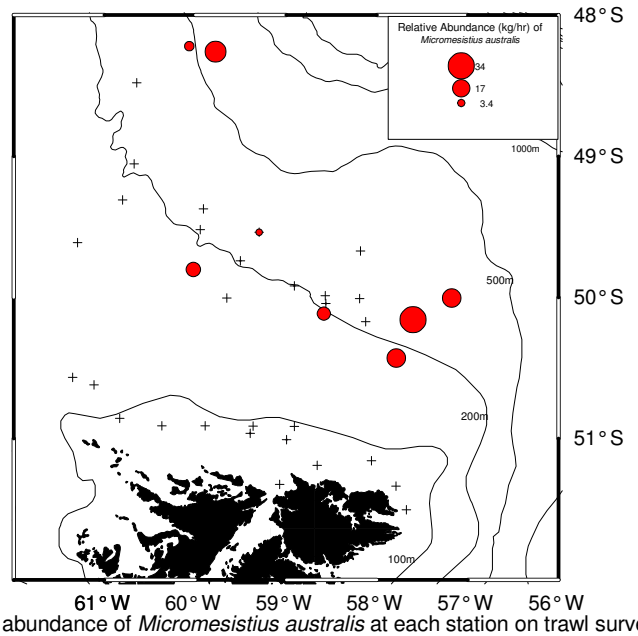


Figure 22: Relative abundance of *Micromesistius australis* at each station on trawl survey ZDLH1-02-2007

Southern blue whiting were caught on 13 of the 36 trawls conducted during the cruise and in water depths of between 124 and 573 m. The greatest catches were encountered on R5 to the northwest of the Islands off the shelf break and also on R1 to the north in over 500 m of water (Figure 22). CPUEs ranged from 0.03 to 33.64 kg/hr (mean = 9.93 ± 11.12).

A total of 193 individual *Micromesistius australis* were sampled for length frequency analysis during the cruise. Their lengths ranged from 10 to 66 cm L_T . The length frequency of southern blue whiting presented a trimodal distribution, probably representing three different cohorts (Figure 23)

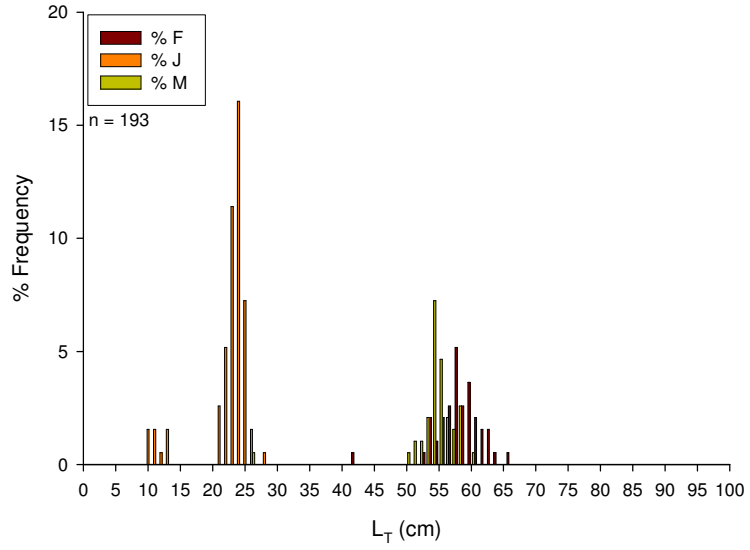


Figure 23: Length frequency distribution of *Micromesistius australis* sampled during ZDLH1-02-2007

Southern blue whiting spawn in October so it was not a surprise to find many individuals in their spent recovering (VIII) and resting (III) stages (Figure 24).

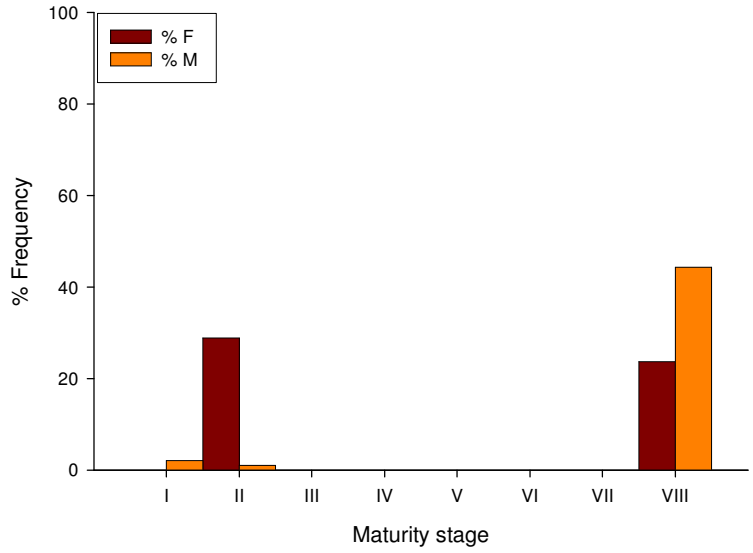


Figure 24: Maturity stages for male and female *Micromesistius australis* sampled on ZDLH1-02-2007

