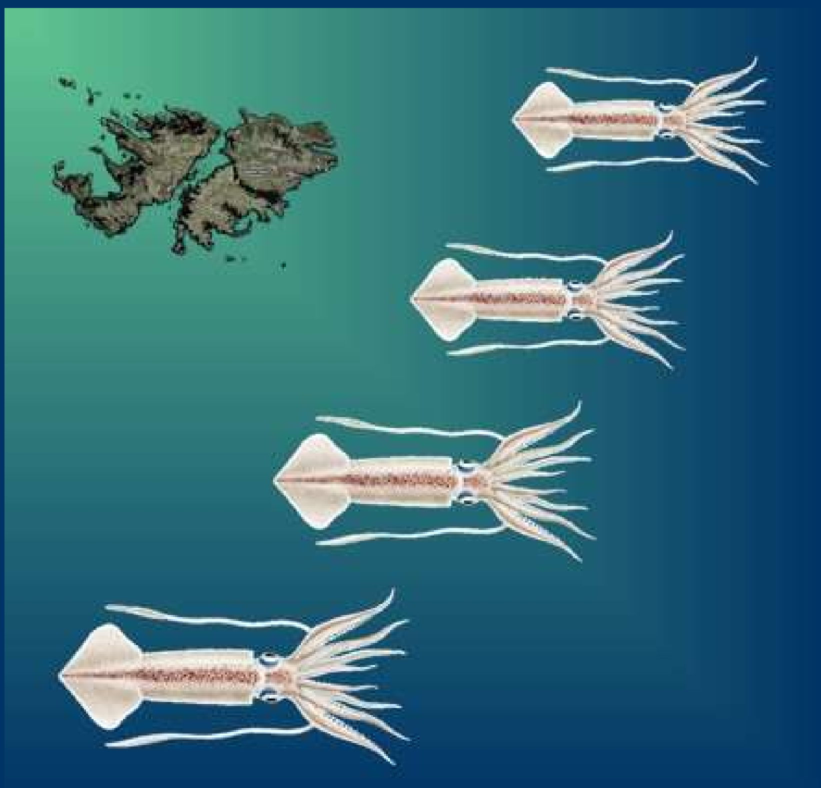
2022 1st Pre-Season Assessment Survey

Falkland calamari

(*Doryteuthis gahi*)



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Summary

1) A stock assessment survey for *Doryteuthis gahi* (Falkland calamari) was conducted in the Loligo Box from 7th to 21st February 2022. Sixty scientific trawls were taken during the survey; 39 fixed-station and 21 adaptive-station trawls. The scientific catch of the survey was 420.67 tonnes *D. gahi*.
2) An estimate of 47,058 tonnes *D. gahi* (95% confidence interval: 40,295 to 60,115 t) was calculated for the fishing zone by inverse distance weighting. This was the third-highest 1st pre-season estimate of the past 10 years, and the highest since 2019. Of the total, 17,165 tonnes were estimated north of 52 ºS, and 29,894 tonnes were estimated south of 52 ºS.
3) Male and female *D. gahi* had significantly greater average mantle lengths, and greater average maturities, north of 52 ºS than south of 52 ºS. Males north: mean mantle length 10.27 cm; mean maturity stage 1.84, south: mean mantle length 9.53 cm; mean maturity stage 1.66. Females north: mean mantle length 10.03 cm; mean maturity stage 1.88, south: mean mantle length 9.31 cm; mean maturity stage 1.59. Sizes were overall the smallest for a 1st pre-season since 2016.
4) 97 taxa were identified in the catches. *D. gahi* was the largest species group at 93.7% of total catch by weight, representing the 'cleanest' *D. gahi* catch of a 1st pre-season since at least 2012. Rock cod at 4.4% was the only other taxon comprising at least 1% of total catch. Biological measurements and samples were taken from *D. gahi*, rock cod, toothfish, kingclip, grenadier, hoki, red cod, southern blue whiting, and common and southern hake.

Introduction

A stock assessment survey for *Doryteuthis gahi* (Falkland calamari – Patagonian longfin squid – colloquially *Loligo*) was carried out by the FIFD on-board the fishing vessel *Argos Cíes* from the 7th to 21st February 2022; experimental license FK018E22. This survey continues the series of surveys that have, since February 2006, been conducted immediately prior to season openings to estimate *D. gahi* stock available to commercial fishing at the start of the season, and to initiate the in-season management model based on depletion time series of the stock.

Objectives of the survey were to:

1) Estimate the biomass and spatial distribution of *D. gahi* on the fishing grounds at the onset of the 1st fishing season, 2022.
2) Estimate the biomass and distribution of common rock cod (*Patagonotothen ramsayi*) and other commercial species in the 'Loligo Box', for continued monitoring of these stocks.
3) Estimate the bycatch of toothfish (*Dissostichus eleginoides*) in *D. gahi* trawls.
4) Collect biological information on *D. gahi*, rock cod, toothfish and opportunistically other fish and invertebrates taken in the trawls.

The survey was designed to cover the 'Loligo Box' fishing zone (Arkhipkin et al. 2008, 2013) that extends along the shelf break across the southern and eastern part of the Falkland Islands Interim Conservation Zone (Figure 1). The delineation of the Loligo Box represents an area of approximately 31,517.9 km^2, subtracting the 3-nautical mile exclusion zone around Beauchêne Island.

