



SCIENTIFIC COUNCIL MEETING – JUNE 2000

Results from the Bottom Trawl Survey on Flemish Cap of July 1999

by

A. Vázquez

Instituto de Investigaciones Marinas
Eduardo Cabello 6, Vigo, Spain
e-mail: avazquez@iim.csic.es

ABSTRACT

A stratified random bottom trawl survey on Flemish Cap was carried out on July 1999 up to a depth of 730 metres. Survey results are presented and compared with results of previous surveys in the series since 1988. Abundance at age indices are presented for cod, American plaice, redfish and Greenland halibut. Results from a comparative trial between the survey gear (Lofoten) and a Campelen 1800 shrimp trawl are presented.

KEYWORDS: Survey, Flemish Cap, Cod, American plaice, Redfish, Greenland halibut.

INTRODUCTION

The survey on Flemish Cap was carried out in 1999 on board R/V Cornide de Saavedra. A total of 117 valid bottom trawls were made up to a depth of 730 metres (400 fathoms) (Figure 1). The survey adequately covered all strata of the bank. A synoptic sheet of the survey with vessel and gear characteristics is shown in Table 1. This was the 12th survey of the series initiated by the EU in 1988. All surveys had a stratified random design following NAFO specifications (Doubleday, 1981). Dates of the previous surveys were:

Year	Vessel	Valid	
		Tows	Dates
1988	Cornide de Saavedra	115	8/7 - 22/7
1989	Cryos	116	12/7 - 1/8
1990	Ignat Pavlyuchenkov	113	18/7 - 6/8
1991	Cornide de Saavedra	117	24/6 - 11/7
1992	Cornide de Saavedra	117	29/6 - 18/7
1993	Cornide de Saavedra	101	23/6 - 8/7
1994	Cornide de Saavedra	116	6/7 - 23/7
1995	Cornide de Saavedra	121	2/7 - 19/7
1996	Cornide de Saavedra	117	28/6 - 14/7
1997	Cornide de Saavedra	117	16/7 - 1/8
1998	Cornide de Saavedra	119	17/7 - 2/8
1999	Cornide de Saavedra	117	2/7 - 20/7

Total biomass of all species was calculated by the swept area method. The results are presented in Table 2, as well as in the table below. Those amounts are assumed to underestimate real values to various degrees, as a consequence of each species having a particular catchability and accessibility to bottom gears. Taking aside these considerations, the total biomass estimated for 1999, even higher than the 1998 minimum, is among the poorest recorded. Redfish shows the highest annual variability probably due to its pelagic habitat, making accessibility to bottom gears more changeable than for demersal or benthic species. Cod, American plaice and skates reached a biomass minimum in 1999. Greenland halibut maintained a continuous biomass increase along the period and reached a maximum in 1998, but decreases in 1999.

Shrimp catches were very sensitive to small changes in cod-end mesh size, as well as the use of a 25 mm liner in 1998, so the interpretation of survey results needs to take into account all those circumstances (Garabana, 1999).

RESULTS

Survey estimates of total biomass of main species on the bank (by the swept area method) were:

survey	American plaice Cod	Redfish	Greenland halibut	Roughhead grenadier	Shrimp
1988	37127	11887	158419	6818	2164
1989	103644	10533	136658	4391	1923
1990	55360	9101	104192	5649	2139
1991	36597	7565	63845	8038	8211
1992	24295	6492	104477	8588	16531
1993	55642	5949	62589	7210	9256
1994	24062	6173	126011	7904	3338
1995	8815	5087	73641	10705	5413
1996	8196	3073	100544	11409	6502
1997	9063	2268	139241	15846	5096
1998	4532	2577	59316	23849	16620
1999	2596	1940	82894	20877	12430 tons

Cod

Mean catch by strata, whole bank biomass estimates by the swept area method and their standard error are presented in Table 3. Total biomass estimates by strata and its comparison with the results of previous surveys are presented in Table 4. Global data compared with Russian survey results are:

Year	EU (1)	Russia: (2)	(3)
1983		23,070	
1984		31,210	
1985		28,070	
1986		26,060	
1987		10,150	21,600
1988	37,127	7,720	34,200
1989	103,644	36,520	78,300
1990	55,360	3,920	15,200
1991	36,597	6,740	8,200
1992	24,295	2,490	2,400
1993	55,642	8,990	9,700
1994	24,062	-	-
1995	8,815	8,260	-
1996	8,196	730	-
1997	9,063	-	-
1998	4,532	-	-
1999	2,596	-	- tons

- 1) Biomass estimated from bottom trawl survey.
- 2) Biomass estimated from bottom trawl survey (Kiseleva and Vaskov 1994; Kiseleva 1996, 1997).
- 3) Biomass estimated of bottom trawlable plus pelagic biomass (Borovkov *et al.* 1993; Kiseleva and Vaskov 1994).

The calculated abundance at age is shown in the table below. The 1990 year-class was the most abundant observed at age 1, but its level was not maintained in the following years, after recruitment. This may indicate that its abundance was overestimated in the 1991 survey. The abundance of the 1991 year-class, although recording a maximum at age 2, decreased quickly as a consequence of the intense fishery on ages 2 and 3 during 1993 and 1994. Later year-classes, those of 1992 and onwards (ages 7 or less in 1999) were weak, weaker than the ones observed in the previous period. The 1995 and 1996 year-classes (ages 4 and 3 in 1999) failed almost completely and, according

to the results of the present survey, the same failure or even worse appears to have occurred for the 1997 and 1998 year-classes (ages 2 and 1 in 1999).

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	458	2418	237	13780	7118	438	315	155	4	4	3	1
2	7196	6062	1179	2560	3706	13274	385	1137	297	14	8	8
3	4037	6964	467	1538	475	2852	2459	123	613	315	9	10
4	1085	2819	1588	193	203	102	456	361	82	436	114	10
5	128	227	1453	628	33	127	12	90	225	36	145	66
6	22	33	394	168	127	17	6	1	19	90	7	41
7	28	12	32	31	21	50		2	1	2	14	2
8	11	7	13	7	1	10	12		1			1
9		1	8	4				1			1	
10			3	1			1	1				
11				2	1							
12										1		
Total	12965	18543	5374	18906	11685	16870	3646	1873	1240	898	300	139
Biomass	37127	103644	55360	36597	24295	55642	24062	8815	8196	9063	4532	2596 t
SOP *	33474	100217	51388	37231	22734	54945	22867	8841	8138	8873	4502	2582 t

abundance (x 10000)

*) SOP = Sum of products: back calculation of biomass as sum of products of frequencies and mean weight at age.

Tables 5, 6 and 7 show length frequency, age-length key and estimated abundance at age of the stock in 1999 respectively. Catch per tow distribution is presented in Figure 2.

American plaice

Mean catch by strata, whole bank biomass estimates by swept area method and its standard error are presented in Table 8. Biomass estimated by strata and comparative results from previous surveys are presented in Table 9. Total biomass in comparison with Russian survey results is shown in the side table:

Year	EU	Russia (1)
1983		8,900
1984		7,500
1985		7,800
1986		20,200
1987		9,300
1988	11,887	6,500
1989	10,533	5,000
1990	9,101	1,200
1991	7,565	14,400
1992	6,492	1,200
1993	5,949	2,700
1994	6,173	
1995	5,087	
1996	3,073	
1997	2,268	
1998	2,577	
1999	1,940	tons

1) Rikhter *et al.* 1991; Borovkov *et al.* 1992, 1993, 1994

The abundance by age groups is presented in the following table. The 1984, 1986 and 1990 year-classes, ages 15, 13 and 9 in 1999, were the most abundant cohort of the last years. Their growth can be easily followed in the table, confirming the suitability of the ageing criterion. It is interesting to note that good year-classes can be recognised at ages 2 and 3, long before recruitment is completed at ages 4 to 7. Fish aged 6 or more roughly correspond with fishable biomass. The abundance of this group (N 6+) decreased along the period except in 1992, when an increase was recorded as the consequence of the income of the abundant 1986 year-class.

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-	-	-	-	-	-	-	-	-	7	-	6
2	2284	454	359	309	736	9	34	19	28	14	22	-
3	625	6847	775	911	679	1365	40	99	103	96	29	20
4	3034	1500	7083	1877	910	969	1789	627	222	22	42	56
5	1975	3238	897	4461	1471	643	782	1620	465	99	62	60
6	3020	3006	2475	1836	3423	320	651	990	1236	311	202	57
7	4154	2868	1717	2009	913	3110	703	988	656	901	457	177
8	4258	1691	1657	1566	1090	339	2487	665	411	200	654	339
9	1492	587	1030	675	624	592	243	1132	308	312	388	371
10	207	261	485	232	289	296	480	128	470	223	267	189
11	109	34	90	8	138	198	166	143	113	372	235	260
12	61	14	15	48	74	229	164	119	63	103	228	163
13	-	-	31	-	16	280	195	119	67	19	73	98
14	-	-	17	-	-	865	398	241	90	77	94	100
15	-	-	-	-	-	28	397	183	62	38	47	49
16+	-	-	-	-	-	35	9	27	20	92	89	82
Total	21219	20500	16631	13932	10363	9268	8538	7100	4321	2886	2889	2027
biomass(t)	11887	10533	9101	7565	6492	5949	6173	5087	3073	2268	2577	1940
SOP (t)		9726	8827	7682	6111	5856	5966	5041	3031	2229	2533	1930
N 6+	13301	8461	7517	6374	6567	6282	5893	4735	3496	2648	2734	1885

abundance (× 1000)

The stock has recorded a steady decline since 1988. Global indices in the table above, such as total abundance, biomass, SOP and N6+, have decreased over the period: their levels in 1997 and 1998 are around 5 times lower than in 1988. Data in the table above indicates two periods for recruitment, and a change from an upper abundance level to a lower one. The 1991 year-class should be the first weak cohort. Neither do the results indicate some signal for an improvement of abundance in future years: the six youngest year-classes, those with less than 9 years old in 1999, were among the weakest observed in this survey. The 1990 year-class (age 9 in 1999), the most abundant cohort of recent years, was less abundant than the 1986 year-class at the same age.

Tables 10, 11 and 12 show length frequency, age-length key and estimated abundance at age of the stock respectively. Catch per tow distribution is presented in Figure 3.

Redfish

All redfish catches were classified by species. The group named *juvenile* contains those individuals of small size for which classification was not possible. The 15 cm maximum length is a good reference for this group, but it was never used as a criterion. The skill required to identify the species increased over time, so the group *juvenile* is not an uniform defined group, but it is maintained for practical reasons.

Mean catch by strata and whole bank data are presented in Tables 13, 17, 21 and 25 for *Sebastes marinus*, *S. mentella*, *S. fasciatus* and the *juvenile* group respectively. Total biomass estimates by the swept area method are summarised in the following table.

Year	<i>Sebastes:</i> <i>marinus</i>	spp.			EU total	Russia	
		<i>mentella</i>	<i>fasciatus</i>	juvenile		bottom (1)	total (2)
1983						154,900	
1984						132,300	
1985						51,900	
1986						309,500	
1987						110,700	
1988	15,397		143,022		158,419	61,400	379,000
1989	22,962		113,696		136,658	90,100	365,900
1990	14,699	72,893		16,601	104,192	20,700	246,400
1991	4,093	50,071	5,680	4,001	63,845	45,500	107,700
1992	4,130	71,810	5,308	23,229	104,477	18,500	99,500
1993	4,173	25,056	4,425	28,935	62,589	72,600	147,100
1994	33,240	35,710	7,829	49,233	126,011	-	-
1995	9,042	59,332	5,032	235	73,641	21,600	-
1996	11,293	77,897	11,025	329	100,544	15,900	-
1997	64,847	56,093	17,471	830	139,241	-	-
1998	6,422	45,358	6,436	1,100	59,316	-	-
1999	9,431	65,254	7,954	255	82,894	-	-

1) Trawlable biomass.

tons

2) Trawlable plus pelagic biomass (Vaskov 1994, Vaskov and Karsakov 1996, Vaskov 1997)

Tables 14, 18, 22 and 26 show length frequency for the four groups. Age-length keys are presented in Tables 15, 19, 23 and 27, and abundance at age in Tables 16, 20, 24 and 28. Catch per tow distribution of the three species is presented in Figures 4, 5 and 6; their abundance at age are given together in the table below.

age	<i>S. marinus</i>			<i>S. mentella</i>			<i>S. fasciatus</i>		
	frequency	m.w.	m.l.	frequency	m.w.	m.l.	frequency	m.w.	m.l.
1	4	12	9	11	10	9	9	12	9
2				237	33	13	71	31	12
3	4	48	14	2291	56	16	232	54	15
4	6	71	16	3971	76	17	749	83	17
5	52	145	21	2224	107	20	1415	114	19
6	263	229	24	2435	166	23	1235	155	22
7	463	287	26	4089	206	24	452	197	23
8	546	350	28	3836	241	26	329	239	25
9	450	443	30	14301	227	25	296	262	26
10	242	490	32	596	300	28	59	354	29
11	77	588	34	24	448	32	32	382	29
12	57	619	34	42	536	34	11	460	31
13	96	680	35	99	488	33	41	461	31
14	20	765	37	13	519	33	6	568	34
15	8	860	38	28	514	33	7	534	33
16	11	806	37	30	535	34	8	687	36
17	3	781	37	20	594	35			
18	15	888	38	52	579	34	1	815	38
19	2	1486	46	8	731	37			
20	5	881	38	10	631	35			
21	1	1392	45	9	541	34			
22				3	901	40			
23				5	692	37			
24				4	713	37			
25+				12	749	38	1	948	40

frequency (×10,000), m.w. – mean weight in grams, m.l. – mean length in cm

Frequencies at age of the three redfish stocks in the survey series are presented in Table 29. The 1990 and 1991 year-classes were in general abundant for the three species, causing the juvenile biomass to peak in 1994, when aged 4 and 3 respectively. These two cohorts remain almost as the most abundant in later years for *S. marinus* and *S. mentella*, indicating the weakness of younger year-classes. For *S. fasciatus*, however, some newer year-classes appear relatively strong, exceeding in abundance to the other two species.

Greenland halibut

Mean catch by strata and whole bank estimates are presented in Table 30. Total biomass estimates by the swept area method by strata and its comparison with results of previous surveys are presented in Table 31 and summarised as follow:

1988	6,818
1989	4,391
1990	5,649
1991	8,038
1992	8,588
1993	7,210
1994	7,904
1995	10,705
1996	11,409
1997	15,846
1998	23,849
1999	20,877 tons

Length frequency, age-length keys and abundance at age of the population were calculated (Tables 32, 33 and 33). Catch per tow distribution is presented in Figure 7. Abundance at age of the stock was calculated in surveys as follows:

age	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	349	922	937	832	6165	2874	1597	1434	525
2		800	933	706	1394	4613	2113	1268	426
3	235	286	599	1082	1369	1527	4396	5149	1904
4	993	861	566	1224	1249	2066	5157	7835	7178
5	1956	1600	960	1365	1709	3070	5216	9168	9818
6	1253	1996	1574	2233	3793	4394	6045	8821	9599
7	2283	1793	1732	2096	3026	2020	3885	6334	4382
8	545	991	1388	1213	1729	1378	1709	2339	1544
9	464	473	905	689	1134	392	593	703	322
10	388	266	257	264	254	75	200	201	101
11	122	139	141	95	68	31	33	27	8
12		67	51	54	26	35	22	6	4
13		18	19	19			23	22	4
14		13	10		7				8
15						8	8		
16+							14		
total	8588	10225	10072	11860	21925	22483	31091	43217	35823
biomass (t)	8038	8588	7210	7904	10705	11409	15846	23849	20877
SOP (t)	8329	8084	7136	7406	9782	11005	15367	23627	20094
N 10+	510	503	478	432	355	149	300	256	125

abundance × 1000

Shrimp

Garabana (1999) presented detailed results.