3.8 Patagonian toothfish – Dissostichus eleginoides

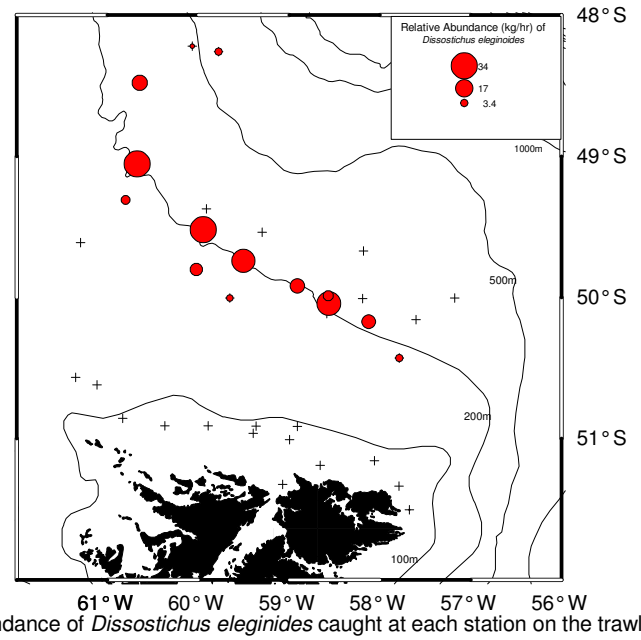


Figure 25: Relative abundance of *Dissostichus eleginides* caught at each station on the trawl survey ZDLH1-02-2007

Toothfish were caught on 15 of the 36 bottom trawl stations and were the 19th most common in terms of catch weight. Toothfish were caught at depths of 39 to 573 m. There greatest abundances occurred on the shelf break at 200 m (Figure 25). Small individuals (~15 cm L_T) were caught to the north of the Islands and to the northwest of Volunteer Point in <50m water depth. CPUEs ranged between 0.08 to 33.92 kg/hr (mean = 12.86 ± 12.04).

A total of fifty three individuals were sampled during the cruise. Otoliths were taken from all of these for age and growth studies and gonads were removed for reproductive studies. Toothfish ranged in size between 49 and 81 cm L_T (mean = 61.57 ± 6.89) over the period of the cruise (Figure 26).

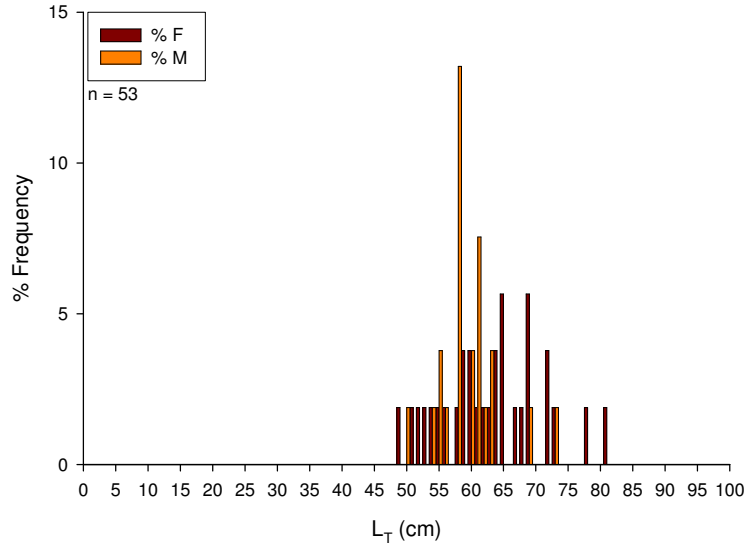


Figure 26: Length frequency distribution of *Dissostichus eleginoides* sampled during ZDLH1-02-2007

Most individuals were in their juvenile and resting stages with one individual female at stage VII (Figure 27).

