BY-CATCH OF FISH IN THE KRILL FISHERY

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Abstract

Observations are reported of icefish being taken as by-catch during krill fishing operations from a research vessel. The results indicate that the by-catch of fish in the commercial krill fishery may be significant in some areas of the South Georgia shelf. The problem is thought to be least in open ocean krill fishing.

Résumé

Observations fournies par un navire de recherche sur le poisson des glaces présent dans les captures accessoires des opérations de pêche de krill. Les résultats indiquent que la capture accessoire de poisson dans la pêcherie commerciale de krill pourrait être significative dans certaines régions du plateau de Géorgie du Sud. Il semblerait que le problème soit de moindre importance dans les opérations de pêche en plein océan.

Резюме

С научно-исследовательского судна была получена информация о наблюдении прилова ледяной рыбы при промысле криля. Результаты показывают, что прилов рыбы при коммерческом промысле криля может быть значительным в некоторых районах шельфа Южной Георгии. Предполагается, что проблема менее серьезна при промысле криля в открытом океане.

Resumen

Se han observado capturas accidentales de draco rayado durante la pesca de krill realizada por un buque de investigación. Las conclusiones indican que la pesca íctica accidental que ocurre en la pesquería comercial de krill puede ser considerable en algunas zonas de la plataforma del archipiélago de las Georgias del Sur. Se cree que este problema se da en menor magnitud en la pesca de krill en alta mar.

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1. INTRODUCTION

During the past 20 years a major krill fishery has become established in the Southern Ocean. Nearly all of the catches have been made using midwater trawls, which, because krill (*Euphausia superba*) only grow to a maximum size of about 6 cm, are made of fine mesh netting. The fishery operates by aimed tows at krill swarms which have been located using echosounders.

Recently concern has been expressed that the fishery may be taking a significant by-catch of fish with the result that it may be responsible for significant levels of mortality in other harvested species (SC-CAMLR, 1989). We have analysed results from research vessel catches, using commercial krill trawls, in order to quantify the by-catch of fish in the krill fishery.

2. MATERIAL AND METHODS

Observations were made on catches from the research vessels *Akademik Knipovich* between January and July 1981 (Anon., 1981), and *Evrika* during January 1987. Both cruises were undertaken in the Atlantic sector of the Southern Ocean. Part of the time the research vessels were operating in conjunction with krill fishing fleets. Precise details of the locations and numbers of commercial fishing vessels are not available to us, were are unable, therefore, to relate these results directly to the total krill catch during the two seasons under consideration. Information is available, however, on the general disposition of the commercial fleet in the area.

Position at the end of each haul was recorded along with maximum and minimum water depth, time and duration of tow. The depth of the footrope of the net and the vertical opening of the net were also recorded.

The constraints of the sampling program meant that not all catches could be sampled but wherever possible representative samples were taken to look for fish. In most cases fish were counted, measured and weighed. When this was not possible qualitative observations were recorded in the field logbooks. When large krill catches were made a subsample of the catch was taken for analysis. Numbers and weights of fish in these subsamples have been increased *pro rata* to give an estimated total number or weight for the haul.

3. RESULTS

Information on individual net hauls from both cruises is set out in Tables 3 to 4 for Subareas 48.3, 48.2 and 48.6 respectively. Estimated numbers of the icefish, *Champsocephalus gunnari*, taken in each tow at South Georgia are set out in Table 4. Numbers of other fish species taken in each tow are set out in Tables 5 to 7.

Several size classes were present in many of the catches. The breakdown of size classes in haul 53 is given in Table 8. Reference to Folkina (1989) suggests all the modal values do not correspond with year classes. Based on the result of Frolkina, we suggest that our class (iv) is probably age two or three, our size classes (ii) and (iii) are age 1 and our size class (i) is age 0. *C. gunnari* occurred frequently in the catches of Subarea 48.3 but only in shallow water. This species was never found in hauls where the net had been in water deeper than 500 m throughout the haul. It did not figure in the catches from the other subareas. Moderate numbers of another icefish, *Chaenocephalus aceratus*, were also present in some hauls although the numbers never approached those of *C. gunnari*.

In contrast to the icefish, Myctophidae species were only present in deep water catches.

All other species were only ever present in small numbers.

4. DISCUSSION

4.1 General Considerations

The two icefish species *C. gunnari* and *C. aceratus*, and the Myctophidae were the only species that occurred in large numbers in the catches. The situations under which the large catches occurred are discussed further. The other species were taken in such small quantities that their presence in the by-catch of the krill fishery is unlikely to affect significantly their recruitment.

4.2 *Chaenocephalus aceratus*

The largest by-catches of this species, in common with *C. gunnari*, were made around South Georgia but they were only present when the krill catch was very small, less than would be required by a commercial fishing fleet. Our results suggest that large-scale krill harvesting is probably having little effect on the stocks of *C. aceratus*.

4.3 Myctophidae

Catches of Myctophidae tended to occur over deep water, in some instances at a great distance from the shelf. These species are themselves the subject of directed fishery in deep water in Subarea 48.3 (SC-CAMLR, 1989, Annex 6, paragraph 7). Everson and Goss (in press) showed that the distribution of krill fishing was concentrated close to or on the shelf and so there is likely to be some geographical separation between fleets harvesting these two resources.

4.4 Seasonal Variation

The results that we have reported here were obtained during the first few months of the year. Krill fishing at South Georgia is at its peak during the winter months and our results give no information for that period.

Krill fishing only takes place during the summer in Subarea 48.2 and our results for that area may therefore provide a reasonable indicator of the situation within the commercial fleets.

5. CONCLUSIONS

Our results from research vessel surveys demonstrate that, under certain circumstances at South Georgia, large numbers of fish are likely to be taken in the course of the directed fishery for krill. The problem appears to be greatest in the vicinity of Clerke Rocks where a commercial fleet was operating in an area where significant numbers of the icefish *C. gunnari* were present. This is the same area that Slosarczyk (1983) noted large numbers of Nototheniidae and Channichthyidae being taken in experimental trawls. Both Slosarczyk and Rembiszewski (1982) and Rembiszewski *et al.* (1978) concluded that although the amounts of fish were likely to cause little contamination to the krill catches they were sufficiently large to have a detrimental effect on the abundance of young fish.