Roughhead grenadier (*Macrourus berglax*)

Total biomass estimated by swept area method in this survey was:

1989	1,024
1990	996
1991	1,587
1992	1,817
1993	3,757
1994	2,350
1995	1,855
1996	1,619
1997	1,425
1998	2,014
1999	1,488 tons

Ageing of fish was started in the 1994 survey. Detailed results were presented by Murua (2000).

Oceanographic conditions

A CTD station was made after each tow. Garabana *et al.* (2000) analysed the results and compared them with those observed in previous years.

Gear catchability comparison trial

During the last days of the survey, a comparative trial was carried out between the Lofoten gear used in the survey, and a Campelen 1800 shrimp trawl gear which was manufactured according to the specifications (McCallum and Walsh 1994). The method used was to make alternative tows with both gears in the same geographical position. Tows made with a gear were repeated the next day with the other one, so a total of 17 valid tows for both gears were available for comparison. Positions of the tows were selected with the following criterion: to maximise the number of visited strata and to maximise the depth range. Those 17 tows as a pull were the basis for the comparison: no variations among strata were taken into account.

The comparison of the catchability of these gears needs to take into account two factors: first, the difference in gear geometry and rigging, the main factor of catchability, and second, the difference in cod-end mesh size: 30 mm in the Lofoten gear and 20 mm for the Campelen, which implies different retention of species with fish length in the selection range. Catchability differences by fish length not attributed to different mesh sizes were also observed, so not only crude comparison of catches were carried out but also differences by length groups were considered.

Table 35 summarises results, and Figure 8 contains explanatory graphics for main species. The Campelen gear appear more efficient for the bulk of species considered, exception of Greenland halibut and the redfish *S. mentella*.

Small size cod, age 2 and mean length 35 cm, was almost only caught by Campelen gear. It seems to indicate that the Lofoten gear is quite inefficient with age 2 cod, but an increase of abundance estimates from age 2 in one year to age 3 in the following year was seldom observed (see table of abundance estimates on page 3). Based on those changes in abundance from one year to the next it had been concluded that recruitment to the survey gear (Lofoten) was completed around age 2. Survey abundance estimates of the same cohort at age 1 and 2 from consecutive years has been observed to increase as a norm. The inefficiency of the gear for age 1 cannot be attributed to cod-end escapement but to a more complex recruitment process, which finish at age 2 according to these views. So it is highly improbable that exist large amount of age 2 cod unavailable to the Lofoten gear and only detectable by the Campelen gear. Taking into account the small size of the sample (26 fish of age 2 caught by the

Campelen gear) we conclude that the apparent difference in age 2 cod as the catches from both gears indicate is an spurious result.

The comparison of catchability for the redfish as a whole is complex. *S. mentella* showed two modal groups around 16-18 and 25 cm (Table 22); both gears fished similarly the smallest length class but the Lofoten gear fished better on large lengths. *S. fasciatus* had a length modal group around 20 cm (Table 26) and both gears fished them similarly. For *S. marinus* the bulk of the catch had lengths bigger than 28 cm (Table 18) and those catches of the Campelen gear were the best. For redfish as a whole, the Campelen gear seems more efficient for small lengths, including juveniles, but for the largest lengths, the Lofoten gear seems more efficient with *S. mentella* and the Campelen one with *S. marinus*. This contradiction would imply very different behaviour for both species, but it is premature at this time to confirm this conclusion.

The Campelen gear caught Greenland halibut more efficiently and variations by fish length were not observed. The sample was wide and quite homogeneous.

For shrimp there were two factors: bigger catchability of the Campelen gear for all lengths and greater retention of the small lengths by the small mesh size of the cod-end of that gear.

ACKNOWLEDGEMENTS

This study was supported by the European Commission (DG XIV, Study 98-048), CSIC, IEO, IPIMAR and the Basque Government.

REFERENCES

- Borovkov, V., S. Kovalev, P. Savvatimsky, V.A. Rikhter and I.K. Sigaev - 1992. Russian research report for 1991. *NAFO SCS Doc.* 92/12.
- Borovkov, V., K. Gorchinsky, S. Kovalev, P. Savvatimsky, V.A. Rikhter and I.K. Sigaev - 1993. Russian research report for 1992. *NAFO SCS Doc.* 93/10.
- Borovkov, V., K. Gorchinsky, S. Kovalev and P. Savvatimsky - 1994. Russian national research report for 1993. *NAFO SCS Doc.* 94/3.
- Doubleday, W.G.- 1981. Manual of Groundfish Surveys in the Northwest Atlantic. *NAFO Sci. Counc. Stud.* 2, 55pp.
- Garabana, D.- 1999. Northern shrimp (*Pandalus borealis*) on Flemish Cap in July 1999. *NAFO SCR Doc.* 99/106.
- Garabana, D., J. Gil and R. Sanchez – 2000. Hydrographic conditions on Flemish Cap in July 1999 and comparison with those observed in previous years. *NAFO SCR Doc.* 2000/..
- Kiseleva, V.M.- 1996. Estimation of cod stock in Div. 3M by data of 1995 trawl survey. *NAFO SCR Doc.* 96/7.
- Kiseleva, V.M.- 1997. Assessment of cod stock on the Flemish Cap from data of trawl survey in 1996. *NAFO SCR Doc.* 97/7.
- Kiseleva, V.M. and A.A. Vaskov - 1994. Assessment of cod stock in NAFO Subarea 3 from 1993 trawl-acoustic survey data. *NAFO SCR Doc.* 94/12.
- McCallum, B.R. and S.J. Walsh –1994. Campelen 1800. Survey trawl reference manual. *Dep. of Fisheries and Oceans*, Newfoundland, Canada.
- Rikhter, V.A., I.K. Sigaev, V. Borovkov, S. Kovalev and P. Savvatimsky - 1991. USSR research report for 1990. *NAFO SCS Doc.* 91/5.

- Murua, H.- 2000. A review on roughhead grenadier (*Macrourus berglax*) biology and population structure on Flemish Cap (NAFO Div. 3M) 1991-1999. *NAFO SCR Doc.* 2000/..
- Vaskov, A.A.- 1994. Assessment of redfish stocks in Divisions 3LN and 3M from trawl-acoustic survey data, 1993. *NAFO SCR Doc.* 94/13.
- Vaskov, A.A.- 1997. Stock assessment of redfish Division 3M by data from 1996 Russian trawl survey. *NAFO SCR Doc.* 97/8.
- Vaskov, A.A. and A.L. Karsakov - 1996. Assessment of the redfish stock in Div. 3M by the data from the trawl survey in 1995. *NAFO SCR Doc.* 96/9.

Table 1 - Technical data of the 1999 survey.

Procedure	Specification
Vessel	R/V Cornide de Saavedra
GT	1.200 t
Power	1.500 + 750 HP
Mean trawling speed	3.37 knots
Trawling time	30 minutes effective time
Fishing gear	type Lofoten
footrope /handrope	31.20 / 17.70 m
footgear	27 steel bobbins of 35 cm
vertical opening	3.4 m (SCANMAR)
warps	100 meters, 45 mm, 200 Kg/100m
trawl doors	polyvalent, 850 Kg
wire length	2.6 times the depth + 80 m
mesh size in cod-end	35 mm nominal (30 mm effective)
Type of survey	Stratified sampling
Station selection procedure	Random
Criterion to change position of a selected tow	- unsuitable bottom for trawling according to ecosounder register. - Information on gear damage from previous surveys.
Criterion to reject data from tow	- tears in cod-end - severe tears in the gear - less than 20 minutes tow - bad behaviour of the gear
Daily period for fishing	6.00 to 22.00 hours
Species for sampling	All fish, squid and shrimp
Species for age determination	Cod, American plaice, redfish (<i>Sebastes marinus</i> , <i>S. mentella</i> and <i>S. fasciatus</i>), Greenland halibut and roughhead grenadier (<i>Macrourus berglax</i>).

Table 2 - Total biomass swept area method estimates for several species or groups of species in 1988-1999 surveys (tons).

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Rajidae	4495	1908	2824	4064	3765	6279	3462	2267	2052	1839	1981	1610
<i>Synaphobranchus sp.</i>	219	88	42	77	70	70	8	16	3	11	37	1
<i>Urophycis sp.</i>	654	167	169	261	69	161	214	83	81	32	229	246
<i>Antimora sp.</i>	392	302	284	560	720	594	799	195	186	235	488	292
Macrouridae	3088	1438	1223	2249	2592	6183	3230	2604	2342	2289	2833	2332
<i>Notacanthus sp.</i>	501	408	65	478	449	705	455	346	180	287	169	62
<i>Illex sp.</i>	5	8	1647	1159	66	1	210	1	87	64	71	18
Anarhichadidae	7973	7478	8120	10097	9095	14304	15516	19217	20559	14036	10987	5583
Witch flounder	909	335	420	769	823	1048	776	705	509	319	240	379
Greenland halibut	6818	4391	5649	8038	8588	7210	7904	10705	11409	15846	23849	20877
Zoarcidae	559	923	1202	1978	1356	3277	1869	2182	1702	1730	2055	896
Cod	37127	103644	55360	36597	24295	55642	24062	8815	8196	9063	4532	2596
American plaice	11887	10533	9101	7565	6492	5949	6173	5087	3073	2268	2577	1940
Redfish	158419	136658	104192	63845	104477	62589	126011	73641	100544	139241	59316	82894
Shrimp*	2164	1923	2139	8211	16531	9256	3338	5413	6502	5096	16620	12430
Others	624	206	1138	664	439	779	503	395	692	584	1109	618
Total	235833	270410	193575	146611	179828	174047	194529	131671	158114	192943	127093	132772

*) Values affected by mesh size cod-end: 40 mm in 1994, 25 mm in 1998 and 30 mm in 1999.

Table 4 - Cod biomass estimated by the swept area method (tons) 1988-1999.

Stratum	depth in fathoms	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1 -	70- 80	1223	590	751	5078	69	469	1969	1421	915	221	114	90
2 -	81-100	9229	9386	1876	4988	4683	8223	7443	2764	3629	1863	1727	1366
3 -	101-140	4065	9344	1994	2236	7704	7670	5539	1042	958	1029	639	132
4 -	"	2846	4404	2355	2637	3131	12885	1714	678	971	779	127	23
5 -	"	1937	9731	7738	9685	4155	6205	840	1158	851	1045	887	233
6 -	"	2932	6173	3007	1392	866	3837	1284	1191	564	977	557	341
7 -	141-200	2022	14571	3582	2308	859	5595	779	111	50	970	71	47
8 -	"	8121	14943	15313	4644	2136	7241	3287	317	85	1464	70	21
9 -	"	167	4784	5895	171	130	907	217	8	94	158	-	18
10 -	"	1217	4454	4255	1417	297	851	460	53	42	274	181	93
11 -	"	2278	12020	3706	1625	204	1526	529	71	37	282	160	232
12 -	201-300	305	2245	1478	115	-	22	-	-	-	-	-	-
13 -	"	8	2304	689	85	-	-	-	-	-	-	-	-
14 -	"	97	686	584	119	61	211	-	-	-	-	-	-
15 -	"	680	7671	2137	98	-	-	-	-	-	-	-	-
16 -	301-400	-	60	-	-	-	-	-	-	-	-	-	-
17 -	"	-	5	-	-	-	-	-	-	-	-	-	-
18 -	"	2	-	-	-	-	-	-	-	-	-	-	-
19 -	"	-	91	-	-	-	-	-	-	-	-	-	-
total		37127	103644	55360	36597	24295	55642	24062	8815	8196	9063	4532	2596

Table 5 - Cod length frequency by strata ($\times 1000$) in the 1999 survey.

length (cm)	stratum											total
	1	2	3	4	5	6	7	8	9	10	11	
21-23	6											6
24-26												
27-29	6											6
30-32		6										6
33-35	6	32		7							7	52
36-38		6										6
39-41		6										6
42-44		13				6					7	26
45-47	6	45				13		8				72
48-50	6	32			7	6					7	59
51-53	12	129		7	7					7	7	169
54-56		129	7		43	13	7	8			7	213
57-59	6	129	7	7	35	45					21	251
60-62		116	21		21	32	7			20	28	246
63-65	6	58	21		14	13	7		8	7	28	163
66-68		32				13						45
69-71		13									7	20
72-74		6				6				7		20
75-77	6	6										13
78-80						6						6

Table 6 – Cod age-length key in 1999.

length (cm)	age										no id	tot n.	no id: tot n.:	no identified total number	
	1	2	3	4	5	6	7	8	9	10					
18-20															
21-23	1												1		
24-26															
27-29		1												1	
30-32		3												3	
33-35		23												23	
36-38		10												10	
39-41		1												1	
42-44			6											6	
45-47			15	1										16	
48-50			2	9	2	1								14	
51-53				10	22									32	
54-56				2	38	5								45	
57-59					31	12								43	
60-62					21	19	1							41	
63-65					5	21								26	
66-68					1	7								8	
69-71					1	2								3	
72-74						2	1							3	
75-77						1	1							2	
78-80								1						1	
81-83															
84-86															
87-89															
90-92									1					1	
total:	1	38	23	22	121	70	3	2						280	

Table 7 - Cod abundance at age by strata ($\times 1000$) in the 1999 survey.

age	stratum											total	mean weight (g)	mean length (cm)
	1	2	3	4	5	6	7	8	9	10	11			
1 :	6											6	101	22
2 :	12	50		7								7	76	34
3 :	6	60			1	19		8				8	102	45
4 :	8	69		2	9	5		1		2	7	103	1298	51
5 :	15	374	26	10	81	65	11	7	2	16	49	656	1848	57
6 :	10	197	29	2	36	55	10	1	6	20	47	413	2436	62
7 :	3	8	1		1	3				3	1	20	3513	70
8 :						6						6	4893	79
9 :														
10 :														
11 :														
12 :														
13 :														
14 :														
15 :														
16+ :														

Table 8 - American plaice catch (Kg) by strata in the 1999 survey.