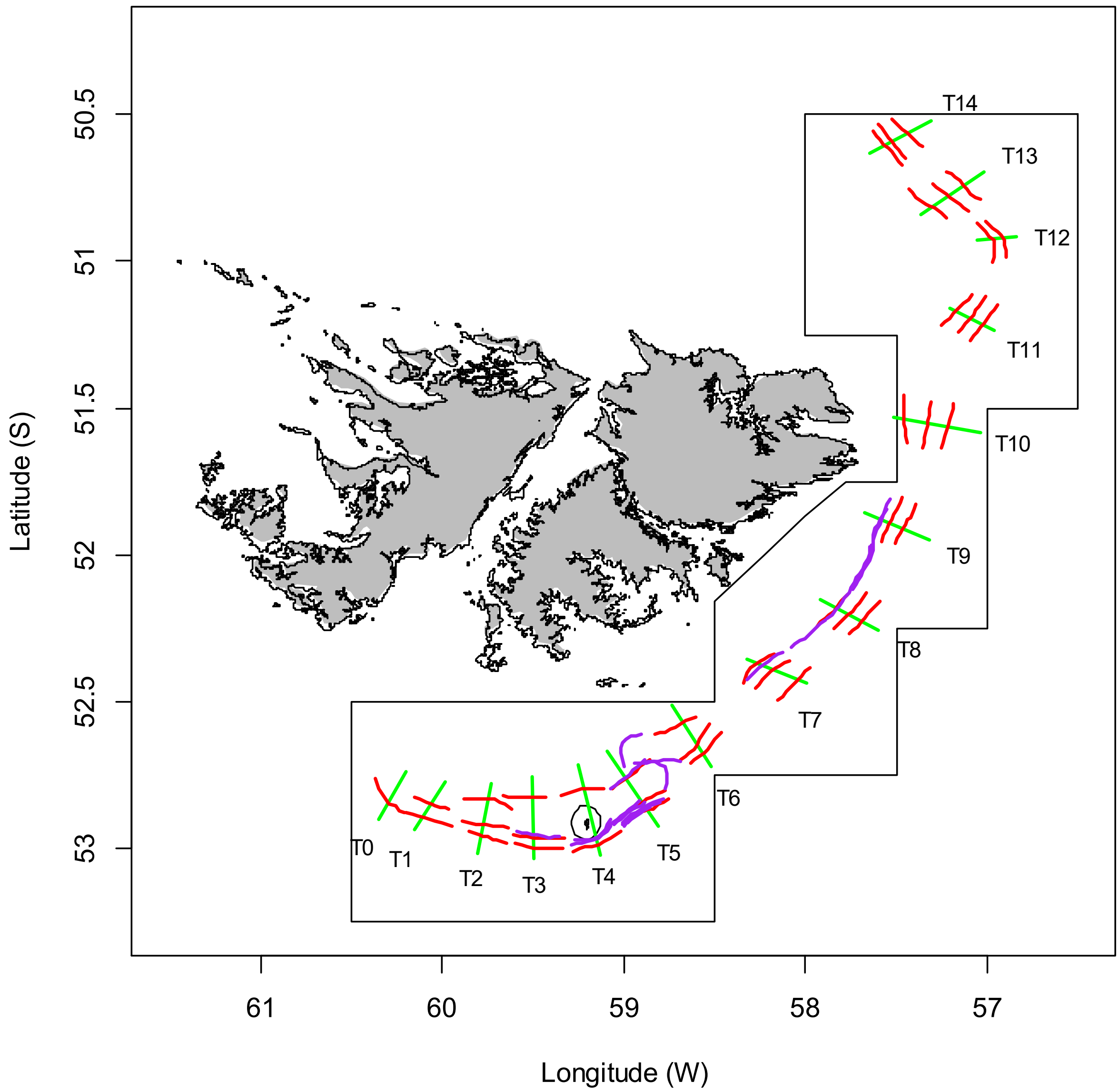

Figure 1. Survey transects (green lines), fixed-station trawls (red lines), and adaptive-station trawls (purple lines) sampled during the 1st pre-season 2022 survey. Boundaries of the 'Loligo Box' fishing zone and the Beauchêne Island exclusion zone are in black.

F/V *Argos Cíes* is a Falkland Islands - registered stern trawler of 75 m length, 1999 gross tonnage, and 4000 main engine bhp. Like all vessels employed for these pre-season surveys, *Argos Cíes* operates regularly in the Falkland Islands calamari fisheries, and used its commercial trawl gear for the survey catches. *Argos Cíes* has previously been used for the preseason surveys of 1st seasons 2019 and 2020 (Winter et al. 2019, 2020), and 2nd season 2021 (Winter et al. 2021). The following FIFD personnel participated in the 1st pre-season 2022 survey:

Brendon Lee	lead scientist
Zhanna Shcherbich	fisheries scientist
Rebecca Nicholls	fisheries observer

Methods

Sampling procedures

The survey plan included 39 fixed-station trawls located on a series of 15 transects perpendicular to the shelf break around the Loligo Box (Figure 1), followed by up to 21 adaptive-station trawls selected to increase the precision of *D. gahi* biomass estimates in high-density or high-variability locations. This dual approach ensures that the scientific requirements of randomization and repeatability are met (via fixed stations) and the spatio-temporal variability of the *D. gahi* population is captured (via adaptive stations) (Gawarkiewicz and Malek Mercer 2018). Trawl tracks were designed for an expected duration of two hours each. All trawls were bottom (demersal) trawls. During the progress of each trawl, GPS latitude, GPS longitude, bottom depth, bottom temperature, net height, cable length, trawl door spread, and trawl speed were recorded on the ship's bridge in 15-minute intervals, and a visual score was assessed of the quantity and quality of acoustic marks observed on the net-sounder. Following the procedure described in Roa-Ureta and Arkhipkin (2007), the acoustic marks were used to apportion the *D. gahi* catch of each trawl to the 15-minute intervals and thereby increase spatial resolution of the catches. For small catches acoustic apportioning cannot be assessed with accuracy, and any *D. gahi* amounts <100 kg were iteratively aggregated by adjacent intervals (if the total *D. gahi* catch in a trawl was <100 kg it was assigned to one interval; the middle one).

Catch estimation

The catch of every trawl was processed by the factory crew and retained catch weight of *D. gahi*, by size category, was calculated from the number of standard-weight blocks of frozen squid recorded by the factory supervisor. Catch weights of commercially valued fish species were also recorded from the number of blocks of frozen product, but without size categorization. Processed product weights were scaled to whole weights using standard conversion factors (FIG 2016). Total catch composition per trawl, including commercially unvalued species, damaged fish, and undersized fish, was estimated using a combination of visual assessment and basket data. Baskets were hand-sorted by the FIFD survey personnel and species weighed separately. The aggregate quantities of bycatch species in baskets were proportioned to the *D. gahi* catch of the whole trawl. Scarce bycatch species, and all toothfish, were collected and weighed entirely from each trawl. Non-commercial bycatches were then added to the factory production weights (as applicable) to give total catch weights of all fish and squid.