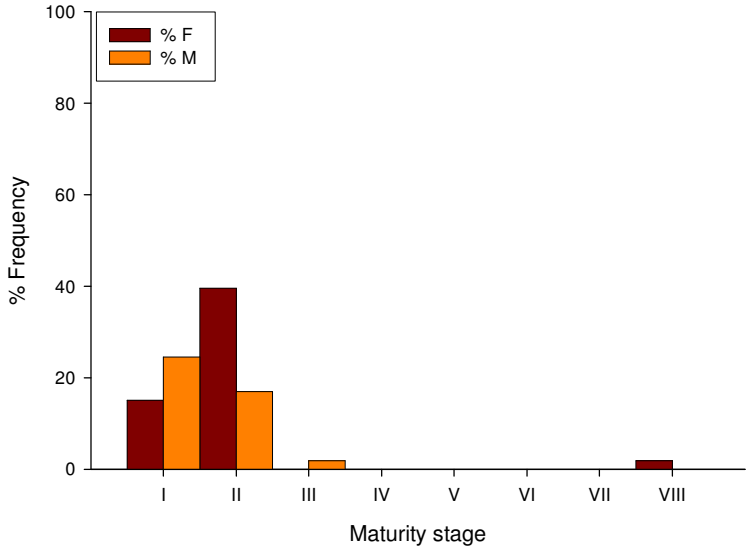


Figure 27: Maturity stages for male and female *Dissostichus eleginoides* sampled on ZDLH1-02-2007

3.9 The hakes – Merluccius hubbsi and *M. australis*

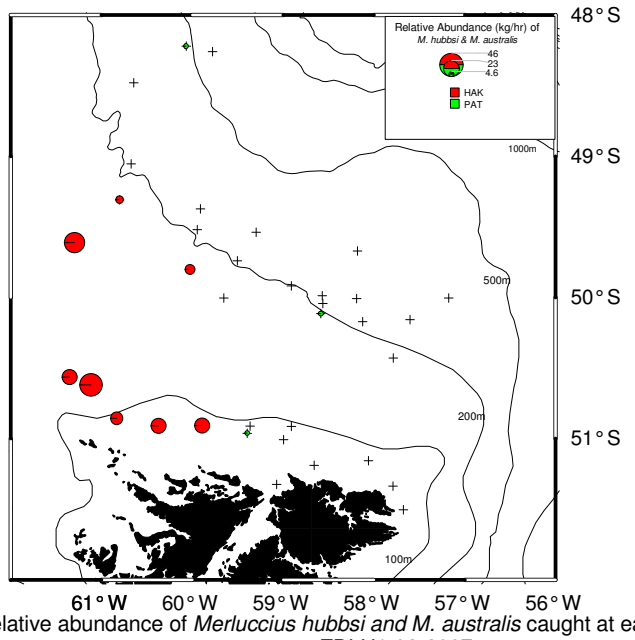


Figure 28: Relative abundance of *Merluccius hubbsi and M. australis* caught at each station on the trawl survey ZDLH1-02-2007

Merluccius hubbsi were caught on 8 of the 36 stations whilst *M. autralis* were caught on 3 of the 36 station. *Merluccius hubbsi* had a more westerly distribution while *M. australis* seemed to have a more easterly and northerly distribution (Figure 28). Their CPUEs ranged from 5.44 to 45.22 kg/hr and 3.21 to 3.69 kg/hr for *M. hubbsi* and *M. australis* respectively.

Only *M. hubbsi* were sampled in sufficient quantities (n = 84) to provide data on length frequency and maturity distributions. During the cruise *M. hubbsi* ranged in length from 42 to 63 cm L_T (mean = 51.49 ± 4.01). Figure 29 illustrates their length frequency distribution.

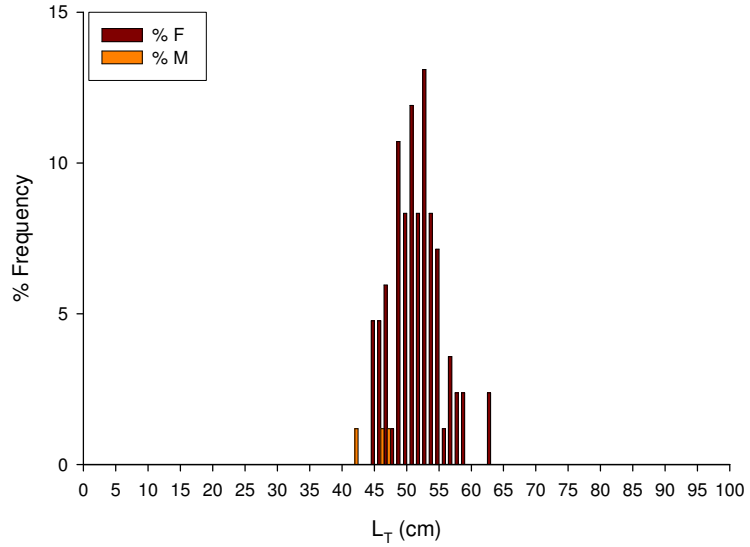


Figure 29: Length frequency distribution of *Merluccius hubbsi* sampled during ZDLH1-02-2007

Their maturities were restricted mainly to stages II and VIII so both resting and spent recovering animals were dominant in the population (Figure 30).