stratum	area squa. miles	tow number	catch per tow		catch per mile towed	
			mean	s.deviat.	mean	s.deviat.
1 -	342	4	11.06	12.92	6.13	7.02
2 -	838	10	20.67	30.27	12.14	17.87
3 -	628	7	1.50	2.33	0.87	1.36
4 -	348	4	1.46	1.36	0.87	0.83
5 -	703	8	0.98	0.77	0.59	0.45
6 -	496	6	0.75	0.90	0.45	0.56
7 -	822	9	0.22	0.43	0.13	0.25
8 -	646	7	0.03	0.08	0.02	0.05
9 -	314	3	-	-	-	-
10 -	951	11	0.74	0.68	0.43	0.39
11 -	806	9	0.44	0.53	0.26	0.31
12 -	670	7	-	-	-	-
13 -	249	3	-	-	-	-
14 -	602	6	0.17	0.42	0.09	0.23
15 -	666	8	-	-	-	-
16 -	634	6	-	-	-	-
17 -	216	2	-	-	-	-
18 -	210	2	-	-	-	-
19 -	414	5	-	-	-	-
total	10555	117	2.37			
			catch per tow		catch per mile towed	
			-----		-----	
	mean		2.37		1.38	
	standard error		0.79		0.46	
			----- (Kg)			

Stock biomass estimated by swept area method = 1,940 tons
 " " " " " by sex (m f) = 404 1,536 tons
 (m f) = male / female

Table 9 - American plaice biomass estimated by swept area method (tons) 1988-1999.

stratum	depth in (brazas)	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1 -	70- 80	979	750	448	808	532	809	496	1672	1096	286	117	279
2 -	81-100	1990	2701	1040	1997	1285	950	899	1001	707	555	1190	1357
3 -	101-140	1025	838	1207	935	473	333	244	189	126	371	213	73
4 -	"	1649	346	661	240	418	429	640	367	201	152	257	40
5 -	"	1949	2319	1406	1055	628	968	922	412	375	464	558	55
6 -	"	358	847	720	376	451	229	606	92	24	10	26	30
7 -	141-200	880	398	562	292	479	239	237	187	54	62	35	14
8 -	"	313	123	209	188	545	365	132	99	42	92	124	2
9 -	"	77	122	262	-	280	154	15	375	41	27	-	-
10 -	"	1742	1118	1555	981	1054	1094	1677	531	311	215	27	54
11 -	"	889	876	973	301	279	219	227	82	51	24	22	28
12 -	201-300	7	14	35	13	8	11	25	9	24	5	-	-
13 -	"	2	-	15	-	-	-	-	2	-	-	-	-
14 -	"	6	6	6	292	22	53	18	11	3	-	3	7
15 -	"	17	74	2	73	28	82	30	51	17	5	5	-
16 -	301-400	4	-	-	3	7	9	4	-	-	-	-	-
17 -	"	-	-	-	-	-	-	-	-	-	-	-	-
18 -	"	-	-	-	-	-	-	-	-	-	-	-	-
19 -	"	-	-	-	11	3	4	2	8	-	-	-	-
total		11887	10533	9101	7565	6492	5949	6173	5087	3073	2268	2577	1940

Table 11 - American plaice age-length key in the 1999 survey.no id: no identified
tot n.: total number**INDETERMINATE**

length (cm)	age																no id	tot n.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+		
8-9																		
10-11	1																	
12-13																		

MALE

length (cm)	age																no id	tot n.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+		
22-23																		
24-25																		
26-27			1															1
28-29				1	1													2
30-31					1													1
32-33				2		1	3											6
34-35					1	1	6	3	3								1	15
36-37						1	8	5	6		1						3	24
38-39						1	4	13	6	5	4	2					1	36
40-41						1	5	15	13	1	3	3					2	43
42-43							1	2	7	3	1						1	15
44-45								3	2	1			1					7
46-47											1							1
total:			1	3	3	5	27	41	37	10	10	5	1				8	151

FEMALE

length (cm)	age																no id	tot n.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+		
22-23																		
24-25			2															2
26-27			2															2
28-29				2														2
30-31																		
32-33				2														2
34-35				2	2				1									5
36-37					3	2	1	1									1	8
38-39					1	1	1	1		1								5
40-41						2	1	2	1									6
42-43							1	6	6	4	1							18
44-45							3	7	10	5	2						1	28
46-47								7	11	10	7	2						37
48-49								6	9	7	16	8	3	1	1	2	1	54
50-51								2	4	1	16	15	8	4	2	5		57
52-53									1	3	8	7	9	9	7	6		50
54-55										1	1	2	3	4		5		16
56-57														3	1	2		6
58-59														1				1
60-61														1				1
total:			4	6	6	5	7	32	43	32	51	34	23	23	11	20	3	300

Table 12 - American plaice abundance at age by strata ($\times 1000$) in the 1999 survey.

age	stratum														total	mean weight (g)	mean length (cm)
	1	2	3	4	5	6	7	8	10	11	14						
1 :						6									6	7	10
2 :																	
3 :			7			6					7				20	146	25
4 :	7	9	10	3	7			8	12						56	284	31
5 :	7	10	4	9		1			14	10	5				60	393	34
6 :	13	15	1	4	6	1	1		7	5	4				57	496	37
7 :	74	56	3	3	9	4	4		14	7	3				177	515	37
8 :	116	148	12	7	13	6	6		16	12	3				339	721	41
9 :	107	195	12	6	13	6	6		16	10					371	794	42
10 :	36	121	9	4	3	4	2		6	2	2				189	944	45
11 :	32	197	7	5	9	3	2		3	2					260	1119	47
12 :	17	127	5	3	6	2	1		1	1					163	1211	48
13 :	6	81	5	2	2	1			1						98	1381	51
14 :	3	90	4	1	1				1						100	1629	53
15 :	1	44	1	1	1				1						49	1477	52
16+ :	3	71	4	1	1	1			1						82	1504	52

Table 13 - Redfish (*Sebastes marinus*) catch (Kg) by strata in the 1999 survey.

stratum	area		catch per tow		catch per mile towed	
	squa. miles	tow number	mean	s.deviat.	mean	s.deviat.
1 -	342	4	0.85	1.03	0.49	0.60
2 -	838	10	3.26	5.00	1.87	2.85
3 -	628	7	0.89	0.71	0.52	0.41
4 -	348	4	1.59	1.08	0.95	0.66
5 -	703	8	3.23	2.52	1.98	1.55
6 -	496	6	26.64	45.19	15.49	26.21
7 -	822	9	4.72	3.65	2.79	2.07
8 -	646	7	3.42	2.26	2.10	1.42
9 -	314	3	3.52	3.68	2.19	2.32
10 -	951	11	35.38	77.82	19.48	41.66
11 -	806	9	75.36	182.51	43.64	104.97
12 -	670	7	1.44	1.37	0.86	0.81
13 -	249	3	0.68	0.76	0.43	0.45
14 -	602	6	1.09	1.21	0.62	0.70
15 -	666	8	0.43	0.62	0.26	0.38
16 -	634	6	-	-	-	-
17 -	216	2	-	-	-	-
18 -	210	2	-	-	-	-
19 -	414	5	-	-	-	-
total	10555	117	11.68			
			catch per tow		catch per mile towed	
			-----		-----	
	mean		11.68		6.70	
	standard error		5.18		2.95	
			----- (Kg)			

Stock biomass estimated by swept area method = 9,431 tons
 " " " " " by sex (m f) = 5,087 4,344 tons
 (m f) = male / female

Table 14 - Redfish (*Sebastes marinus*) length frequency by strata ($\times 1000$) in 1999.

length (cm)	stratum															total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
8-				14												14
9-				7												7
10-			7	7												14
11-																
12-																
13-			7											8		15
14-											7					7
15-						6				30						36
16-					7					37	7					51
17-										30	7					37
18-	6			7		6				20	7					47
19-	6	19				19	7									52
20-		6			14		30			21	14					84
21-		78	7		21	21	22	8		7	89					253
22-		65	7	14	42	87	51			124	42			15		448
23-		109	14	7	57	103	95	8		194	70			8		665
24-	18	103	14		28	166	58	8		346	508	8		30	14	1300
25-	18	122	7	7	50	127	109	8	42	486	301	24		8	14	1323
26-	18	58	28	7	42	185	87	61		453	794	8		15	7	1764
27-	6	51	14	28	28	172	87	53	12	563	1485	32	14	8	14	2565
28-		52			56	189	95	76	51	620	1522	23		23		2706
29-		38	14	21	28	198	95	121	24	467	1426	23	7			2462
30-		25	21	21	71	284	58	38	40	453	1224	16		16		2265
31-	6	12	7	7	21	149	66	23	24	483	863	31	7	8	13	1720
32-		13		7	14	175		16	27	496	870	16		8		1640
33-					21	116	14	46	12	340	441			8	7	1005
34-				7	28	110	22	8		243	535		7	8	7	974
35-		6			7	93	29	8		150	298					591
36-			7		14	6	7			180	115	16				346
37-						33				143	237	8				421
38-		6				25				56	61					150
39-						8				30	68					106
40-										80	7					87
41-						17				34	7					57
42-										17						17
43-											7					7
44-										7	7					14
45-											7					7
46-										17						17
47-										7	54					61
48											7					7

Table 16 - Redfish (*Sebastes marinus*) abundance at age by strata (× 1000) in the 1999 survey.

age	stratum															total	mean weight (g)	mean length (cm)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
1 :			7	28												35	12	9
2 :																		
3 :			7			3				14	9			8		41	48	14
4 :					7	7				44	5					63	71	16
5 :	12	87	8	12	44	68	60	5		120	95			7		518	145	21
6 :	22	236	34	18	103	326	194	39	13	714	857	16	2	36	15	2625	229	24
7 :	28	220	32	25	121	411	233	107	50	1171	2118	47	6	39	22	4630	287	26
8 :	9	121	32	35	109	458	219	159	73	1246	2905	48	11	23	11	5459	350	28
9 :	6	47	20	25	72	442	122	86	57	1087	2445	48	9	23	14	4503	443	30
10 :	2	21	6	11	39	255	47	48	31	624	1296	19	3	14	7	2423	490	32
11 :		3	2	2	17	88	16	13	5	259	353	7	1	5	2	773	588	34
12 :		1		2	12	75	14	14	1	178	263	1	2	4	2	569	619	34
13 :		5	2	4	12	111	20	6	2	295	482	17	2	2	2	962	680	35
14 :		1	1		5	22		3		85	84	1				203	765	37
15 :		1				5				37	32					75	860	38
16 :			1		3	7		1		64	37			1		114	806	37
17 :			1		1	1				25	2					30	781	37
18 :			1		3	10		1		90	43			1		149	888	38
19 :										16						16	1486	46
20 :			1		1	1				50						53	881	38
21 :											7					7	1392	45
22 :																		

Table 17 - Redfish (*Sebastes mentella*) catch (Kg) by strata in the 1999 survey.

stratum	area		catch per tow		catch per mile towed	
	squa. miles	tow number	mean	s.deviat.	mean	s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	-	-	-	-
3 -	628	7	0.11	0.15	0.06	0.08
4 -	348	4	0.11	0.22	0.07	0.13
5 -	703	8	2.06	5.23	1.34	3.43
6 -	496	6	0.96	1.00	0.56	0.58
7 -	822	9	18.70	21.38	11.46	13.10
8 -	646	7	47.43	48.64	29.09	29.92
9 -	314	3	1494.13	1646.41	827.83	858.01
10 -	951	11	126.52	172.09	72.05	93.55
11 -	806	9	33.13	51.54	19.51	30.16
12 -	670	7	76.49	74.25	46.09	43.75
13 -	249	3	110.33	67.33	70.72	41.67
14 -	602	6	120.30	79.28	67.49	42.60
15 -	666	8	57.59	53.72	34.83	33.67
16 -	634	6	3.40	4.18	2.07	2.65
17 -	216	2	4.50	6.36	3.10	4.38
18 -	210	2	0.91	1.29	0.53	0.75
19 -	414	5	5.05	6.57	3.16	4.12

total 10555 117 81.40

		catch per tow	catch per mile towed
mean		81.40	46.37
standard error		28.87	15.09

----- (Kg)
 Stock biomass estimated by swept area method = 65,254 tons
 " " " " " by sex (i m f) = 50 32,677 32,527 tons
 (i m f) = immature / male / female

Table 18 - Redfish (*Sebastes mentella*) length frequency by strata ($\times 10,000$) in 1999.

length (cm)	stratum																			total
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19			
9-		1	1				1	8											10	
10-			1																1	
11-			1		1	1	79												82	
12-	1		2	3	2	11	40	4	2										66	
13-	3		8	12	10	33		50	11										127	
14-	2		3	3	13	19	8	88	16										151	
15-	1		8	1	32	78	96	549	87			11	19						884	
16-			11	4	85	165	207	1270	155			22	32						1950	
17-			9	6	81	127	72	822	90	2		9	25						1242	
18-			5	3	66	194	413	843	109	6	2	3	37					1	1680	
19-		1	12	4	50	218	318	708	118	10		10	43					1	1495	
20-			6	3	44	152	207	398	79	5		10	15					1	920	
21-	1		2	1	28	110	183	183	75	16	5	2	13						618	
22-	1		6	1	30	135	350	297	81	16	19	20	38						995	
23-	1		8	2	47	108	1156	425	109	52	39	167	85						2198	
24-			6	1	85	142	3631	592	152	158	85	456	180						5488	
25-			4	2	95	135	4848	617	161	333	204	560	252	3			1	2	7215	
26-			6	1	74	94	3729	422	86	455	221	462	260	4				3	5815	
27-		1	2		43	55	1029	131	44	286	153	198	152	2			2	7	2104	
28-					9	13	195	35	11	165	57	116	75	5				4	685	
29-			1		4	5	120	2	3	50	25	26	31	2				2	270	
30-					1	4			1	23	6	15	10	5				3	68	
31-								16		1	7	7	19	11	5			1	2	68
32-								8		2	16	9	26	8	5	1		2	2	77
33-					2					2	9	22	10	4				4	4	53
34-					1					6	10	23	9	2	3	1		2	2	56
35-										7	6	20	5	2	7			1	1	48
36-					1					6	4	12	5	1				1	1	29
37-										7	2	7				1				17
38-										1	2	6	3						1	13
39-									1	1	2	2				1				7
40-										1	1			1	1					3
41-										1		1								2
42-											1			1				1		3
43-																		1		1
44-																				
45-												1	1					1		2

Table 19 - Redfish (*Sebastes mentella*) age-length key in the 1999 survey.

length (cm)	age																									no id	tot n.		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+				
9-	2																										2		
10-																													
11-																													
12-		2																										2	4
13-		8																										10	18
14-		3	7																									7	17
15-			14	3																								4	21
16-			20	13																								3	36
17-			6	15				1																				6	28
18-			1	19	4																							6	30
19-				22	13																							8	43
20-					21	4																						7	32
21-					7	8																						7	22
22-					2	10	2			5																		7	26
23-						8	7			12																		6	33
24-						3	10	1		17																		5	36
25-						1	6	4		25																		5	41
26-							3	11		23	3																	4	44
27-							1	7		25	1																	3	37
28-							1	6		5	1																	4	17
29-								4		3	12				1													3	24
30-								1		1	7				1	2												7	20
31-								2			3	5	1	5		2	3	1										4	28
32-											2	2	1	3		1	1	1	1									5	19
33-											1	1	1	7		2												6	20
34-											1	5		2		2												4	17
35-											3	2	1		1	3												8	20
36-												1																5	10
37-												1																4	7
38-																												6	8
39-																													
40-																												1	3
41-																												1	1
42-																													
43-																												1	2
44-																												1	1
45-																													
total:	2	13	48	72	47	34	30	37	116	30	8	9	26	2	7	9	3	14	1	2	3		2	1	3	151	670		

