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Results from Bottom Trawl Survey of Flemish Cap in July 1993

by

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The survey of Flemish Cap was carried out in 1993 on board R/V Cornide de Saavedra. A synoptic sheet of the survey with ship and gear characteristics is shown in Table 1. This was the sixth survey of the series initiated by the EU in 1988 (Vazquez, 1989, 1990, 1991, 1992, 1993). Dates of 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

All surveys had a stratified random design following NAFO specifications (Doubleday, 1981).

A total of 101 valid bottom trawls were made up to a depth of 720 metres (400 fathoms) (Figure 1). The survey was concluded before the data planned due to loss of the three available gears: two of the deepest strata were not visited, and in another one only one tow was made. Nevertheless the survey covered adequately 16 of the 19 strata the bank is divided into.

Total biomass of all species was calculated by the swept area method, and estimates for unvisited strata were included. The results are presented in Table 2, where some species are grouped to balance possible identification errors in former surveys.

RESULTS

Weighted (by stratum area) mean catches in half-hour tows of the main species on the bank were:

	1988	1989	1990	1991	1992	1993
cod	46.74	146.04	70.81	47.06	30.30	67.06
American plaice	15.01	14.25	11.64	9.69	7.98	7.09
redfish	207.50	194.40	133.26	81.46	126.92	70.94
Greenland halibut ...	7.93	5.85	7.22	7.91	10.31	7.25
shrimp	2.50	2.71	2.71	10.17	20.28	9.45

Kg

For each species, data on biomass and abundance for missing strata were calculated after adjusting results of all surveys up to date to a multiplicative model with two factors: year and stratum. The multiplicative model was solved by assuming that the variance of catch

(biomass or abundance) is proportional to a power of the mean (Vazquez and Larrañeta, 1980) . The power 1.80 was used because that was the value observed with all survey data (Figure 2).

Cod

Mean catch by strata and whole bank data and their standard error are presented in Table 3. Biomass estimated by the swept area method by strata and its comparison with results of previous surveys are presented in Table 4. Cod stock biomass had a maximun in 1989, and in comparison with Russian survey results is:

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	17,300
1991	36,597	6,740	8,200
1992	24,295		2,500
1993	55,642		

tons

1) Biomass estimated from bottom trawl survey.
2) Biomass estimates from bottom trawl survey (Kuzmin, 1992).
3) Russian estimates of bottom trawlable plus pelagic biomass (Kuzmin, 1992; Borovkov et al., 1993)

The abundances by age-groups were calculated as follows:

	year:					
age	1988	1989	1990	1991	1992	1993
1 -	458	2085	237	13780	7118	438
2 -	7196	1100	1179	2560	3706	13274
3 -	4037	8422	467	1548	475	2852
4 -	1085	4922	1588	192	203	102
5 -	128	1858	1453	622	33	127
6 -	22	127	394	173	127	17
7 -	28	15	32	25	21	50
8 -	11	12	13	1	1	10
9 -			8	4		
10 -		1	3			
11 -				1	1	
12 -						
						x 10000
total	12965	18542	5374	18906	11685	16870	
biomass	37127	103644	55360	36597	24295	55642	t
SOP *)	33474	100217	51388	37231	22734	54945	t

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

With 35 mm mesh size used in the cod end, recruitment is believed to be completed before age 2.

The 1990 year-class was the more abundant one observed at age 1 and remains relatively abundant. The 1991 year-class was the more abundant one observed at age 2. The entry of these two relatively abundant year classes produced a sharp increase in total biomass, which in 1993 is approximately double that in 1992. These two year-classes may contribute to increase fishable biomass in the near future.

Tables 5, 6 and 7 show length frequency, age-length key and estimated age composition of the stock respectively. Catch per tow distribution is presented in Figure 3.

American plaice

Mean catch by strata and whole bank data and its standard error are presented in Table 8. Biomass estimated by swept the area method

by strata and its comparison with results of previous surveys are presented in Table 9. Total biomass in comparison with Russian survey results is:

year	EU	Russia(1)
1983	-	8,900
1984	-	7,500
1985	-	7,800
1986	-	20,200
1987	-	9,300
1988	11,868	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	

tons

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

The abundances by age-groups were calculated as follows:

age	year: 1988	1989	1990	1991	1992	1993
2 -	2284	454	359	309	736	9
3 -	625	6847	775	911	679	1365
4 -	3034	1500	7083	1877	910	969
5 -	1975	3238	897	4461	1471	643
6 -	3020	3006	2475	1836	3423	320
7 -	4154	2868	1717	2009	913	3110
8 -	4258	1691	1657	1566	1090	339
9 -	1492	587	1030	675	624	592
10 -	207	261	485	232	289	286
11 -	109	34	90	8	138	198
12 -	61	14	15	48	74	229
13 -	-	-	31	-	16	280
14 -	-	-	17	-	-	865
15 -	-	-	-	-	-	28
16 -	-	-	-	-	-	35
total	21219	20500	16631	13932	10363	9268
biomass	11868	10533	9101	7565	6492	5949
SOP		9726	8827	7682	6111	5856
N 6+	13301	8461	7517	6374	6567	6282

x 1000

The 1986 year-class (age 7 in 1993) remains the most abundant cohort of recent years; the one of 1984 was also relatively abundant. Year-classes from 1987 to 1989 (6, 5 and 4 years in 1993) appear weak, at the same or lower level than the one of 1985 (age 8 in 1993). The 1990 year-class (age 3 in 1993) appears with an abundance greater than the three former ones; its abundance at two and three years old was the second highest observed, following that produced by the abundant 1986 year-class. Finally, the 1991 year-class (age 2 in 1993) was very weak.

Tables 10, 11 and 12 show length frequency, age-length key and estimated age composition of the stock respectively. Catch per tow distribution is presented in Figure 4.

Redfish

All redfish catches were classified by species before sampling the catches. All specimens less than 15 cm length, or those difficult to classify, were separated into an independent group called "juvenile".

Mean catch by strata and whole bank data and its standard error are presented in Tables 13, 17, 21 and 25 for Sebastes marinus, S. mentella, S. fasciatus and "juvenile", respectively. Total biomass values estimated by the swept area method are summarized in the next table:

year	Sebastes: marinus	spp. mentella	spp. fasciatus	spp. juvenile	EU total	Russia bottom(1)	Russia total(2)
1983						154,900	
1984						132,300	
1985						51,900	
1986						309,500	
1987						106,400	
1988	15,289		142,933		158,222	47,000	379,000
1989	22,958		113,675		136,633	83,300	365,900
1990	14,699		72,893	16,601	104,193	17,700	246,400
1991	4,093	50,071	5,680	4,001	63,846	45,400	107,700
1992	4,130	71,810	5,308	23,229	104,477	18,200	99,500
1993	4,173	25,056	4,425	28,935	62,589		

tons

1) Trawlable biomass (t) from these surveys.
2) Trawlable plus pelagic biomass (t) from Russian surveys (Vaskov and Oganin, 1992; Vaskov and Ivanova, 1993)

Sebastes mentella is the species that supports the highest catches, and it is also the one that produces the more variable abundance indices. The alternation of years with high (1990 and 1992) and low (1991 and 1993) abundance indices observed in this survey is also apparent in Russian survey results. So sharp changes in abundance should be attributed to changes in accessibility of the species, which has quite pronounced pelagic characters. This interpretation is also supported by the lack of coincidence of high and low years in this survey and in the Russian one.

