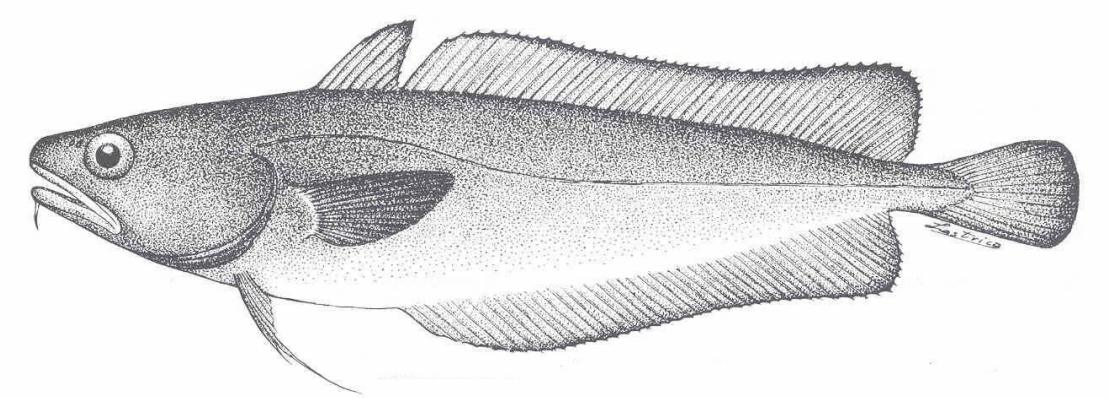
Scientific Report

Fisheries Research Cruise ZDLH1-10-2005



Fisheries Department
Falkland Islands Government

Scientific Report

Fisheries Research Cruise

ZDLH1-10-2005

FPRV Dorada

4th to 17th October 2005

Fisheries Department
Falkland Islands Government
Stanley
Falkland Islands

Participating Scientific Staff	Principle author of Section
Dr. Alexander Arkhipkin	*1.0 – 1.5 and 3.2*
Dr. Paul Brickle	*1.6, 1.7, and 3.0 – 3.7 - Editor*
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Joost Pompert	*3.8 and chart preparation*
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1.0 Introduction

A joint UK-Argentine survey of southern blue whiting which had been originally planned for September 2004, did not occur for various reasons. It was decided to use the spare vessel time to investigate the spawning grounds of several commercial finfish resources around the Falkland Islands at the beginning of the austral spring. The following report summarises the research activities carried out on the R/V *Dorada* in October 2005.

1.1 Region

The southern and western parts the Falkland Islands Shelf and west of the Jason Island group. (Figure 1).

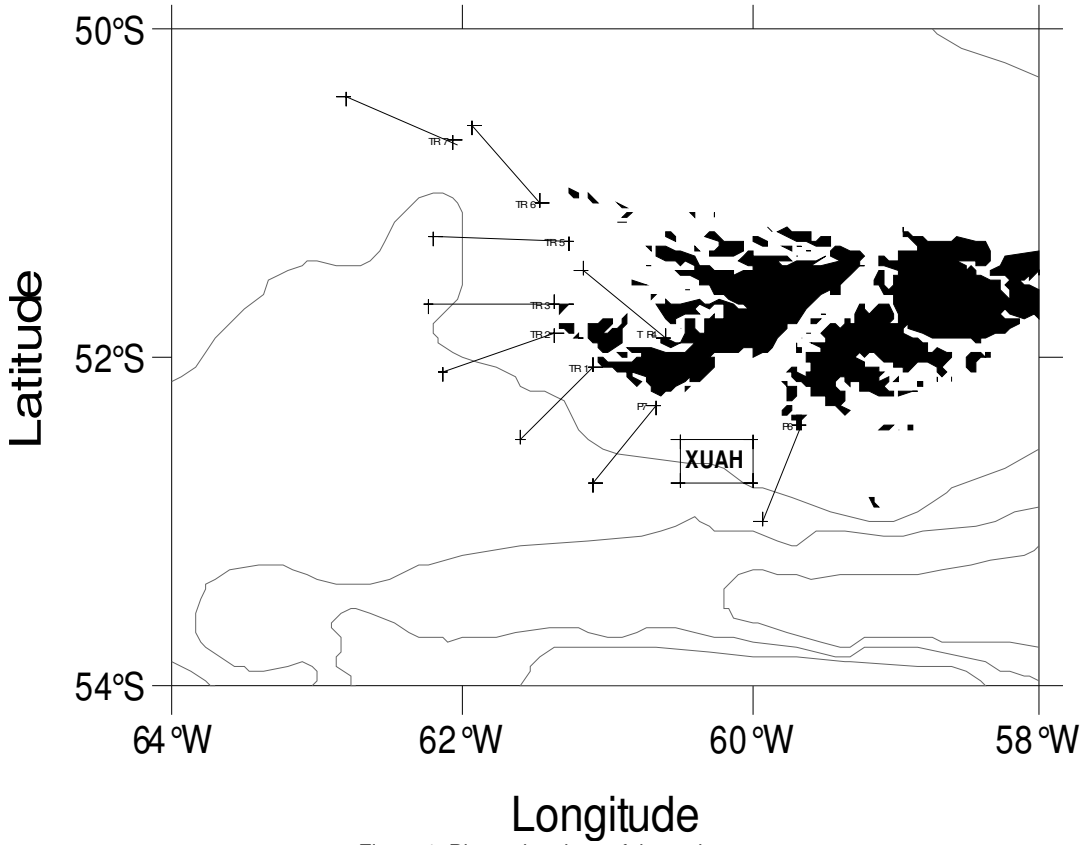

Figure 1. Planned regions of the cruise.

1.2 Cruise objectives

1. To carry out a demersal survey of the spawning grounds of redcod
2. To carry out a ray survey of the area and in particular stations within XUAH.
3. To look for redfish spawning aggregations west of the Jason Islands.
4. To tag skates for migration and age validation studies.
5. To continue oceanographic studies of the Falkland shelf.

1.3 Cruise plan and key dates

One of the main aims of the survey was to identify the spawning grounds of redcod to the southwest of the Falkland Islands in order to analyse their hydrographic characteristics, sample spawning fish for

analysis of age structure and fecundity, with possible development of a set of conservative measures to manage this decreasing in recent years but valuable commercial stock. Alongside with this work, the other main objective was to catch and tag as many commercial species of skates and rays as possible for the further analysis of their migration patterns and to for the validation of age.

The vessel departed from Stanley at 20:00Z hrs on the 4th October and proceeded to the first station on P6 (100 m). Three trawl stations were conducted on the 5th October, and next day the vessel spent the whole day in XUAH ('skate box') conducting four trawls to catch skates and rays for tagging. During the rest of the week, three-four trawls were conducted every day to the southwest and west of the Falklands. The weather deteriorated on the 12th October, and remained very windy (F8-F9) until 15th October. During this period, it was not possible to fish in open waters because of high seas, but two trawls per day were undertaken in both Queen Charlotte and King George Bays. The remaining two days were devoted to trawling west of Jason Islands with the aim of catching spawning redfish. Oceanographic stations (up to three per day) were made either before or after trawling operations. The cruise was completed with the return to Stanley on 17th October. A total of 13 days were spent at sea.

1.4 Vessel characteristics

The cruise was conducted on board the Fishery Patrol/Research Vessel *Dorada* registered in the Falkland Islands.

Table 1: Characteristics of the Fisheries Protection and Research Vessel, *Dorada*

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

1.5 Personnel and responsibilities

The following personnel participated in the cruise:

Dr. Alexander Arkhipkin	Chief Scientist, oceanographic survey
Dr. Paul Brickle	Trawl survey
Dr. Lianos Triantafillos	Trawl survey
Joost Pompert	Trawl survey
Sarah Crofts	Trawl survey
Bahadir Onsoy	Trawl survey
Melissa Pritchard	Trawl survey

1.6 Equipment used

Acoustics

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

1. Scientific echosounder SIMRAD EK500 38/120 KHz
2. Sonardata Echolog (data acquisition) and Echoview (post-processing) software

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.

Oceanographic

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

1. CTD SBE 25 with oxygen sensor and SeaTech fluorometer
2. Thermosalinometer SBE45

1.7 Sampling

1.7.1 Acoustic survey

During the survey acoustic data were logged along the entire track. The data were archived in SonarData EK5 format on a PC in the dry lab running the SonarData Echolog500.

1.7.2 Trawl stations and biological sampling

During the ZDLH1-10-2005 research cruise the station numbers ranged from 2185 to 2259 (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: Dates, locations, modal depths and duration of oceanographic (C) and trawl (B) stations carried out during research cruise ZDLH1-10-2005 between 5th October and 16th October 2005.

Station	XDate	Start Latitude		Start Longitude		Finish Latitude		Finish Longitude		Modal Depth	Activity	Duration mins
2185	05/10/2005	52	28.80	59	42.20	52	28.70	59	42.40	101	C	4
2186	05/10/2005	52	28.60	59	41.20	52	29.30	59	47.30	106	B	78
2187	05/10/2005	52	44.40	59	49.40	52	44.40	59	49.50	162	C	8
2188	05/10/2005	52	45.80	59	45.80	52	45.10	59	51.80	162	B	71
2189	05/10/2005	52	58.80	59	55.10	52	58.90	59	54.60	288	C	12
2190	05/10/2005	52	58.30	59	54.10	52	58.40	59	45.60	244	B	83
2191	05/10/2005	52	41.60	60	17.50	52	38.00	60	20.80	207	B	77
2192	05/10/2005	52	38.10	60	20.00	52	38.00	60	19.80	193	C	9
2193	06/10/2005	52	36.90	60	9.60	52	36.90	60	9.40	151	C	6
2194	06/10/2005	52	36.80	60	9.40	52	34.20	60	13.70	156	B	69
2195	06/10/2005	52	33.40	60	20.40	52	33.40	60	20.20	156	C	7
2196	06/10/2005	52	32.80	60	20.80	52	35.00	60	16.20	160	B	72
2197	06/10/2005	52	34.15	60	27.30	52	34.25	60	27.00	185	C	8
2198	06/10/2005	52	34.10	60	26.00	52	38.50	60	19.40	190	B	105
2199	06/10/2005	52	37.40	60	26.80	52	36.00	60	35.50	227	B	99
2200	06/10/2005	52	36.20	60	34.90	52	36.10	60	34.60	259	C	17
2201	07/10/2005	52	18.70	60	39.80	52	18.70	60	39.80	114	C	6
2202	07/10/2005	52	21.10	60	37.00	52	24.00	60	44.70	150	B	92
2203	07/10/2005	52	25.50	60	48.40	52	25.50	60	48.30	177	C	8
2204	07/10/2005	52	25.40	60	48.60	52	28.00	60	54.60	197	B	73
2205	07/10/2005	52	31.80	60	53.70	52	31.80	60	53.20	254	C	11
2206	07/10/2005	52	31.50	60	53.80	52	33.60	60	42.90	264	B	100
2207	07/10/2005	52	36.80	60	45.10	52	40.30	60	54.00	324	B	109
2208	07/10/2005	52	40.50	60	53.80	52	40.50	60	53.30	360	C	15
2209	08/10/2005	52	30.00	61	31.60	52	30.10	61	30.90	337	C	14