Table 20 - Redfish (*Sebastes mentella*) abundance at age ($\times 10,000$) in the 1999 survey.

age	stratum																	total	mean weight (g)	mean length (cm)
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19			
1 :		1	1			1	8											11	10	9
2 :	4		10	15	15	43	46	86	18									237	33	13
3 :	2		17	7	106	208	238	1451	196	1		24	41					2291	56	16
4 :		1	23	11	179	446	622	2271	294	11	2	26	84				1	3971	76	17
5 :	1		13	5	90	334	542	957	186	19	5	17	53				2	2224	107	20
6 :	1		9	2	64	207	1172	530	150	58	37	125	80					2435	166	23
7 :			6	1	65	120	2563	463	121	174	98	323	153	1			1	4089	206	24
8 :			4	1	58	79	2315	323	80	309	152	320	185	4		1	5	3836	241	26
9 :	1	1	16	3	214	344	8810	1332	336	917	487	1191	626	10		2	11	14301	227	25
10 :					7	11	298	22	9	85	38	66	48	7			5	596	300	28
11 :								1		4	3	9	4	2			1	24	448	32
12 :								3		6	5	16	6	3	2		1	42	536	34
13 :				2	1	8		1	16	14	33	13	5	2			4	99	488	33
14 :								1		2	2	5	1	1	1			13	519	33
15 :								1		3	4	11	5	2	1		1	28	514	33
16 :								1		5	4	12	4	1	2		1	30	535	34
17 :								1	1	2	3	8	3	1	1			20	594	35
18 :				1		4			6	7	18	9	2	2			3	52	579	34
19 :									1	1	3	1	1				1	8	731	37
20 :									2	2	4	1	1		1			10	631	35
21 :							1		2	1	4	1						9	541	34
22 :										1				1	1			3	901	40
23 :									2	1	2							5	692	37
24 :									2		2							4	713	37
25+ :									1	3	2	4	1		1			12	749	38

Table 21 - Redfish (*Sebastes fasciatus*) catch (Kg) by strata in the 1999 survey.

stratum	area squa. miles	tow number	catch per tow		catch per mile towed	
			mean	s.deviat.	mean	s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	0.79	1.48	0.45	0.83
3 -	628	7	1.12	0.66	0.64	0.37
4 -	348	4	1.08	1.03	0.65	0.63
5 -	703	8	4.99	6.30	3.15	4.15
6 -	496	6	11.42	10.71	6.67	6.22
7 -	822	9	10.85	7.56	6.63	5.03
8 -	646	7	22.91	15.64	13.98	9.44
9 -	314	3	18.09	7.21	10.45	3.26
10 -	951	11	37.00	44.50	21.20	25.01
11 -	806	9	18.28	12.22	10.76	7.02
12 -	670	7	6.61	5.49	4.07	3.39
13 -	249	3	2.62	2.72	1.62	1.60
14 -	602	6	4.64	2.95	2.63	1.61
15 -	666	8	4.48	5.98	2.69	3.69
16 -	634	6	0.02	0.05	0.01	0.03
17 -	216	2	-	-	-	-
18 -	210	2	-	-	-	-
19 -	414	5	0.06	0.09	0.04	0.06

total	10555	117	9.58			
				catch per tow		catch per mile towed
				-----		-----
			mean	9.58		5.65
			standard error	1.36		0.78
				-----		-----

----- (Kg)

Stock biomass estimated by swept area method = 7,954 tons
 " " " " " by sex (i m f) = 10 3,676 4,268 tons

Table 24 - Redfish (*Sebastes fasciatus*) abundance at age ($\times 10,000$) in the 1999 survey.

age	stratum															total	mean weight (g)	mean length (cm)	
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				19
1 :	3	1	2	1					1	1							9	12	9
2 :	4	4	2	24	8	5	2	6	11	5							71	31	12
3 :	6	6	1	36	30	14	10	17	83	28	1						232	54	15
4 :	13	9	3	45	71	52	66	39	318	110	5	1	9	8			749	83	17
5 :	16	11	6	63	115	130	202	72	502	214	23	4	23	34			1415	114	19
6 :	7	10	7	46	79	129	229	65	350	186	55	6	23	42		1	1235	155	22
7 :	1	3	2	12	15	47	89	27	116	69	35	4	14	18			452	197	23
8 :		1	1	8	8	33	59	19	90	52	27	5	14	12			329	239	25
9 :		1	1	7	6	27	48	21	86	46	25	5	14	9			296	262	26
10 :					1	4	5	7	24	7	5	2	3	1			59	354	29
11 :					1	1	2	6	14	4	2	1	1				32	382	29
12 :									8	1	1		1				11	460	31
13 :						1	1	4	27	3	2	1	2				41	461	31
14 :									6								6	568	34
15 :									6				1				7	534	33
16 :									8								8	687	36
17 :																			
18 :									1								1	815	38
19 :																			
20 :																			
21 :																			
22 :																			
23 :																			
24 :																			
25+:									1								1	948	40

Table 25 - Juvenile redfish (*Sebastes sp.*) catch (Kg) by strata in the 1999 survey.

stratum	area squa. miles	tow number	catch per tow		catch per mile towed	
			mean	s.deviat.	mean	s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	0.00	0.01	0.00	0.00
3 -	628	7	0.18	0.20	0.10	0.11
4 -	348	4	0.02	0.03	0.01	0.02
5 -	703	8	0.77	1.07	0.48	0.64
6 -	496	6	1.06	1.46	0.62	0.84
7 -	822	9	0.37	0.45	0.22	0.26
8 -	646	7	0.24	0.42	0.14	0.25
9 -	314	3	-	-	-	-
10 -	951	11	1.04	0.98	0.59	0.56
11 -	806	9	0.76	0.60	0.45	0.34
12 -	670	7	-	-	-	-
13 -	249	3	-	-	-	-
14 -	602	6	0.01	0.02	0.00	0.01
15 -	666	8	-	-	-	-
16 -	634	6	-	-	-	-
17 -	216	2	-	-	-	-
18 -	210	2	-	-	-	-
19 -	414	5	-	-	-	-

total	10555	117	0.31			
			catch per tow		catch per mile towed	
			mean	0.31	0.18	
			standard error	0.05	0.03	

----- (Kg)

Stock biomass estimated by swept area method = 255 tons

Table 26 - Juvenile redfish (*Sebastes sp.*) length frequency by strata ($\times 1000$) in the 1999 survey.

length (cm)	stratum										total
	2	3	4	5	6	7	8	10	11	14	
7-		28			13		15	7	21		84
8-	6	180	7	56	220	131	158	197	226		1182
9-	6	305	34	1012	1644	901	610	1996	1617	15	8141
10-		139		1624	2620	392	309	1697	960	15	7756
11-		14		254	125	58	23	209	56		739
12-		7		64	199	65	23	411	99		867
13-		35		85	477	160		667	290		1713
14-		21		14	119	7		160	64		385
15-								130	14		144
16-								62			62

Table 27 - Juvenile redfish (*Sebastes sp.*) age-length key in the 1999 survey.

length (cm)	age					no id	tot n.
	1	2	3	4	5		
6-							
7-						1	1
8-	4					1	5
9-	16					2	18
10-	6	1				1	8
11-		1					1
12-		3					3
13-		4					4
14-		1	1				2
total:	26	10	1			5	42

Table 28 - Juvenile redfish (*Sebastes sp.*) abundance at age by strata ($\times 10,000$) in the 1999 survey.

age	stratum										total	mean weight (g)	mean length (cm)
	2	3	4	5	6	7	8	10	11	14			
1 :	1	60	4	246	411	137	103	365	267	3	1597	11	9
2 :		9		64	123	34	9	161	61		461	21	12
3 :		1		1	6			8	3		19	32	14

Table 29 - Frequencies at age of redfish stocks.

Age	<i>S. marinus</i>									<i>S. mentella</i>							<i>S. fasciatus</i>								
	1991	1992	1993	1994	1995	1996	1997	1998	1999	1992	1993	1994	1995	1996	1997	1998	1999	1992	1993	1994	1995	1996	1997	1998	1999
1									4			10	6		6	11			2						9
2				20	122	51						49	259	280	59	151	237		12	81	235	89	115	71	
3	12	11	65	231	765	139			4	132		1074	3040	1620	480	2140	2291	5	82	264	400	486	1483	416	232
4	225	74	125	770	1342	791	612		6	2673	173	5249	19700	11726	3190	1371	3971	469	265	1284	875	1407	2340	922	749
5	357	234	228	808	1529	2120	1523		52	9884	550	2273	11900	30498	17631	1534	2224	1131	634	1777	1108	2620	1867	1475	1415
6	179	197	254	885	406	1168	4227		263	3829	1420	1285	490	4765	10163	3950	2435	417	485	885	422	1064	1714	549	1235
7	175	149	157	1087	281	438	3480		463	3048	1013	1915	870	850	794	2713	4089	140	204	353	238	533	784	472	452
8	73	100	119	755	146	170	2062		546	2181	637	1178	980	826	331	11249	3836	83	99	118	105	200	300	697	329
9	53	65	50	578	76	121	452		450	1361	228	778	570	641	217	447	14301	54	47	40	31	127	202	96	296
10	72	56	59	431	61	87	897		242	862	317	605	550	374	251	69	596	16	26	23	11	23	79	38	59
11	46	56	39	448	57	63	856		77	631	335	519	610	281	133	46	24	19	12	15	17	27	211	16	32
12	44	35	37	324	32	72	915		57	465	410	330	280	284	134	275	42	13	2		8	34		39	11
13	39	32	11	420	48	34	611		96	446	259	253	220	168	72	30	99	3	5	4	7	4			41
14	9	14	14	145	26	25	420		20	321	260	161	250	188	121	40	13	9	3		2	13			6
15	18	14	6	222	23	28	315		8	174	297	172	260	147	34	18	28		1	5	1	7			7
16	9	2	4	22	14	14	70		11	172	69	85	160	106	48	28	30		3					3	8
17	18	1	4	83	17	10	56		3	107	95	59	102	69	44	53	20					3			
18		3	1	24	6	3	18		15	69	44	84	87	67	11	2	52	2							1
19	6	3	5	50	3		26		2	72	34	38	46	32	14	6	8	2				2			
20	7	1			7	3	121		5	19	26	22	38	41	16		10								
21	3	2		23			13		1	13	31	13	25	18	6		9								
22		1		10	1	1	3					13	11	5	2	3	3					1			
23	1			9	1					5	10	7	5	13			5								
24														5		2	4								
25+	5	1		51	9	4				16	3	2	31	17		2	12		2						1

(frequencies × 10,000)

Table 30 - Greenland halibut (*Reinhardtius hippoglossoides*) catch (Kg) by strata in the 1999 survey.

stratum	area		catch per tow		catch per mile towed	
	squa. miles	tow number	mean	s.deviat.	mean	s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	0.05	0.16	0.03	0.10
3 -	628	7	7.11	6.01	4.09	3.39
4 -	348	4	7.21	5.20	4.19	2.98
5 -	703	8	6.94	5.90	4.30	3.81
6 -	496	6	7.57	3.61	4.47	2.16
7 -	822	9	34.77	20.82	21.15	13.13
8 -	646	7	37.06	36.10	22.78	22.39
9 -	314	3	14.18	4.32	8.32	2.50
10 -	951	11	20.23	7.71	11.86	4.70
11 -	806	9	20.41	6.38	12.09	3.91
12 -	670	7	66.27	28.30	40.35	16.88
13 -	249	3	46.78	27.55	29.02	15.85
14 -	602	6	23.23	9.70	13.24	5.45
15 -	666	8	55.40	21.82	33.11	13.58
16 -	634	6	22.34	5.93	13.30	3.29
17 -	216	2	31.27	4.14	20.64	1.62
18 -	210	2	51.58	66.79	32.74	42.72
19 -	414	5	29.70	12.09	18.10	6.94
total	10555	117	24.57			
			catch per tow		catch per mile towed	
			-----		-----	
	mean		24.57		14.83	
	standard error		1.72		1.06	
			----- (Kg)			

Stock biomass estimated by swept area method = 20,877 tons
 " " " " " by sex (i m f) = 12 7,449 13,416 tons
 (i m f) = immature / male / female

Table 31 - Greenland halibut (*Reinhardtius hippoglossoides*) biomass estimated by swept area method (tons) 1988-1999.

stratum	depth in fathoms	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1 -	70- 80	-	-	-	-	-	-	-	-	-	-	-	-
2 -	81-100	-	3	6	-	-	-	-	119	-	2	6	3
3 -	101-140	26	31	8	8	18	3	-	21	106	89	361	342
4 -	"	142	20	-	15	27	10	-	5	0	23	40	194
5 -	"	73	96	-	28	41	1	2	21	35	96	170	403
6 -	"	31	18	15	12	8	15	-	31	104	224	355	296
7 -	141-200	84	62	63	186	242	93	211	890	1130	1401	2566	2319
8 -	"	149	219	63	177	373	138	38	328	353	1048	973	1962
9 -	"	177	162	53	75	318	30	42	175	157	250	464	348
10 -	"	106	81	48	169	356	31	231	518	705	848	1348	1504
11 -	"	44	60	20	104	225	230	232	484	660	617	1208	1299
12 -	201-300	399	637	290	749	609	918	1200	1129	2091	2213	3029	3604
13 -	"	63	122	214	43	24	141	150	125	293	476	545	963
14 -	"	362	289	315	775	834	469	610	404	888	1564	1438	1063
15 -	"	428	166	505	958	633	1356	1469	1740	1425	2647	3991	2940
16 -	301-400	1352	1342	2492	2487	1798	2141	1500	1832	2065	1742	3303	1125
17 -	"	262	118	130	408	39	105	730	730	254	517	725	594
18 -	"	104	49	449	348	57	208	380	943	188	548	763	917
19 -	"	3016	919	977	1498	2988	1321	1108	1211	956	1539	2562	999
total		6818	4391	5649	8038	8588	7210	7904	10705	11409	15846	23849	20877

Table 32 - Greenland halibut (*Reinhardtius hippoglossoides*) length frequency by strata ($\times 1000$) in the 1999 survey.