Age composition of the three species are given together in the following table.

age	S. marinus freq.	S. marinus m.w.	S. mentella freq.	S. mentella m.w.	S. fasciatus freq.	S. fasciatus m.w. *)
4 :	65	98			82	91
5 :	125	127	173	113	265	133
6 :	228	182	550	172	634	175
7 :	254	252	1420	218	485	229
8 :	157	351	1013	297	204	298
9 :	119	445	637	377	99	381
10 :	50	530	228	430	47	435
11 :	59	566	317	464	26	498
12 :	39	648	335	535	12	528
13 :	37	711	410	606	2	642
14 :	11	718	259	641	5	590
15 :	14	700	260	718	3	698
16 :	6	896	297	751	1	827
17 :	4	949	69	827	3	543
18 :	4	947	95	846		
19 :	1	1292	44	865		
20 :	5	1149	34	940		
21 :			26	1149		
22 :			31	1076		
23 :	+	1230				
24 :			10	1076		
25+:			3	1001	2	999

*) frequencies x 10000 and mean weight en gr.

Tables 14, 18, 22 and 26 show length frequencies for the four groups. Age-length keys were made for three species (Tables 15, 19 and 23). Age compositions for each of the three species are presented in tables 16, 20 and 24. Catch per tow distribution of the three species and juveniles are presented in Figures 5 to 8.

Greenland halibut (Reinhardtius hippoglossoides)

Mean catch by strata and whole bank estimates are presented in table 27. Biomass estimated by the swept area method by strata and its comparison with results of previous surveys are presented in Table 28. Total biomass was:

1988 - 6,818
1989 - 4,391
1990 - 5,649
1991 - 8,038
1992 - 8,588
1993 - 7,210 tons

Length frequencies, age-length key and age composition of the population were calculated (Tables 29, 30 and 31). Catch per tow distribution is presented in Figure 9.

Age composition of the stock was calculated as follows:

age		1991	1992	1993
1	-	349	922	937
2	-		800	933
3	-	235	286	599
4	-	993	861	566
5	-	1956	1600	960
6	-	1253	1996	1574
7	-	2283	1793	1732
8	-	545	991	1388
9	-	464	473	905
10	-	388	266	257
11	-	122	139	141
12	-		67	51
13	-		18	19
14	-		13	10
15	-			
16	-			
				x 1000
total		8588	10225	10072
biomass		8038	8588	7210
SOP		8329	8084	7136

The 1986 year-class (age 7 in 1993) remains being the more abundant. Year 1986 was fairly good for, at least, cod, American plaice and Greenland halibut recruitment.

Shrimp (Pandalus borealis)

In Table 32 mean catch by strata and whole bank data are presented. Swept area method total biomass estimates in these five years are:

1988 - 2,164
1989 - 1,865
1990 - 2,140
1991 - 8,203
1992 - 15,886
1993 - 9,163 tons

Detailed results on shimp were presented by Sainza (1993).

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.

Doubleday, W.G.- 1981. Manual of Groundfish Surveys in the Northwest Atlantic. NAFO Sci. Counc. Stud. 2, 55pp.

Kuzmin, S.A.- 1992. Stock assessment of cod from NAFO Subarea 3 by the data from 1991 trawl-acoustic survey. NAFO SCR Doc. 92/13.

Rikhter, V.A., I.K. Sigaev, V. Borovkov, S. Kovalev and P. Savvatimsky - 1991. USSR research report for 1990. NAFO SCS Doc. 91/5.

Sainza, C.- 1993. Northern shimp (Pandalus borealis) stock on Flemish Cap in June-July 1993. NAFO SCR Doc. 93/104.

Vaskov, A.A. and I.A. Oganin - 1992. Evaluation of redfish stocks in Divisions 3LN and 3M by the trawl-acoustic survey in 1991. NAFO CR Doc. 92/12.

Vaskov, A.A. and T.O. Ivanova - 1993. Stock assessment of redfish in Division 3M by the data from 1992 trawl-acoustic survey. NAFO SCR Doc. 93/11.

Vazquez, A. and M.G. Larrañeta - 1980. Assessment of cod stock in Division 3NO. NAFO SCR Doc. 80/II/10.

Vazquez, A.- 1989. Results from bottom-trawl survey of Flemish Cap in July 1988. NAFO SCR Doc. 89/60, 15 pp.

Vazquez, A.- 1990. Results from bottom-trawl survey of Flemish Cap in July 1989. NAFO SCR Doc. 90/68, 25 pp.

Vazquez, A.- 1991. Results from bottom-trawl survey of Flemish Cap in July-August 1990. NAFO SCR Doc. 91/28, 25 pp.

Vazquez, A.- 1992. Results from bottom-trawl survey of Flemish Cap in July 1991. NAFO SCR Doc. 92/27, 17 pp.

Vazquez, A.- 1993. Results from bottom-trawl survey of Flemish Cap in July 1992. NAFO SCR Doc. 93/19, 22 pp.

Table 1 - Technical data of the survey.

Procedure	specification
Vessel	R/V CORNIDE DE SAAVEDRA
GT	1,200 t
power	1,500 + 750 HP
Trawling speed	3.45 knots
Trawling time	30 minutes
Trawl gear	type "Lofoten"
footrope / handrope	31.20 / 17.70 m
footgear	27 steel bobbins of 35 cm
vertical opening	2.5 - 2.8 m
warps	100 meters
trawl doors	polivalent, 850 Kg
wire length	3 times the depth
mesh size in codend	35 *mm*
Type of survey	stratified sampling
Station selection procedure	random
Criterion to change position of a selected tow:	- unsuitable bottom for trawling according to ecosoneder register. - information on from previous surveys.
Criterion to reject data from tow	- tears in codend - 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 fishes, squid and shrimp
Species for age determination	cod, American plaice, redfish (Sebastes marinus, S. mentella and S. fasciatus) and Greenland halibut

Table 2 - Total biomass swept area method estimates for several species or groups of species in 1988-1993 surveys.

species	surveys: 1988	1989	1990	1991	1992	1993
Rajidae	4495	1908	2824	4064	3765	6279
Synaphobranchus sp.	219	88	42	77	70	70
Urophycis sp.	654	167	169	261	69	161
Antimora sp.	392	302	284	560	720	594
Macrouridae	3088	1438	1223	2249	2592	6183
Notacanthus sp.	501	408	65	478	449	705
Illex sp.	5	8	1647	1159	66	1
capelin					15	101
Anarhichadidae	7973	7478	8120	10097	9095	14304
witch flounder	909	335	420	769	823	1048
Greenland halibut	6818	4391	5649	8038	8588	7210
Zoarcidae	559	923	1202	1978	1356	3277
cod	37127	103644	55360	36597	24295	55642
American plaice	11886	10533	9101	7565	6492	5949
redfish	158417	136658	104194	63845	104477	62589
shrimp	2164	1923	2139	8211	16531	9163
others	624	206	1138	664	424	678
Total	235833	270410	193575	146611	179828	173954