Biomass calculation

Biomass density estimates of *D. gahi* per trawl were calculated as catch weight divided by swept-area. The calculation thus assumed a catchability coefficient = 1, as commonly used in fishery surveys (Somerton et al. 1999)[a]. Swept area is the product of trawl distance × trawl width, and trawl distance was defined as the sum of distance measurements from the start GPS position to the end GPS position of each 15-minute interval[b]. Trawl width was derived from the distance between trawl doors (determined per interval) according to the equation (Seafish 2010):

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[a] Albeit more likely to underestimate than overestimate true density (Harley and Myers 2001); thus conservative.

[b] At the end of any trawl the net will continue to 'fish' for some distance as it is being hauled. Swept-area bias caused by this factor cannot be quantified but is unlikely to be substantial.

trawl width = (door distance × footrope length) / (footrope + bridle + sweep)

Measurements of *Argos Cíes*' trawl, provided by the vessel master, were: bridle + sweep = 160 + 21 m and footrope = 180 m.

Biomass density estimates were extrapolated to the fishing area using an inverse distance weighting algorithm (Ramos and Winter 2020). As previously, the fishing area was delineated to 20,062.8 km^2, partitioned for analysis into 800 area units of 5×5 km. Forty area units with average depth either <90 m or >400 m, where calamari trawlers do not work, were assumed for this analysis to comprise zero *D. gahi*. Biomass densities from all 800 area units were averaged and multiplied by the total fishing area for total biomass, as well as separately north and south of 52 ºS; the standard sub-area demarcation (Winter and Arkhipkin 2015).

Uncertainty of the biomass density extrapolation was estimated by hierarchical bootstrapping. For 30,000 iterations a number of survey trawls equivalent to the total number were randomly selected with replacement, and within each selected survey trawl its 15-minute intervals were randomly selected with replacement. The trawl's catch was re-proportioned according to the selected intervals' acoustic scores, thus varying the spatial distribution of the catch over that trawl track. When applicable, the aggregation of *D. gahi* amounts <100 kg (see Sampling procedures) was summed to an interval of the trawl also chosen randomly; not necessarily the middle interval. At each of the 30,000 iterations, the inverse distance weighting algorithm was re-calculated over the 5 × 5 km area units.

Biological analyses

Random samples of *D. gahi* (target n = 150, as far as available) were collected from the factory at all trawl stations. Biological analysis at sea included measurements of the dorsal mantle length rounded down to the nearest half-centimetre, sex, and maturity stage scored by inspection of the gonads. Statistical significance of sex ratio departures from 50/50, in total and by station, was evaluated with randomized re-sampling tests. Statistical significance of differences in mantle length and maturity stage distributions were evaluated with non-parametric Kruskal-Wallis tests.

Additional specimens of *D. gahi* were collected according to area stratification (north, central, south) and depth (shallow, medium, deep), and frozen for statolith extraction and age analysis (Arkhipkin 2005), as well as calculation of the length-weight relationship $W = \alpha \cdot L^{\beta}$ (Froese 2006). A sample of 100 rock cod was taken at every trawl station, as far as available. All catches of toothfish were collected from trawl stations to maximize the time series catch and biological information base for juvenile toothfish. Otoliths were taken from toothfish that corresponded to required size categories, and other commercial fish species as available.

Results

Catch rates and distribution

The survey started as usual[c] with fixed-station trawls in the north and proceeded throughout the Loligo Box. A schedule of 4 scientific trawls per day was maintained every day (Table A1), resulting in 60 scientific trawls total recorded during the survey: 39 fixed station trawls catching 169.59 t *D. gahi*, and 21 adaptive-station trawls catching 251.08 t *D. gahi*. Fifteen optional trawls (directed by the vessel master, after survey hours) yielded an additional 264.85

[c] Since at least 2010 (Arkhipkin et al. 2010).

t *D. gahi*, bringing the total catch for the survey to 685.52 t. The scientific survey catch of 420.67 t is the highest for a 1st pre-season since at least 2006 (Table 1).

Average *D. gahi* catch density (Figure 2) among fixed-station trawls north of 52º S was 1.21 t km^{-2}; the highest for 1st pre-seasons since at least 2011 when this format of data analysis was first used (second-highest: 0.73 t km^{-2} in 2016; Winter et al. 2016). Average *D. gahi* catch density among fixed-station trawls south of 52º S was 4.10 t km^{-2}; also the highest for 1st pre-seasons since at least 2011 (second-highest: 3.70 t km^{-2} in 2015; Winter et al. 2015). Average *D. gahi* catch density among adaptive-station trawls north of 52º S was 5.00 t km^{-2}; the highest for a 1st pre-season survey since 2014. Average *D. gahi* catch density among adaptive-station trawls south of 52º S was 9.04 t km^{-2}; the highest since 2019 and second-highest on record for a 1st pre-season survey.