From the limited observations we have recorded in this paper we are unable to indicate whether this effect is present during the winter months when the South Georgia krill fishery is at its seasonal peak (Everson and Goss, in press).

We suggest two ways of researching this topic further. Firstly, we would recommend rigorous monitoring of the krill fishery in order to determine the magnitude of the problem in

the field. Secondly, we consider it important to determine the locations and times of year when the demersal fish are at greatest risk. At South Georgia this would mean that results from young fish surveys in winter would be of particular importance. Examination of data from such research cruises would provide guidance to help krill fishermen avoid catching young fish.

The largest by-catches of *C. gunnari* were associated with moderate or low catch rates of krill. The highest catch rates of krill contained a small proportion of by-catch species. This tends to indicate that commercial fishing on dense krill swarms may have only a minor effect on the icefish. Approximately one haul in 20 was however taking large amounts of krill and fish. There is clearly a need for further information on the relationship between the krill swarms and associated demersal fish species.

C. gunnari was not present in the by-catches from Subareas 48.2 or 48.6 and so from this information we would conclude that there is only a very small by-catch of this species in the krill fishery in these areas.

Our results also indicate that other demersal species are probably not present in great quantity in the by-catch in these areas.

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Table 1: Information on trawls in Subarea 48.3 (South Georgia).

Column headings are as follows: a-Haul number, b-Day, c-Month, d-Latitude (degrees south), e-Latitude (minutes), f-Longitude (degrees west), g-Longitude (minutes), h-Water Depth at Start of Trawling, i-Water Depth at End of Trawling, j-Minimum Depth of Footrope of Net, k-Maximum Depth of Footrope of Net, l-Vertical Opening of Net, m-Time, n-Duration of Tow (hours).

a	b	c	d	e	f	g	h	i	j	k	l	m	n
Cruise of RV *Akademik Knipovich* in 1981													
47	10	4	54	54	34	50	230	255	45	40	30	845	2.00
48	10	4	54	56	34	51	230	130	30	40	24	1640	0.92
49	11	4	54	55	35	2	220	155	40	31	27	225	1.58
50	11	4	54	49	34	49	240	580	35	35	27	600	1.33
51		4	54	55	34	50	500	185	40	35	27	850	1.00
52		4	54	56	34	46	260	145	35	35	26	1645	1.17
53	12	4	54	52	34	51	225	300	35	35	24	650	2.25
54		4	54	46	34	59	250	257	55	42	32	1130	0.92
55		4	54	53	35	3	280	180	32	50	24	1705	2.25
56	14	4	54	57	35	4	170	170	50	50	24	540	2.50
57		4	54	52	35	8	165	165	40	50	27	945	2.25
58		4	54	47	35	16	110	350	75	250	25	1650	3.83
59	15	4	54	44	34	55	450	295	40	45	30	1055	1.66
60		4	54	40	34	50	350	305	40	40	29	1520	2.33
61	16	4	54	41	34	51	360	500	40	50	30	715	1.08
62		4	54	43	34	57	260	290	50	50	33	1015	1.75
63		4	54	45	35	1	255	250				1325	1.75
64	17	4	54	39	35	32	120	120	60	50	30	2115	2.75
65	18	4	54	38	35	14	225	205				235	1.42
66	18	4	54	31	35	19	160	160	50	40	30	725	1.83
67	18	4	54	30	35	10	300	300	50	50	30	1550	2.67
68	19	4	54	29	35	15	300	1160	40	50	30	630	1.50
69	19	4	54	28	35	13	500	600	50	60	25	1025	1.08
70	19	4	54	29	35	7	400	500	40	40	30	1745	1.83
71	20	4	54	14	35	18	250	470				545	2.25
86	10	5	55	0	33	47	3000	3000	70	150		1430	
87	11	5	54	57	31	34	4700	4700	65	150		315	0.50
88	11	5	54	34	32	11	5120	5120	35	55	30	1100	0.50
89	12	5	54	33	34	53	700	700	35	110	30	905	0.58
90	12	5	54	55	34	55	125	180	35	50	27	1700	0.50
91	12	5	54	51	34	42	130	130	37	55	27	1945	1.00
92	12	5	54	49	34	49	320	320	35	110	30	2210	0.67
93	13	5	54	16	35	26	230	120	32	55	30	600	0.50
94	13	5	54	10	35	36	200	200	45	65	30	825	2.08
95	13	5	53	55	34	40	3310	3310	37	53	30	1810	0.50
96	15	5	54	6	35	43	240	240	45	60	30	750	1.42
97	15	5	54	13	35	16	700	690	65	150		1210	0.50
98	15	5	53	51	35	10	3200	3200	42	54	30	1620	0.58
99	16	5	53	58	35	33	980	980	42	54	30	700	0.67
100	16	5	54	3	35	34	230	130	45	65	30	955	1.83
101	16	5	54	13	35	59	215	215	37	54	30	1650	0.50
106	18	5	54	0	35	58	270	300	100	100		1210	0.58
107	19	5	53	47	35	52	630	780	37	54	30	1720	0.50
109	19	5	52	5	36	25	3700	3700	37	54	30	1625	0.50

Table 1 (continued)

a	b	c	d	e	f	g	h	i	j	k	l	m	n
Cruise of RV *Akademik Knipovich* in 1981 (continued)													
110	20	5	53	10	36	13	3000	3000	100	100		245	0.70
111	20	5	53	37	36	30	620	620	37	54	30	730	0.50
112	20	5	53	45	36	35	180	180	35	60	30	940	0.50
113	20	5	53	41	37	31	320	315	65	150		1535	0.50
114	23	5	53	35	38	20	2550	2550	37	54	30	630	0.50
Cruise of RV *Evrika* in 1987													
6	6	1	56	23	27	29	180	150	40	40		2140	0.92
7	7	1	56	17	26	33	3000	3000				220	0.50
30	18	1	55	28	35	36	250	310	95	150		1655	1.17
31	19	1	54	53	34	43	128	300	20	50		135	1.25
32	19	1	54	53	34	38	200	300	30	130		440	0.92
122	27	2	54	54	34	31	275	270	50	50		2150	0.50
145	4	4	54	40	35	26	150	150	0	35		1400	0.42