Table 3 - Cod catches (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	18.16	13.47	10.28	7.28
2 -	838	10	131.30	347.64	73.59	193.40
3 -	628	7	158.75	361.60	91.60	207.59
4 -	348	4	438.84	710.87	277.70	458.59
5 -	703	8	112.79	71.11	66.20	43.18
6 -	496	6	102.15	221.73	58.02	125.23
7 -	822	9	85.06	189.60	51.05	113.50
8 -	646	6	150.83	200.25	84.07	111.50
9 -	314	3	36.33	33.95	21.66	20.50
10 -	951	8	11.32	14.71	6.71	8.83
11 -	806	9	24.01	37.24	14.20	22.10
12 -	670	7	0.40	1.06	0.25	0.65
13 -	249	2	-	-	-	-
14 -	602					
15 -	666	6	-	-	-	-
16 -	634	7	-	-	-	-
17 -	216	1	-	-	-	-
18 -	210					
19 -	414	4	-	-	-	-
total	10555	101				

	catch per tow	catch per mile towed
mean	67.06	39.39
standard error	18.74	11.24

(Kg)

Stock biomass estimated by swept area method = 55,431 tons
Biomass estimated for missing strata = 211 tons

Total biomass = 55,642 tons
standard error = 15,878

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

stratum	depth in fathoms	survey 1988	1989	1990	1991	1992	1993
1 -	70- 80	1223	590	697	5078	69	469
2 -	81-100	9229	9386	1878	4988	4683	8223
3 -	101-140	4065	9344	2174	2236	7704	7670
4 -	"	2846	4404	2242	2637	3131	12885
5 -	"	1937	9731	7681	9685	4155	6205
6 -	"	2932	6173	2988	1392	866	3837
7 -	141-200	2022	14571	3987	2308	859	5595
8 -	"	8121	14943	14524	4644	2136	7241
9 -	"	167	4784	5765	171	130	907
10 -	"	1217	4454	3813	1417	297	851
11 -	"	2278	12020	3509	1625	204	1526
12 -	201-300	305	2245	1443	115	-	22
13 -	"	8	2304	667	85	-	-
14 -	"	97	686	496	119	61	211
15 -	"	680	7671	2131	98	-	-
16 -	301-400	-	60	-	-	-	-
17 -	"	-	5	-	-	-	-
18 -	"	2	-	-	-	-	-
19 -	"	-	91	-	-	-	-
total		37127	103644	53977	36597	24295	55642

Table 5 - Cod length frequency by strata (x 10000).

length (cm)	stratum 1	2	3	4	5	6	7	8	9	10	11	12	total	missing strata	TOTAL
12-14	44	5			5								54		54
15-17	238	33	1		42	2							316	1	317
18-20	16	3		1	9	1	2	1			1		34		34
21-23	3	9	87	418	18	5	4	7	1	2	1		554	2	556
24-26	19	127	623	2032	48	44	14	102	3	6	4		3022	12	3034
27-29	24	555	981	1982	47	88	35	655	1	4	12		4384	17	4401
30-32	30	814	798	1125	81	117	61	822		8	10		3867	15	3882
33-35	14	461	290	349	68	59	43	319		4	11		1617	6	1623
36-38	4	240	55	76	125	39	32	97	1	6	9		684	3	687
39-41	4	140	52	60	201	83	91	95	4	12	32		775	3	778
42-44	5	67	41	16	186	79	119	56	11	18	22		621	2	623
45-47	4	36	21	6	102	53	108	35	10	5	27		407	2	409
48-50	1	24	4	1	44	33	36	9	5	5	16		177	1	178
51-53		11	1		16	12	23	2	4	3	3		76		76
54-56	1	1	1		5	4	8		2	1	1		23		23
57-59					1	7	9	2	2	1	3		24		24
60-62	1		4	1	3	9	17	4	4	1	4		47		47
63-65		2	1	1	5	7	29	1	2	2	3		53		53
66-68		1	1		1	2	10	1	2	2	4	1	25		25
69-71			1		1	1	3		4	1	1		12		12
72-74			2		1	1	1	1	2	1			8		8
75-77			1		1	1			2	2	1		8		8
78-80			1		1	1	1		2	1	1		9		9
81-83		1					1				1		3		3
84-86							1						1		1
87-89			1			1					1		2		2
90-92															
93-95					1		1						1		1
96-98										1			1		1

Table 6 - Cod age-length key.

length (cm)	age 1	2	3	4	5	6	7	8	9	10	11	12	no id	tot n.
0- 2														
3- 5														
6- 8														
9-11														
12-14	19													19
15-17	117													117
18-20	15													15
21-23	1	63											2	66
24-26	1	126											6	133
27-29		145											1	146
30-32		172	2										6	180
33-35		95	18										17	130
36-38		15	78										4	97
39-41		1	204										3	208
42-44			224	3									6	233
45-47			159	8	2								5	174
48-50			78	14									8	100
51-53			22	13			1						12	48
54-56			2	14	6								2	24
57-59				2	11	4	1						1	19
60-62				1	42	5	1							49
63-65				1	40	1	6						3	51
66-68					17	4	12						2	35
69-71					3	3	9						1	16
72-74					2		9	3						14
75-77							10							10
78-80							9	3						12
81-83							3	1						4
84-86								1						1
87-89								2					1	3
90-92														
93-95								2						2
96-98								1						1
total:	153	617	787	56	123	17	61	13					80	1907

Table 7 - Cod age composition by strata (x 100000).

age	stratum 1	2	3	4	5	6	7	8	9	10	11	12	total	missing strata	TOTAL	mean weight (gr)
1 :	30	4	1	2	6								43		43	43
2 :	9	192	273	583	27	31	15	186	1	2	4		1323	5	1328	222
3 :	2	55	22	21	64	29	39	33	3	5	10		283	1	284	655
4 :		1			2	2	3				1		9		9	1209
5 :			1		1	2	5	1	1		1		12		12	2270
6 :							1						1		1	2371
7 :						1	1		1	1	1		5		5	3449
8 :																5890
9 :																0
10 :																0
11 :																0
12 :																0
13 :																0
14 :																0
15 :																0
16+:																0

Table 8 - American plaice catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	30.10	19.16	17.75	10.62
2 -	838	10	14.84	10.21	8.50	5.63
3 -	628	7	6.70	3.20	3.97	1.94
4 -	348	4	14.63	11.13	9.24	7.36
5 -	703	8	17.74	28.13	10.33	16.32
6 -	496	6	5.83	3.06	3.46	1.78
7 -	822	9	3.57	3.09	2.18	1.87
8 -	646	6	7.58	9.09	4.24	5.08
9 -	314	3	6.52	10.64	3.68	5.96
10 -	951	8	14.31	12.28	8.63	7.74
11 -	806	9	3.34	1.70	2.04	1.11
12 -	670	7	0.22	0.42	0.13	0.23
13 -	249	2	-	-	-	-
14 -	602					
15 -	666	6	1.43	1.00	0.93	0.70
16 -	634	7	0.17	0.28	0.11	0.18
17 -	216	1	-	-	-	-
18 -	210					
19 -	414	4	0.11	0.17	0.07	0.11
total	10555	101				

	catch per tow	catch per mile towed
mean	7.09	4.19
standard error	0.94	0.55

(Kg)

Stock biomass estimated by swept area method = 5,896 tons
Biomass estimated for missing strata = 53 tons