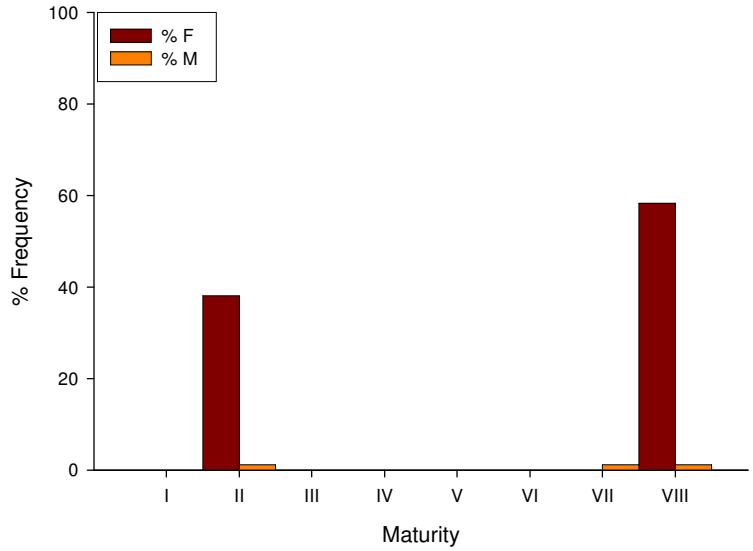


Figure 30: Maturity stages for male and female *Merluccius hubbsi* sampled on ZDLH1-02-2007

4.0 Skates and rays - Rajidae

This family, of which a total of some 14 or 15 species from 4 genera (*Bathyraja, Amblyraja, Dipturus,* and *Psammobatis*) were caught, comprised 8.57% of the total catch from 36 trawl stations. 35 stations yielded rajid catches. Station 2714, a shallow water station in the Northern entrance of Falkland Sound, was the exception (Figure 31). The most abundant species overall were *Bathyraja griseocauda*, *Bathyraja brachyurops,* and *Bathyraja albomaculata*, together 70.3% of the total Rajidae catch (see table 4, Figure 31, and biological discussion).

Figures 29 and 30 illustrate the relative abundances of the remaining species. In the genus *Psammobatis* there were three, possibly four species identified. Pending further taxonomic clarification, the shallow water species (down to about 120 m) is probably *Psammobatis rudis* (RPR), whereas *P. normani* (RPN) is the most widely spread. A third species was recognized, and this may well be *P. parvacauda*. Lastly *P. scobina* is arguably found in our region, and comparison with Chilean samples should provide further clarification.

A hitherto unidentified *Dipturus* sp. was caught in a total of 8 stations (listed as RAY). A total of 14 specimens caught were frozen for further work. Their size ranged from 25 to 152 cm TL, but interestingly even the largest specimens were still only sub-adults.

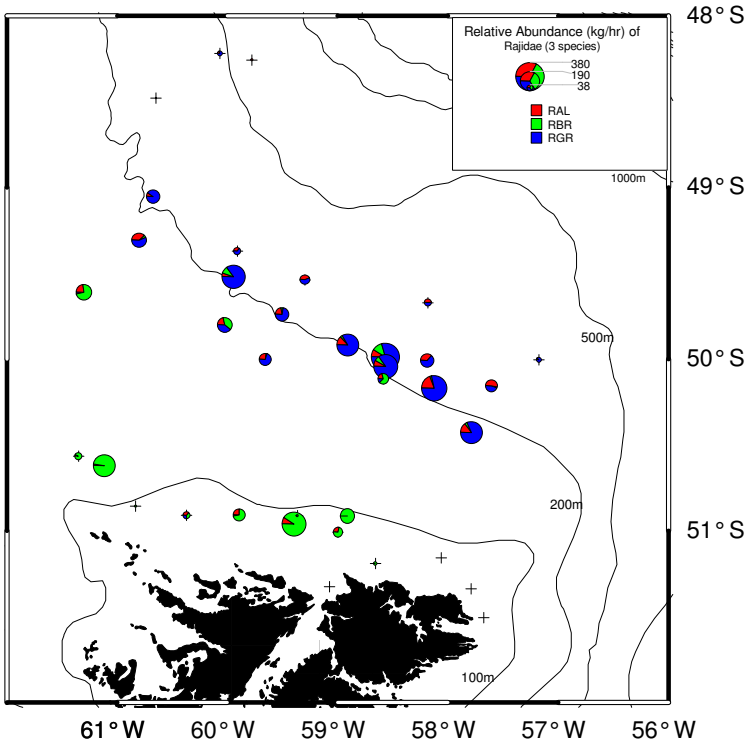


Figure 31: Relative abundance of *B. griseocauda, B. brachyurops,* and *B. albomaculata.*