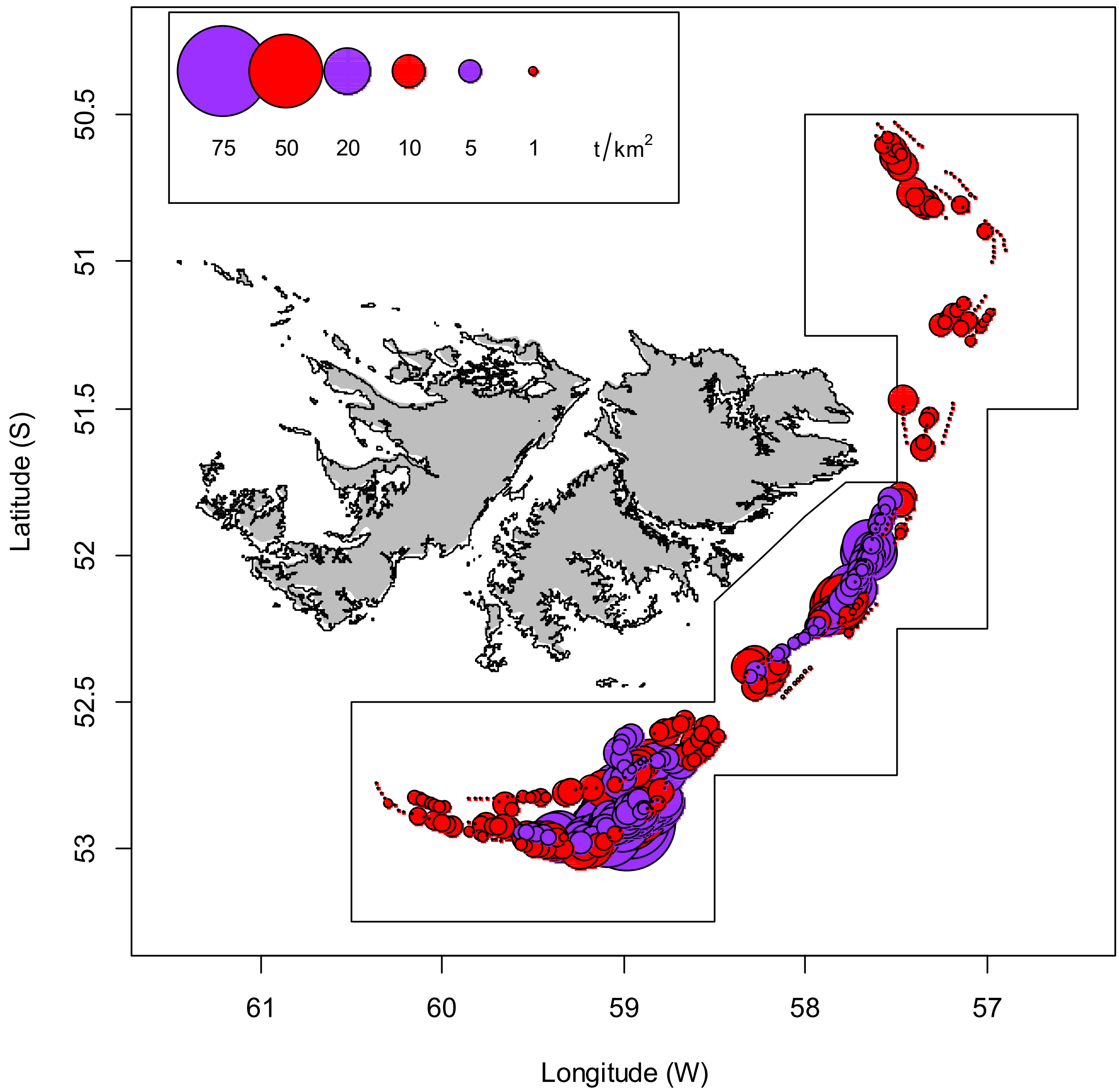


Figure 2. *D. gahi* CPUE (t km^{-2}) of fixed-station (red) and adaptive-station (purple) trawls per 15-minute trawl interval. Boundaries of the 'Loligo Box' fishing zone and the Beauchêne Island exclusion zone (mostly hidden) are traced in black.

Table 1. *D. gahi* pre-season survey scientific catches and biomass estimates (in metric tonnes). Before 2006, surveys were not conducted immediately prior to season opening.

Year	First season			Second season		
	No. trawls	Catch	Biomass	No. trawls	Catch	Biomass
2006	70	376	10213	52	240	22632
2007	65	100	2684	52	131	19198
2008	60	130	8709	52	123	14453
2009	59	187	21636	51	113	22830
2010	55	361	60500	57	123	51754
2011	59	50	16095	59	276	51562
2012	56	128	30706	59	178	28998
2013	60	52	5333	54	164	36283
2014	60	124	34673	58	207	40090
2015	57	184	36424	53	137	25422
2016	57	65	21729	58	225	43580
2017	59	180	48785	63*	314	56807
2018	59*	115	32194	53	510	183593
2019	55	382	49618	51	298	50880
2020	59	268	27991	55	575	92194
2021	55	280	31770	59	534	77526
2022	60	421	47058			

* Includes four juvenile toothfish transect trawls.

Biomass estimation

Total *D. gahi* biomass in the fishing area was estimated at 47,058 tonnes, with a 95% confidence interval of [40,295 to 60,115 t]. The total was the third-highest 1st pre-season estimate of the past 10 years, and the highest since 2019 (Table 1). Partition of the estimated biomass was 17,165 tonnes north [8,839 to 22,205 t] vs. 29,894 tonnes south [27,650 to 41,788 t]. At 36.5% of the total, this partition represents the highest proportion of biomass north for 1st pre-seasons since 2016 (Winter et al. 2016). Within the north sub-area 50% of *D. gahi* density was aggregated in 55 of 368 5×5 km area units, and 95% of density was aggregated in 189 of the 368 5×5 km area units (Figure 3). Within the south sub-area 50% of *D. gahi* density was aggregated in 47 of 392 5×5 km area units[d], and 95% of density was aggregated in 242 of the 392 5×5 km area units (Figure 3).

Biological data

Ninety-seven taxa were identified in the survey catches (Appendix Table A2). *D. gahi* was the predominant catch with the highest proportion for a 1st pre-season since at least 2012 (93.7%, Table A2); narrowly higher than the 93.2% in 2020 (Winter et al. 2020). The second-highest catch species was rock cod *Patagonotothen ramsayi*, for the fourth consecutive 1st pre-season, with 4.4% of the total. No other species accounted for ≥1% of the total (Table A2). Blue whiting catch was the lowest for a 1st pre-season since at least 2012.

D. gahi were collected and frozen from 15 stations for statolith sampling ashore. During the survey 8974 *D. gahi* were measured for length and maturity (4147 males, 4827 females, from 57 of the trawls[e]). The total sex ratio was significantly ($p < 0.0001$) majority female.

[d] Excluding depths <90 m or >400 m.

[e] The last trawl failed to record stage one females from the electronic measuring board, and had to be excluded as biased.