Table 2: Information on trawl in Subarea 48.2, South Orkney Island. (Column headings are the same as for Table 1.)

a	b	c	d	e	f	g	h	i	j	k	l	m	n
Cruise of RV *Akademik Knipovich* in 1981													
74	27	4	60	39	50	57	420	420	35	35	25	1300	0.50
75	27	4	60	59	53	5	1500	1500	37	55	30	2255	0.50
76	28	4	60	30	53	52	3000	3000	37	55	30	550	0.50
77	28	4	60	58	53	48	1760	1760				1215	
78	29	4	62	9	55	27	330	330	35	60	30	1025	0.50
81	30	4	62	34	56	5	205	205	37	40	30	1635	1.25
82	1	5	62	36	35	34	320	320	50	50	30	950	0.75
Cruise of RV *Evrika* in 1987													
9	8	1	57	15	26	31						656	0.58
12	10	1	58	53	26	41	1000	990				1850	0.50
13	10	1	58	56	26	38						2200	0.50
14	11	1	58	16	26	38						120	0.42
17	12	1	59	59	28	9	2000	2000	45	45		2235	0.58
18	13	1	60	3	30	20	2000	2000	30	30		1240	0.58
19	13	1	59	59	30	20	2000	2000	30	20		1500	1.00
20	13	1	59	59	30	28	1000	1000	25	25		1755	1.00
21	13	1	60	3	30	28	2700	2700	25	25		2045	1.00
29	17	1	60	14	60	15	1400	500	15	45		1100	0.83
35	23	1	61	41	27	59	4000	4000	5	125		2215	2.50
36	23	1	63	3	27	57	4000	4000	30	35		1315	1.16
51	30	1	62	36	41	48	3000	3000	0	50		1110	2.50
52	30	1	62	35	41	50	3000	3000	20	50		1625	2.50
53	30	1	62	5	42	30	3000	3000	20	50		2300	2.00
54	31	1	60	44	44	12	150	125	0	65		1150	1.16

Table 2 (continued)

a	b	c	d	e	f	g	h	i	j	k	l	m	n
Cruise of RV *Evrika* in 1987 (continued)													
55	31	1	60	29	45	2	580	638	30	140		1650	0.92
56	31	1	60	30	44	51	650	400	0	35		2030	2.00
57	1	2	60	25	46	20	125	130	20	50		230	0.75
58	1	2	60	23	45	59	150	600	30	110			
61	3	2	60	28	47	2	250	200	40	70		1310	0.42
62	4	2	60	31	46	13	100	230	0	30		50	0.66
63	4	2	60	26	45	59	130	120	70	120		1000	0.33
64	5	2	60	26	46	11	215	600	30	80		400	1.00
65	5	2	60	26	46	18	100	120	0	50		1600	0.42
66	6	2	60	25	46	6	318	320	30	20		725	0.75
67	6	2	60	27	45	47	150	240	5	110		1930	2.33
68	7	2	60	25	45	48	250	210	20	70		440	2.84
69	7	2	60	25	46	28	180	200	20	70		1315	0.50
70	7	2	60	26	46	25	250	300	20	800		2050	1.67
71	8	2	60	23	46	16	1500	1500				1125	0.33
72	8	2	60	26	46	11	150	1500	10	50		2300	1.00
73	9	2	60	26	45	59	150	150	0	30		245	0.50
74	9	2	60	27	45	51	180	220	25	55		1335	1.16
75	9	2	60	23	46	18	780	600	70	100		1650	1.16
76	10	2	60	26	46	20	230	460	30	90		730	1.50
77	10	2	60	25	46	28	140	210	40	100		1250	2.16
78	11	2	60	24	46	23	131	400	30	90		700	2.42
79	11	2	60	26	46	43	170	550	25	90		1230	2.00
80	12	2	60	25	46	15	100	600	0	40		15	4.00
81	12	2	60	25	46	19	250	300	120	210		950	2.42
82	13	2	60	26	48	30			140	120		1535	0.16
83	13	2	60	27	46	28	600	700	30	150		1720	3.16
104	13	2	60	27	46	11	360	600	70	90		1835	2.25
111	23	2	60	36	45	36	360	305	0	40			

Table 3: Information on trawl in Subarea 48.6. (Column headings are the same as for Table 1.)

a	b	c	d	e	f	g	h	i	j	k	l	m	n
Cruise of RV *Akademik Knipovich* in 1981													
5	5	3	63	44	9	39	5100	5100	48	85	28	1245	0.50
6	6	3	64	22	6	1	5200	5200	48	67	30	925	0.50
7	7	3	64	54	2	25	5000	5000	48	67	30	545	0.50
8	8	3	66	37	2	18	4500	4500	40	70	28	30	0.58
9	8	3	67	57	2	19	3700	3700	60	70	30	950	0.50
10	8	3	68	37	2	6	3500	3500	31	65	28	1715	0.50
11	9	3	69	35	1	14	2000	2000	53	80	28	1030	1.17
12	10	3	69	23	3	8	2100	2100	50	50	30	100	0.50
13	10	3	69	10	4	57	2180	2180	38	38	28	1915	0.75
14	12	3	69	51	10	14	340	345	48	135	32	1615	0.83
17	14	3	69	35	12	32	220	220	38	55	24	715	0.75