Length (cm)	stratum																			total
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
10-11														14					14	
12-13									7										7	
14-15			7	7		7	16		47	42									126	
16-17			7	21	13	7	53		101	28			8						238	
18-19			7		13	15	46		40	14			8						141	
20-21							16		14	7									35	
22-23									20										20	
24-25						22	23		61	21				7					132	
26-27		35		7	51	124	150		67	49	8								492	
28-29		63		14	32	109	135		40	21	8		8					7	437	
30-31		62		14	19	95	38		67	21		7	8	20			18		368	
32-33		42	14	57	32	240	98		148	84	78	7	38	99	50	19	43	54	1103	
34-35		166	54	92	97	385	181	65	249	261	219	77	122	263	84	29	77	81	2504	
36-37		187	48	134	161	661	573	82	430	360	492	77	175	520	194	76	111	121	4404	
38-39	6	124	137	164	168	820	677	163	437	487	788	184	282	659	168	209	137	264	5876	
40-41		98	55	220	77	734	655	139	612	473	1076	211	252	791	269	152	307	271	6391	
42-43		42	48	71	64	675	512	99	390	311	967	204	236	725	260	48	222	197	5071	
44-45		7	21	42	12	276	248	33	174	218	819	268	121	600	202	77	94	217	3431	
46-47		7		14	13	80	189	16	148	78	414	113	137	284	185	86	94	189	2045	
48-49						87	61	16	47	28	242	98	68	224	84	58	43	68	1124	
50-51						36	30	8	14	28	226	70	46	145	76	86	35	68	867	
52-53						7				94	28	45	47	67	39	26	40		393	
54-55						7	15		7	7	55	21	30	73	50	10	17	14	306	
56-57							8				16	14	15	20	17				89	
58-59											23	14	23	26			17		104	
60-61											24			13	8	10	9	7	70	
62-63														8	7				15	
64-65							8				8								15	
66-67																				
68-69															8				8	
70-71												7							7	

Table 33 - Greenland halibut (*Reinhardtius hippoglossoides*) age-length key in the 1999 survey.

																	no id:	no identified		
																	tot n.:	total number		
MALE	length (cm)	age															no id	tot n.		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			16+	
	14-15	4																	4	
	16-17	5																	5	
	18-19	2																	2	
	20-21		1																1	
	22-23		1																1	
	24-25		6																6	
	26-27		5	7															12	
	28-29		2	14	1														17	
	30-31			15	6	1													22	
	32-33			11	14														25	
	34-35			2	14	6	1												23	
	36-37				18	9	4											2	33	
	38-39				7	18	5											1	31	
	40-41				2	18	15	2											37	
	42-43				1	6	16	6	2										31	
	44-45					1	17	10	1									1	30	
	46-47					2	8	13	1										24	
	48-49						1	14	5	1									21	
	50-51						1	9	7	1								1	19	
	52-53								7	1	1								9	
	54-55							1	3	1									5	
	56-57								1		1								2	
	58-59																			
	60-61										1								1	
	62-63										2								2	
	total:	11	15	49	63	61	68	55	27	4	5							5	363	

FEMALE	length (cm)	age															no id	tot n.		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+			
	14-15	6																		6
	16-17	7																		7
	18-19	5																		5
	20-21	1																		1
	22-23		1																	1
	24-25		8	3																11
	26-27		8	17																25
	28-29		3	7																10
	30-31			11	2	1														14
	32-33			7	13	2														22
	34-35			5	23	5														33
	36-37			3	12	10	2											5		32
	38-39				19	18	4											11		52
	40-41				1	17	12	2										13		45
	42-43				1	11	24	2										6		44
	44-45					1	13	10	3									1		28
	46-47					1	12	13	2									4		32
	48-49						7	11	2											20
	50-51							12	9	3										24
	52-53							7	18	2								1		28
	54-55								5	10	5	1								21
	56-57								5	4										9
	58-59								6	5	1	1								13
	60-61									4	3									7
	62-63										1									1
	64-65										1									1
	66-67																			
	68-69															1				1
	70-71													1	1					2
	total:	19	20	53	71	66	74	62	55	23	7	1	1	1	1			41	495	

Table 35 – Results from the comparative trial between Lofoten and Campelen fishing gears by repeating tows.

Catch ratio: quotient between mean catch per mile Campelen/Lofoten

Occurrence: number of tows where that species occurred in the gears: Lofoten, Campelen and both.

Catch – Catch in number: absolute values.

Species	Catch ratio	Occurrence	Catch (Kg)	Catch in Number	observations
Cod	1.81	6-9-6	59-89	31-69	the smallest cod was better caught by the Campelen gear
American plaice	1.84	7-9-7	94-148	81-138	no size differences observed
<i>Sebastes</i> (juveniles)	37.78	4-10-4	0.3-11	28-936	size < 15 cm
<i>Sebastes marinus</i>	6.71	13-14-13	20-119	53-308	no size differences observed
<i>Sebastes mentella</i>	0.42	8-11-8	560-209	2653-1250	the biggest sizes were better caught by the Lofoten gear
<i>Sebastes fasciatus</i>	1.26	14-15-14	118-133	675-892	the smallest sizes were better caught by the Campelen gear
Greenland halibut	0.40	13-14-13	461-168	752-284	no size differences observed
Roughhead grenadier	2.12	7-7-7	22-41	43-171	
Shrimp	5.00	9-13-9	228-1027	37-300 ('000)	large effect of the small cod-end mesh size of the Campelen gear
<i>Raja radiata</i>	5.93	6-14-5	15-82	9-50	
<i>Chauliodus sloani</i>	1.64	6-8-6	2-2	54-84	
<i>Stomias boa</i>	1.36	2-2-1	0.1-0.1	21-44	
<i>Urophycis chesteri</i>	6.20	7-10-7	6-35	113-935	effect of the small cod-end mesh size of the Campelen gear
<i>Antimora rostrata</i>	2.77	2-2-2	9-22	75-301	effect of the small cod-end mesh size of the Campelen gear
<i>Nezumia bairdi</i>	3.41	9-10-9	10-31	172-1054	
Wolffish (<i>A. lupus</i>)	3.54	12-12-11	38-116	92-359	no size differences observed
Wolffish (<i>A. minor</i>)	1.60	11-14-11	64-92	35-65	no size differences observed
<i>Lycodes smarki</i>	16.40	6-11-6	2-31	11-230	
<i>Lycodes reticulatus</i>	5.58	11-13-11	5-26	43-362	sizes <25 cm were better caught by the Campelen gear
<i>Triglops murrayi</i>	11.01	9-10-9	1-9	42-646	
Witch flounder	4.03	6-11-6	11-38	20-62	no size differences observed
Squid	2.04	11-10-6	0.2-1	15-85	effect of the small cod-end mesh size of the Campelen gear

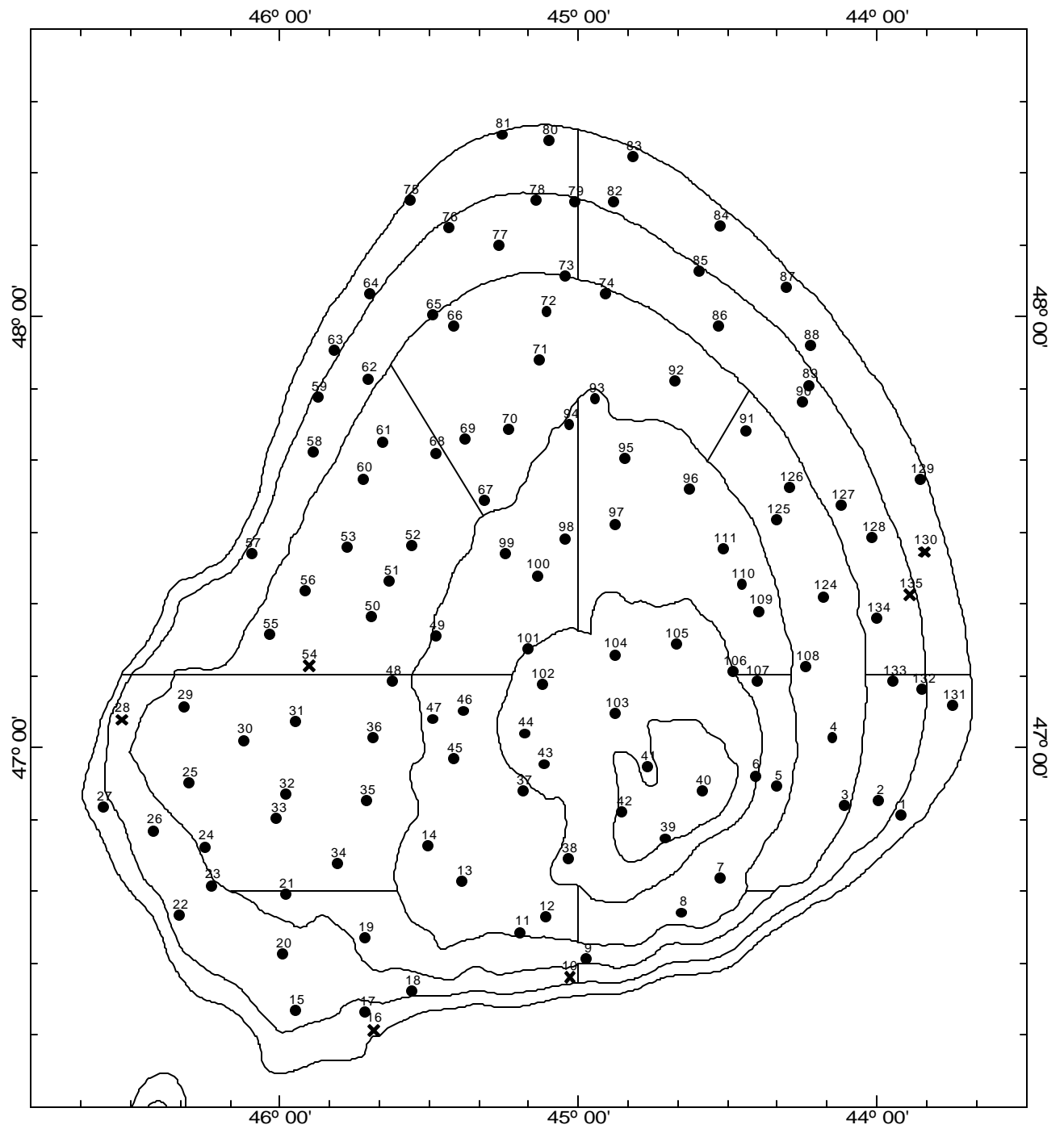


Figure 1 - Hauls position of the Flemish Cap-99 survey.