Total biomass = 5,949 tons
standard error = 781

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

stratum	depth in fathoms	survey 1988	1989	1990	1991	1992	1993
1 -	70- 80	979	750	448	808	532	809
2 -	81-100	1990	2701	1040	1997	1285	950
3 -	101-140	1025	838	1207	935	473	333
4 -	"	1649	346	661	240	418	429
5 -	"	1949	2319	1406	1055	628	968
6 -	"	358	847	720	376	451	229
7 -	141-200	880	398	562	292	479	239
8 -	"	313	123	209	188	545	365
9 -	"	77	122	262	-	280	154
10 -	"	1742	1118	1555	981	1054	1094
11 -	"	889	876	973	301	279	219
12 -	201-300	7	14	35	13	8	11
13 -	"	2	-	15	-	-	-
14 -	"	6	6	6	292	22	53
15 -	"	17	74	2	73	28	82
16 -	301-400	4	-	-	3	7	9
17 -	"	-	-	-	-	-	-
18 -	"	-	-	-	-	-	-
19 -	"	-	-	-	11	3	4
total		11886	10533	9101	7565	6492	5949

Table 10 - American plaice length frequency by strata (x 1000).

length (cm)	stratum 1	2	3	4	5	6	7	8	9	10	11	12	15	16	19	total	missing strata	TOTAL
16-17																		
18-19										9				8		17		17
20-21				7			7			9					9	33		33
22-23		13	28	21	21	40	22			9	14					169	2	171
24-25		45	77	42	48	106	37	32	8	74	29					501	5	506
26-27		45	49	84	109	113	30	40		28	51					549	5	554
28-29	21	64	7	21	41	53	37	24			50					319	3	322
30-31	96	167	49	28	54	20	37	48		37	36		9			583	5	588
32-33	109	90	35	21	48	27	37	73	16	28	14					499	4	503
34-35	130	77	7	49	34	13	15	32	8	121	21	8			9	527	5	532
36-37	178	257	42	28	88	33	30	32	59	130	50		9			939	8	947
38-39	239	231	7	35	55	14	22	24	34	271	51	8	19			1009	9	1018
40-41	212	212	14	14	40	14	37	16	84	308	43	8	28	16		1048	9	1057
42-43	110	122	28	63	136	27	60	16	42	186	43		37			871	8	879
44-45	82	64	49	56	136	13	52	24	25	177	7		19			707	6	713
46-47	41	58	21	56	150	20	15	41		131	14					547	5	552
48-49	41	39	7	14	61	20	22	16		37	22					280	3	283
50-51	27	45	49	21	102	13	7	32		19	14					331	3	334
52-53	14	39	21	28	48	20		8		28						205	2	207
54-55		6	14	14	14			8								56	1	57
56-57				7				16								23		23
58-59								16								16		16

Table 11 - American plaice age-length key.

MALE

length (cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+	no id	n. tot
							age											
16-17																		
18-19																		
20-21																		
22-23			8															8
24-25			24	1			1										2	28
26-27			33	3	1													37
28-29			10	9	3		1										1	24
30-31			2	25	8	2	1		1								2	41
32-33				14	12	2	2										2	32
34-35				3	3	2	16	1	3	1			1				1	31
36-37					3	5	41	4	6	4	1	1		4			1	70
38-39						3	40	7	9	3	6	2	3	6			5	84
40-41						2	36	7	10	4	3	5	2	3			4	76
42-43							6	6	5	2		5	3	7			2	36
44-45							2		1	3		1	1	2			2	12
46-47								1					1					2
total:			77	55	30	16	146	26	35	17	10	14	11	22			22	481

FEMALE

length (cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+	no id	n. tot
							age											
16-17																		
18-19																	1	1
20-21			2														1	3
22-23			11															11
24-25			33	1													3	37
26-27			30	2													3	35
28-29			8	9													2	19
30-31			3	17	1												1	22
32-33				18	6		1											25
34-35				5	12		1										3	21
36-37					21	2	2										1	26
38-39						6	8					1						15
40-41					1	3	22	2	1					1				30
42-43						1	53	1	1		1		1	1			1	60
44-45						2	41		8	1		1	2	5			2	62
46-47							23	3	9	6	3	1	4	9				58
48-49							3	3	5	3	1	4	7	14			1	41
50-51									1	2	6	3	4	25	1	1	2	45
52-53										1		2	2	19	1	4		29
54-55													1	7	1			9
56-57														3				3
58-59													1		1			2
total:			87	52	41	14	154	9	25	13	11	12	22	84	4	5	21	554

Table 12 - American plaice age composition by strata (x 1000).

age	stratum 1	2	3	4	5	6	7	8	9	10	11	12	15	16	19	total	missing strata	TOTAL	mean weight (gr)
1 :										9						9		9	46
2 :	15	136	154	150	191	268	112	83	7	115	113				9	1353	12	1365	140
3 :	137	199	66	62	110	68	69	104	11	60	63	2	6		3	960	9	969	265
4 :	96	162	22	49	84	31	35	56	9	50	29	5	3		6	637	6	643	363
5 :	58	56	10	17	35	9	14	15	12	64	19	3	5			317	3	320	528
6 :	503	509	109	166	357	79	149	95	144	757	136	9	60	8	1	3082	28	3110	669
7 :	79	73	7	9	26	7	9	7	18	77	12	1	9	2		336	3	339	691
8 :	115	114	20	25	63	14	21	18	25	137	20	1	12	2		587	5	592	736
9 :	57	50	10	12	35	8	10	10	12	62	12		4	1		283	3	286	820
10 :	33	39	10	9	28	5	6	8	6	41	8		2	1		196	2	198	861
11 :	46	45	9	9	28	7	7	7	9	43	9	1	6	1		227	2	229	884
12 :	47	43	13	16	48	10	10	20	6	51	10		4			278	2	280	1022
13 :	111	138	68	70	166	36	24	62	16	128	27		10	1		857	8	865	1165
14 :	1	3	3	3	6	1		10		1						28		28	1754
15 :	3	6	4	4	9	3		2		4						35		35	1529
16+:																			

Table 13 - Redfish (Sebastes marinus) catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	2.84	2.00	1.85	1.46
2 -	838	10	5.49	14.28	3.21	8.44
3 -	628	7	2.12	3.16	1.25	1.88
4 -	348	4	1.25	1.44	0.71	0.82
5 -	703	8	2.45	3.09	1.39	1.68
6 -	496	6	5.01	4.90	2.89	2.74
7 -	822	9	3.63	4.57	2.31	3.04
8 -	646	6	1.68	2.20	0.95	1.26
9 -	314	3	6.58	6.10	4.23	4.12
10 -	951	8	27.76	53.51	17.24	34.00
11 -	806	9	6.48	7.22	3.88	4.27
12 -	670	7	-	-	-	-
13 -	249	2	0.24	0.34	0.13	0.19
14 -	602					
15 -	666	6	0.10	0.17	0.07	0.11
16 -	634	7	-	-	-	-
17 -	216	1	-	-	-	-
18 -	210					
19 -	414	4	-	-	-	-
total	10555	101				

	catch per tow	catch per mile towed
mean	4.68	2.86
standard error	1.77	1.12

(Kg)

Stock biomass estimated by swept area method = 4,026 tons
Biomass estimated for missing strata = 147 tons