Table 3 (continued)

a	b	c	d	e	f	g	h	i	j	k	l	m	n
Cruise of RV *Akademik Knipovich* in 1981 (continued)													
18	14	3	69	2	12	49	1800	1800	45	45	27	1610	0.83
19	15	3	68	49	13	22	2700	2700	26	57	25	355	0.58
20	15	3	68	55	12	39	2050	2050	62	62	28	1245	1.33
21	15	3	69	17	11	50	760	740	33	53	23	1850	0.50
22	16	3	69	9	10	55	1800	1800	35	60	25	915	0.58
23	16	3	69	31	10	52	750	750	40	35	30	1405	0.50
24	17	3	69	7	10	3	2400	2400	50	50	30	1440	1.08
25	18	3	67	11	9	40	3100	3100	35	50	24	1735	0.58
26	20	3	63	12	5	14	5220	5220	32	68	24	1750	0.83
27	21	3	63	20	1	25	4500	4500	40	95	30	1125	0.67
28	22	3	64	4	3	25	2730	2730	28	40		1200	0.50
29	23	3	64	38	7	14	4000	4000	35	48	27	710	0.58
30	24	3	64	36	3	18	2270	2270	30	50	26	740	0.50
32	25	3	65	15	1	15	3000	3000	37	60	24	810	0.58
34	26	3	65	20	6	60	4600	4600	40	40	30	1110	0.50
35	27	3	65	52	3	31	4500	4500	35	35	30	1435	0.50
36	28	3	66	30	2	30	3850	3850	35	35	30	425	0.50
37	28	3	67	8	3	13	4000	4000	35	60	30	1115	0.50
38	29	3	68	39	6	5	3200	3200	40	68	30	1545	1.41
39	30	3	69	7	1	45	3460	3460	40	40	22	1655	1.33
Cruise of RV *Evrika* in 1987													
37	24	1	64	12	28		4000	4000	5	35		2400	1.75
38	25	1	65	28	27	59	4000	4000	200	245		1200	1.00
48	25	1	68	13	29	60	4000	4000	100	130		2350	0.50

Table 4: Estimated total numbers of *C. gunnari* in hauls at South Georgia using a krill trawl. NQ = Present but not quantified.

Haul	Catch Krill (tonnes)	Sample Size (kg)	Size Classes (i)	(ii)	(iii)	(iv)	Total
RV *Akademik Knipovich*							
47	0.20	all					NQ
48	0.10	all	0	0	0	69	69
49	0.00	all	0	9	11	0	20
50	0.55	10.15	3901	0	0	0	3901
51	13.00						NQ
52	16.00						NQ
53	0.30	21.16	3162	170	128	170	3629
54	17.00	all	0	0	0	0	0
55	1.00	all					NQ
56	1.00	all	0	0	110	0	110
57	10.00	all	0	0	0	1033	1033

Table 4 (continued)

Haul	Catch Krill (tonnes)	Sample Size (kg)	Size Classes (i)	(ii)	(iii)	(iv)	Total
RV *Akademik Knipovich* (continued)							
58	1.70	all	0	0	0	24577	24577*
59	10.00	all	0	0	0	0	0
60	2.50	all					NQ
61	0.30	all	0	0	0	0	0
62	6.00	all	0	0	0	0	0
63	15.00	22.00	682	0	0	0	682
64	1.60	all					NQ
65	0.00	all					0
66	8.00	all	0	0	0	0	0
67	7.00	all	0	0	0	0	0
68	4.00	10.00	800	0	0	0	800
69	18.00	all	0	0	0	0	0
70	5.00	all	0	0	0	0	0
71	9.00	all	0	0	0	0	0
86	0.00	all					0
87	0.00	all	0	0	0	0	0
88	0.00	all					0
89	0.00	all					0
90	few	all	3	2	2	0	7
91	0.00	all					0
92	0.00	all	3	2			5
93	0.50	all	2	0	0	0	2
94	0.15	all	4	1	0	0	5
95	0.00	all					0
96	12.00	all					NQ
97	0.10	all	0	0	0	0	0
98	0.04	all	0	0	0	0	0
99	0.00	all	0	0	0	0	0
100	15.00	all					NQ
101	few	all					0
106	0.00	all	0	0	0	0	NQ
107	0.00	all					1
109	0.00	all					0
110	0.00	all	0	0	0	0	0
111	0.00	all					NQ
112	few	all					NQ
113		all					NQ
114	few	all					
RV *Evrika*							
6	few		0	0	0	0	
7	0.00	all	0	0	0	0	
30	0.00	all	0	0	0	0	
31	0.50	all	0	0	0	0	
32	2.00	all	0	0	0	0	
122	20.00	all	0	0	0	0	
145	20.00	all	0	0	0	0	

* Haul 58, *Champsocephalus gunnari* was estimated to make up 70% of the catch. The size range was 16 to 22 cm which by analogy to Table 8 would have had a mean weight of 48.4 g.

Table 5: Catches of fish other than *Champsocephalus gunnari* at South Georgia.

ACER = *C. aceratus*, PSEU = *Pseudochaenichthys georgianus*, LARS = *Nototheniops larseni*, MYCT = Myctophidae, NQ is the same as in Table 4.

Haul	Krill Catch (tonnes)	Sub-Sample (kg)	ACER	PSEU	LARS	MYCT (n)	MYCT (kg)
RV *Akademik Knipovich*							
47	0.2000		NQ	0	NQ	0	
48	0.1000		162	0	0	0	
49	0.0050		62	1	60	0	
50	0.5500	10.15	2	1	1	0	
51	13.0000		NQ	0	0	0	
52	16.0000		NQ	0	0	0	
53	0.3000	0.0212	83	0	0	0	
54	17.0000		0	0	0	0	
55	1.0000		NQ	0	0	0	
56	1.0000		NQ	1	2	2	
57	10.0000		NQ	0	0	0	
58	1.7000		0	0	0	0	
59	10.0000		0	0	0	0	
60	2.5000		NQ	0	0		8.0
61	0.3000		0	0	0	0	
62	6.0000		0	0	0	0	
63	15.0000		0	0	0	0	
64	1.6000		0	0	0	0	
65	0.0000		0	0	0	0	
66	8.0000		0	0	0	0	
67	7.0000		0	0	0	0	
68	4.0000		0	0	0	0	
69	18.0000		0	0	0		NQ
70	5.0000		0	0	0	0	
71	9.0000		0	0	0	0	
86	0.0000		0	0	0	0	
87	0.0001		0	0	0	46	
88	0.0000		0	0		0	
89	0.0000		0	0	0	0	
90	few		NQ	1	NQ	0	
91	0.0000		590	0	4	0	
92	0.0000		17	0	2	9	
93	0.5000		NQ	0	0	0	
94	0.1500		NQ	0	0	0	
95	0.0000		0	0	0	40	0.5
96	12.0000		0	0	0	0	
97	0.1000		0	0	0	0	
98	0.0400		0	0	0	0	1.5
99	0.0001		0	0	0	1	
100	15.0000		1	0	0	0	
101	few		0	0	2	0	
106	0.0020		0	0	0	0	
107	0.0000		0	0	0		NQ
109	0.0000		0	0	0		15.0
110	0.0000		0	0	0		0.7

Table 5 (continued)

Haul	Krill Catch (tonnes)	Sub-Sample (kg)	ACER	PSEU	LARS	MYCT (n)	MYCT (kg)
RV *Akademik Knipovich* (continued)							
111	0.0000		0	0	0	0	
112	few		1	0	0	0	
113			0	1	0	0	
114	few					NQ	
RV *Evrika*							
6	few		0	0	0	2	
7	0.0000		0	0	0	0	
30	0.0000		0	0	0		1.5
31	0.5000		0	0	0	0	
32	2.0000		0	0	0	0	
122	20.0000		0	0	0	0	
145	20.0000		0	0	0	0	

Table 6: South Orkney data for fish in krill catches.