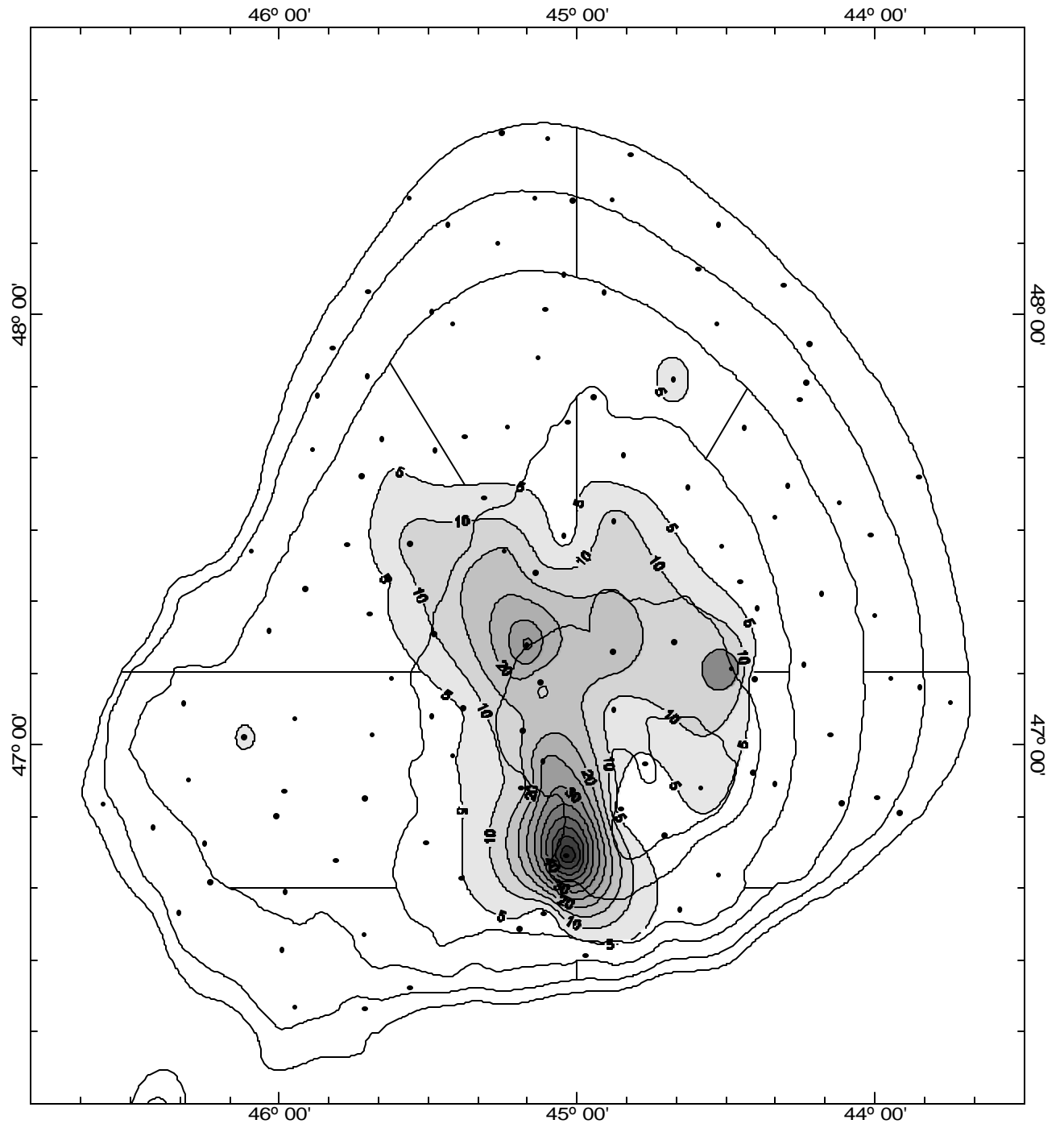


Figure 2 - Cod (*Gadus morhua*) catch distribution in Kg/tow

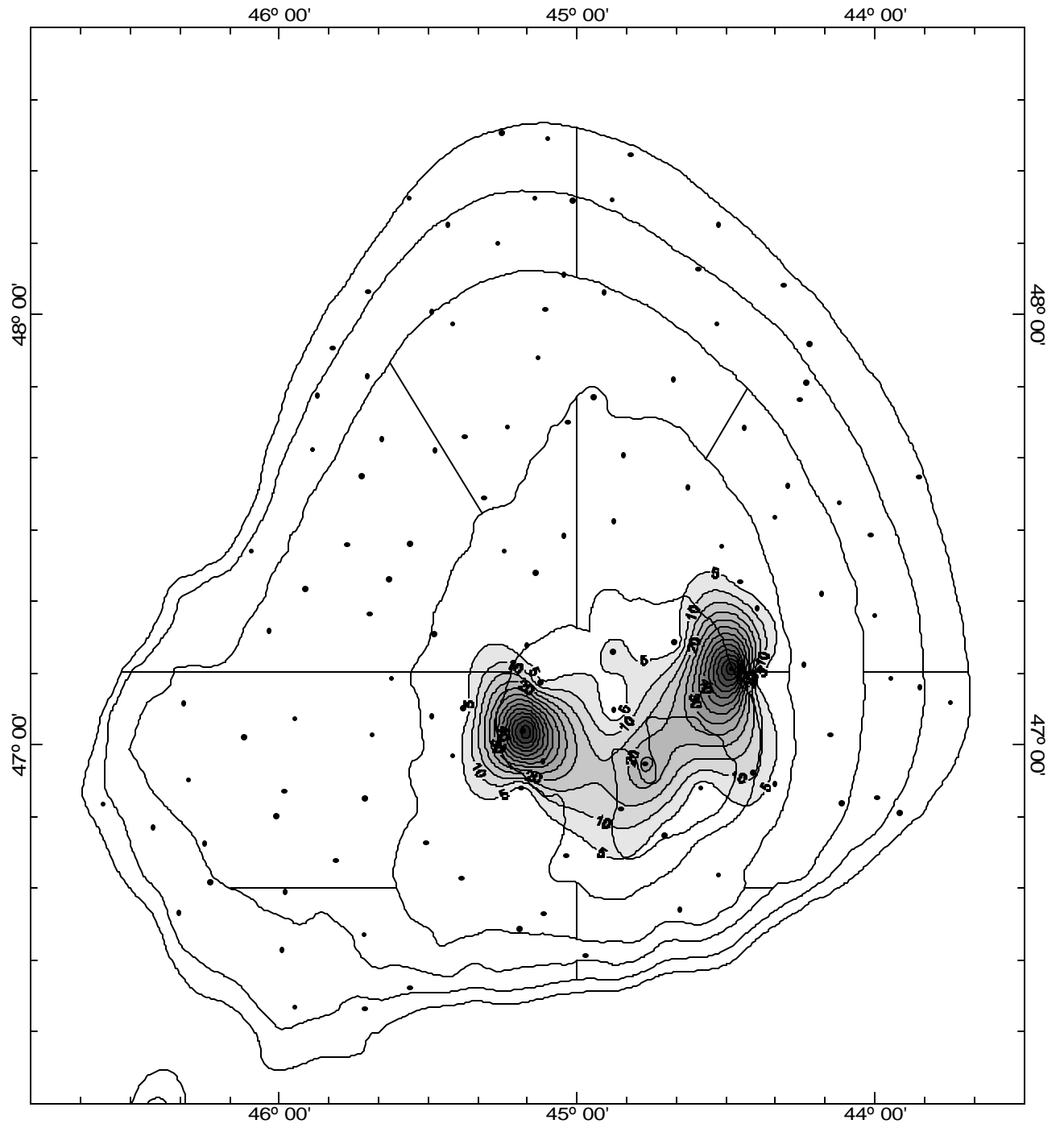


Figure 3 - American plaice (*Hippoglossoides platessoides*) catch distribution in Kg/tow