Table 4: Catch (kg) of Rajidae

Species Code	*Species name*	***Total Catch (kg)***	***Total Sampled (kg)***	***Total Discarded (kg)***	***Proportion (%)***
RGR	*Bathyraja griseocauda*	***1,328.791***	***1,328.791***	***1,328.791***	***37.37%***
RBR	*Bathyraja brachyurops*	***722.484***	***722.484***	***722.484***	***20.32%***

RAL	*Bathyraja albomaculata*	***458.060***	***458.060***	***458.060***	***12.88%***
RBZ	*Bathyraja cousseauae*	***186.643***	***186.643***	***186.643***	***5.25%***
RMC	*Bathyraja macloviana*	***182.164***	***182.164***	***182.164***	***5.12%***
RSC	*Bathyraja scaphiops*	***174.997***	***174.997***	***174.997***	***4.92%***
RFL	*Raja flavirostris*	***100.555***	***100.555***	***100.555***	***2.83%***
RPX	*Psammobatis spp.*	***96.094***	***96.094***	***0.000***	***2.70%***
RMU	*Bathyraja multispinis*	***95.906***	***95.906***	***95.906***	***2.70%***
RAY	*Ray spp.(Dipturus sp.)*	***85.200***	***85.200***	***0.000***	***2.40%***
RDO	*Raja doellojuradoi*	***71.086***	***71.086***	***71.086***	***2.00%***
RMG	*Bathyraja magellanica*	***44.312***	***44.312***	***44.312***	***1.25%***
RPN	*Psammobatis normani*	***9.490***	***9.490***	***0.000***	***0.27%***
		3,555.782	***3,555.782***		

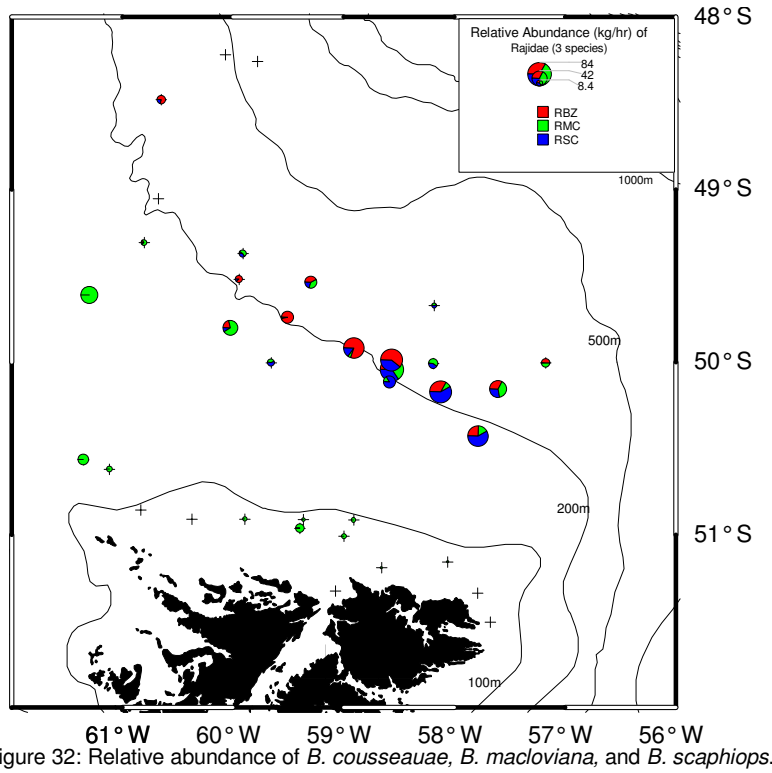


Figure 32: Relative abundance of *B. cousseauae, B. macloviana,* and *B. scaphiops*.