The species are: A = *C. aceratus*, B = *Chionodraco sp.*, C = other Channichthyidae, D = Myctophidae, E = *Notolepis coatsi*, F = *Pleuragramma antarcticum*, G = Other species, NQ as Table 4.

Haul	Krill Catch (tonnes)	Sub-Sample (kg)	Species A	B	C	D (n)	D (kg)	E	F	G
RV *Akademik Knipovich*										
74	0.0000		0	0	0	0		0	0	0
75	0.0000		0	0	0		3	0	0	0
76	0.0000		0	0	0		2	0	0	0
77	0.0000		0	1	0	0	0	0	0	3
78	0.0005		0	2	5	0	0	0	2	
81	0.1000		0	NQ	NQ	0		0	NQ	NQ
82	9.0000	0.0360	0	2	3	0	0	0	4	1
RV *Evrika*										
9	0.0000		0	0	0	0	0	0	0	0
12	0.0000		0	0	0	0	0	0	0	0
13	few		NQ	0	0	NQ		0	0	0
14	0.0500		2	0	0	0	0	0	0	2
17	few									NQ
18	5.0000		0	0	0	0	0	2	0	0
19	0.0000		0	0	0	0	0	0	0	0
20	8.0000		0	0	0	0	0	0	0	2
21	0.1000		0	0	0	0	0	0	0	1
29	0.0000									NQ

Table 6 (continued)

Haul	Krill Catch (tonnes)	Sub-Sample (kg)	Species A	B	C	D (n)	D (kg)	E	F	G
RV *Evrika* (continued)										
35	0.0400		0	0	0	0	10	0	0	0
36	0.5000		0	0	0	0	0	1	0	0
51	8.0000									NQ
52	2.0000									NQ
53	0.1000			2		NQ				
54	0.0000		0	0	2	0	0	1	0	
55	15.0000		0	0	0	0	0	0	0	0
56	0.0000		0	0	0	0	0	0	0	0
57	25.0000		0	0	1	0	0	0	0	0
58	20.0000									
61	15.0000		0	0	0	0	0	0	1	2
62	15.0000		0	0	0	0	0	0	0	1
63	20.0000		4	0	0	0	0	0	0	10
64	15.0000		1	0	0	0	0	0	0	1
65	15.0000		3	0	0	0	0	0	0	0
66	25.0000		0	0	0	0	0	0	0	0
67	15.0000		0	0	0	0	0	0	0	0
68	0.0000		0	0	0	0	0	0	0	0
69	20.0000		0	0	0	0	0	0	0	1
70	25.0000		0	0	0	0	0	0	0	0
71	20.0000		0	0	0	0	0	0	0	0
72	3.0000		0	0	0	4	0	0	0	1
73	25.0000		0	0	0	0	0	1	0	0
74	0.0000		0	0	0	0	0	0	0	0
75	25.0000		0	0	0	0	0	0	0	2
76	15.0000		0	0	0	0	0	0	0	0
77	30.0000		0	0	0	0	0	0	0	4
78	10.0000		2	0	0	0	0	0	0	
79	30.0000		1	0	0	0	0	0	0	0
80	5.0000		0	0	0	27	1	1	0	5
81	30.0000		0	0	0	0	0	0	0	0
82	0.0000									
83	15.0000		0	0	0	0	0	0		0
104										
111	10.0000		0	0	0	0	0	0	0	0

Table 7: Fish catches in krill trawls from Subarea 48.6.

Species codes are the same as for Table 6 with the addition of I = *Pagothenia brachysoma*, J = *Chionobathyscus dewitti*.

Haul	Krill Catch (tonnes)	Species I	B	C	J	D (n)	D (kg)	E	F	G
RV *Akademik Knipovich*										
5	0.0100	0	0	0	0	0	0	0	0	
6	0.5000	1	0	0	0	0	0	0	0	
7	1.0000	0	0	0	0	0	0	0	0	
8	few	0	0	0	0		5	0	0	
9	0.3000	0	0	0	2	0	0	0	0	
10	few		14					0	0	
11	2.5000	4	15	2	0	0	0	1	0	7
12	0.0010	0	0	1	0	0	3	0	0	
13	few	0	0	0	0	0	0	3	0	1
14	0.0010	0	NQ	0	0	0	0	0	2	
17	0.1000	0	NQ	0	0	0	0	0	0	
18	5.0000	0	NQ	NQ	0			0	NQ	
19	few	0	0	4	0	0	0	0	0	
20	0.0100	0	2	269	0	0	0	0	0	
21	0.0100	0	0	0	0		20	0	0	
22	4.0000	0	NQ	NQ	0	0	0	0	0	
23	0.0020	0	2	70	0	0	0	0	0	
24	3.0000	0	0	3	0	0	0	0	0	2
25	0.0001	0	0	0	0	0	0	0	0	0
26	few	0	0	0	0	0	0	0	0	0
27	0.5000	0	0	0	0	0	0	5	0	0
28	few	0	0	0	0	0	0	NQ	0	
29	0.0000	0	0	0	0	0	0	0	0	0
30	0.0050	0	0	0	0	0	0	0	0	0
32	few	0	0	0	0	0	0	0	0	0
34	few	0	0	0	0	0	0	0	0	0
35	0.0100	0	0	0	0	0	0	0	0	2
36	0.0000	0	0	0	0	0	10	0	0	0
37	few	0	0	0	0	0	0	0	0	0
38	2.5000	0	1	0	0	0	0	1	0	0
39	4.0000	0	0	0	0	0	0	1	0	1
RV *Evrika*										
37	few	0	0	0	0	0	0	0	0	0
38	0.0000	0	0	0	0	0	0	1	0	0

Table 8: Comparison of size classes of *Champsocephalus gunnari* with published information.