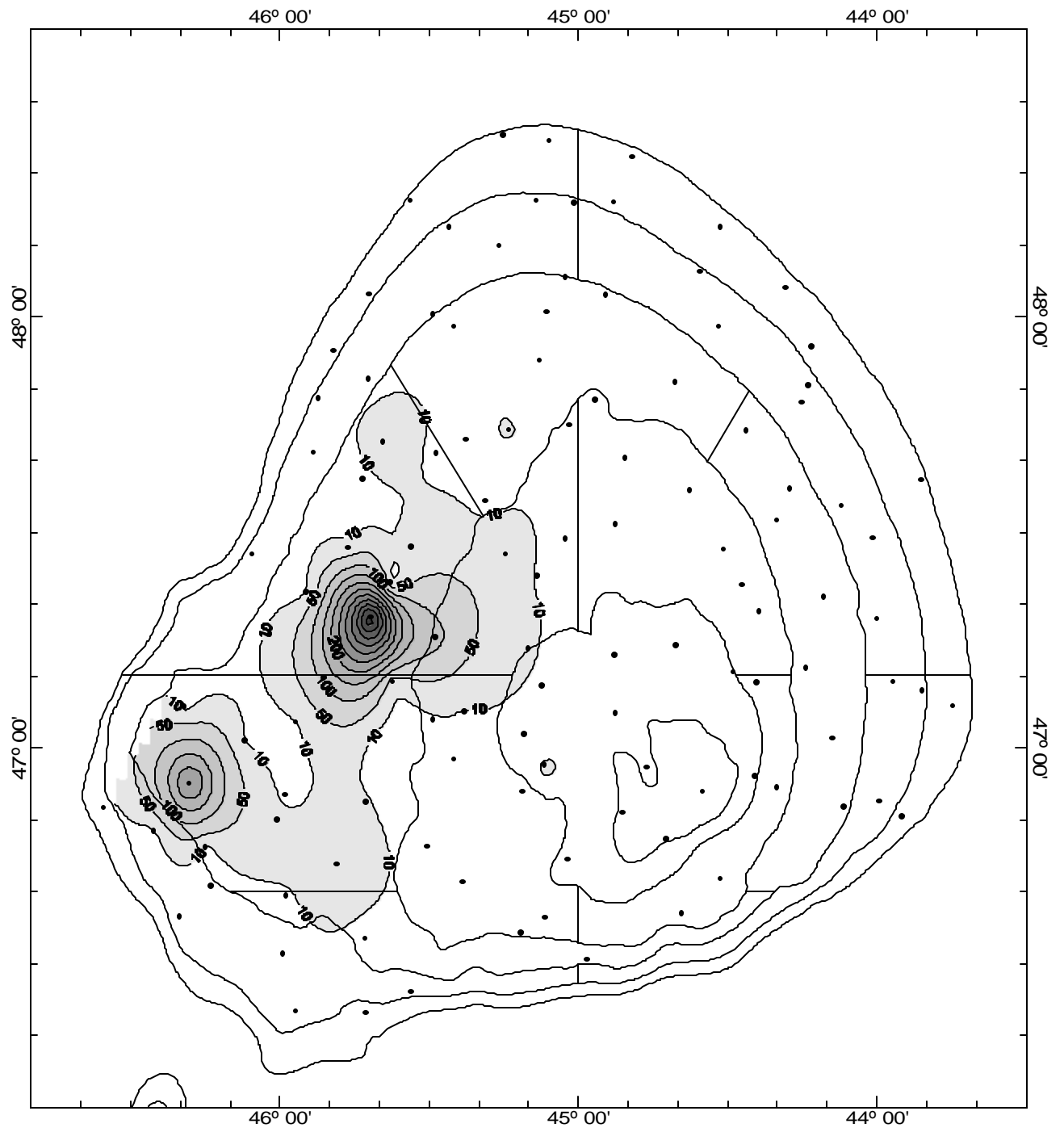


Figure 4 - Redfish (*Sebastes marinus*) catch distribution in Kg/tow

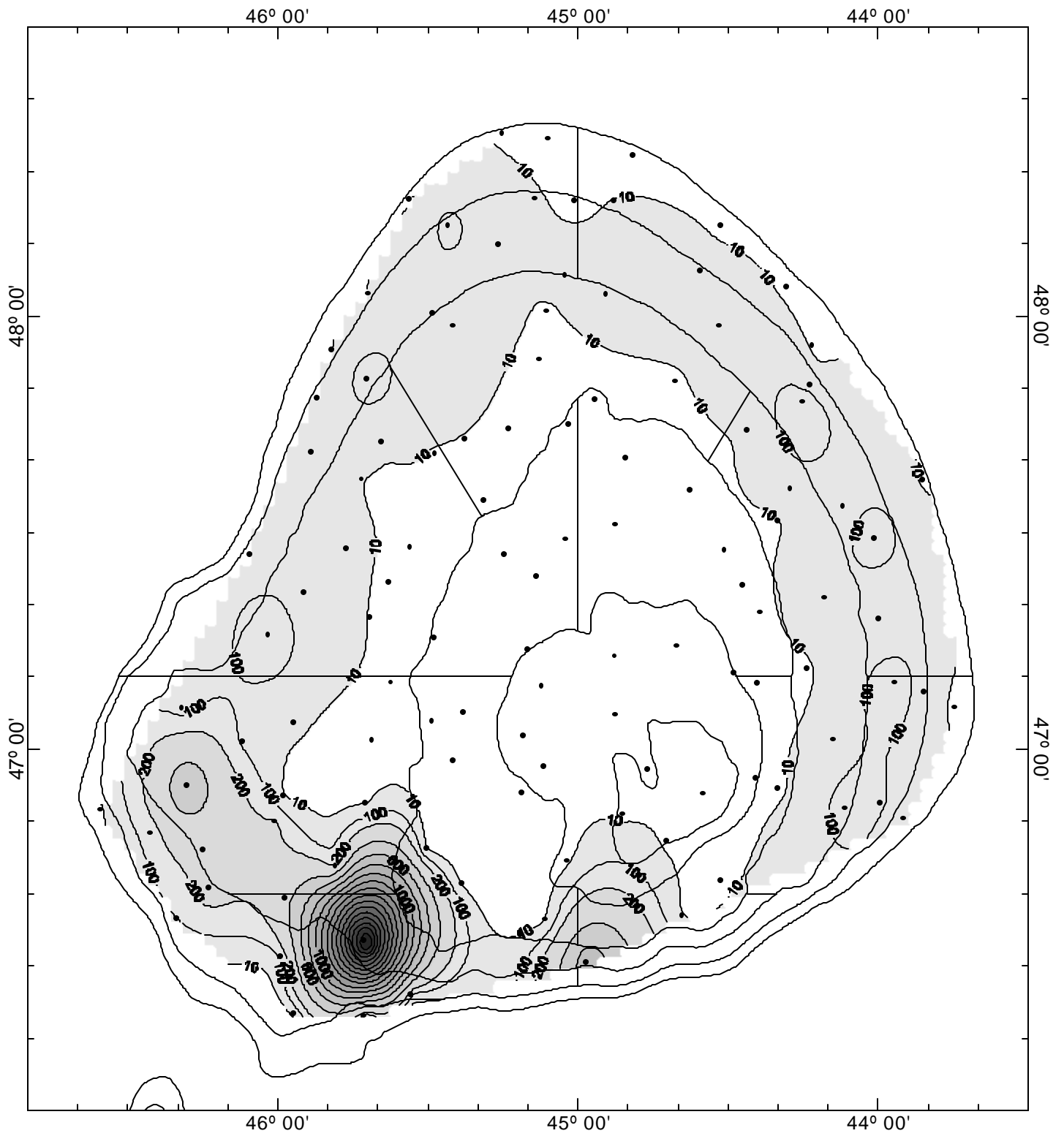


Figure 5 - Redfish (*Sebastes mentella*) catch distribution in Kg/tow

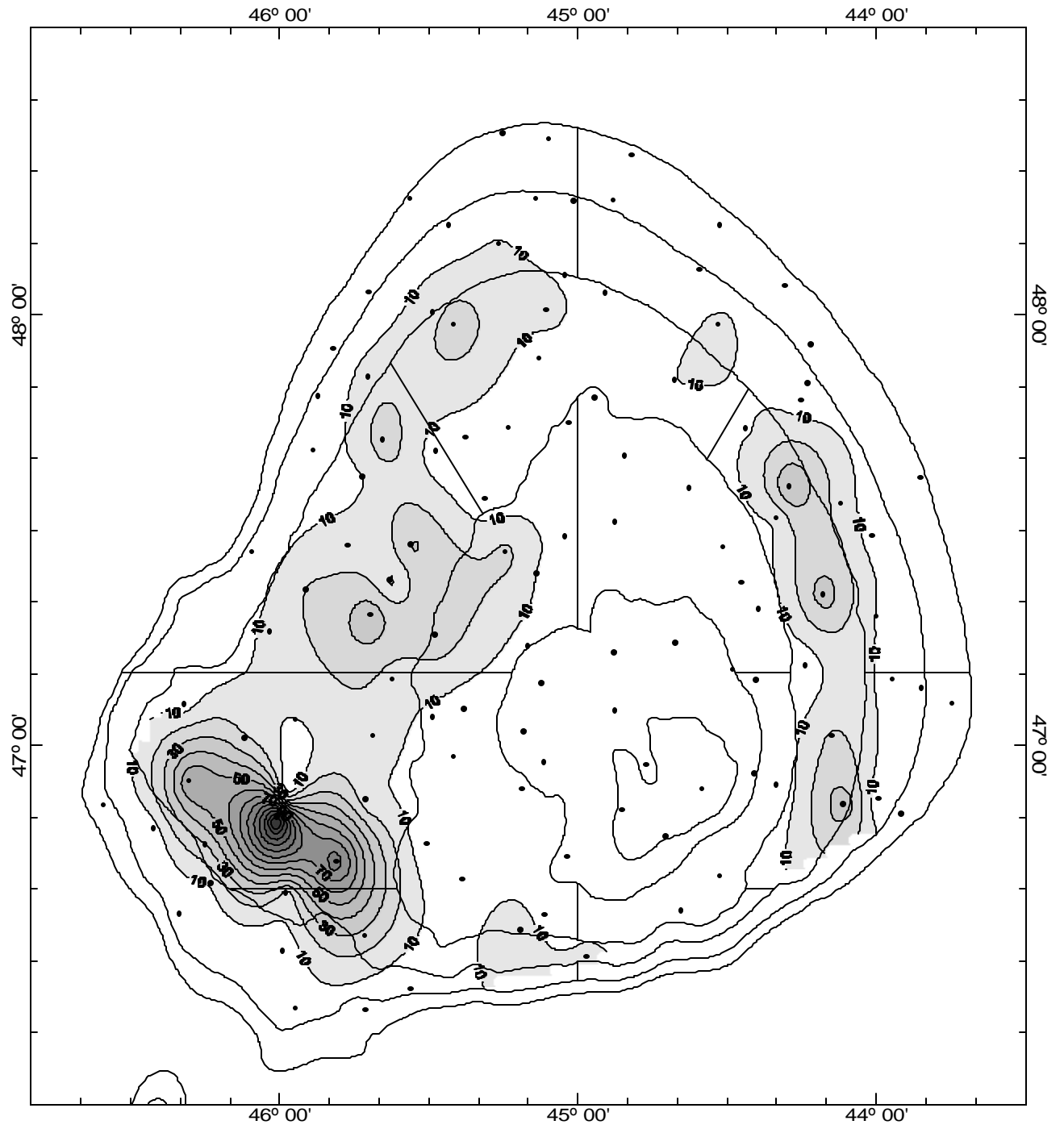


Figure 6 - Redfish (*Sebastes fasciatus*) catch distribution in Kg/tow

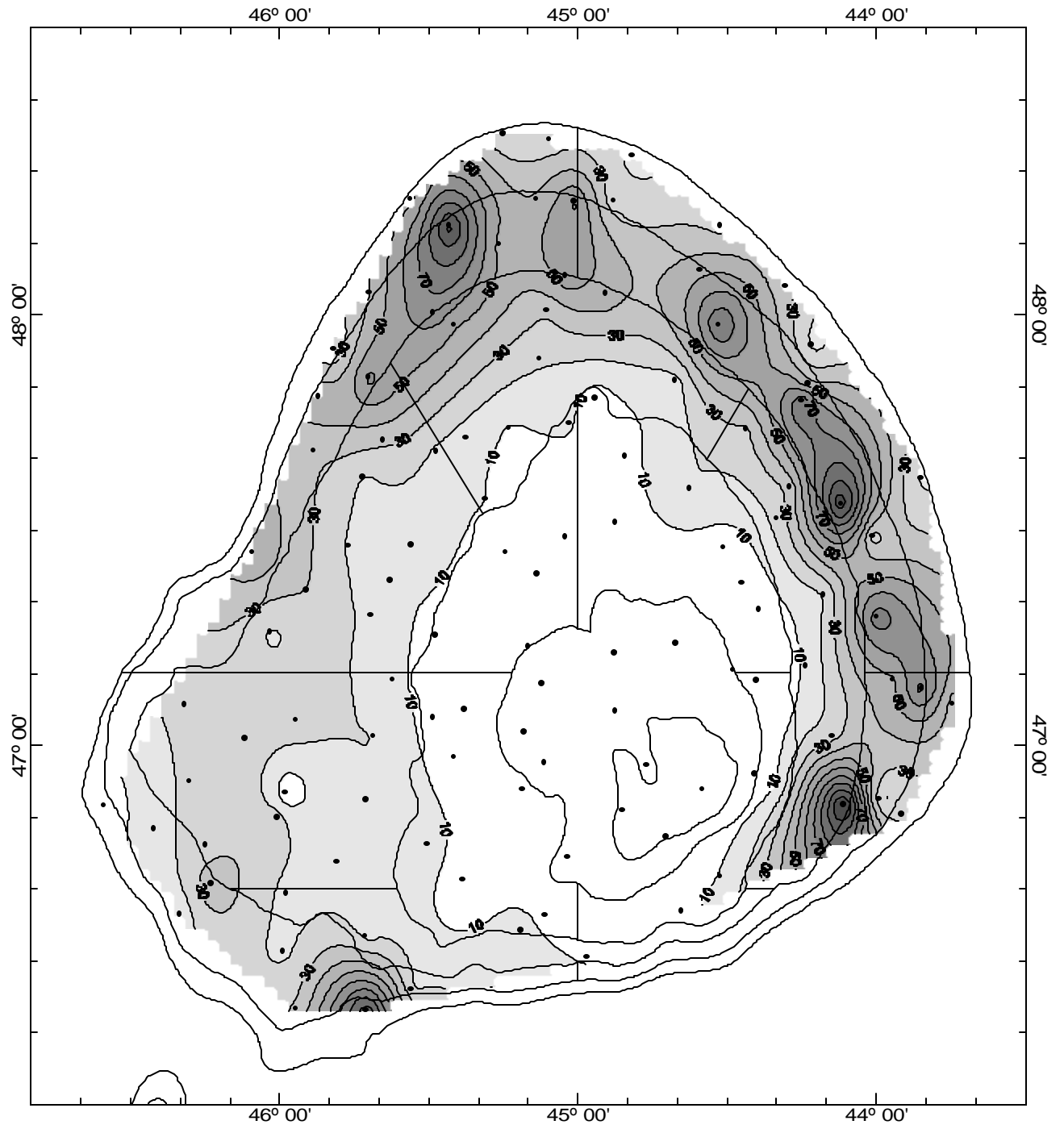
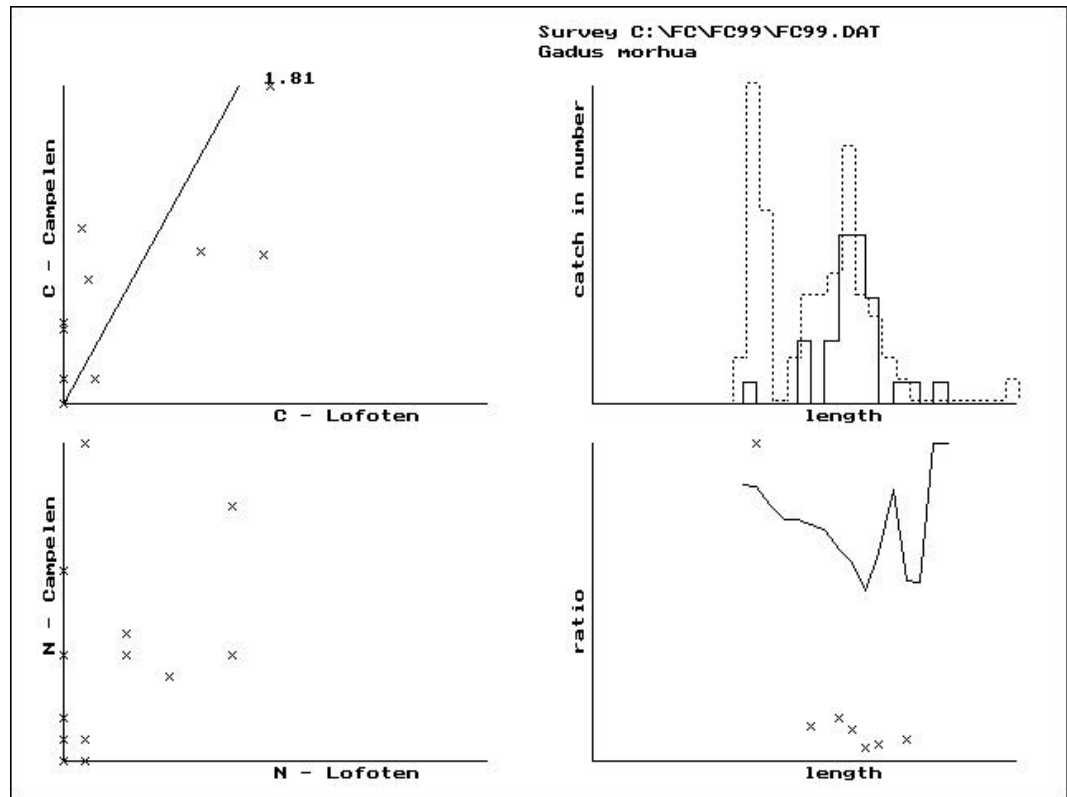


Figure 7 - Greenland halibut (*Reinhardtius hippoglossoides*) catch distribution in Kg/tow.



Cod

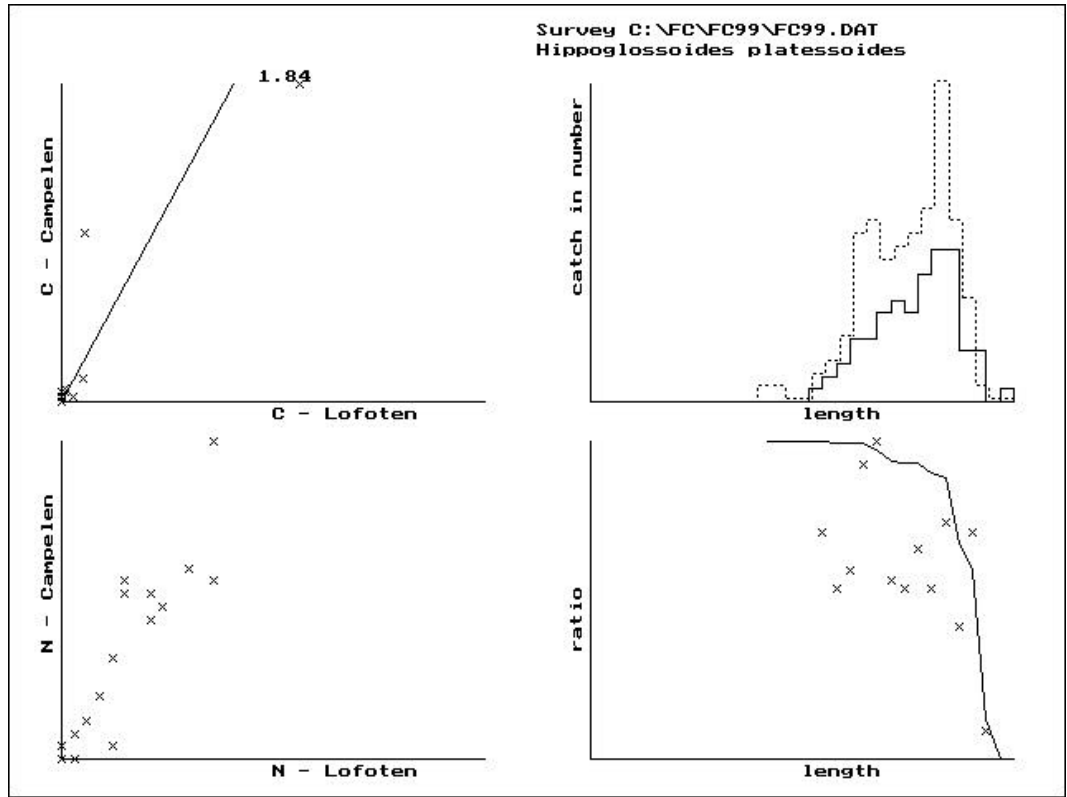
Figure 8 – Comparison of catches obtained with the Lofoten and Campelen survey gears fishing both in the same set of 17 geographical positions.

Upper-left square: catch in weight with the Campelen gear (ordinates) vs the catch with the Lofoten (abscissas) gear in the same geographic position. The ratio between the whole catch for each gear (Campelen / Lofoten) is written, and it is also represented with a straight line with such slope.

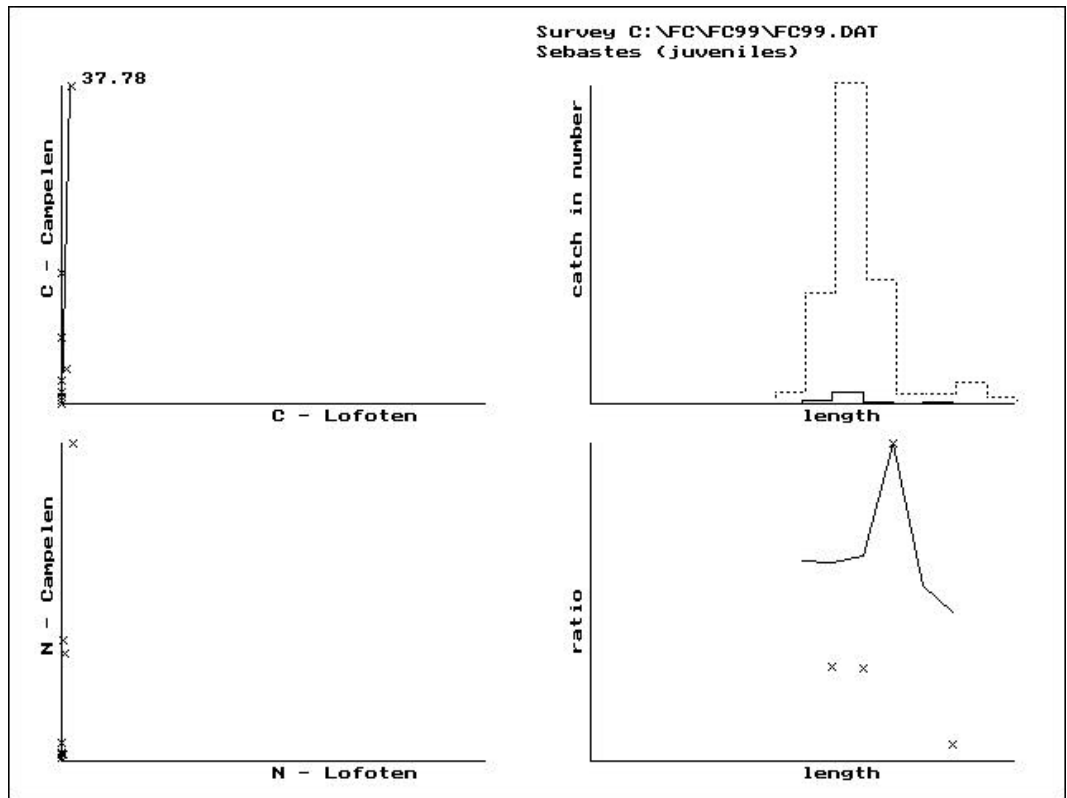
Bottom-left square: catch in number with both gears in the same geographic position.

Upper-right square: length frequency distribution with the gears Lofoten (solid line) and Campelen (dot line). It allows identifying catchability differences by length.

Bottom-right square: quotients of total catch in number for both gears (Campelen / Lofoten) (only when the Lofoten catch was not zero). Graphic (solid line) of cumulative catch in weight by length, in decreasing order: from the biggest length to the reference one, calculated as sum of products (frequency \times mean weight). At its left end this line points to the same ratio as indicated in the upper-left square. It would be a horizontal straight line only if catchability ratio by length-class was constant.