Station	XDate	Start Latitude		Start Longitude		Finish Latitude		Finish Longitude		Modal Depth	Activity	Duration
2210	08/10/2005	52	30.00	61	30.80	52	26.20	61	39.00	332	B	112
2211	08/10/2005	52	20.20	61	27.10	52	20.10	61	26.70	260	C	11
2212	08/10/2005	52	20.00	61	26.60	52	14.70	61	28.10	251	B	102
2213	08/10/2005	52	7.30	61	25.60	52	7.30	61	25.30	163	C	8
2214	08/10/2005	52	7.20	61	25.10	52	3.10	61	29.60	164	B	92
2215	08/10/2005	52	13.90	61	21.70	52	10.30	61	29.20	200	B	96
2216	08/10/2005	52	2.90	61	5.10	52	2.80	61	5.00	100	C	5
2217	09/10/2005	51	50.70	61	22.10	51	50.70	61	22.90	99	C	5
2218	09/10/2005	51	55.30	61	20.90	51	52.00	61	25.30	104	B	60
2219	09/10/2005	51	57.90	61	44.00	51	58.00	61	43.90	164	C	7
2220	09/10/2005	52	0.00	61	41.00	51	57.20	61	46.60	171	B	96
2221	09/10/2005	52	1.20	61	51.40	52	1.30	61	51.20	246	C	10
2222	09/10/2005	52	5.20	61	47.20	51	58.90	61	48.80	229	B	149
2223	10/10/2005	51	40.70	62	13.10	51	40.70	62	12.80	220	C	6
2224	10/10/2005	51	40.30	62	12.80	51	33.80	62	13.30	232	B	105
2225	10/10/2005	51	35.60	62	4.80	51	35.50	62	4.40	206	C	8
2226	10/10/2005	51	35.40	62	4.20	51	38.90	62	3.10	195	B	69
2227	10/10/2005	51	38.50	61	55.00	51	38.40	61	54.70	164	C	8
2228	10/10/2005	51	38.10	61	55.10	51	44.20	61	55.10	167	B	101
2229	10/10/2005	51	39.90	61	37.10	51	39.80	61	36.90	140	C	6
2230	10/10/2005	51	39.70	61	37.50	51	35.10	61	41.30	146	B	96
2231	10/10/2005	51	39.80	61	22.10	51	39.80	61	21.90	94	C	5
2232	11/10/2005	51	29.40	61	23.10	51	29.40	61	23.00	100	C	6
2233	11/10/2005	51	30.90	61	43.20	51	30.90	61	43.10	150	C	7
2234	11/10/2005	51	30.50	61	43.00	51	24.40	61	44.70	152	B	91
2235	11/10/2005	51	26.70	61	55.00	51	26.70	61	54.80	198	C	9
2236	11/10/2005	51	27.20	61	55.40	51	33.40	62	1.70	205	B	100
2237	11/10/2005	51	31.40	62	8.40	51	31.50	62	8.10	227	C	11
2238	11/10/2005	51	31.30	62	7.90	51	24.70	62	7.50	222	B	99
2239	12/10/2005	51	45.40	60	42.50	51	45.40	60	42.40	50	C	4
2240	12/10/2005	51	45.60	60	42.60	51	48.80	60	42.90	46	B	55
2241	12/10/2005	51	49.80	60	44.60	51	53.30	60	45.60	46	B	54
2242	13/10/2005	51	32.20	60	42.20	51	32.00	60	42.10	67	C	4
2243	13/10/2005	51	31.80	60	42.10	51	29.20	60	46.10	69	B	58
2244	13/10/2005	51	39.30	60	35.20	51	35.50	60	36.30	58	B	63
2245	14/10/2005	51	34.40	60	34.50	51	37.50	60	32.70	56	B	56
2246	14/10/2005	51	44.10	60	43.70	51	47.20	60	40.20	52	B	53
2247	15/10/2005	51	17.80	61	16.20	51	17.70	61	16.20	120	C	6
2248	15/10/2005	51	17.50	61	17.30	51	20.00	61	25.40	133	B	92
2249	15/10/2005	51	16.90	61	42.60	51	16.90	61	42.60	172	C	7
2250	15/10/2005	51	16.70	61	42.60	51	22.00	61	49.10	180	B	101
2251	15/10/2005	51	15.70	62	10.30	51	15.60	62	10.10	199	C	9
2252	15/10/2005	51	15.30	62	9.70	51	9.60	62	2.30	194	B	97
2253	15/10/2005	50	59.20	61	47.40	51	3.80	61	53.00	175	B	100
2254	15/10/2005	51	3.20	61	26.60	51	3.20	61	26.40	114	C	6
2255	16/10/2005	50	34.70	61	55.70	50	34.80	61	55.60	178	C	8
2256	16/10/2005	50	34.50	61	55.60	50	40.20	61	51.60	179	B	94
2257	16/10/2005	50	46.90	61	42.20	50	47.50	61	42.00	150	C	6
2258	16/10/2005	50	47.00	61	41.80	50	52.50	61	38.50	146	B	96
2259	16/10/2005	50	51.40	61	37.50	50	55.50	61	42.30	137	B	100

2.0 Oceanography

2.1 Oceanographic methods

A logging CTDO (SBE-25, Sea-Bird Electronics Inc., Bellevue, USA) was deployed to obtain profiles of temperature (ºC), salinity (PSU), and dissolved oxygen (ml l^{-1}). The CTD was deployed for the first minute at about 8-10 m depth to allow polarization of the oxygen sensor. It was then hauled to 1 m depth and deployed again either to depth about 10-20 m above the bottom (shelf and continental slope) or down to 1000 m in the open sea. 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 oxygen 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. 5.2-2000.

Oceanographic data were collected at 36 oceanographic stations. These stations were conducted either before or after each trawl, and also at some inshore and offshore sites (depth range 50-360 m), in the western part of the Falkland shelf (Figure 2).

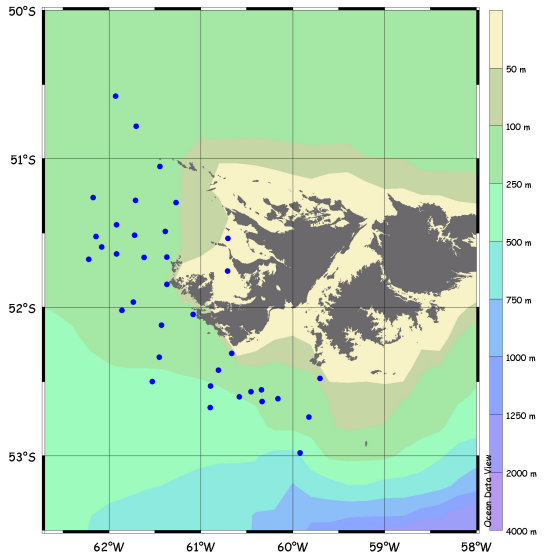

Figure 2: Oceanographic stations conducted during the research cruise ZDLH1-10-2005

2.2 Results

CTD stations covered the south-western part of the FICZ, and waters south of Falkland Sound. Temperatures ranged from 5.2º to 6.6ºC, salinity from 33.4 to 34.1, oxygen – from 5.8 to 6.9 ml/l, and densities from 25.3 to 26.9 kg/m^3.

This spring's oceanographic survey was carried out about one month later than in 2002 – 2004 because it was not aimed at investigating the blue whiting spawning grounds. Therefore, this temporal difference makes it difficult to estimate the inter-annual variability of the main oceanographic features in the area.

The oceanographic situation was characterised by the presence of colder, more saline and oxygen-poor waters inshore at depths shallower of 100 - 150 m. Inshore primary productivity was relatively low (Figures 3, 4, and 5). This pattern was similar to that observed during the "blue whiting" surveys in September 2002-2005.

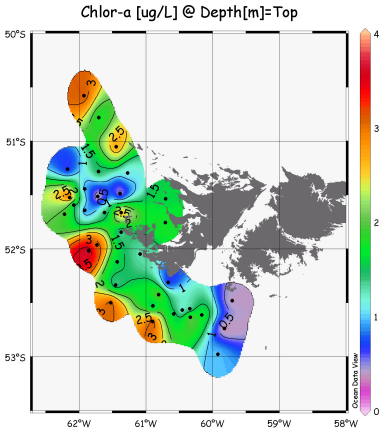

Figure 3: Iso-surface of chlorophyll “a” at the surface during research cruise ZDLH1-10-2005

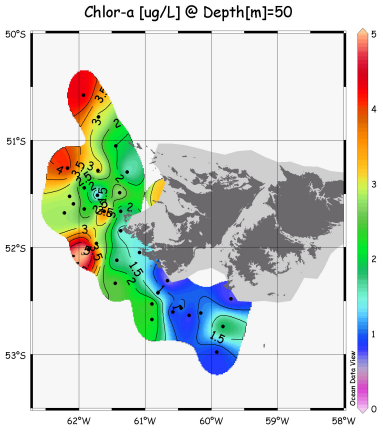

Figure 4: Iso-surface of chlorophyll “a” at the horizon of 50 m during research cruise ZDLH1-10-2005

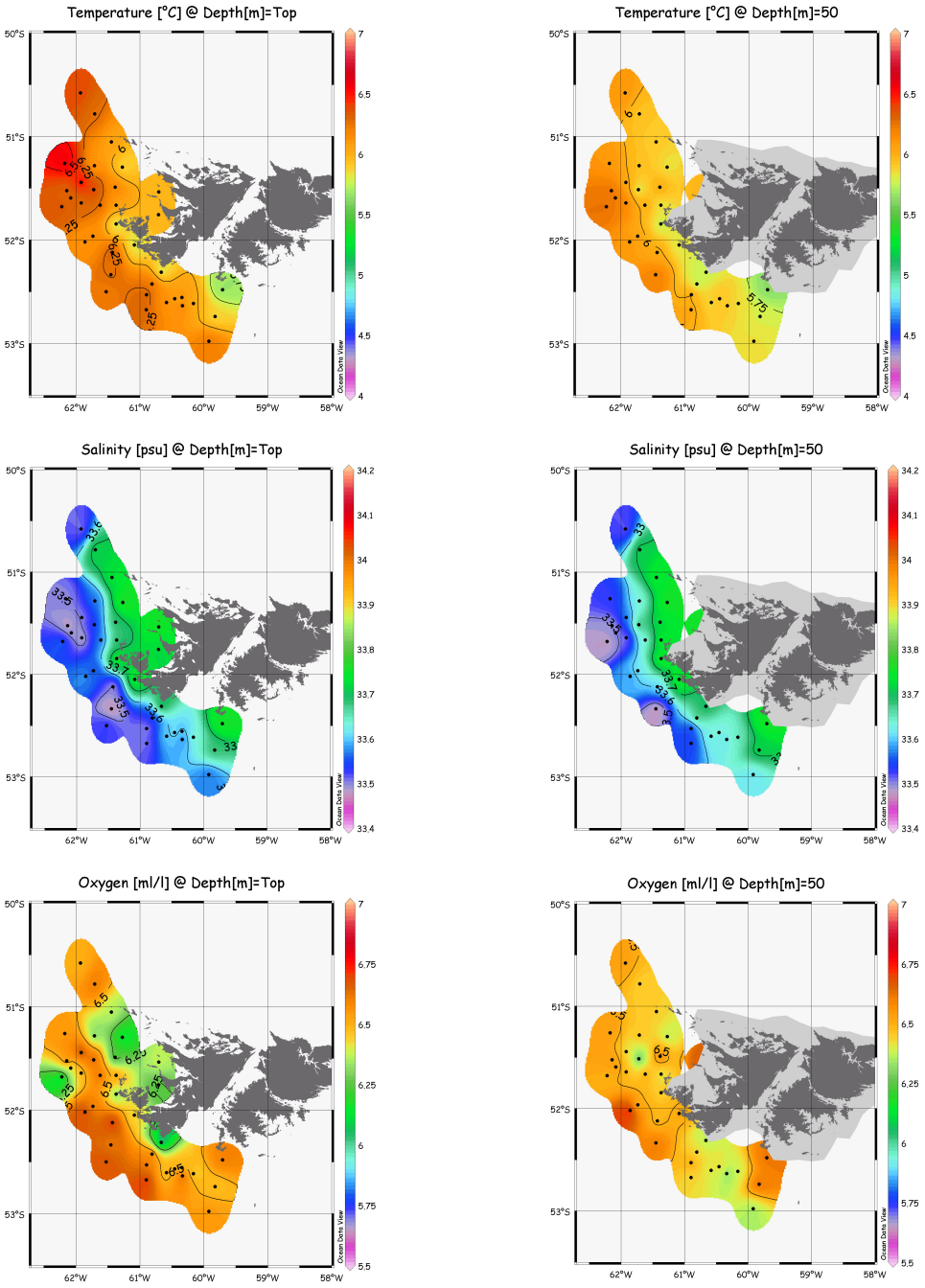

Figure 5: Oceanographic situation on the shelf in October 2005.