Data from Haul 53, *Akademik Knipovich*				
Size Class (Table 4)	n	Length Range (mm)	Total Weight (g)	Mean Weight (g)
(i)	223	26-46	31.9	0.143
(ii)	12	76-97	24.6	2.05
(iii)	9	106-119	51.2	5.69
(iv)	12	194-226	581	48.42
Size-at-age from Frolkina (1989) and Frolkina and Dorovskikh (1989)				
Age	Mean Length	Length Range (mm)	Mean Weight (g)	
1	108	70-130	2.7	
2	181	140-240	24.8	
3	245	200-300	77.6	

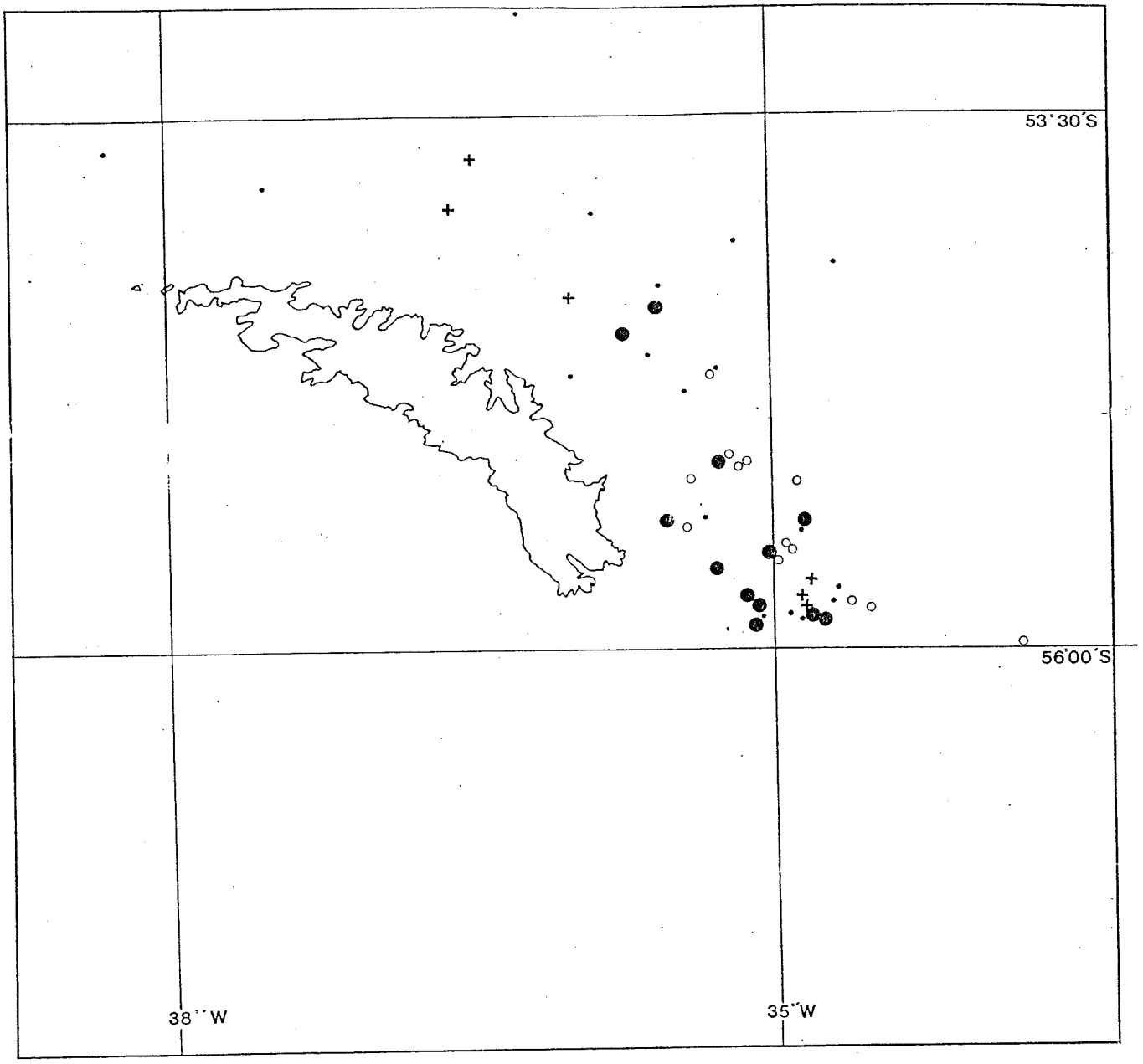

Figure 1: Locations of hauls around South Georgia in Subarea 48.3. Five hauls in deep water beyond the limits of this map and where no fish were caught have been excluded.

Key:

- • = < 1 tonne krill, < 100 *Champsocephalus gunnari*
- \+ = < 1 tonne krill, > 100 *Champsocephalus gunnari*
- o = > 1 tonne krill, < 100 *Champsocephalus gunnari*
- ● = > 1 tonne krill, > 100 *Champsocephalus gunnari*