Total biomass = 4,173 tons
standard error = 1,634

Table 14 - Redfish (Sebastes marinus) length frequency by strata.
(x 1000)

length (cm)	stratum 1	2	3	4	5	6	7	8	9	10	11	13	15	total	missing strata	TOTAL
14-								16						16	1	17
15-	7	13												20	1	21
16-	27	71	14											113	4	117
17-	116	115	7	14	21			8		19				300	11	311
18-	82	154	7	21	28	13	14	32		9				362	13	375
19-	81	122	21	28	7	53	15	65	8	9	36			447	16	463
20-	61	174	42		27	53	37	8		82	101			586	21	607
21-	47	270	63		34	113	97	16	25	63	79			809	29	838
22-	41	161	35	7	34	93	60	16	42	137	100		9	737	27	764
23-	27	245	28	21	27	67	82	24	50	176	108			856	31	887
24-	28	154	35	14	21	40	67	40	25	321	101			846	31	877
25-	27	96	63	7	54	54	37	16	67	221	80		18	743	27	770
26-	21	71	14		21	67	52		33	308	72			659	24	683
27-		38	14		27	66	74	8	127	177	86			620	23	643
28-		38	28		14	47	45	24	16	323	14			551	20	571
29-		39	21		27	20	30	8	50	280	44			520	19	539
30-		19	14		14	33	44	16	25	468	43			679	25	704
31-			14	14	14	14			42	314	57			468	17	485
32-		19			14		22	16	8	374	50	9		514	19	533
33-			7		14	14	15	8	16	288	51			412	15	427
34-					7	7	22			258	36			330	12	342
35-		6	7	7	7	14	7			234	50			333	12	345
36-		6		7			22			100	36			171	6	177
37-		6					15			96	7			124	5	129
38-					7		7			19	7			40	1	41
39-										86	21			108	4	112
40-					7	7				28				41	1	42
41-										44	7			51	2	53
42-							7			51				58	2	60
43-										18				18	1	19
44-								8						8		8
45-								8		9	7			25	1	26
46-																
47-					7					9				16	1	17
48-																
49-																
50-										9	7			17	1	18

Table 15 - Redfish (Sebastes marinus) age-length key.

MALE

length (cm)	age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+	no id	n. tot
14-	1																							1
15-	1																						1	2
16-	2	1																					5	8
17-		7																					9	16
18-	1																						14	15
19-		3	6																				18	27
20-		5	3																				10	18
21-		1	14	1																			20	36
22-			6	7																			7	20
23-			1	15																			15	31
24-			1	6	3																		15	25
25-			2	8	3																		11	24
26-				7	10																		9	26
27-				1	11	1																	10	23
28-					5	1						1											10	17
29-					2	5																	7	14
30-					1	4	5	2															3	15
31-							5	2	1	1													5	14
32-							1	4	1	1													3	10
33-								2	3	1													6	12
34-									1	2	1	1											3	8
35-										3	2	1											4	10
36-									1	1		1			1								1	5
37-												1	1										2	4
38-													1	1									1	3
39-												2		1	1								1	5
40-																							3	3
41-															1									1
42-																							1	1
43-																							1	1
44-																							1	1
45-																						1	1	2
46-																								
47-																							1	1
total:	5	17	33	45	35	11	11	10	7	9	3	7	2	2	3							1	198	1

FEMALE length (cm)	age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+	no id	n. tot
14-	1																							1
15-																								
16-	2	1																					4	7
17-	2	5																					7	14
18-		7																					10	17
19-		2	2																				12	16
20-		1	3																				14	18
21-		1	12																				17	30
22-			7	8																			15	30
23-			3	10																			15	28
24-			3	10																			15	28
25-			2	14	3																		14	33
26-				3	6																		11	20
27-				2	12																		6	20
28-					3	5																	8	16
29-					1	6																	6	13
30-						5	1	1															4	11
31-						3	2	1															4	10
32-							2	3															3	8
33-							1	2																3
34-									3															3
35-										1	1												2	4
36-										2		1	1										1	5
37-																								
38-										1													2	3
39-													1	1										2
40-																								
41-																	1						1	2
42-															1	1				1				3
43-																1							1	2
44-																								
45-																							1	1
46-																								
47-																							1	1
48-																								
49-																								
50-																							1	1
51-																						1		1
total:	5	17	32	47	25	19	6	7	3	4	1	1	2	1	1	2	1			1		1	175	1

Table 16 - Redfish (Sebastes marinus) age composition (x 1000).

age	stratum 1	2	3	4	5	6	7	8	9	10	11	13	15	total	missing strata	TOTAL	mean weight (gr)
1 :																	0
2 :																	0
3 :																	0
4 :	182	208	35	18	18	40	17	65	8	24	14			629	23	652	98
5 :	178	436	55	45	62	100	71	54	16	82	108		1	1208	44	1252	127
6 :	126	546	122	19	97	239	193	45	91	423	284		11	2196	80	2276	182
7 :	73	407	105	28	94	191	199	62	165	831	283		13	2451	89	2540	252
8 :	6	106	63	2	67	116	126	37	148	720	125		3	1519	55	1574	351
9 :		39	24	10	26	39	49	22	61	802	79			1151	42	1193	445
10 :		9	7	2	12	8	15	8	19	337	64	5		486	18	504	530
11 :		4	6	2	15	13	23	8	18	412	66	2		569	21	590	566
12 :		4	2	7	8	13	16	2	2	276	43	1		374	14	388	648
13 :		8	4	4	7	5	24	2	2	241	54	1		352	13	365	711
14 :		4	1	2	1	1	12			67	20			108	4	112	718
15 :		5	3	1	9	7	7		4	80	17			133	5	138	700
16 :										47	7			54	2	56	896
17 :					2	2				31	7			42	2	44	949
18 :		2			2	2	4			30	2			42	2	44	947
19 :								8		3				11		11	1292
20 :							7			42				49	2	51	1149
21 :																	0
22 :																	0
23 :										3				3		3	1230
24 :																	0
25+:																	0

Table 17 - Redfish (Sebastes mentella) catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	-	-	-	-
3 -	628	7	-	-	-	-
4 -	348	4	-	-	-	-
5 -	703	8	0.05	0.14	0.03	0.08
6 -	496	6	0.06	0.15	0.04	0.09
7 -	822	9	10.86	16.06	6.53	9.50
8 -	646	6	2.96	5.05	1.76	3.06
9 -	314	3	9.33	9.25	5.51	5.60
10 -	951	8	22.46	36.60	13.17	21.00
11 -	806	9	16.60	24.58	10.12	14.99
12 -	670	7	90.41	71.04	56.45	46.24
13 -	249	2	70.65	90.16	40.66	52.12
14 -	602					
15 -	666	6	82.28	39.42	52.34	23.50
16 -	634	7	36.38	34.58	23.84	23.80
17 -	216	1	296.75	-	185.19	-
18 -	210					
19 -	414	4	25.80	29.15	16.95	18.71
total	10555	101				

	catch per tow	catch per mile towed
mean	26.47	16.47
standard error	4.74	2.82

(Kg)

Stock biomass estimated by swept area method = 23,186 tons
Biomass estimated for missing strata = 1,870 tons

Total biomass = 25,056 tons
standard error = 4,290

Table 18 - Redfish (Sebastes mentella) length frequency by strata (x 1000).