3.0 Biological sampling

3.1 Catch and by-catch

Trawling was conducted at 39 stations on the southern and western Falkland Islands shelf. Trawling time varied between 53 and 149 minutes.

A total of 22,425 kg, consisting of over 80 species, was caught during the cruise. In terms of weight, the greatest catch during the cruise was hoki *Macruronus magellanicus* followed by redcod *Salilota australis* and the Patagonian rockcod *Patagonotothen ramsayi*.

Table 3: Total catch of trawl stations conducted during research cruise ZDLH1-10-2005

Species Code	*Species name*	*Total Catch (kg)*	*Total Sampled (kg)*	*Total Discarded (kg)*	*Proportion (%)*
WHI	*Macruronus magellanicus*	5,811.763	845.477	5,668.763	25.92%
BAC	*Salilota australis*	4,062.333	731.811	3,594.188	18.12%
PAR	*Patagonotothen ramsayi*	3,695.365	94.203	3,515.258	16.48%
BLU	*Micromesistius australis*	1,909.770	126.543	1,909.770	8.52%
MUG	*Munida gregaria*	1,021.177	4.453	1,021.177	4.55%
RFL	*Raja flavirostris*	637.118	637.118	637.118	2.84%
SPN	Sponges	594.117	7.490	574.627	2.65%
LOL	*Loligo gahi*	510.250	266.525	451.822	2.28%
RBR	*Bathyraja brachyurops*	482.476	482.476	482.476	2.15%
SHT	Mixed invertebrates	478.490	0.000	478.490	2.13%
CGO	*Cottoperca gobio*	425.631	79.494	421.631	1.90%
DGH	*Schroederichthys bivius*	374.952	33.200	374.952	1.67%
BRY	Bryozoa	247.176	0.000	247.176	1.10%
RAL	*Bathyraja albomaculata*	246.132	236.132	246.132	1.10%
HAK	*Merluccius hubbsi*	242.801	242.801	0.000	1.08%
GRF	*Coelorhynchus fasciatus*	190.256	0.000	190.256	0.85%
WRM	Worm cases	179.850	0.000	179.850	0.80%
RMC	*Bathyraja macloviana*	127.970	127.970	127.970	0.57%
RSC	*Bathyraja scaphiops*	113.590	113.590	113.590	0.51%
RBZ	Unidentified ray #3	104.427	104.427	104.427	0.47%
SQT	Ascidiacea	101.357	0.000	101.357	0.45%
RGR	*Bathyraja griseocauda*	100.728	100.728	100.728	0.45%
GRC	*Macrourus carinatus*	96.120	96.120	96.120	0.43%
RMU	*Bathyraja multispinis*	71.031	71.031	71.031	0.32%
KIN	*Genypterus blacodes*	66.731	66.731	12.975	0.30%
STE	*Sterechinus sp.*	57.140	0.000	57.140	0.25%
MUU	*Munida subrugosa*	46.288	0.373	46.288	0.21%
TOO	*Dissostichus eleginoides*	44.597	44.597	2.826	0.20%
COL	*Cosmasterias lurida*	38.189	0.000	38.189	0.17%
NEM	*Neophyrnichthys marmoratus*	32.060	32.060	32.060	0.14%
ANM	Anemone	28.849	0.000	28.849	0.13%
RPX	*Psammobatis spp.*	26.175	21.503	26.175	0.12%
DGS	*Squalus acanthias*	25.963	20.779	25.963	0.12%
GOC	*Gorgonocephalas chilensis*	22.479	0.000	22.479	0.10%
RED	*Sebastes oculatus*	21.854	21.516	8.619	0.10%
OCC	Octocorals	21.726	0.000	21.726	0.10%
AST	Asteroidea	19.721	0.000	19.721	0.09%
PAT	*Merluccius australis*	16.529	16.529	0.000	0.07%
PAW	*Patagonotothen wiltoni*	14.580	14.580	1.992	0.07%

Species Code	*Species name*	*Total Catch (kg)*	*Total Sampled (kg)*	*Total Discarded (kg)*	*Proportion (%)*
PES	*Peltarion spinosulum*	13.387	0.000	13.387	0.06%
AUC	*Austrocidaris canaliculata*	11.058	0.000	11.058	0.05%
RDO	*Raja doellojuradoi*	10.332	10.332	10.332	0.05%
SAR	*Sprattus fuegensis*	9.257	3.638	7.045	0.04%
WLK	Whelks	9.197	0.000	9.197	0.04%
MUL	*Eleginops maclovinus*	7.155	7.155	3.655	0.03%
OCM	*Octopus megalocyathus*	5.512	4.590	0.922	0.02%
EUO	*Eurypodius longirostris*	5.462	0.000	5.462	0.02%
SUN	Sunstar *Labidaster radiosus*	5.254	0.000	5.254	0.02%
AUL	*Austrolycus laticinctus*	5.078	0.000	0.078	0.02%
ANT	Anthozoa	4.217	0.000	4.217	0.02%
PAG	*Paralomis granulosa*	3.921	0.000	3.421	0.02%
BEJ	*Benthoctopus sp.cf.januarii*	3.446	2.847	0.599	0.02%
ING	*Moroteuthis ingens*	3.240	2.277	3.240	0.01%
EEL	*Iluocoetes fimbriatus*	3.181	2.971	0.210	0.01%
COT	*Cottunculus granulosus*	3.099	1.546	3.099	0.01%
PTE	*Patagonotothen tessellata*	2.593	2.593	2.370	0.01%
EUL	*Eurypodius latreillei*	2.057	0.000	2.057	0.01%
BEE	*Benthoctopus eureka*	1.754	1.754	0.000	0.01%
CHE	*Champsocephalus esox*	1.249	1.249	0.496	0.01%
XXX	Unidentified animal	0.954	0.024	0.930	0.00%
SEP	*Seriolella porosa*	0.806	0.806	0.408	0.00%
PYM	*Physiculus marginatus*	0.716	0.716	0.716	0.00%
RMG	*Bathyraja magellanica*	0.700	0.000	0.700	0.00%
ZYP	*Zygochlamys patagonica*	0.506	0.000	0.506	0.00%
COG	*Patagonotothen guntheri*	0.397	0.397	0.397	0.00%
BRP	Brachiopoda	0.395	0.000	0.395	0.00%
BUT	*Stromateus brasiliensis*	0.285	0.285	0.285	0.00%
NUD	*Nudibranchia*	0.284	0.000	0.284	0.00%
POL	Polychaeta	0.282	0.000	0.282	0.00%
MYF	*Myxine fernholmi*	0.261	0.000	0.261	0.00%
OPH	*Ophiuroidea*	0.237	0.000	0.237	0.00%
HOL	*Holothuroidea*	0.222	0.000	0.222	0.00%
CRB	Crab	0.090	0.000	0.090	0.00%
SRP	*Semirossia patagonica*	0.088	0.088	0.000	0.00%
CAS	*Campylonotus semistriatus*	0.083	0.000	0.083	0.00%
ARD	*Arbacia dufresni*	0.055	0.055	0.000	0.00%
CAV	*Campylonotus vagans*	0.051	0.000	0.051	0.00%
PYX	*Pycnogonida*	0.024	0.000	0.024	0.00%
ZYX	Dead *Zygochlamys patagonica*	0.014	0.000	0.014	0.00%
PAO	*Patagonotothen cornucola*	0.004	0.000	0.004	0.00%
		22,424.664	**4,683.580**	**21,145.899**	

3.2 Loligo gahi

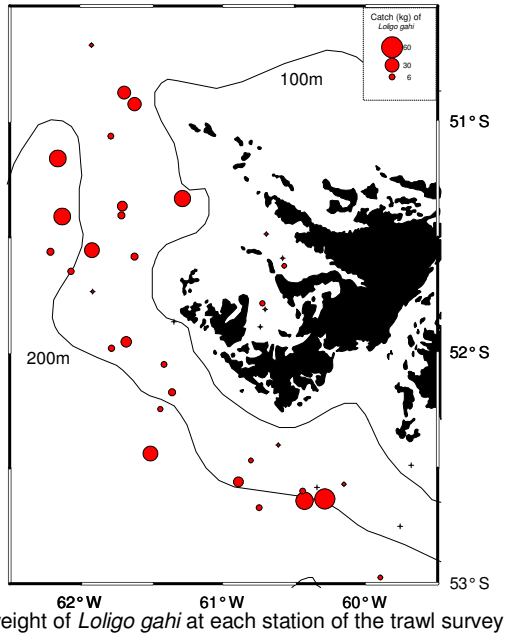

Figure 6: Catch weight of *Loligo gahi* at each station of the trawl survey ZDLH1-10-2005

The Patagonian squid *Loligo gahi* was abundant almost everywhere in the survey area. The largest catches were observed at depths around 200 m to the south of Falkland Sound (58 kg per 0.5 hrs trawl) and to the west of the Falkland Islands (30-40 kg per 1 hr trawl). The lowest catches were observed in shallow waters (both Queen Charlotte and King George Bays) (Figure 6).

All squid caught on the shelf (>100 m depths) belonged to the spring-spawning cohort (SSC). They were mainly in a pre-spawning condition (females at maturity stages III-V and males at stages IV-V). In shallow water bays of West Falkland, small and immature squid (5-7 cm ML) of the autumn-spawning cohort (ASC) were abundant.

Length-frequency distributions and maturities of males and females were analysed separately for depth ranges less than and more than 200 m, and for the following regions: East, Southwest, West and Shallow-water Bays (Figure 7).