Sixteen individual trawls had a significant preponderance of females, distributed along the perimeter of the survey area. Five individual trawls had a significant preponderance of males, of which four were clustered to the west of Beauchêne Island, and one was to the north at latitude S 51° 28.5'. Preponderance of females had a significant positive correlation with depth ($p < 0.01$), concurring with earlier studies that have found females move deeper (Hatfield et al. 1990, Arkhipkin and Middleton 2002).

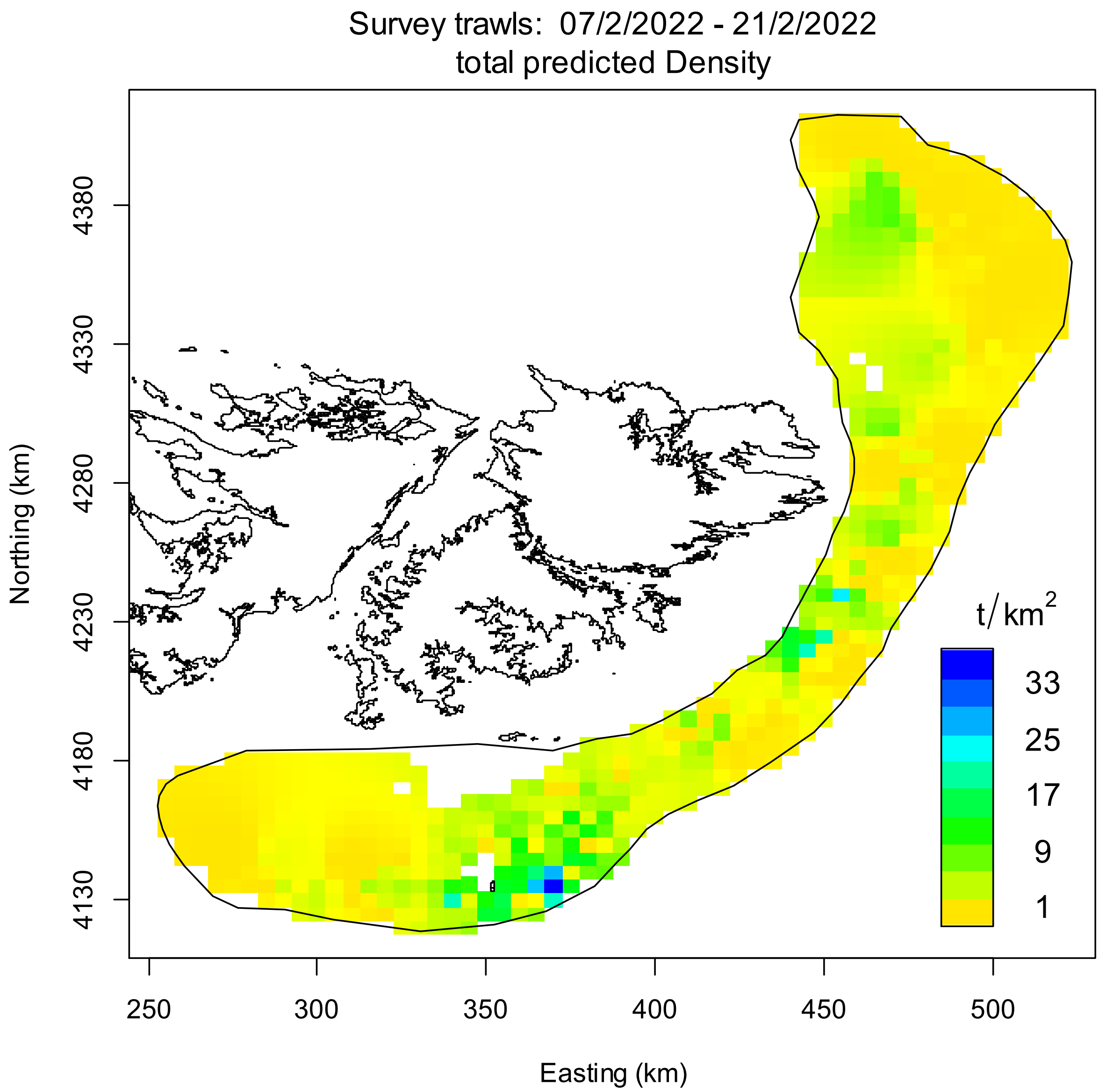
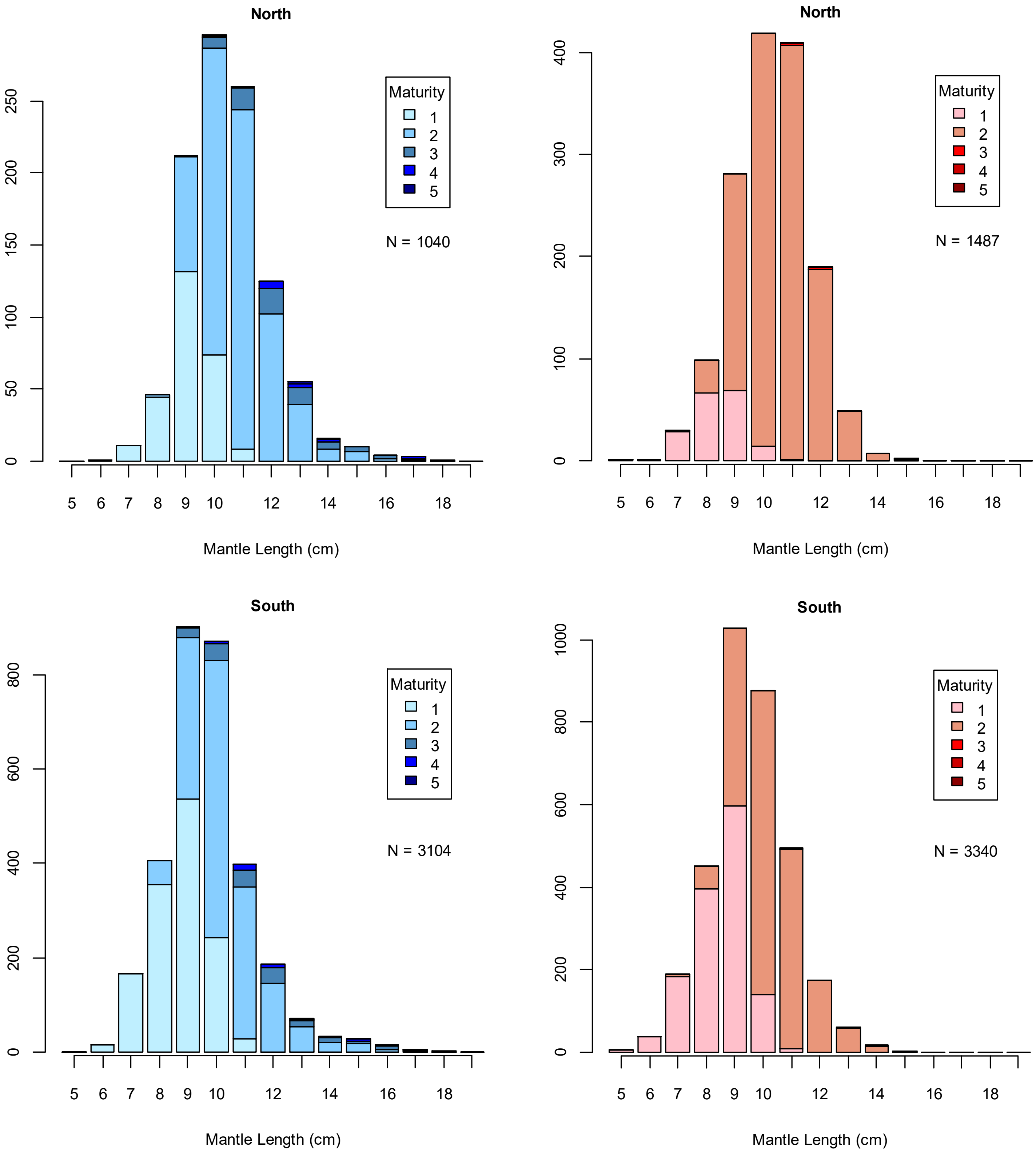