length (cm)	stratum 5	6	7	8	9	10	11	12	13	15	16	17	19	total	missing strata	TOTAL
14-																
15-								24						24	2	26
16-								8						8	1	9
17-								23		24				48	4	52
18-			59	56		56	165	124	19	132				614	50	664
19-			149	81	8	168	302	55	28	30				822	66	888
20-			74	24	8	183	259	55	47	115				765	62	827
21-			29	16	8	154	152	58		77		38	9	540	44	584
22-			112	57	8	204	237	139	9	597	8			1372	111	1483
23-			247	89	16	321	562	393	38	1474	77	113	28	3358	271	3629
24-			359	203	59	483	691	811	28	1906	132	225	149	5048	407	5455
25-			321	40	50	190	404	996	131	1272	241	563	132	4340	350	4690
26-			157	24	42	140	180	887	122	923	326	1426	271	4499	363	4862
27-			37	8	93	164	166	680	216	1148	342	863	244	3959	319	4278
28-			22	16	93	226	173	1118	215	1274	288	750	122	4296	347	4643
29-		7	82		85	147	115	646	160	1091	209	451	103	3095	250	3345
30-	7		59		42	273	151	818	224	894	202	488	56	3216	259	3475
31-			67		42	218	50	768	188	590	287	413	150	2774	224	2998
32-			112	8	42	215	115	578	122	624	240	225	75	2358	190	2548
33-			164	8	16	216	144	646	178	438	210	638	66	2724	220	2944
34-			67	8	17	255	65	585	271	558	194	338	131	2489	201	2690
35-			82	8		170	43	543	168	254	233	825	75	2403	194	2597
36-			60			83	65	534	225	298	226	826	113	2428	196	2624
37-			37		17	128	22	507	113	238	225	1051	84	2424	196	2620
38-			37	8		129	29	409	131	101	109	600	47	1599	129	1728
39-			7	8		89	29	187	94	194	62	563	112	1347	109	1456
40-			22	8	8	48	7	75	9	50	109	376	56	769	62	831
41-			15		8	22	7	88	37	31	54	75	9	348	28	376
42-			7				7	38			47	225	37	362	29	391
43-						13	7	20	9	19	23		9	101	8	109
44-					8			26		16	8	113		170	14	184
45-										25			9	34	3	37
46-					8					16				24	2	26
47-			7							16				23	2	25
48-												38		38	3	41

Table 19 - Redfish (Sebastes mentella) age-length key.

MALE

length (cm)	age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+	no id	n. tot
14-																								
15-																								
16-																							2	2
17-																							3	3
18-		7																					22	29
19-		9	1																				20	30
20-		1	6																				22	29
21-			3																				16	19
22-			1	2																			20	23
23-			3	10																			24	37
24-			1	17	1																		9	28
25-				15	1																		10	26
26-					11																		12	23
27-					4																		19	23
28-						4	1																18	23
29-						3		1															18	22
30-						3	5	4	1														16	29
31-							1	5	3	2													18	29
32-								2	7	4	1												17	31
33-									6	6	6	1	1										14	34
34-										5	5	5											17	32
35-									1	3	1	3	5	1									10	24
36-									1		5	7	3	1	2		1						15	35
37-												1	2			1							15	19
38-											1	1		2	2	1							6	13
39-															1	2							10	13
40-														1									10	11
41-																							2	2
42-																								
43-																							1	1
44-																		1						1
total:		17	15	44	17	10	7	12	19	20	19	18	11	5	5	4	1	1					366	1

FEMALE length (cm)	age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+	no id	n. tot
14-																								
15-																							1	1
16-																								
17-																								
18-		1																					8	9
19-		2	2																				6	10
20-			2																				10	12
21-			1																				8	9
22-		1	4	4																			17	26
23-			3	5																			30	38
24-			1	16																			8	25
25-				15	7																		5	27
26-					8																		16	24
27-					8																		13	21
28-					1	5																	15	21
29-						3																	16	19
30-						1	3		1														15	20
31-							1	4															15	20
32-							1	1		2	1												16	21
33-								1	4	1													16	22
34-									2	4	3		1										11	21
35-										2	1	1	2										14	20
36-										2	1	3	3		1								12	22
37-										3		1	6	3		1							19	33
38-											1	2	2		3								12	20
39-												1	4	2	1	1	3						16	28
40-														1	2	1	1	2				1	13	21
41-																			3		1		17	21
42-																	1	1					9	11
43-																		1					7	8
44-																							5	5
45-																							4	4
46-																							2	2
47-																							1	1
total:		4	13	40	24	9	5	6	7	14	7	8	18	6	7	3	5	4	3		1	1	357	1

Table 20 - Redfish (Sebastes mentella) age composition (x 10000).

age	stratum 5	6	7	8	9	10	11	12	13	15	16	17	19	total	missing strata	TOTAL	mean weight (gr)
1 :																	0
2 :																	0
3 :																	0
4 :																	0
5 :			22	11	2	32	53	12	6	21		1		160	13	173	113
6 :			37	17	4	66	89	66	5	191	9	18	7	509	41	550	172
7 :			81	26	13	83	133	243	26	410	61	193	45	1314	106	1420	218
8 :			10	3	20	42	38	201	46	270	73	189	45	937	76	1013	297
9 :	1	1	13		11	39	23	138	35	183	41	87	17	589	48	637	377
10 :			6		4	16	6	57	14	51	20	29	8	211	17	228	430
11 :			11	1	4	27	13	76	20	67	27	36	11	293	24	317	464
12 :			14	1	2	29	12	73	22	60	26	58	13	310	25	335	535
13 :			14	1	2	28	12	89	31	56	32	101	13	379	31	410	606
14 :			7	1	1	15	5	53	19	33	20	77	9	240	19	259	641
15 :			5	1	1	13	4	48	16	25	20	98	10	241	19	260	718
16 :			6	1	1	17	6	58	20	27	23	104	12	275	22	297	751
17 :			1			4	1	15	4	6	5	25	3	64	5	69	827
18 :			1			5	2	14	5	11	8	36	6	88	7	95	846
19 :			1			2		7	2	4	5	17	3	41	3	44	865
20 :			1			2	1	5	1	3	4	12	2	31	3	34	940
21 :					1	1	1	5	1	3	3	9		24	2	26	1149
22 :			1				1	3			4	17	3	29	2	31	1076
23 :																	0
24 :								1			1	6	1	9	1	10	1076
25+:								1			1	1		3		3	1001

Table 21 - Redfish (Sebastes fasciatus) catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	-	-	-	-
3 -	628	7	0.39	0.49	0.23	0.30
4 -	348	4	0.22	0.45	0.13	0.26
5 -	703	8	0.68	1.00	0.40	0.60
6 -	496	6	0.64	0.87	0.39	0.53
7 -	822	9	3.15	2.98	1.93	1.75
8 -	646	6	2.48	2.11	1.40	1.21
9 -	314	3	26.30	30.36	16.13	18.26
10 -	951	8	34.39	80.44	21.54	51.02
11 -	806	9	4.09	5.10	2.51	3.24
12 -	670	7	1.07	0.97	0.65	0.60
13 -	249	2	0.61	0.87	0.34	0.48
14 -	602					
15 -	666	6	2.96	1.13	1.91	0.79
16 -	634	7	0.19	0.34	0.13	0.23
17 -	216	1	-	-	-	-
18 -	210					
19 -	414	4	0.15	0.19	0.10	0.12
total	10555	101				

	catch per tow	catch per mile towed
mean	4.98	3.09
standard error	2.62	1.66

(Kg)

Stock biomass estimated by swept area method = 4,352 tons
Biomass estimated for missing strata = 73 tons

Total biomass = 4,425 tons
standard error = 2,377

Table 22 - Redfish (Sebastes fasciatus) length frequency by strata (x 1000).