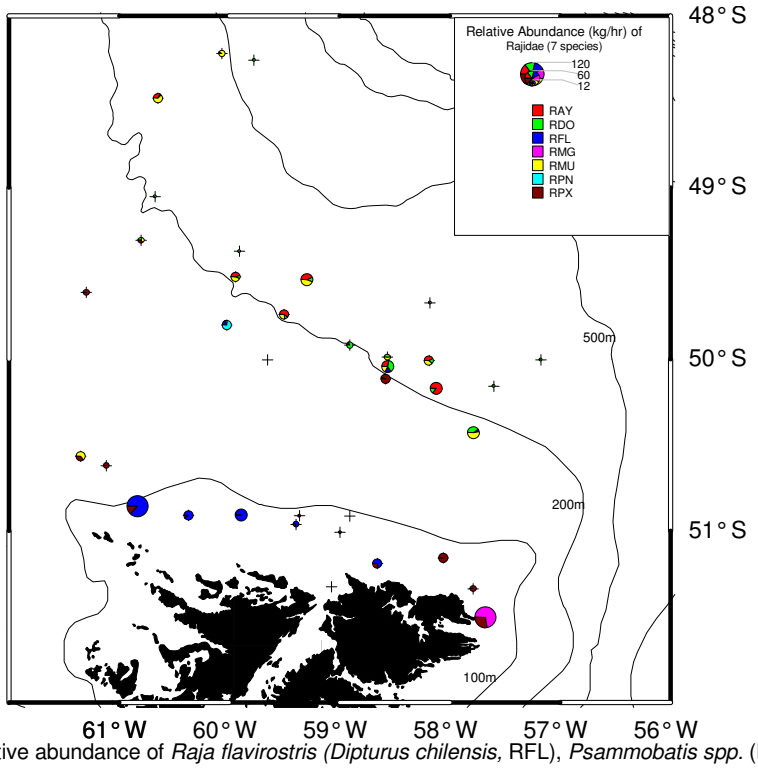


Figure 33: Relative abundance of *Raja flavirostris (Dipturus chilensis,* RFL), *Psammobatis spp.* (RPX, 3 species including RPN for some stations), *B. multispinis* (RMU), *Dipturus sp.* (listed as RAY), *Raja doellojuradoi* (RDO), *B. magellanica* (RMG), and *P. normani* (RPN)

4.0.1 Tag & Release program

One of the main cruise objectives was to tag and release as many rays as possible, from most species. Exceptions to this were all specimens of *Psammobatis*, which were kept for taxonomic study, either on board or ashore. Furthermore, most *B. cousseauae, B. macloviana,* and *B. multispinis* were kept for further detailed study (age/growth, diet, and reproduction).

Recovering the tagged animals will enable verification of the age/growth studies undertaken by scientists at FIFD, as well as help studies on migration patterns. A recovery program has been affected through the commercial fleet, but to date (April 2007) only two animals have been re-captured.

Table 5: Number of rajids tagged (also 4 dogfish and 1 catshark)

Species Code	*Number Tagged*	*Proportion (%)*
RGR	599	39.10%
RBR	325	21.21%
RAL	323	21.08%
RSC	109	7.11%
RDO	93	6.07%
RMC	22	1.44%
RPX	19	1.24%
RPN	15	0.98%
RFL	13	0.85%
RBZ	9	0.59%
DGS	4	0.26%
DGH	1	0.07%

Total	**1532**

During this cruise, a total number of 1,532 specimens (of the 2,393 caught, or 64%) were tagged with a t-bar tag (Table 5). As described in previous *Dorada* cruise reports, all skates were additionally injected with the antibiotic oxytetracycline (dosage of 20 mg per 1kg of bodyweight, in 20 mg/ml solution). Figure 34 shows the number of specimens tagged at each station.

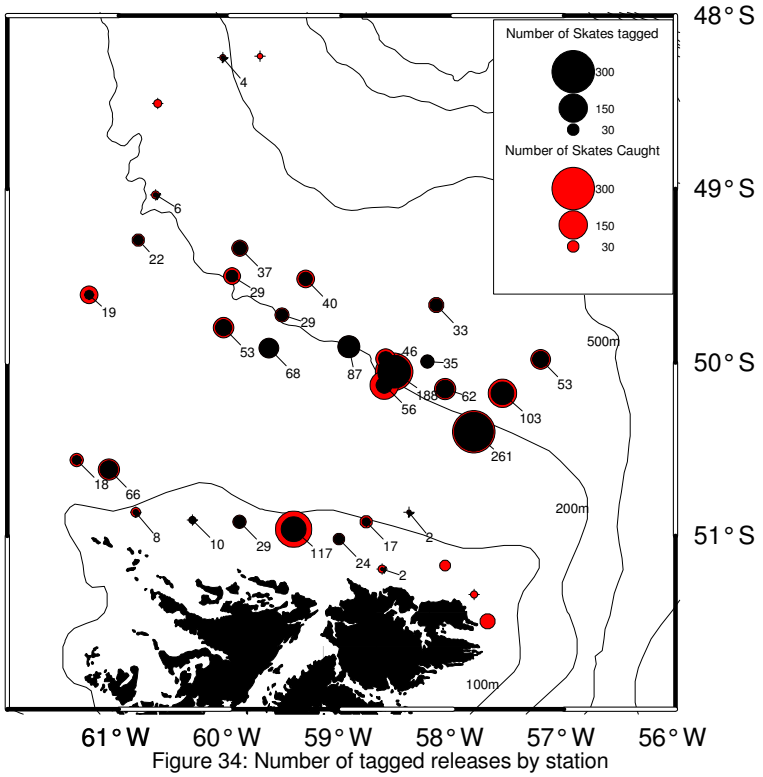


Figure 34: Number of tagged releases by station

4.0.2 Biology

In this section the three species of major importance in the region are briefly discussed. *B. griseocauda, B. brachyurops, and B. albomaculata* together made up 70% of the skate catch by weight

Bathyraja griseocauda

A total of 1,329 kg was caught, comprising 37% of the skate catch in 23 of the 36 stations. The depth range was 126 – 478 m, with highest weight and numbers around the 200m depth contour (see Figure 31). Of the 680 animals caught, 599 were tagged (or 88%).