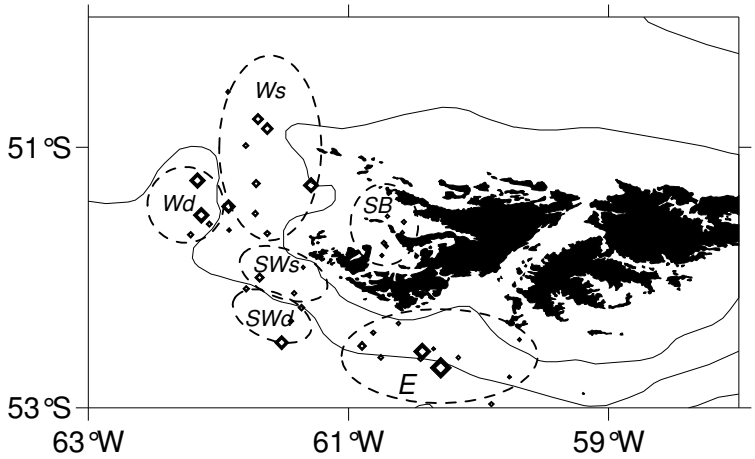

Figure 7: Regions chosen for the length frequency analysis of *Loligo gahi* during the survey. East (E), Southwest shallow (SWs) and deep (SWd), West shallow (Ws) and deep (Wd) and Shallow-water Bays (SB)

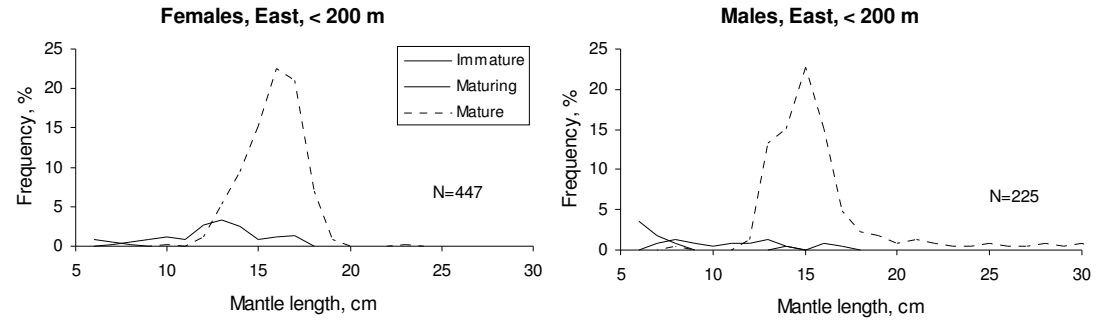

Figure 8: Length frequency distributions of females and males of *Loligo gahi* at different depths in the Eastern region

In the Eastern region, mature males and females of the SSC dominatedcatches, with females slightly larger than males (Figure 8). There was also a female bias in the sex ratio (approx. 2:1). This situation is quite typical for the end of the feeding season, when large mature males started to move to their spawning grounds located in shallow waters followed by females at a later date.

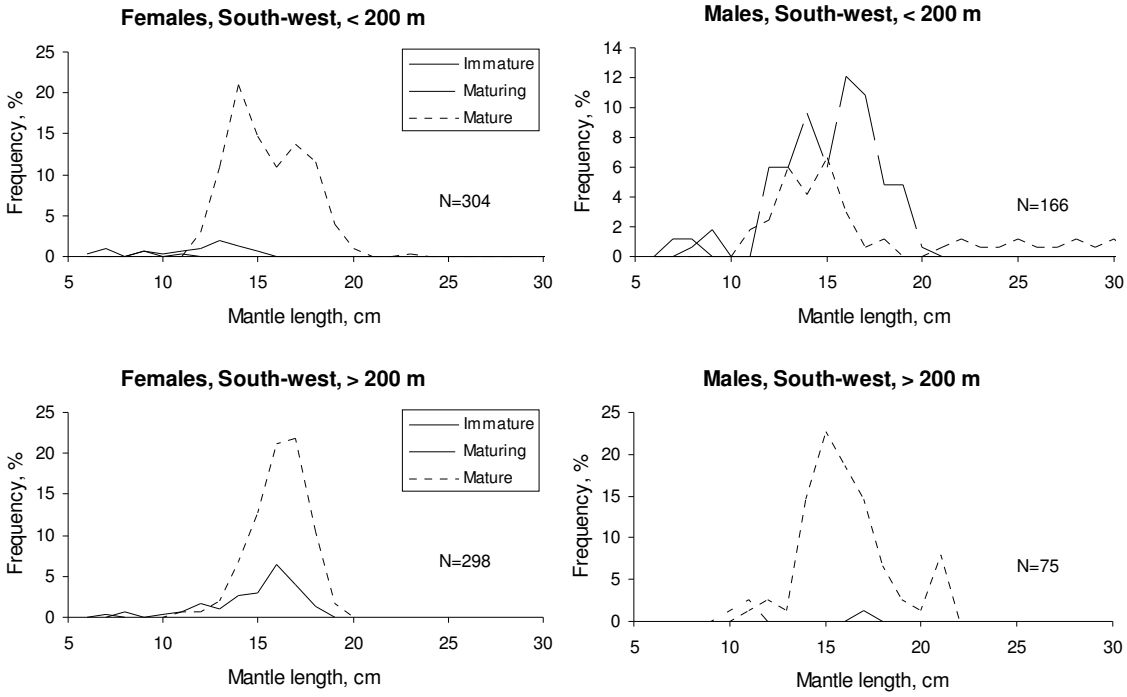

Figure 9: Length frequency distributions of females and males of *Loligo gahi* at different depths in the South-western region

In the South-western region at depths < 200 m, length-frequency composition of both females and males was bimodal, with a quite pronounced mode of smaller (12-13 cm) mature squid in addition to the larger (16-17 cm ML) squid observed in deeper waters (>200 m) and in the Eastern region. Sex ratios showed a female prevalence, which was noticeably greater in deeper waters (almost 4:1) (Figure 9).

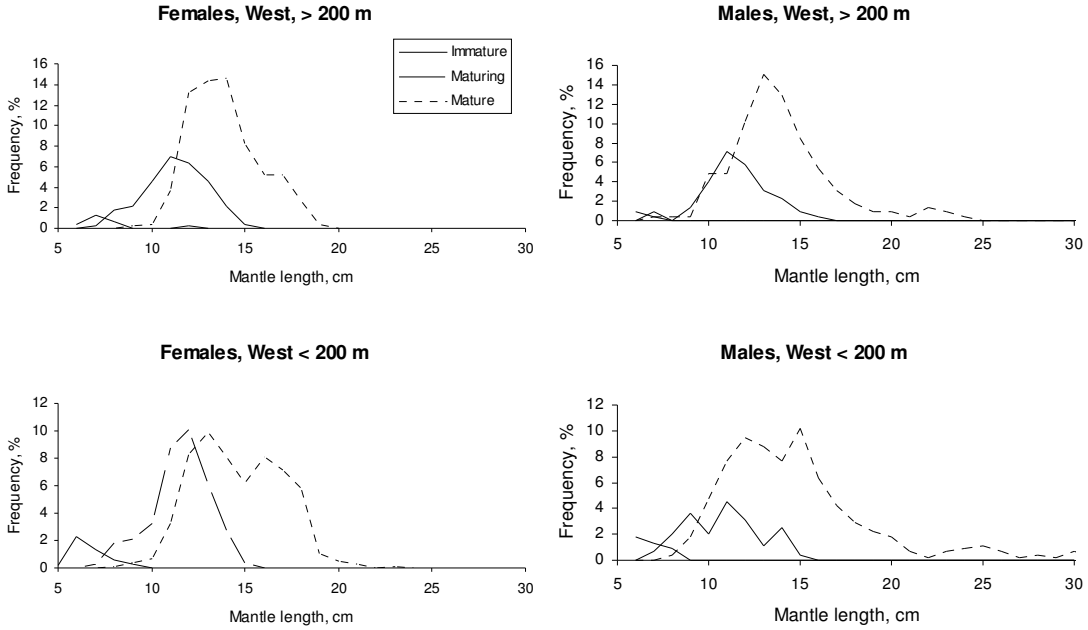

Figure 10: Length frequency distributions of females and males of *Loligo gahi* at different depths in the Western region.

In the Western region, length frequencies had similar patterns to the southwestern region, with bimodal length composition in shallow waters and unimodal length composition in deep waters (Figure 10). However, squid in deep waters were represented mainly by animals of 12-14 cm ML, observed as the second mode in shallow waters of the South-western region. Proportions of maturing squid were also noticeably higher than in both previous regions. Sex ratios again illustrated a female bias, 2:1 in shallow waters and 3:1 in deep waters.

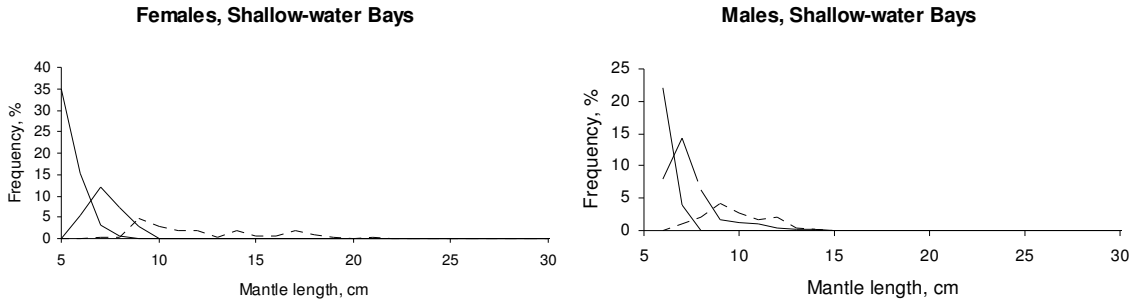

Figure 11: Length frequency distributions of females and males of *Loligo gahi* in inshore waters of the West Falkland

Shallow water Bays were characterized by the presence of large numbers of small ASC squid. Large mature females also occurred here, but in very small quantities (Figure 11). Interestingly, several small (7-8 cm ML) females were encountered, which were already mature, and some of them had already been mated with spermatophores embedded in their mantles.

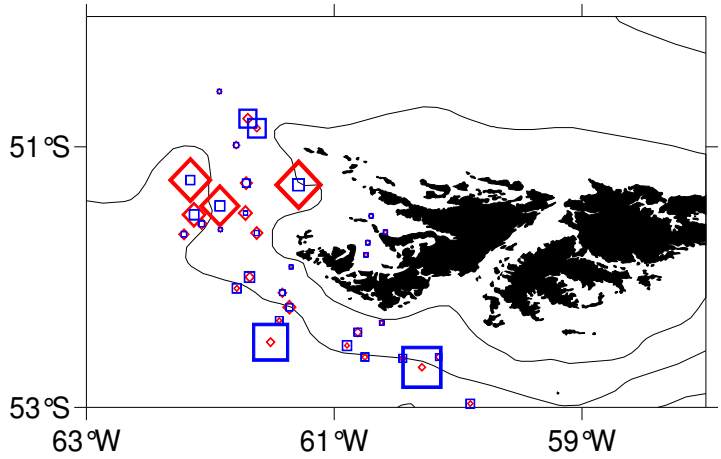

Figure 12: Spatial distribution (density in numbers by 1 hr trawl) of small (12-14 cm ML, red) and large (16-18 cm ML, blue) females of the spring-spawning cohort during the survey. Symbol size is proportional to density (minimum 1 individual, maximum 360 ind/trawl)

As was indicated above, two modes of mature females were present in the study areas. Their spatial distribution was different (Figure 12). Large females mainly occurred in the southern and northern parts of the area, whereas small females were abundant in the middle part (to the west of the Falklands). It is likely that the low temperatures in inshore waters prevented squid migrations to their spawning grounds.

3.3 Salilota australis

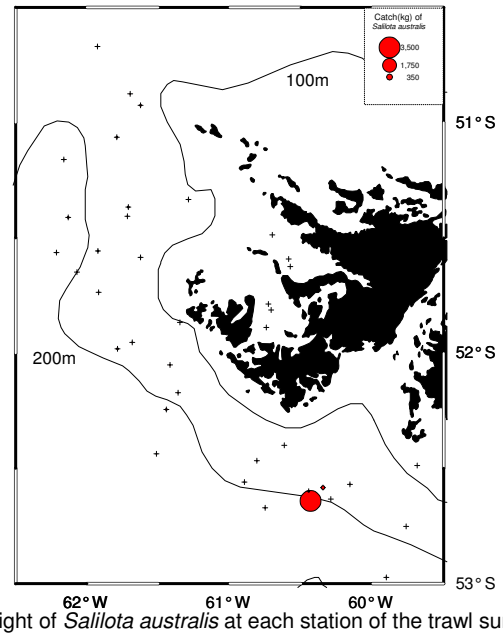

Figure 13: Catch weight of *Salilota australis* at each station of the trawl survey ZDLH1-10-2005

Redcod were caught on 28 of the 39 bottom trawl stations conducted on this cruise and totalled 4,062.33 kg (Figure 13). Redcod were caught between 129 m – 335 m (mean = 197.79 m sd ± 52). Catches ranged between 0.052 to 3,460.14 kg (mean = 145.08 kg sd ± 650). The greatest catch of redcod was on station 2198, south of Cape Meredith, in 182 m of water.