length (cm)	stratum 3	4	5	6	7	8	9	10	11	12	13	15	16	19	total	missing strata	TOTAL
10-			7												7		7
11-																	
12-																	
13-																	
14-					7										7		7
15-						8	33								42	1	43
16-	14		20		22		8								65	1	66
17-	28		81	7	22	56	42	47	43						328	6	334
18-	35	14	34	33	59	162	221	114	58			19			750	13	763
19-	7	7	14	20	45	81	170	210	94			37			685	12	697
20-	21		7	34	67	57	398	420	187			76			1267	21	1288
21-	14		14	27	127	81	500	709	194	16		180	8		1869	32	1901
22-			21	13	105	41	713	1247	252	70	9	207	39		2717	46	2763
23-	14	14	14	14	150	89	619	1452	202	86	28	132		19	2831	48	2879
24-		7	7	7	157	32	288	1388	201	71	9	152	16	9	2343	40	2383
25-	14		20		52	57	152	868	58	24		66			1311	22	1333
26-			14	7	74	8	102	792	36	8	9	37			1088	18	1106
27-					15		85	522	14			18			654	11	665
28-				7	37	8	51	512	7	8		9			639	11	650
29-					7	8	51	463	36			9			575	10	585
30-					15	8	25	328	22						399	7	406
31-					22		8	289	14						334	6	340
32-							16	212							230	4	234
33-					22	16	8	134	7						188	3	191
34-					7			19							27		27
35-					7			9							16		16
36-								48							48	1	49
37-					7										7		7
38-																	
39-								9							9		9
40-								39							39	1	40
41-					15										15		15

Table 23 - Redfish (Sebastes fasciatus) age-length key.

MALE

length (cm)	age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+	no id	n. tot
14-																								
15-																							1	1
16-	2																						3	5
17-	4	5																					12	21
18-	1	12																					18	31
19-		7	8																				12	27
20-		6	16																				6	28
21-		2	24	2																			5	33
22-		1	23	12	1																		10	47
23-			4	31	1																		7	43
24-			2	25	1																		4	32
25-				3	9																		6	18
26-				1	9	2																	5	17
27-					4	1																	1	6
28-					1	3	2																4	10
29-					1	2	3																2	8
30-						1	1	1															1	4
31-							1	4																5
32-									1														1	2
33-										2														2
total:	7	33	77	74	27	9	7	5	1	2													98	2

FEMALE length (cm)	age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+	no id	n. tot
14-	1																							1
15-	1																							1
16-	3																							3
17-	4	4																					4	12
18-	2	16																					14	32
19-		5	2																				16	23
20-		6	13																				7	26
21-		3	18																				6	27
22-			17	10																			5	32
23-			1	26	3																		6	36
24-			1	23	6	1																	8	39
25-			1	13	4																		9	27
26-				3	5																		5	13
27-				1	2																		1	4
28-						1																	3	4
29-						2																		2
30-						1	5	1																7
31-							2	3	2															7
32-								2	1		1			1										5
33-							2	1	1	3													1	8
34-									1		2													3
35-										1	1	2												4
36-												1	2											3
37-														1										1
38-													1											1
39-																							1	1
40-																						1		1
41-												1					1							2
total:	11	34	53	76	20	5	9	7	5	4	4	4	3	2			1					1	86	2

Table 24 - Redfish (Sebastes fasciatus) age composition (x 1000).

age	stratum 3	4	5	6	7	8	9	10	11	12	13	15	16	19	total	missing strata	TOTAL	mean weight (gr)
1 :																		0
2 :																		0
3 :																		0
4 :	52	8	98	24	69	148	196	119	79			12			805	14	819	91
5 :	41	14	42	64	164	223	725	844	305	11	1	162	6	1	2603	44	2647	133
6 :	29	9	41	56	314	172	1557	2823	581	130	26	439	40	13	6230	106	6336	175
7 :	17	11	33	16	276	109	680	2877	320	123	21	258	16	14	4771	81	4852	229
8 :	1	1	12	8	97	27	202	1502	68	18	8	61	1	1	2007	34	2041	298
9 :				1	25	14	86	810	32	1		8			977	17	994	381
10 :					19	3	15	387	30			3			457	8	465	435
11 :					11	6	14	217	6						254	4	258	498
12 :					20	3	4	92	1						120	2	122	528
13 :					3			20							23		23	642
14 :					6	3	2	35	1						47	1	48	590
15 :					2			24							26		26	698
16 :					5			9							14		14	827
17 :					1	3	2	23	1						30	1	31	543
18 :																		0
19 :																		0
20 :																		0
21 :																		0
22 :																		0
23 :																		0
24 :																		0
25+:					15										15		15	999

Table 25 - Juvenile redfish (Sebastes sp.) catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	4.75	6.08	2.92	3.52
2 -	838	10	1.48	2.72	0.85	1.54
3 -	628	7	2.74	4.87	1.64	2.90
4 -	348	4	0.81	0.99	0.46	0.57
5 -	703	8	1.39	1.81	0.81	1.08
6 -	496	6	7.00	4.66	4.15	2.57
7 -	822	9	54.97	129.96	32.71	76.47
8 -	646	6	18.11	29.08	10.56	16.79
9 -	314	3	542.90	893.83	306.15	500.93
10 -	951	8	56.31	67.92	32.89	38.62
11 -	806	9	85.90	142.18	53.32	91.70
12 -	670	7	4.28	10.92	2.64	6.73
13 -	249	2	1.25	1.77	0.69	0.98
14 -	602					
15 -	666	6	7.22	17.63	4.94	12.08
16 -	634	7	-	-	-	-
17 -	216	1	-	-	-	-
18 -	210					
19 -	414	4	-	-	-	-
total	10555	101				

	catch per tow	catch per mile towed
mean	34.81	20.36
standard error	16.30	9.23

(Kg)

Stock biomass estimated by swept area method = 28,647 tons
Biomass estimated for missing strata = 288 tons

Total biomass = 28,935 tons
standard error = 13,117

Table 26 - Juvenile redfish (Sebastes sp.) length frequency by strata (x 100000).

length (cm)	stratum 1	2	3	4	5	6	7	8	9	10	11	12	13	15	total	missing strata	TOTAL
7-										1					2		2
8-			1			2	1		1	1	3				8		8
9-	1	1			1	1				1	1				6		6
10-	2	2			1	3	6	4	1	3	14				35		35
11-	4	2	1		1	6	55	13	7	46	72	3			212	2	214
12-	6	2	4		1	10	107	21	8	77	110	8			354	4	358
13-	7	5	3		3	9	50	18	28	75	80	4		2	285	3	288
14-	5	3	4		3	9	117	49	348	194	226	10	1	12	981	10	991
15-	5	4	4	1	3	11	256	55	1452	332	383	18	1	22	2546	26	2572
16-	2	3	3	1	2	7	127	23	776	151	235	7	1	12	1350	14	1364
17-	2	1	3	1	2	2	26	6	185	28	42	1		8	306	3	309
18-	1		2			1	5	3	2	23	30	4		10	80	1	81
19-			1				3	2	1	7	16			3	33		33
20-							1				4			1	6		6
21-										1					1		1