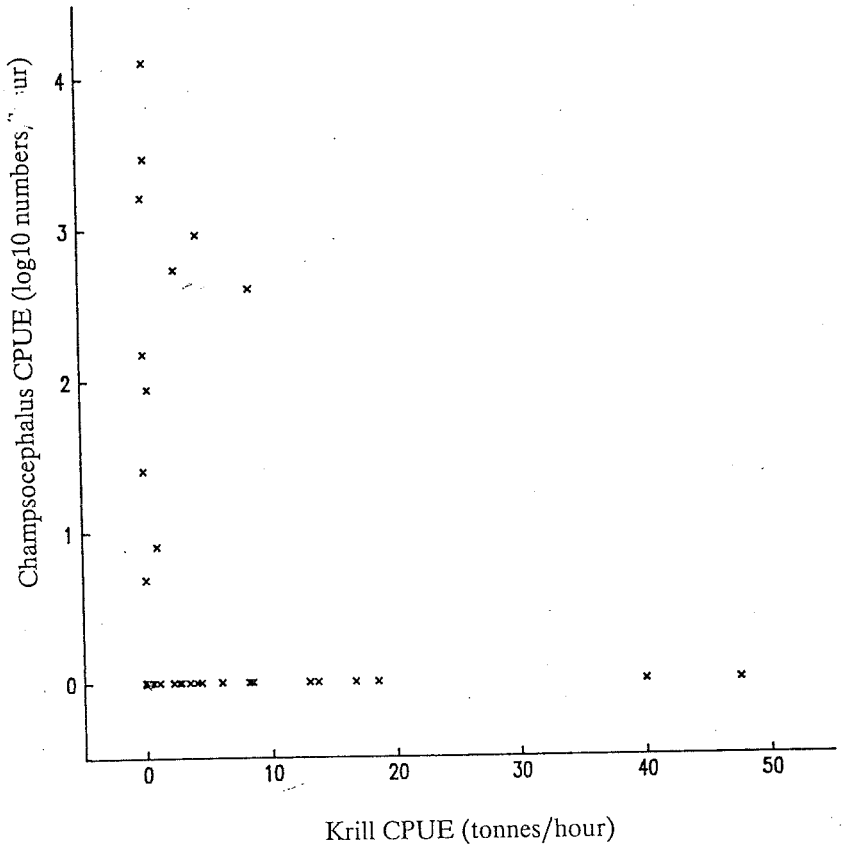

Figure 2: *Champsocephalus gunnari* CPUE in $\log_{10}$ numbers/hour vs krill CPUE in tonnes/hour.

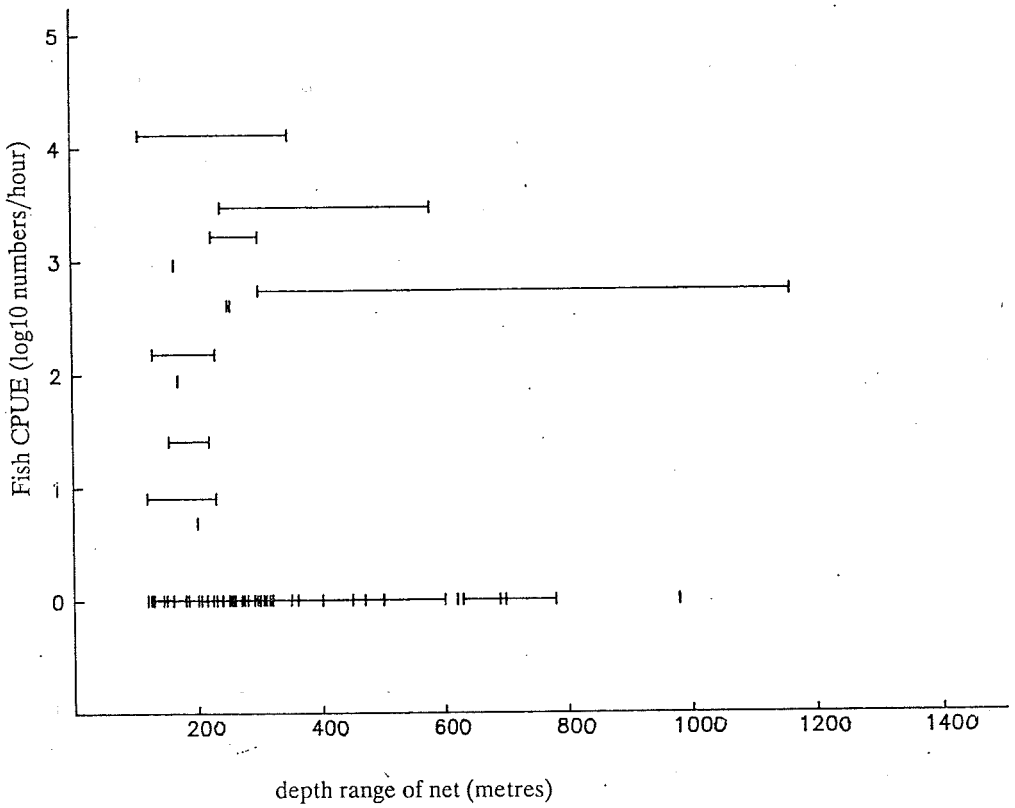

Figure 3: Fish CPUE in $\log_{10}$ numbers/hour vs depth range of net in metres.