Figure 3. *D. gahi* predicted density estimates per 5 km^2 area units. Blank area units within the perimeter are either <90 or >400 m average depth. Coordinates were converted to WGS 84 projection in UTM sector 21F using the R library rgdal (proj.maptools.org).

Figure 4 [next page]. Length-frequency distributions by maturity stage of male (blue) and female (red) *D. gahi* from trawls north (top) and south (bottom) of latitude 52 °S. Three males in the south had recorded mantle lengths > 20 cm (1× 20.5 cm; maturity 4, and 2× 36 cm [questionable]; maturity 2), and are excluded from the plot.



D. gahi mantle length and maturity distributions north and south of 52° S are plotted in Figure 4. For males north: mean mantle length 10.27 cm; mean maturity stage 1.84 (on a scale of 1 to 6, Lipinski 1979), males south: mean mantle length 9.53 cm; mean maturity stage 1.66. Females north: mean mantle length 10.03 cm; mean maturity stage 1.88, females south: 9.31

cm; stage 1.59. On average, these are the smallest sizes for a 1st pre-season since 2016 (Winter et al. 2016). Mantle length distributions were significantly different between north and south for both males and females (Kruskal-Wallis test, $p < 0.05$). Maturity stage distributions were also significantly different between north and south for both males and females ($p < 0.05$). Mantle lengths and maturities of males and females were also positively correlated with the sampling day ($p < 0.001$, $R^2 = 19.8\%$), suggesting that they grew continuously and no substantial immigration occurred during the survey itself.

Otoliths taken during the survey are summarized in Table A3.

Pinniped and seabird monitoring

The 1st pre-season survey 2022 was conducted without seal exclusion devices (SED) in the trawls. Pinniped and seabird monitoring during the survey was carried out by Argos compliance officer Jano van Heerden. No pinniped interactions were recorded. Two black-browed albatross (*Thalassarche melanophris*) mortalities occurred in trawls, and one black-browed albatross was released alive.

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Appendix

Table A1. Survey stations with total *Doryteuthis gahi* catch. Time: Stanley FI time. The actual fishing schedule operated on ship time, one hour advanced. Latitude: °S, longitude: °W. Transects labelled A were adaptive-station trawls.