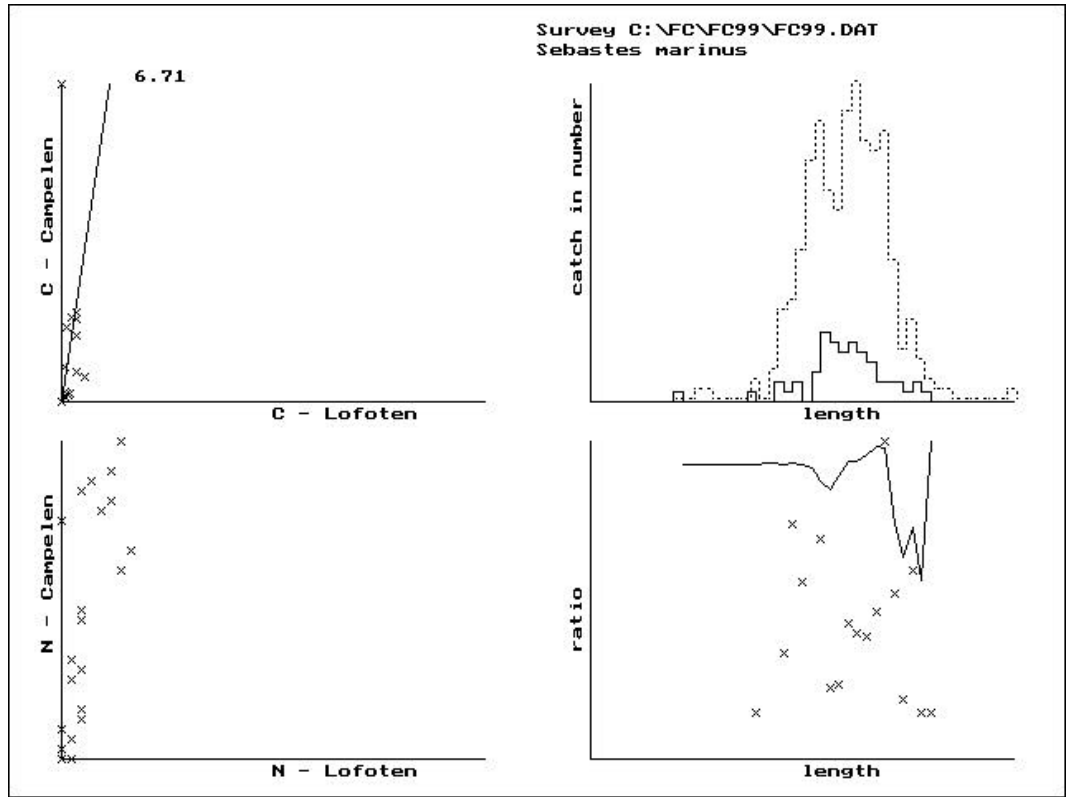


American plaice

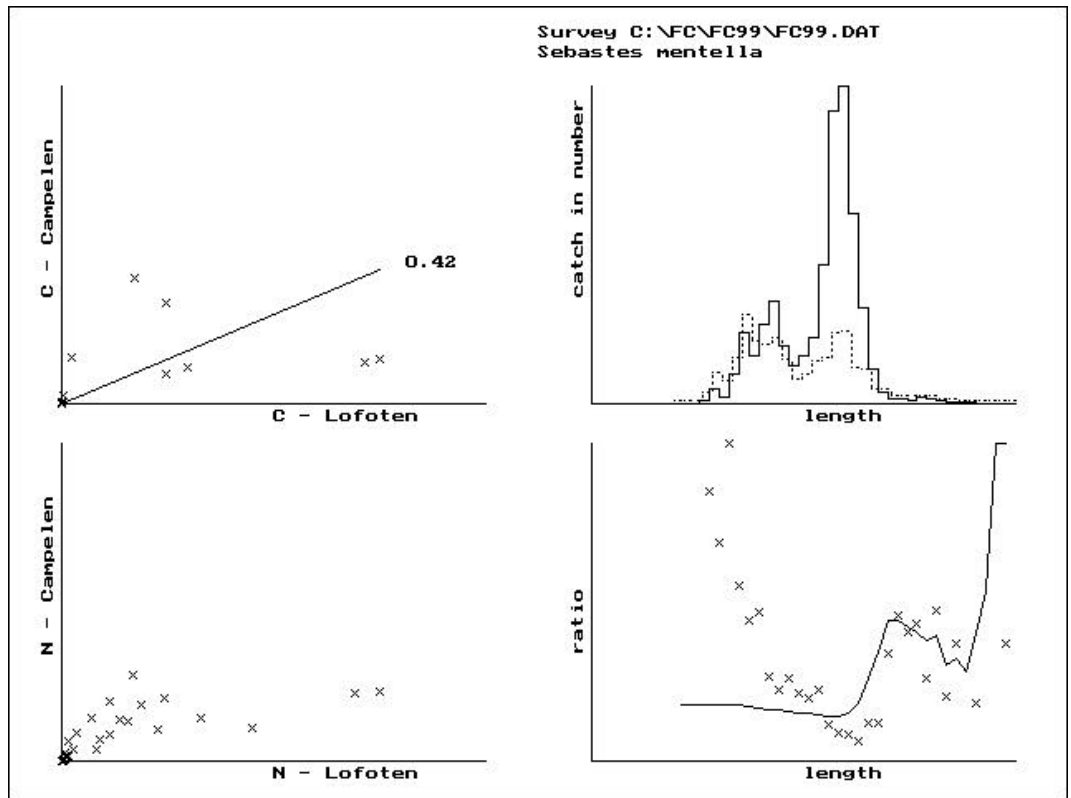


Redfish (juveniles)

Figure 8 - (continuation)

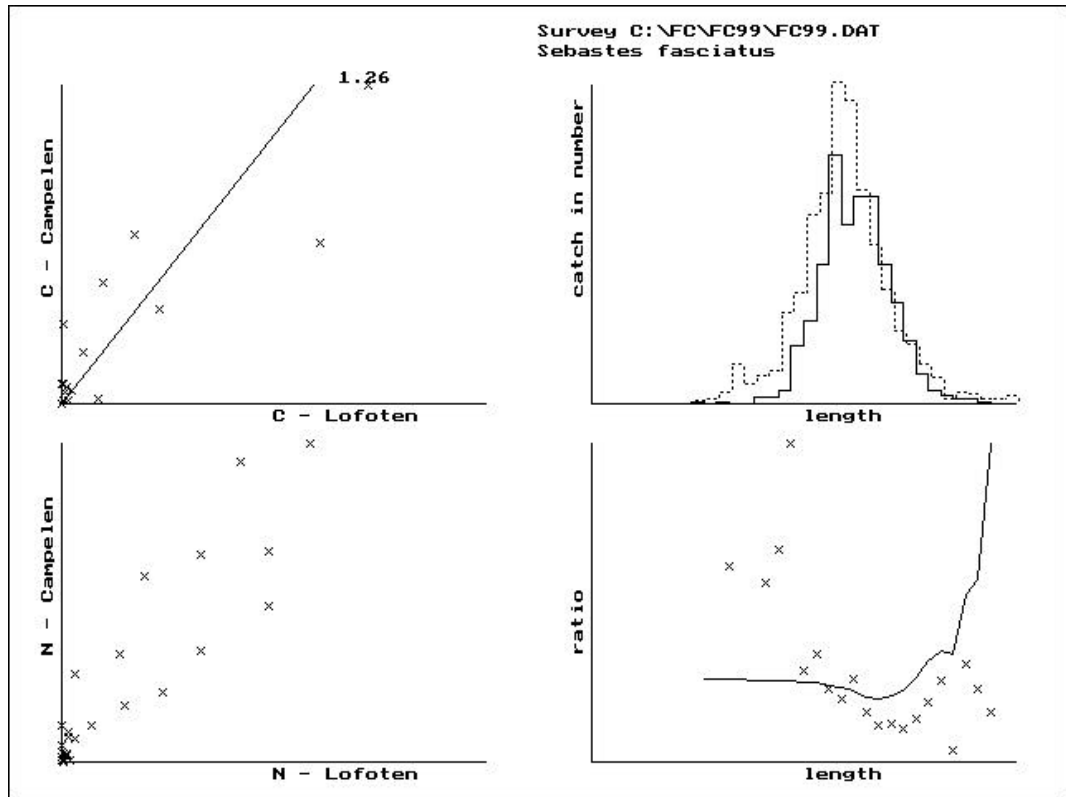


Redfish (*S. marinus*)

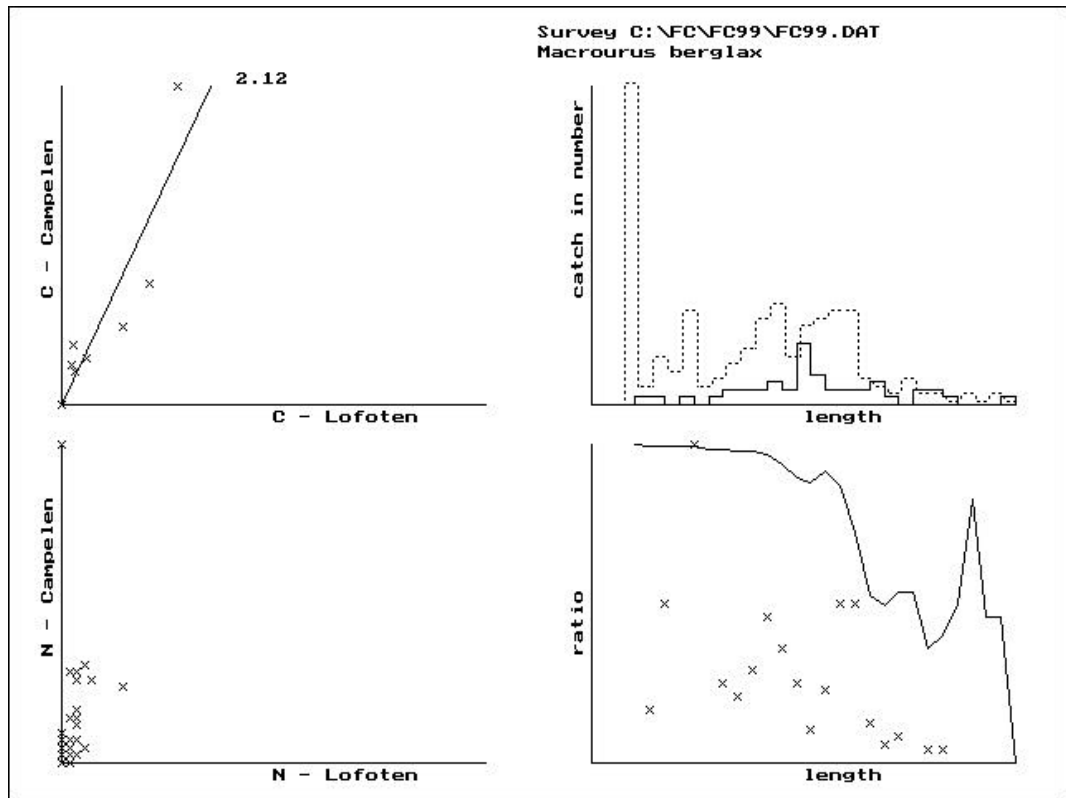


Redfish (*S. mentella*)

Figure 8 - (continuation)

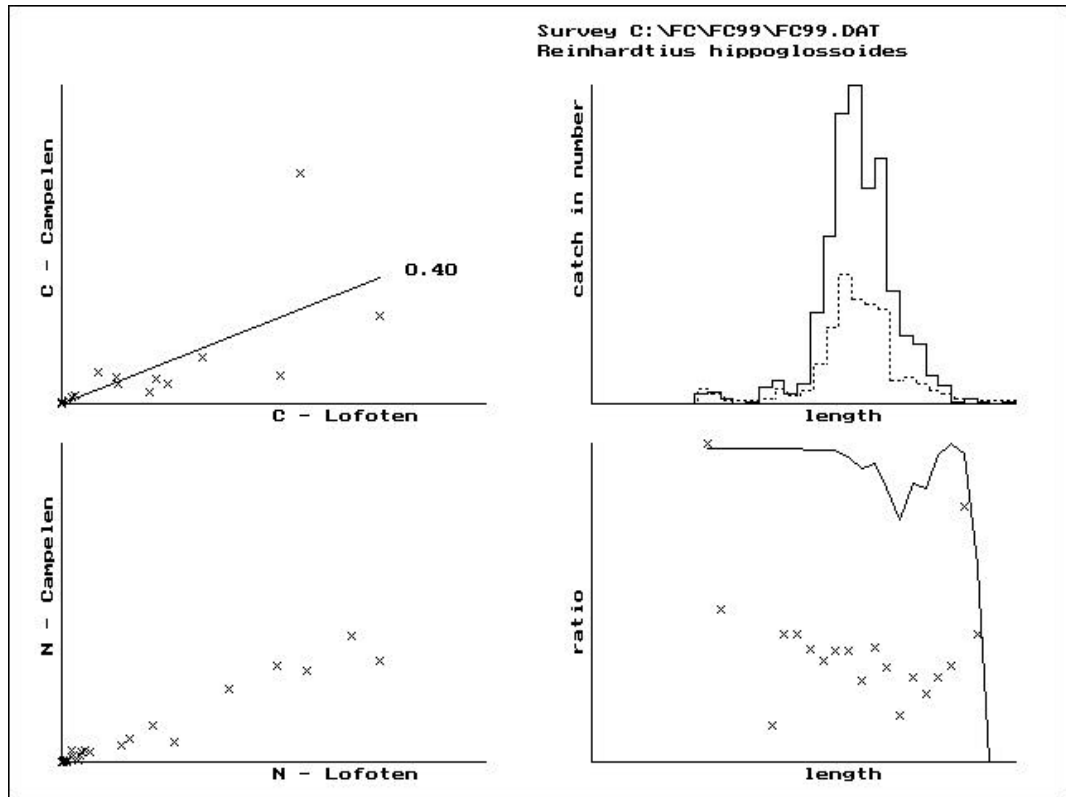


Redfish (*S. fasciatus*)

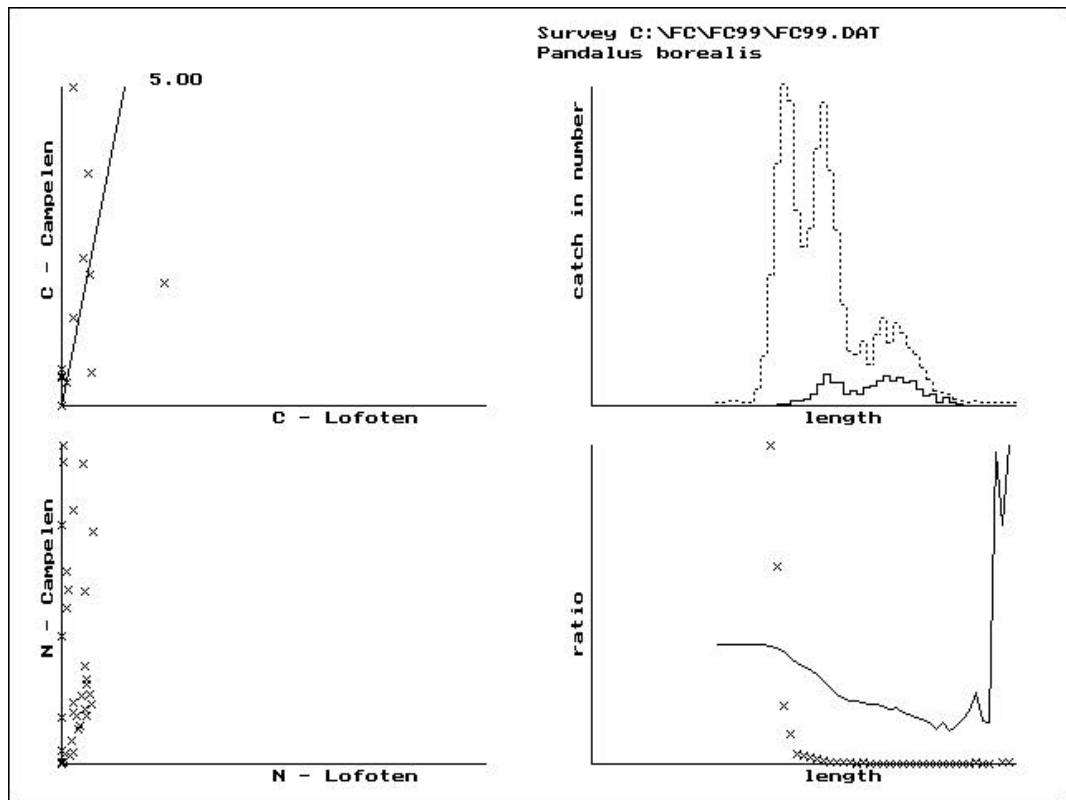


Roughhead grenadier

Figure 8 - (continuation)



Greenland halibut



Shrimp

Figure 8 - (continuation)