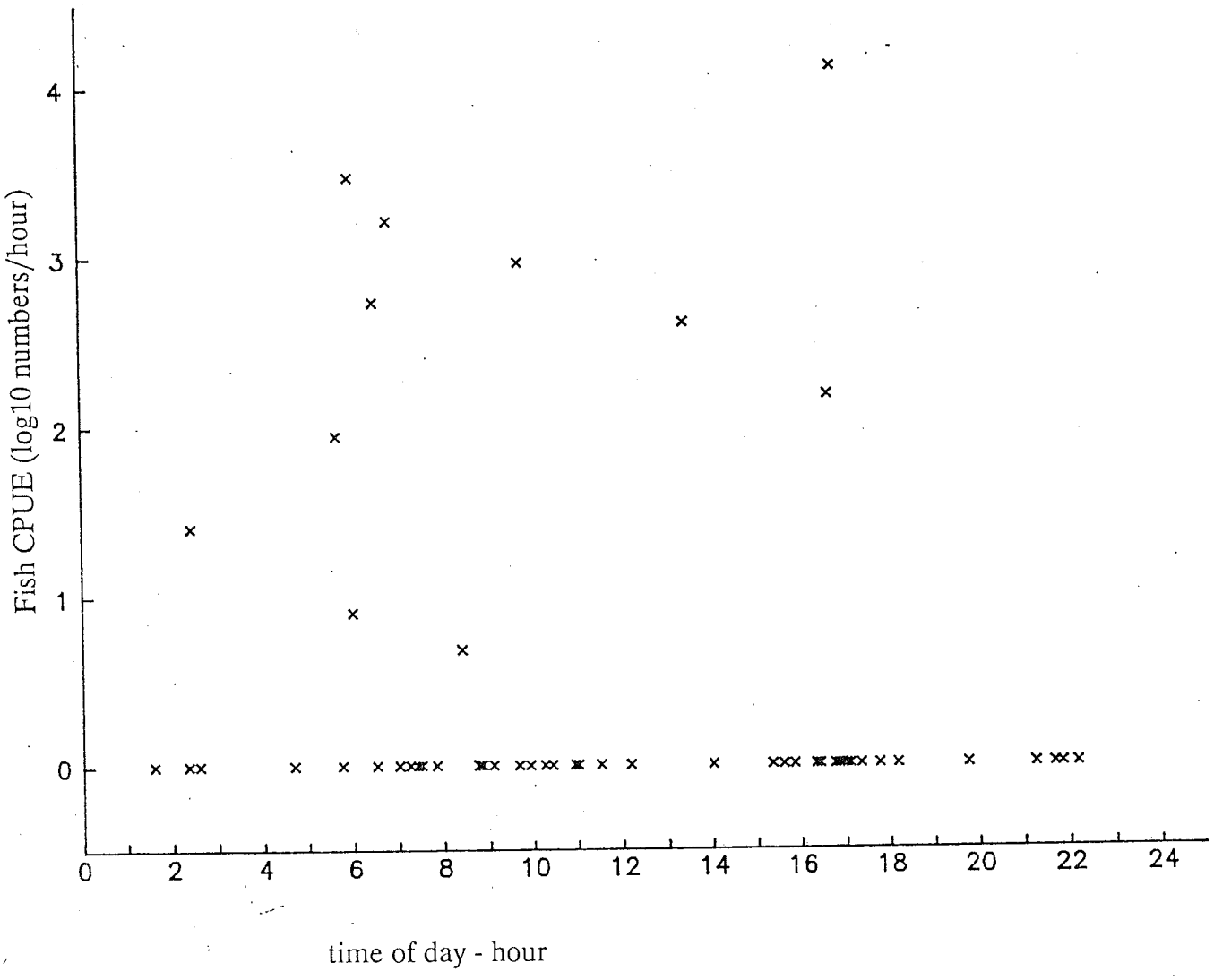

Figure 4: Fish CPUE in $\log_{10}$ numbers/hour vs time of day.

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Figure 4: CPUE de poissons en nombres log_{10}/heure en fonction de l'heure du jour.

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Таблица 2: Информация по тралениям в Подрайоне 48.2, Южные Оркнейские острова. (Заголовки колонок те же, что в Таблице 1.).

Таблица 3: Информация по тралениям в Подрайоне 48.6. (Заголовки колонок те же, что в Таблице 1.).

Таблица 4: Оценки общего количества *C. gunnari* в тралениях в районе Южной Георгии с использованием крилевого трала. NQ = присутствует, но не подсчитана.

Таблица 5: Прилов других видов рыб кроме *Champsocephalus gunnari* в районе Южной Георгии.
ACER = *C. aceratus*, PSEU = *Pseudochaenichthys georgianus*, LARS = *Nototheniops larseni*, MYCT = Myctophidae, NQ то же, что в Таблице 4.

Таблица 6: Прилов рыбы при промысле криля в районе Южных Оркнейских островов. Обозначения видов: A = *C. aceratus*, B = *Chinodraco sp.*, C = другие белокровные, D = Ьнсещзршвфуб E = *Notolepis coatsi*, F = *Pleuragramma antarcticum*, G = прочие виды, NQ что и в Таблице 4.

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Ключ:
• = < 1 тонны криля, < 100 *Champsocephalus gunnari*
+ = < 1 тонны криля, > 100 *Champsocephalus gunnari*
o = > 1 тонны криля, < 100 *Champsocephalus gunnari*
● = > 1 тонны криля, > 100 *Champsocephalus gunnari*

Рисунок 2: CPUE *Champsocephalus gunnari* в $\log_{10}$ количество/час в сравнении с CPUE криля в тонны/час.

Рисунок 3: CPUE рыбы в $\log_{10}$ количество/час в сравнении с диапазоном глубин сети в метрах.

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Tabla 1: Datos de arrastres efectuados en la Subárea 48.3 (Georgia del Sur).

Los encabezamientos de las columnas corresponden a: a-número de arrastre, b-día, c-mes, d-latitud (grados sur), e-latitud (minutos), f-longitud (grados oeste), g-longitud (minutos), h-profundidad del agua al inicio del arrastre, i-profundidad del agua al término del arrastre, j-profundidad mínima de la relinga inferior de la red, k-profundidad máxima de la relinga inferior de la red, l-abertura vertical de la red, m-hora, n-duración de los arrastres (horas).

Tabla 2: Datos de arrastres efectuados en la Subárea 48.2, isla Orcadas del Sur. (Los encabezamientos de las columnas corresponden a la tabla 1.)

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LARS = *Nototheniops larseni*, MYCT = Myctophidae, NQ según tabla 4.

Tabla 6: Datos de peces extraídos del archipiélago de las Orcadas del Sur en las capturas de krill.
Las especies son: A = *C. aceratus*, B = *Chionodraco* sp., C = otros caenictidos, D = mictófidos, E = *Notolepis coatsi*, F = *Pleuragramma antarcticum*, G = otras especies, NQ igual que en tabla 4.

Tabla 7: Capturas de peces en arrastres de krill en la Subárea 48.6.
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Clave:

• = < 1 tonelada de krill, < 100 *Champocephalus gunnari*
+ = < 1 tonelada de krill, > 100 *Champocephalus gunnari*
o = > 1 tonelada de krill, < 100 *Champocephalus gunnari*
● = < 1 tonelada de krill, > 100 *Champocephalus gunnari*

Figura 2: CPUE de *Champsocephalus gunnari* expresada en $\log_{10}$ número/horas *versus* la CPUE del krill en toneladas/hora.

Figura 3: CPUE de peces expresada en $\log_{10}$ número/horas *versus* el rango de profundidad de la red en metros.

Figura 4: CPUE de peces expresada en $\log_{10}$ número/horas *versus* la hora del día.