Transect / Trawl	Data Station	Date	Start			End			Depth (m)	*D. gahi* (kg)
			Time	Lat	Lon	Time	Lat	Lon		
14 - 39	347	07/02/2022	06:00	50.52	57.53	08:00	50.61	57.36	250	0
14 - 38	348	07/02/2022	08:40	50.65	57.45	10:40	50.53	57.60	141	2093
14 - 37	349	07/02/2022	11:10	50.56	57.63	13:10	50.67	57.47	135	5779
13 - 34	350	07/02/2022	13:50	50.75	57.43	15:50	50.85	57.23	129	6161
12 - 33	351	08/02/2022	06:00	50.98	56.89	08:00	50.87	57.01	119	120
13 - 36	352	08/02/2022	08:45	50.79	57.04	10:45	50.70	57.23	254	38
13 - 35	353	08/02/2022	11:25	50.73	57.30	13:25	50.83	57.10	130	644
12 - 32	354	08/02/2022	13:55	50.87	57.06	15:55	51.01	56.97	113	531
11 - 31	355	09/02/2022	05:55	51.15	56.94	07:55	51.27	57.09	141	840
11 - 30	356	09/02/2022	08:30	51.24	57.16	10:30	51.12	57.01	128	1107
11 - 29	357	09/02/2022	11:00	51.12	57.08	13:00	51.22	57.25	112	2867
10 - 26	358	09/02/2022	14:30	51.45	57.45	16:30	51.62	57.44	126	1536
10 - 28	359	10/02/2022	05:40	51.63	57.25	07:40	51.48	57.19	224	75
10 - 27	360	10/02/2022	08:25	51.48	57.31	10:25	51.64	57.36	148	2217
9 - 25	361	10/02/2022	11:35	51.83	57.40	13:35	51.96	57.51	217	460
9 - 24	362	10/02/2022	14:20	51.95	57.58	16:20	51.80	57.47	159	3110
8 - 23	363	11/02/2022	05:40	52.16	57.59	07:40	52.27	57.76	257	177
8 - 22	364	11/02/2022	08:20	52.25	57.84	10:20	52.13	57.66	199	1346
8 - 21	365	11/02/2022	11:00	52.13	57.77	13:00	52.24	57.94	136	19934
7 - 18	366	11/02/2022	14:10	52.34	58.17	16:10	52.44	58.34	144	4077
2 - 6	367	12/02/2022	05:40	52.98	59.65	07:40	52.94	59.85	240	554
2 - 5	368	12/02/2022	08:35	52.91	59.88	10:35	52.93	59.63	170	5130
3 - 8	369	12/02/2022	11:25	52.95	59.60	13:25	52.97	59.33	176	11889
4 - 11	370	12/02/2022	14:15	53.01	59.28	16:15	52.94	59.02	220	11418
0 - 1	371	13/02/2022	05:40	52.76	60.37	07:40	52.88	60.21	245	177
1 - 3	372	13/02/2022	08:20	52.88	60.20	10:20	52.92	59.95	225	3242
1 - 2	373	13/02/2022	11:00	52.87	59.96	13:00	52.83	60.15	189	1886
2 - 4	374	13/02/2022	14:00	52.83	59.88	16:00	52.87	59.62	159	1600
3 - 7	375	14/02/2022	05:40	52.82	59.67	07:40	52.83	59.43	153	1482
4 - 10	376	14/02/2022	08:25	52.82	59.34	10:25	52.80	59.12	110	5434
5 - 12	377	14/02/2022	11:00	52.80	59.07	13:00	52.70	58.86	120	10640
5 - 13	378	14/02/2022	14:00	52.80	58.77	16:00	52.87	58.98	144	16382
7 - 20	379	15/02/2022	05:40	52.50	58.15	07:40	52.38	57.98	258	312
7 - 19	380	15/02/2022	08:20	52.37	58.09	10:20	52.46	58.28	184	7490
6 - 17	381	15/02/2022	11:30	52.60	58.46	13:30	52.71	58.63	226	3082
5 - 14	382	15/02/2022	14:35	52.83	58.76	16:35	52.90	58.97	164	18795
6 - 16	383	16/02/2022	06:35	52.70	58.69	08:35	52.58	58.53	164	7589
6 - 15	384	16/02/2022	07:05	52.56	58.60	09:05	52.61	58.83	130	4355
A - 1	385	16/02/2022	11:35	52.61	58.91	13:35	52.72	58.99	108	5626
A - 2	386	16/02/2022	14:20	52.71	58.90	15:00	52.80	58.77	138	7224
3 - 9	387	17/02/2022	05:40	52.98	59.60	07:40	53.00	59.34	238	5020
A - 3	388	17/02/2022	08:20	52.99	59.28	10:20	52.93	59.08	163	23305
A - 4	389	17/02/2022	11:10	52.94	59.11	13:10	52.84	58.91	145	15170
A - 5	390	17/02/2022	14:00	52.84	58.88	16:00	52.92	59.06	144	14770
A - 6	391	18/02/2022	05:40	52.86	58.86	06:55	52.91	58.98	152	25776

A - 7	392	18/02/2022	07:40	52.92	59.00	09:40	52.84	58.80	150	24407
A - 8	393	18/02/2022	10:30	52.84	58.80	12:30	52.92	59.00	147	25090
A - 9	394	18/02/2022	14:40	52.92	59.00	16:40	52.83	58.78	145	18400
A - 10	395	19/02/2022	05:40	52.94	59.59	07:40	52.96	59.35	170	11520
A - 11	396	19/02/2022	08:25	52.97	59.27	10:25	52.90	59.08	159	19333
A - 12	397	19/02/2022	11:20	52.80	59.07	13:20	52.70	58.88	118	6599
A - 13	398	19/02/2022	14:00	52.71	58.94	16:00	52.71	58.69	136	5457
A - 14	399	20/02/2022	05:40	52.43	58.32	07:40	52.33	58.13	154	1984
A - 15	400	20/02/2022	08:15	52.31	58.08	10:15	52.22	57.90	133	3671
A - 16	401	20/02/2022	10:50	52.22	57.88	12:50	52.10	57.73	139	9011
A - 17	402	20/02/2022	13:40	52.11	57.75	15:40	51.98	57.64	132	14104
A - 18	403	21/02/2022	05:40	52.11	57.74	07:40	51.97	57.63	138	3254
A - 19	404	21/02/2022	08:15	51.95	57.63	10:15	51.81	57.53	136	1717
A - 20	405	21/02/2022	10:50	51.85	57.56	12:50	51.98	57.63	136	4756
A - 21	406	21/02/2022	13:35	51.98	57.63	15:35	52.12	57.74	141	9905

Table A2. Empirical estimates of survey total catches by species / taxon.

Species Code	Species / Taxon	Total catch (kg)	Total catch (%)	Sample (kg)	Discard (kg)
LOL	*Doryteuthis gahi*	420667	93.7	302	0
PAR	*Patagonotothen ramsayi*	19822	4.4	256	18289
BLU	*Micromesistius australis*	3113	0.7	140	2884
ING	*Onykia ingens*	818	0.2	0	818
BAC	*Salilota australis*	817	0.2	79	0
CGO	*Cottoperca gobio*	390	0.1	0	390
PTE	*Patagonotothen tessellata*	377	0.1	0	377
GRF	*Coelorinchus fasciatus*	375	0.1	45	371
PMB	*Protomyctophum bolini*	291	0.1	0	291
ILL	*Illex argentinus*	253	0.1	78	42
ALF	*Allothunnus fallai*	215	<0.1	174	0
WHI	*Macruronus magellanicus*	205	<0.1	73	142
ZYP	*Zygochlamys patagonica*	195	<0.1	0	195
GYN	*Gymnoscopelus nicholsi*	167	<0.1	1	167
DGH	*Schroederichthys bivius*	148	<0.1	0	148
GRC	*Macrourus carinatus*	135	<0.1	135	24
TOO	*Dissostichus eleginoides*	125	<0.1	125	0
KIN	*Genypterus blacodes*	111	<0.1	55	0
MED	Medusa sp.	94	<0.1	0	94
SPN	Porifera	60	<0.1	0	60
PAU	*Patagolycus melastomus*	54	<0.1	7	25
GOC	*Gorgonocephalus chilensis*	52	<0.1	0	52
SAL	*Salpa* sp.	50	<0.1	0	50
ALG	Algae	34	<0.1	0	34
RFL	*Dipturus lamillai*	30	<0.1	0	10
BUT	*Stromateus brasiliensis*	19	<0.1	0	19
PAT	*Merluccius australis*	15	<0.1	13	1
SAR	*Sprattus fuegensis*	14	<0.1	7	7
HYD	Hydrozoa	11	<0.1	0	11
TRP	*Tripylaster philippi*	9	<0.1	0	9
SQT	Ascidiacea	9	<0.1	0	9
DGS	*Squalus acanthias*	9	<0.1	0	9
STA	*Sterechinus agassizii*	6	<0.1	0	6
NEM	*Psychrolutes marmoratus*	6	<0.1	0	6