Total lengths ranged between 12 cm and 85 cm (mean = 30.92 cm sd ± 12.61). Females were larger than males (32.16 cm sd ± 13.93; 30.75 cm sd ± 10.05 respectively) and were more numerous with a sex ratio of 57%.

The catches were centred in three main areas (Figure 14). The fish caught in area 1 were larger on average (Figure 15) and more mature (Figure 16) than those caught in areas 2 and 3. At station 2198 (Area 1) we encountered large numbers of mature females in maturity stage IV and V which provided us with a great opportunity to collect ovaries for fecundity studies. This was the only large spawning

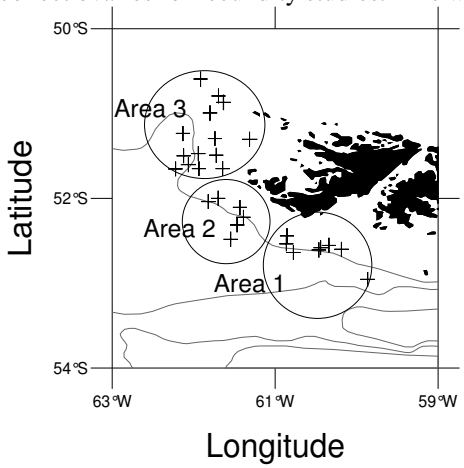

Figure 14: Chart illustrating the areas used in the catch analysis of *Salilota australis* during ZDLH1-10-2005

aggregation we encountered during the cruise.

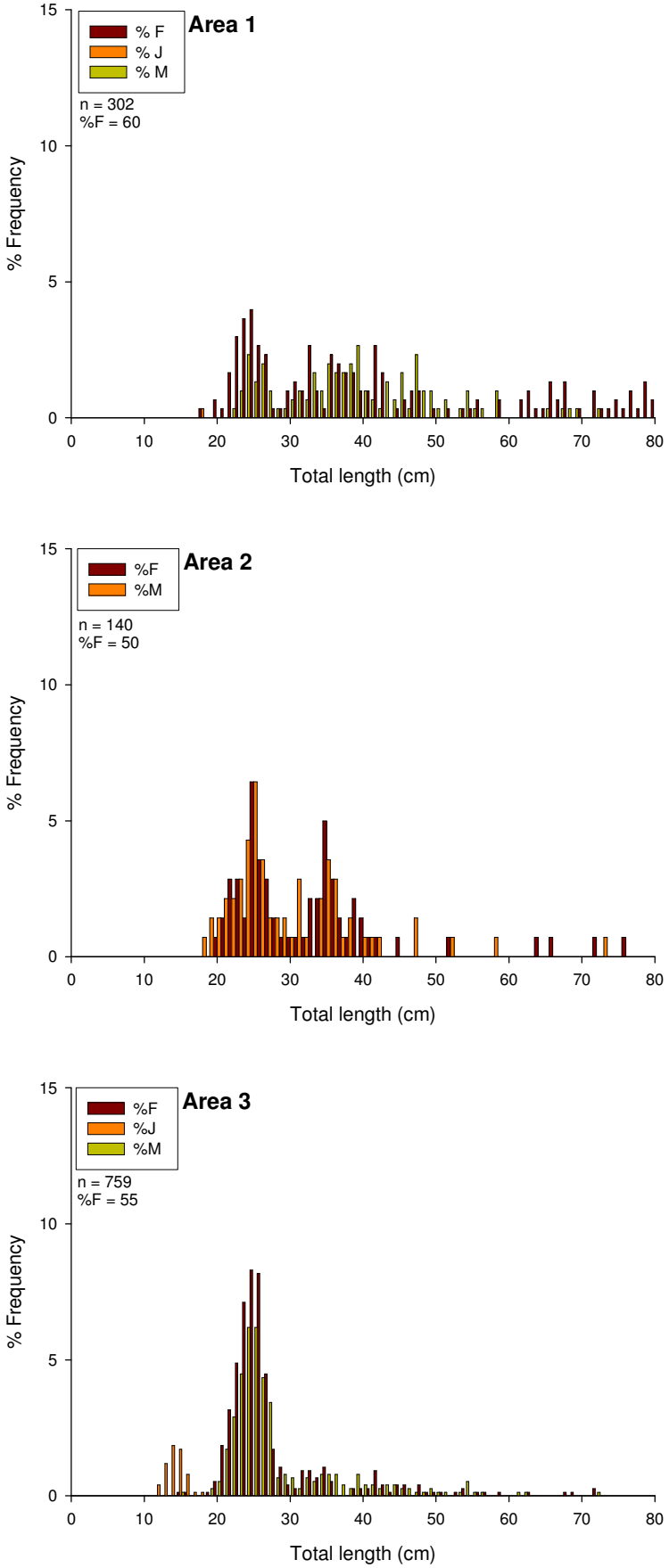

Figure 15: Length frequency distributions for *Salilota australis* caught in areas 1, 2 and 3 during ZDLH1-10-2005.

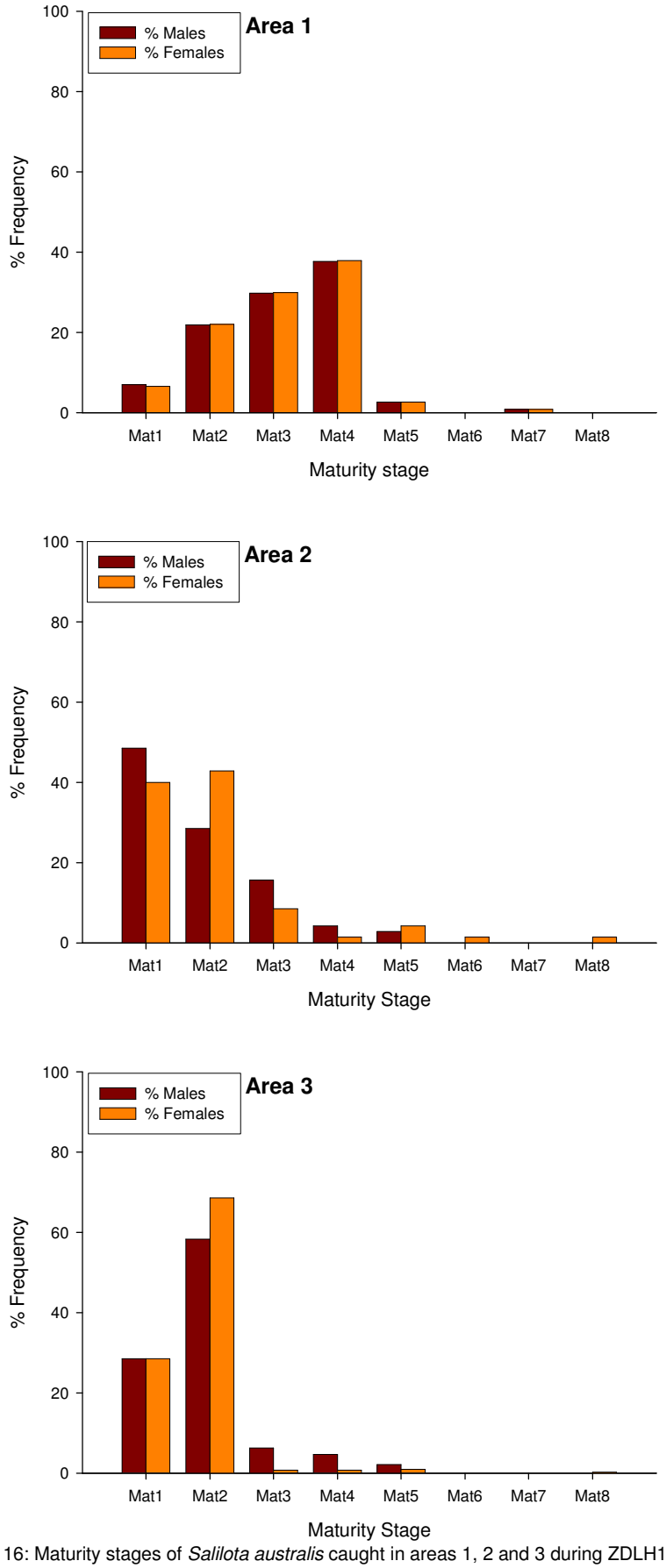

Figure 16: Maturity stages of *Salilota australis* caught in areas 1, 2 and 3 during ZDLH1-10-2005.

3.4 *Macruronus magellanicus*

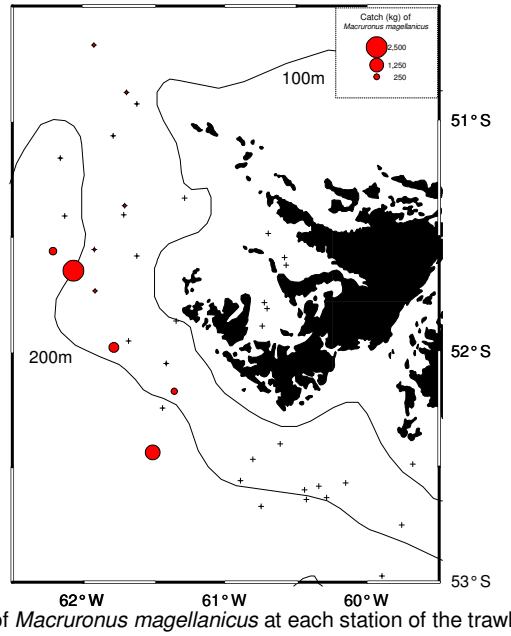

Figure 17: Catch weight of *Macruronus magellanicus* at each station of the trawl survey ZDLH1-10-2005

Hoki were caught on 22 of the 39 bottom trawl stations conducted on this cruise and was the most common species encountered in terms of weight (5,811 kg) (Figure 17). Hoki were caught between 133 and 335 m (mean = 206 m sd ± 54.64). Catches ranged between 0.41 to 2499.70 kg (mean = 264.17 kg sd ± 595.54). The largest catch was encountered on station 2226 over 202 m water depth.

Pre-anal lengths ranged between 11 and 43 cm (mean = 25.54 cm sd ± 5.34). Females were larger than males on average (26.75 cm sd ± 5.34; 23.47 cm sd ± 4.44 respectively). Their pooled length frequency distribution was trimodal with modes at 18, 24 and 32 cm pre-anal length (Figure 18).

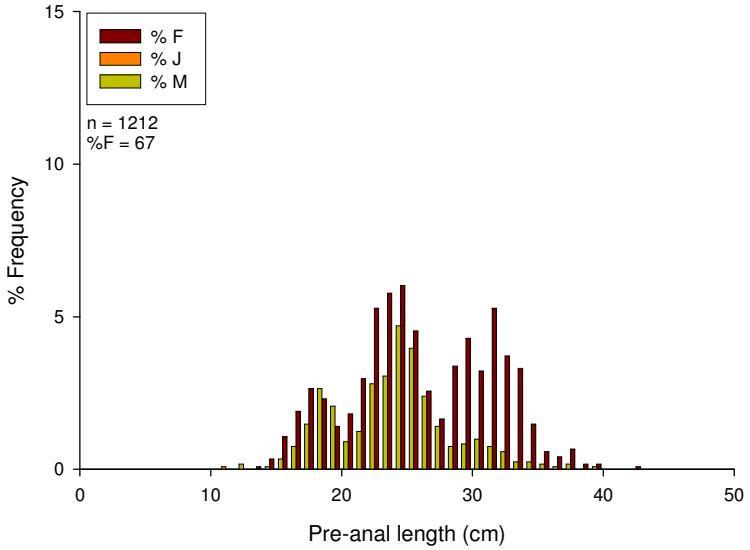

Figure 18: Pooled length frequency distribution of *Macruronus magellanicus* caught during the ZDLH1-10-2005 research cruise.