There were four stations where catches exceeded 100 kg, one of which (st. 2702) yielded 244 kg (n=121). The second highest catch was st. 2694 with 190 kg but resulting in the highest numbers (n=195). Disk width ranged between 15 cm and 101 cm with a mean of 39.1cm (xF=40.9, xM 37.5). Overall, the population revealed a slight (52.2%) male predominance. It was apparent from the data that juveniles and sub-adults were predominant (see Figure 35). No egg capsules were recovered of this species, suggesting that egg-laying takes place in deeper waters than those surveyed.

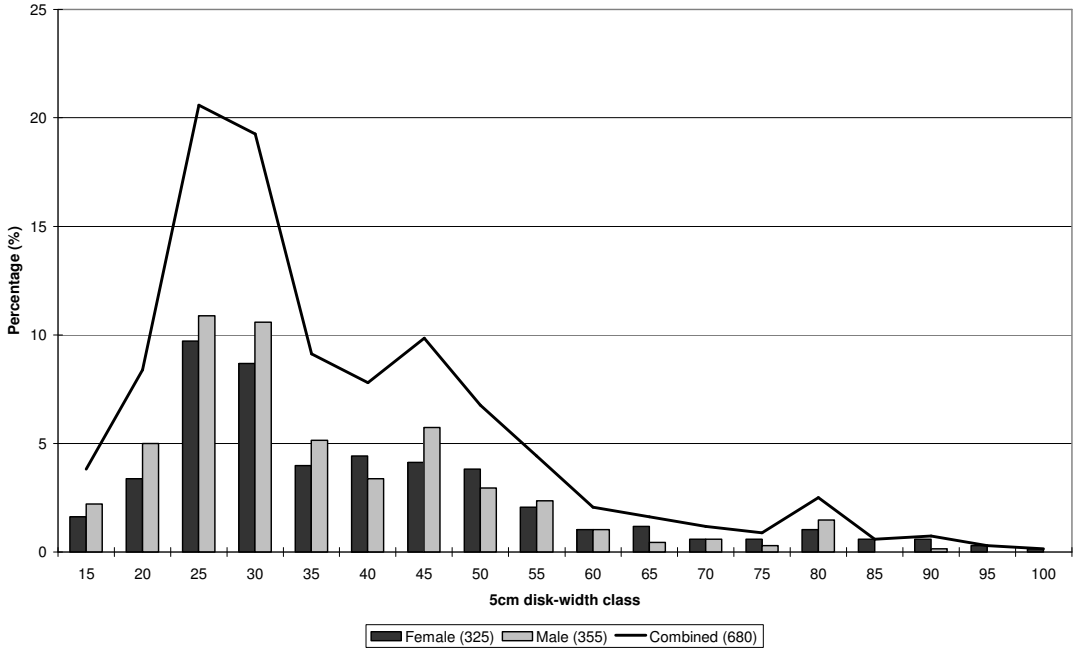


Figure 35: Size Frequency of *Bathyraja griseocauda*

Bathyraja brachyurops

A total of 722 kg was caught in 24 of the 36 stations, comprising 20.3% of the skate catch. The depth range was 66 – 348 m, with highest weight and numbers (259 kg and n=201 respectively) at station 2713 at a depth of 124 m (see Figure 31), a much shallower depth distribution than that of *B. griseocauda*. Of the 482 animals caught, 325 were tagged and released (or 67%).

There were eight stations where numbers were 20 or more, and the mean depth for these was 136 m. Disk width ranged between 8 cm and 79 cm with a mean of 37.8 cm (xF=37.9, xM 37.8). Overall, the population revealed a slight (53.9%) male predominance (see Figure 36). Egg capsules were found in a number of stations.