RBR	*Bathyraja brachyurops*	5	<0.1	0	3
LIS	*Lithodes santolla*	4	<0.1	0	3
ILF	*Iluocoetes fimbriatus*	4	<0.1	3	1
CHE	*Champsocephalus esox*	4	<0.1	3	2
RDO	*Amblyraja doellojuradoi*	3	<0.1	0	3
ANM	Anemonia	3	<0.1	0	3
RSC	Bathyraja scaphiops	2	<0.1	0	0
RAY	Rajiformes	2	<0.1	0	0
RAL	*Bathyraja albomaculata*	2	<0.1	0	0
OPV	*Ophiacantha vivipara*	2	<0.1	0	2
OCM	*Enteroctopus megalocyathus*	2	<0.1	2	0
OCC	Octocorallia sp	2	<0.1	0	2
MLA	*Muusoctopus longibrachus akambei*	2	<0.1	2	0
FUM	*Fusitriton m. magellanicus*	2	<0.1	0	2
CTA	*Ctenodiscus australis*	2	<0.1	0	2
SEP	*Seriolella porosa*	1	<0.1	1	0
RMC	*Bathyraja macloviana*	1	<0.1	0	1
PYM	*Notophycis marginata*	1	<0.1	1	0
POA	*Glabraster antarctica*	1	<0.1	0	1
OPL	*Ophiura lymani*	1	<0.1	0	1
MXX	Myctophidae spp.	1	<0.1	1	0
HEO	*Henricia obesa*	1	<0.1	0	1
HAK	*Merluccius hubbsi*	1	<0.1	1	0
WRM		<1	<0.1	0	0
UHH	*Tripilaster* sp.	<1	<0.1	0	0
THN	*Thysanopsetta naresi*	<1	<0.1	0	0
SUN	*Labidiaster radiosus*	<1	<0.1	0	0
SRP	*Semirossia patagonica*	<1	<0.1	0	0
SER	*Serolis* spp.	<1	<0.1	0	0
PYX	Pycnogonida	<1	<0.1	0	0
PRX	*Paragorgia* sp.	<1	<0.1	0	0
POL	Polychaeta	<1	<0.1	0	0
POE	*Pogonolycus elegans*	<1	<0.1	0	0
PMC	*Protomyctophum choriodon*	<1	<0.1	0	0
PLU	Primnoidae	<1	<0.1	0	0
PES	*Peltarion spinulosum*	<1	<0.1	0	0
OPS	*Ophiactis asperula*	<1	<0.1	0	0
ODP	*Odontaster pencillatus*	<1	<0.1	0	0
ODM	*Odontocymbiola magellanica*	<1	<0.1	0	0
NUD	Nudibranchia	<1	<0.1	0	0
NOW	*Paranotothenia magellanica*	<1	<0.1	0	0
MYX	*Myxine* spp.	<1	<0.1	0	0
MUN	*Munida* spp.	<1	<0.1	0	0
MUG	*Munida gregaria*	<1	<0.1	0	0
MAV	*Magellania venosa*	<1	<0.1	0	0
LOS	*Lophaster stellans*	<1	<0.1	0	0
ISO	*Isopoda*	<1	<0.1	0	0
ICA	*Icichthys australis*	<1	<0.1	0	0
HEX	*Henricia* sp.	<1	<0.1	0	0
EUL	*Eurypodius latreillii*	<1	<0.1	0	0
ELS	*Electrona subaspera*	<1	<0.1	0	0
DIA	*Diaulula* spp.	<1	<0.1	0	0
CYX	*Cycethra* sp.	<1	<0.1	0	0
CRY	*Crossaster* sp.	<1	<0.1	0	0
COT	*Cottunculus granulosus*	<1	<0.1	0	0
COG	*Patagonotothen guntheri*	<1	<0.1	0	0
CAZ	*Calyptraster* sp.	<1	<0.1	0	0
CAS	*Campylonotus semistriatus*	<1	<0.1	0	0
BRY	Bryozoa	<1	<0.1	0	0

BAO	*Bathybiaster loripes*	<1	<0.1	0	0
AUC	*Austrocidaris canaliculata*	<1	<0.1	0	0
ANT	Anthozoa	<1	<0.1	0	0
AGO	*Agonopsis chiloensis*	<1	<0.1	0	0
		448,745		1,504	24,567

Table A3. Summary of otolith numbers by species by sex taken during the survey.

Species		N otoliths	
		M	F
Common Rockcod	*Patagonotothen ramsayi*	180	123
Patagonian Toothfish	*Dissostichus eleginoides*	66	80
Red cod	*Salilota australis*	31	46
Grenadier-Ridge Scaled Rattail	*Macrourus carinatus*	2	60
Hoki	*Macruronus magellanicus*	17	32
Southern Blue Whiting	*Micromesistius australis*	29	19
Slender Tuna	*Allothunnus fallai*	12	9
Kingclip	*Genypterus blacodes*	6	14
Icefish	*Champsocephalus esox*	2	9
Patagonian Hake	*Merluccius australis*	0	9
Grenadier-Banded Whiptail	*Coelorinchus fasciatus*	0	6
Dwarf codling	*Notophycis marginata*	0	1
Common Hake	*Merluccius hubbsi*	0	1