For both males and females, most hoki individuals were in their resting stage (maturity stage 2). Fewer animals were found to be at stages 3, 4, 7 and 8 (Figure 19). Spawning animals individuals are never encountered in Falkland Islands waters although hoki occur here all year round. However, having said this, we did encounter one spawning male at station 2258. In November to December post- spawning fish generally arrive in the north-western part of the FICZ and in January they spread over the rest of the northern shelf (FIFD unpublished data). It is possible that the small number of individuals in stages 7 and 8 represent the start of the migration of post spawning animals in the zone from their spawning grounds along the coasts of Argentina.

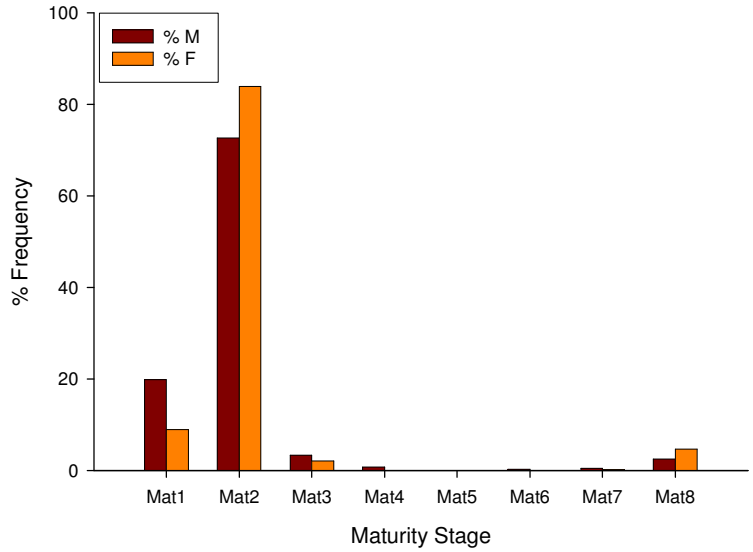

Figure 19: Maturity stages of *Macruronus magellanicus* encountered during the ZDLH1-10-2005 survey

3.5 Patagonotothen spp.

Five species of *Patagonotothen* were caught during the cruise with *P. ramsayi* being the most abundant. The others in order of abundance include *P. wiltoni, P. tessellata, P. guntheri* and *P. trigramma* (Table 3). *Patagonotothen trigramma* was caught on station 2240 in Queen Charlotte Bay. This is the second record of this species in the Falkland Islands. It was last seen in 1913 and described by Regan in the same year. The holotype resides in the National Museumsof Scotland, Edinburgh. Hence its name, this species has three lateral lines and the fact that it has been grouped with the *Patagonotothen* genus, which only have two lateral lines, would suggest that the genus may need revising.

3.5.1 Patagonotothen ramsayi

A total of 3,695.37 kg of *P ramsayi* were caught over the duration of ZDLH1-10-2005 at 38 of the 39 trawl stations conducted. Catches ranged from 0.01 to 694.92 kg (mean = 97.25 kg ± 135.88). *Patagonotothen ramsayi* were caught between 45 and 335 m (mean = 171.92 m ± 68.12) with the largest catches occurring between 100 and 200 m (Figure 20).

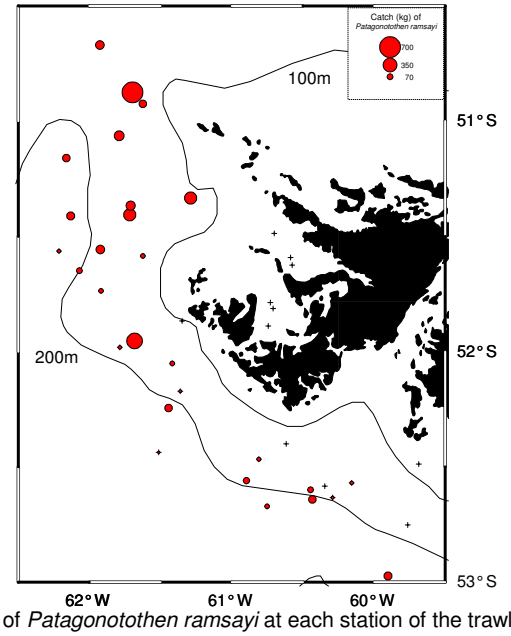

Figure 20: Catch weight of *Patagonotothen ramsayi* at each station of the trawl survey ZDLH1-10-2005

The smallest animals were found inshore (<100 m) with fish of 10 cm L_T found at depths of less than 60 m. They became progressively larger on average with increasing depth (13.94 cm sd ± 4.77; 21.54 cm sd ± 4.79; and 22.30 cm sd ± 5.67 for < 100 m, 100 – 200 m, and > 200 m respectively) (Figure 21).

At all depths most fish were at maturity stage II with some post spawning individuals at stages VII and VIII and fewer spawning animals at stages V and VI (Figure 22). This is in agreement with Brickle et al (in press) where they found that male and female *P. ramsayi* started to mature in May. The majority offemale and male maturity stages V and VI were found between June and August suggesting that this is when most spawning occurs. In October and November, large numbers of post spawning (maturity stages VII and VIII) animals were found.

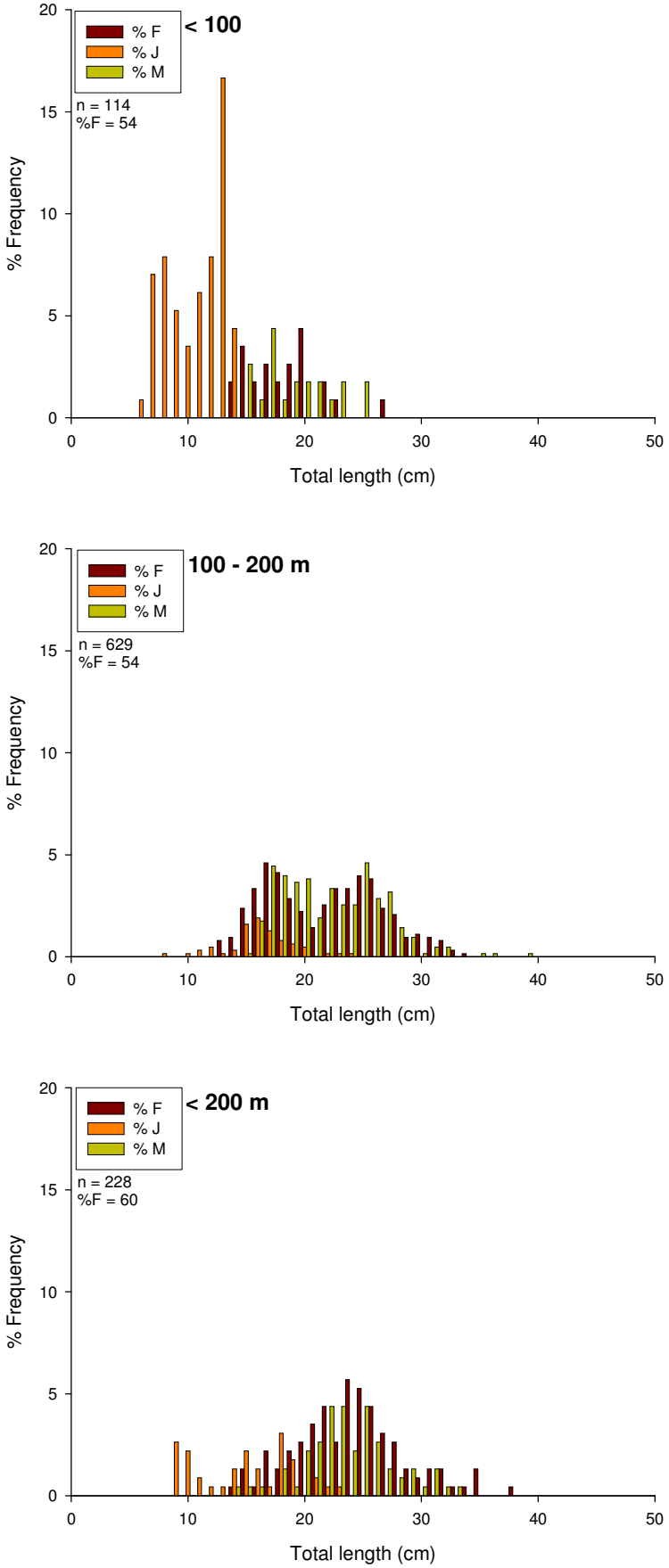

Figure 21: Length frequency distributions for *P. ramsayi* caught at difference depths during ZDLH1-10-2005

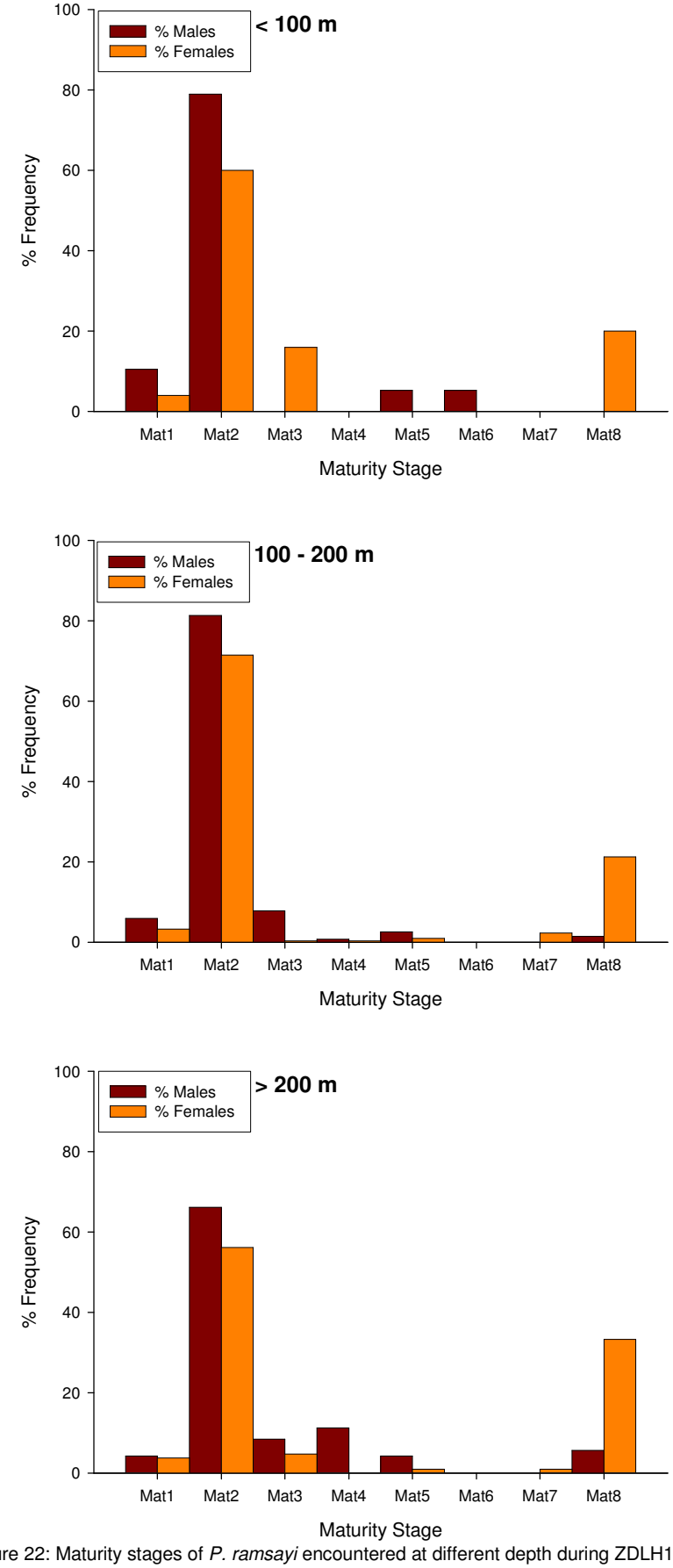

Figure 22: Maturity stages of *P. ramsayi* encountered at different depth during ZDLH1-10-2005

3.6 Munida spp.

Both species of the lobster krill were caught during ZDLH1-10-2005 (Figure 23). *Munida gregaria* were caught on two stations on P6 south of George and Baron Islands and in both Queen Charlotte Bay and King George Bay, West Falkland. Whereas *Munda subrugosa* were only caught

Figure 23: Left, *Munida subrugosa*; Right, *Munida gregaria* with *Pseudione galacanthae* (Bopyrid parasite)

in Queen Charlotte and King George Bays. *Munida gregaria* was far more abundant than *M. subrugosa* with catches of 1,021.18 kg and 46.26 kg respectively (Figure 24).