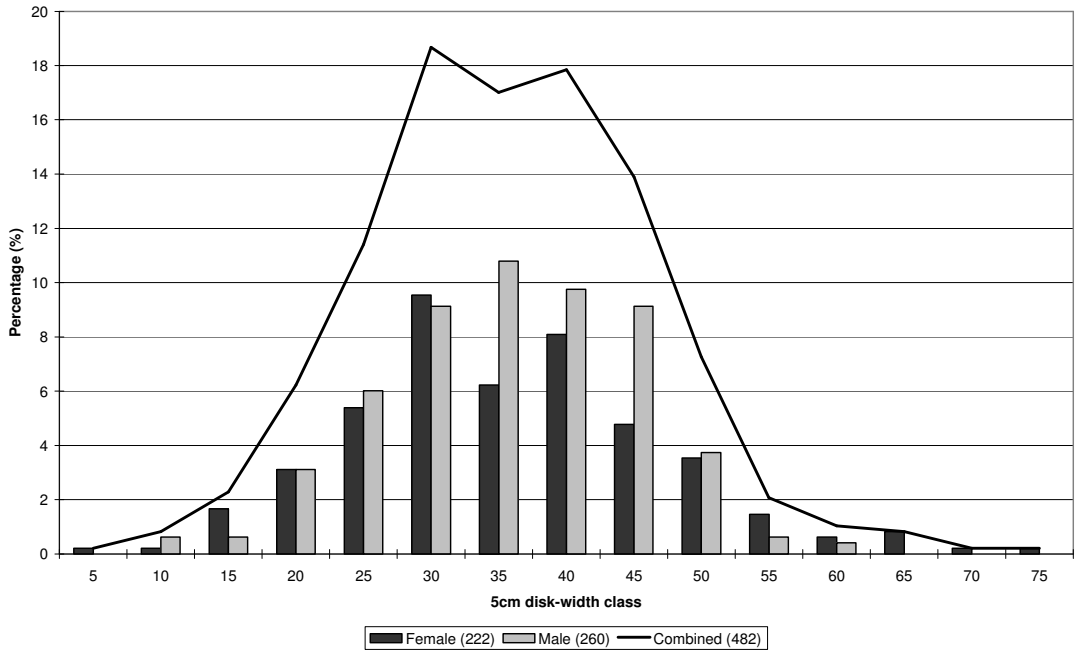


Figure 36: Size Frequency of *Bathyraja brachyurops*

Bathyraja albomaculata

A total of 458 kg was caught in 28 of the 36 stations, comprising 12.9% of the skate catch. The depth range was 124-594 m (see Figure 31), with highest weight and numbers (47 kg and n=48 respectively) at station 2696 at a depth of 324 m. Of the 418 animals caught, 323 were tagged (or 77%).

There were eight stations where numbers were 20 or more, and the mean depth for these was 136 m. Disk width ranged between 9 cm and 53 cm with a mean of 32 cm (xF=32.9, xM 31.3), and the female proportion was 50% (Figure 37). Although this species appears to inhabit the same depth range with *B. griseocauda*, its population structure shows a pre-dominance of sub-adult and adult specimens, rather than the more sub-adult population of *B. griseocauda*. Egg capsules of this species were also widely distributed.

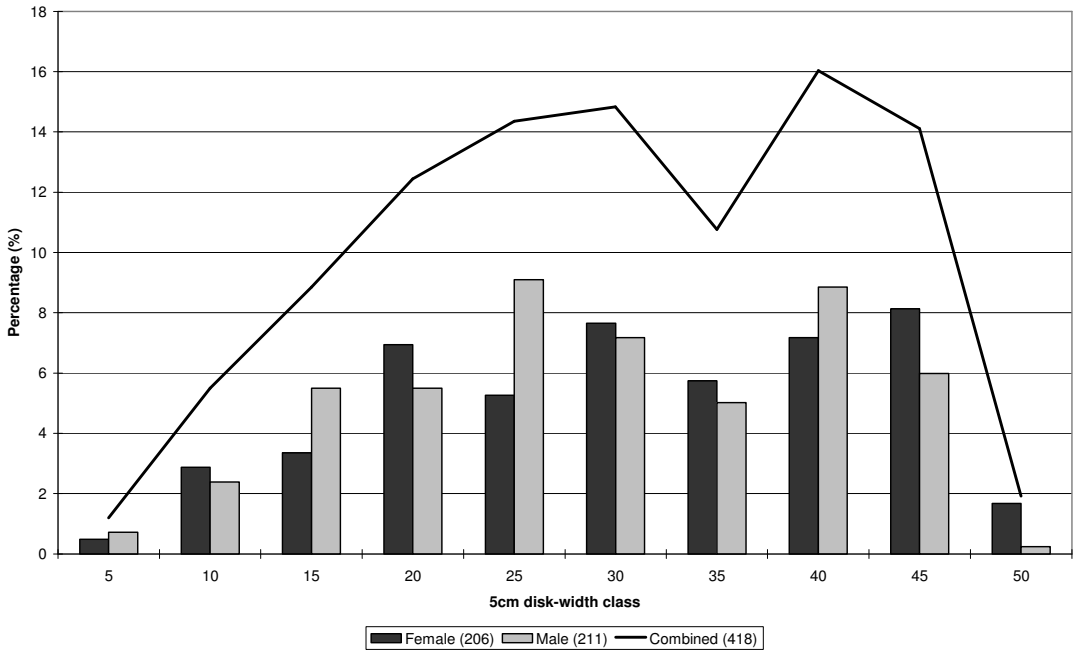


Figure 37: Size Frequency of *Bathyraja albomaculata*