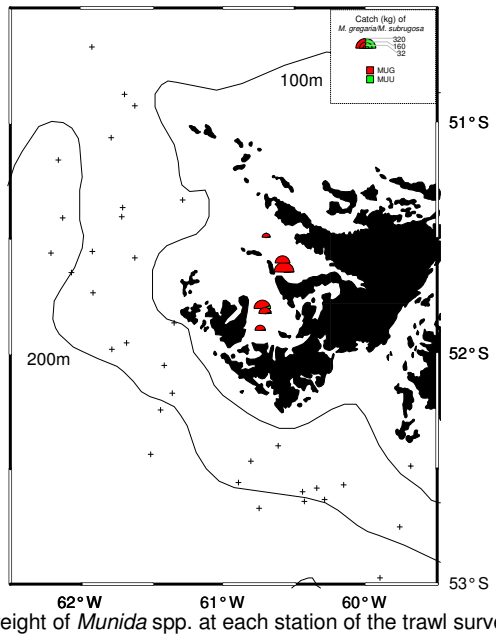

Figure 24: Catch weight of *Munida* spp. at each station of the trawl survey ZDLH1-10-2005

Munda gregaria were a little larger than *M. subrugosa* with mean carapace lengths of 25.74 mm (15 – 38 mm, sd ± 3.67) and 24.76 mm (16 – 34 mm, sd ± 4.26) respectively.

The length frequency distributions for *Munida gregaria* in both Queen Charlotte and King George Bay were very similar with two modes at 21 – 22 mm and 27 – 28 mm carapace length (Figure 25). Queen Charlotte and King George Bays also has similar sex ratios (51.23 and 53.13 % F, respectively), and similar proportions of females with eggs (33.13 % and 36.31 % respectively).

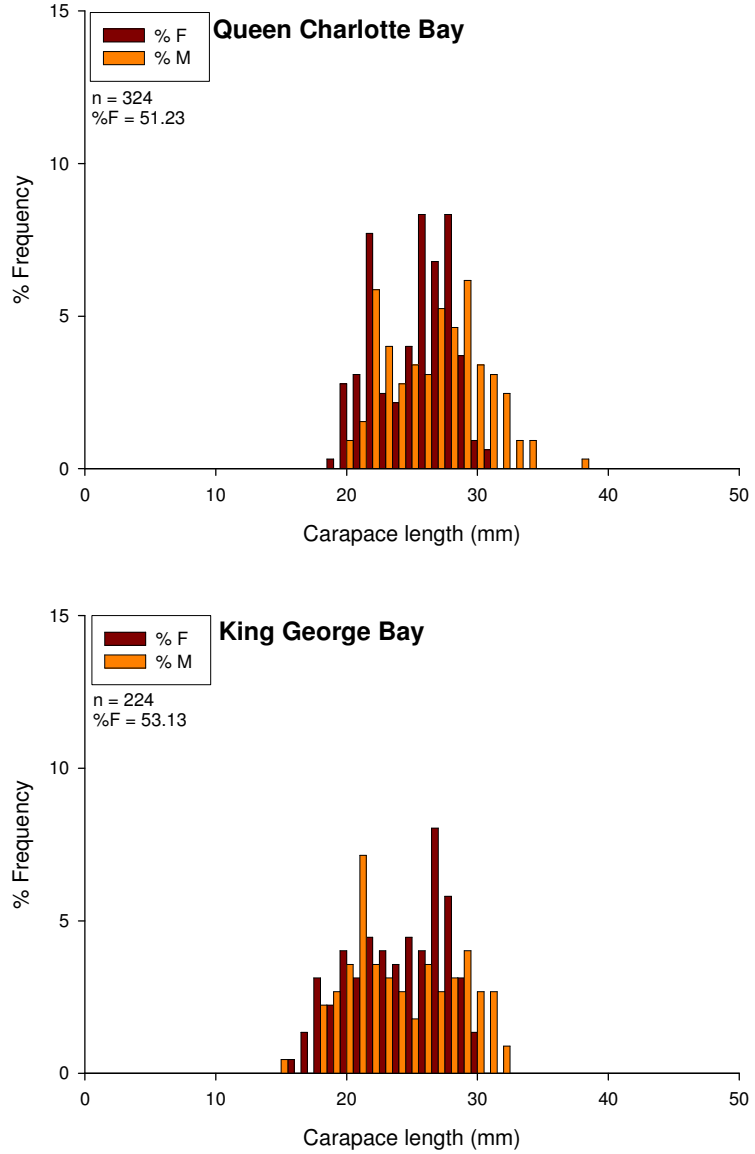

Figure 25: Length frequency distributions of *Munida gregaria* caught in Queen Charlotte and King George Bays during ZDLH1-10-2005.

3.7 Red fish – Sebastes oculatus

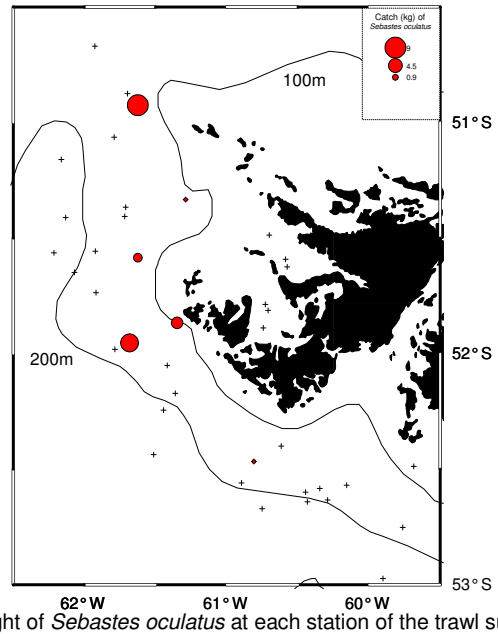

Figure 26: Catch weight of *Sebastes oculatus* at each station of the trawl survey ZDLH1-10-2005

The local redfish *S. oculatus*, as with other redfish, is ovoviviparous meaning that it gives birth to live young and therefore fertilization is internal. One of the objectives of the cruise was to survey the spawning grounds of *S. oculatus*. However, due to bad weather we did not have time to fully survey their spawning grounds.

A total of 21.85 kg were caught on 6 out of the 39 bottom trawls conducted during ZDLH1-10-2005. Apart from a station on the transect P6 *S. oculatus* were mainly caught in the west of the region from Cape Meredith round to the north west of the Jason Island group. All catches occurred between 100 – 200 m depth (Figure 26). Catches ranged from 0.34 – 9.19 kg (mean = 3.64 sd ± 3.61). Redfish ranged in size from 26 to 39 cm L_T (mean = 30.65 sd ± 3.57). Male maturities were mostly in stage II and III with approximate 20% in the spent/recovering stage (VII). Females on the other hand ranged between matuity stages III and VI with 37% and 31% at stages V and VI respectively. The latter stages are characterised by having large ovaries packed with eggs containing eyed larvae.

3.8 Rajidae

This family, of which a total of some 11 species from 3 genera were caught, comprised 8.57% of the total catch from 39 trawl stations. 30 stations yielded catches of rajids. The most abundant species were *Raja flavirostris*, *Bathyraja brachyurops,* and *Bathyraja albomaculata*, together 71.1% of the total Rajidae catch (see Table 4). Figure 27 shows the rajid catches by species and station.

Table 4: Catch (kg) of Rajidae

Species Code	***Species name***	***Total Catch (kg)***	***Total Sampled (kg)***	***Total Discarded (kg)***	***Proportion (%)***
RFL	*Raja flavirostris*	637.118	637.118	637.118	33.17%
RBR	*Bathyraja brachyurops*	482.476	482.476	482.476	25.12%
RAL	*Bathyraja albomaculata*	246.132	236.132	246.132	12.81%
RMC	*Bathyraja macloviana*	127.970	127.970	127.970	6.66%
RSC	*Bathyraja scaphiops*	113.590	113.590	113.590	5.91%
RBZ	*Bathyraja cousseauae*	104.427	104.427	104.427	5.44%
RGR	*Bathyraja griseocauda*	100.728	100.728	100.728	5.24%
RMU	*Bathyraja multispinis*	71.031	71.031	71.031	3.70%
RPX	*Psammobatis spp.*	26.175	21.503	26.175	1.36%
RDO	*Raja doellojuradoi*	10.332	10.332	10.332	0.54%
RMG	*Bathyraja magellanica*	0.700	0.000	0.700	0.04%
	Grand Total	**1920.679**	**1905.307**	**1920.679**	

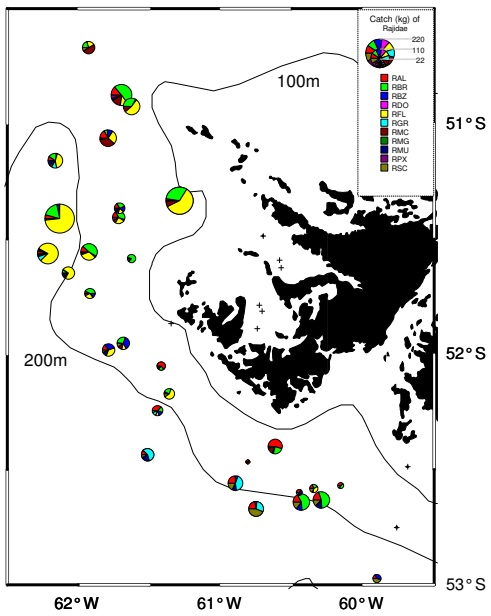

Figure 27: Catch weight of *Sebastes oculatus* at each station of the trawl survey ZDLH1-10-2005

3.8.1 Tag & Release program

One of cruise objectives was to tag and release as many rays as possible, from all species, except the genus *Psammobatis.* Recovering these animals will enable verification of the age/growth studies undertaken by scientists at FIFD, as well as help studies on migration patterns. Figure 28 shows the number of specimens tagged at each station, as well as the exact release positions. During this cruise, a total number of 659 specimens were tagged with a t-bar tag, as shown in Figure 29, and injected with

the antibiotic oxytetracycline (dosage of 20mg per 1kg of bodyweight, in 20mg/ml solution)(see Figure 30). This lays an opaque marker on hard structures that fluoresces under UV light.

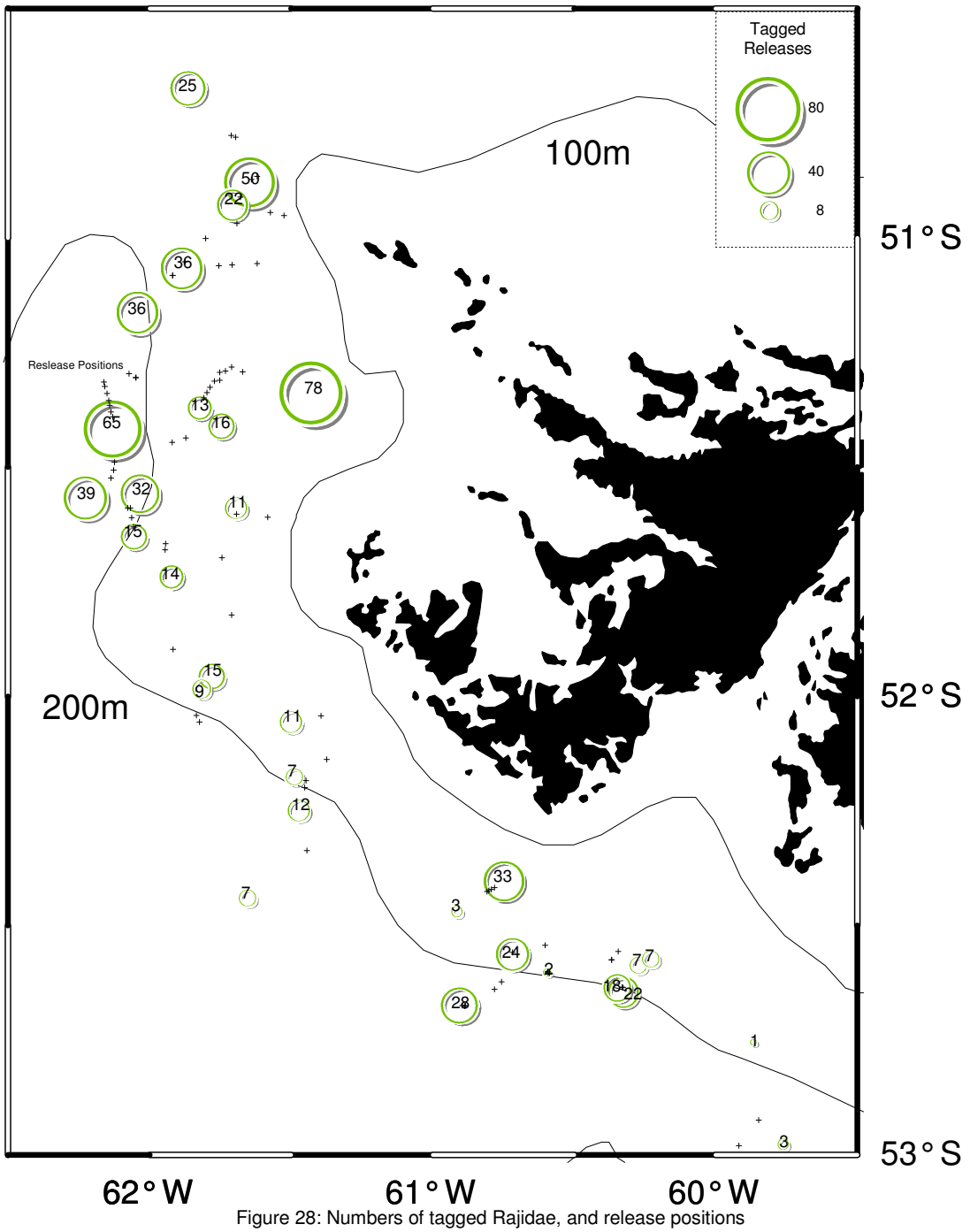

Figure 28: Numbers of tagged Rajidae, and release positions

Figure 29: Inserted T-bar tag

Figure 30: Injection with oxytetracycline (OTC)

3.8.2 Biology

Raja flavirostris

During the research cruise, this species was the most predominant ray catch, with a total of 637kg (188 specimens) caught, mainly in the western stations, north of 52°S (see also Figure 28). Eighteen stations yielded catches of this species. The three largest catches were at stations 2238, 2248, and 2224, yielding 154kg (n=52), 114kg (n=31), and 102kg (n=31) respectively. The animals ranged in disk width between 32cm and 82cm with a mean of 57.2cm (XF=57.4, XM 56.6). For clarity, specimens were grouped in 5cm size classes (disk-width). The most dominant size classes were 50 and 55cm DW (Figure 31). Maturity was not assessed for a majority of the specimens, but these dominant size classes were sub-adults.

Overall, the population revealed a strong (78%) female bias. In the most productive catches, the sex ratios were 80.7%, 61.3%, and 80.8%. One of the shallower and 'closer to shore' stations (2248) had the "comparatively low" female proportion of 61.3%. There appeared to be a weak correlation with female percentage versus depth, with females less predominant in shallower waters.
Whatever the case, unlike most other skate species, the sex ratio of this species has been reported before by observers to be fluctuating, and segregated migration patterns, in this case by sub-adult specimens, are the most likely causes.

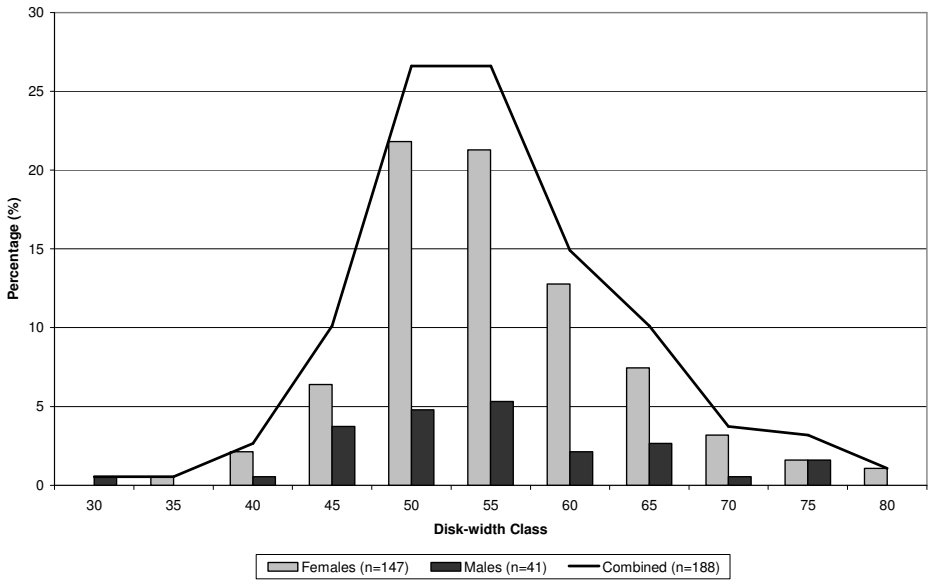

Figure 31: Size frequency of *Raja flavirostris*

Bathyraja brachyurops

This species was the second most common ray species, with a catch of 482kg (209 specimens) from 27 trawls. It was also one of the most evenly distributed species, together with *B. albomaculata.* The maximum catch was 63.36kg at station 2248, and the mean catch 17.87kg (StDev 18.80).
Figure 32 shows the size frequency for all the specimens, with clearly the 40cm disk-width class being predominant. The mean disk-width for females was 45.17cm, with the mean for males 41.35 cm. Although maturity data was not always recorded, this is a sub-adult size class. Interestingly, although in most size classes the sex ratio was more or less 1:1, the females were noticeably predominant in the larger size classes 55, 60, and 65.

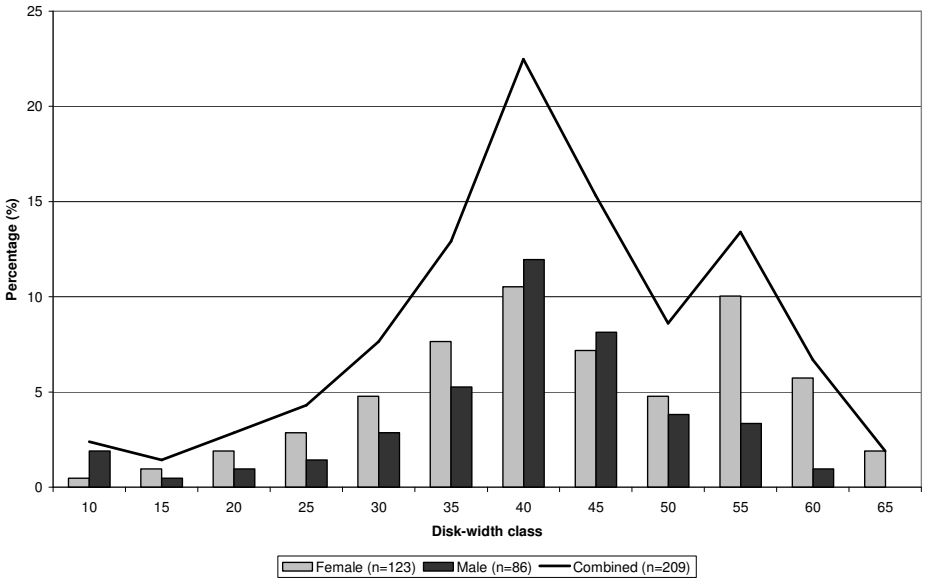

Figure 32: Size frequency of *Bathyraja brachyurops*

Bathyraja albomaculata

This species was the third most common ray species, with a catch of 246kg (146 specimens) from 27 trawls. The maximum catch was 33.22kg at station 2202 (south of C. Meredith), and the mean catch 9.12kg (sd ± 7.11). Figure 33 shows the size frequency for all the specimens, with clearly the 40cm disk-width class being predominant. Although maturity was not assessed (except males externally), these specimens, as well as the larger ones, were adult, and presumed to be in spawning condition.

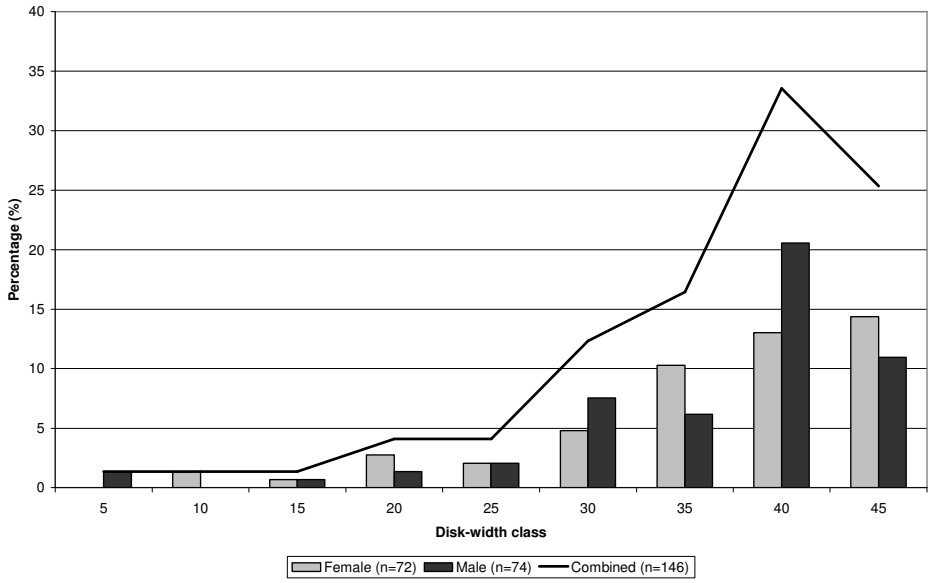

Figure 33: Size frequency of *Bathyraja albomaculata*