Table 27 - Greenland halibut (Reinhardtius hippoglossoides) catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	-	0.01	-	-
3 -	628	7	0.06	0.11	0.03	0.06
4 -	348	4	0.38	0.76	0.22	0.43
5 -	703	8	0.01	0.03	0.01	0.02
6 -	496	6	0.36	0.48	0.23	0.32
7 -	822	9	1.37	2.91	0.85	1.79
8 -	646	6	2.72	3.88	1.60	2.35
9 -	314	3	1.29	2.24	0.73	1.26
10 -	951	8	0.43	0.56	0.25	0.32
11 -	806	9	3.56	3.42	2.14	2.06
12 -	670	7	16.83	7.12	10.28	4.31
13 -	249	2	7.50	0.28	4.23	0.03
14 -	602					
15 -	666	6	24.11	11.01	15.27	6.84
16 -	634	7	39.24	33.33	25.33	22.11
17 -	216	1	5.83	-	3.64	-
18 -	210					
19 -	414	4	34.44	26.19	23.93	19.29
total	10555	101				

	catch per tow	catch per mile towed
mean	7.25	4.64
standard error	1.05	0.71

(Kg)

Stock biomass estimated by swept area method = 6,533 tons
Biomass estimated for missing strata = 677 tons

Total biomass = 7,210 tons
standard error = 1,103

Table 28 - Greenland halibut biomass estimated by the swept area method (tons).

stratum	depth in fathoms	survey 1988	1989	1990	1991	1992	1993
1 -	70- 80	-	-	-	-	-	-
2 -	81-100	-	3	6	-	-	-
3 -	101-140	26	31	8	8	18	3
4 -	"	142	20	-	15	27	10
5 -	"	73	96	-	28	41	1
6 -	"	31	18	15	12	8	15
7 -	141-200	84	62	63	186	242	93
8 -	"	149	219	63	177	373	138
9 -	"	177	162	53	75	318	30
10 -	"	106	81	48	169	356	31
11 -	"	44	60	20	104	225	230
12 -	201-300	399	637	290	749	609	918
13 -	"	63	122	214	43	24	141
14 -	"	362	289	315	775	834	469
15 -	"	428	166	505	958	633	1356
16 -	301-400	1352	1342	2492	2487	1798	2141
17 -	"	262	118	130	408	39	105
18 -	"	104	49	449	348	57	208
19 -	"	3016	919	977	1498	2988	1321
total		6818	4391	5649	8038	8588	7210

Table 29 - Greenland halibut (Reinhardtius hippoglossoides) length frequency (x 1000).

length (cm)	stratum 2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	19	total	missing strata	TOTAL
10-11						15											15	2	17
12-13						37	8		19	29	8			8			109	11	120
14-15	6	8		7	7	67	32		56	79	16						279	29	308
16-17		8			26	75	41		37	173	23						384	40	424
18-19				7		45	8		47	79	16						201	21	222
20-21						7	8		9	14							39	4	43
22-23						21			28	51			9				109	11	120
24-25					14	75	41		56	172	31	9				9	408	42	450
26-27					26	36	49		56	223	47		9				448	46	494
28-29					27	7	24		9	101		9	19				197	20	217
30-31							8			21			28			18	77	8	85
32-33		8				37	57		9	58	46		66			19	302	31	333
34-35					7	29	49			72	47	9	95	23		9	340	35	375
36-37						15	16			43	62		104	24		56	321	33	354
38-39						14					47	9	104	54		94	323	33	356
40-41							8	17		14	101	9	188	116		19	474	49	523
42-43						22				14	102	9	160	170		75	554	57	611
44-45						7	8		9	14	101		198	256		122	717	74	791
46-47								16			187	9	151	295	18	150	828	86	914
48-49						7		8		22	125	9	198	319		244	932	97	1029
50-51						7	24			7	85	9	113	349	18	168	784	81	865
52-53			7							7	62	18	85	170		94	445	46	491
54-55											31	9	75	101		75	292	30	322
56-57							16			7	16	19	19	93	18	74	263	27	290
58-59											16	9	28	47	18	47	165	17	182
60-61											8		9	39		19	75	8	83
62-63													9	16		9	34	4	38
64-65														16		19	34	4	38
66-67														8			8	1	9
68-69																			
70-71																			
72-73										7							7	1	8
74-75																			
76-77																			
78-79																9	9	1	10

Table 30 - Greenland halibut (Reinhardtius hippoglossoides) age-length key.

MALE

length (cm)	age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	no id	n. tot
10-11																
12-13	1															1
14-15																
16-17	2															2
18-19																
20-21		3														3
22-23		7	1													8
24-25		18	6													24
26-27		13	10	2												25
28-29		2	2	6												10
30-31			3	1	1	1										6
32-33			5	6	5	1									1	18
34-35			6	2	10	2										20
36-37				5	7	4	2								3	21
38-39				2	12	6	2								6	28
40-41					4	12	5								4	25
42-43					3	11	10	4							3	31
44-45					4	10	12		1							27
46-47					1	14	14	7							4	40
48-49					1	8	14	15	5	1					2	46
50-51						3	5	13	10						4	35
52-53						3	3	4	6			1			1	18
54-55								2	9	4	1					16
56-57							1	4	4	1						10
58-59									2	1	2					5
total:	3	43	33	24	48	75	68	49	37	7	3	1			28	5

FEMALE

length (cm)	age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	no id	n. tot
10-11																
12-13																
14-15	1															1
16-17	5															5
18-19	2	1														3
20-21		1														1
22-23		4			1											5
24-25		16	4	1												21
26-27		12	8	3	1										1	25
28-29		3	5	4												12
30-31				3												3
32-33			6	9	2										1	18
34-35			3	5	9	2										19
36-37			2	3	3	5	1								2	16
38-39				1	4	3									2	10
40-41				3	6	8	3	3							3	26
42-43					5	13	6	2							2	28
44-45					4	18	14	4	4						6	50
46-47					1	6	25	10	2	1					6	51
48-49					3	6	13	19	6	2					8	57
50-51					1	1	17	20	7	1					3	50
52-53						2	6	12	10	2	1				6	39
54-55							2	4	6	2	1				1	16
56-57							1	4	13	2	2	1			1	24
58-59								3	2	3	2		1		1	12
60-61								1		5	1	1				8
62-63									1		1	1			1	4
64-65											2	1	1			4
66-67															1	1
68-69																
70-71																
72-73																
74-75																
76-77																
78-79														1		1
total:	8	37	28	32	40	64	88	82	51	18	10	4	2	1	45	1

Table 31 - Greenland halibut (Reinhardtius hippoglossoides) age composition (x 1000).

	stratum																		mean
age	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	19	total	missing strata	TOTAL	weight (gr)
1 :	6	15		11	31	206	78		137	305	53			7			849	88	937	28
2 :		1		3	32	134	78		127	378	58	9	17	1		7	845	88	933	105
3 :		3			24	5695					51	7	68	8		15	543	56	599	200
4 :		4			15	34	57	2	14	141	62	8	115	18		43	513	53	566	288
5 :		1			4	39	42	5	7	78	139	13	260	154	1	127	870	90	960	495
6 :					1	28	22	12	4	45	245	16	394	421	7	231	1426	148	1574	692
7 :			1			15	14	12	4	27	263	19	352	549	14	299	1569	163	1732	856
8 :			3			8	15	8		18	178	24	240	467	19	278	1258	130	1388	1044
9 :			2			2	13	1		11	90	26	151	306	16	202	820	85	905	1243
10 :							2			1	26	8	40	90	7	59	233	24	257	1462
11 :							1			1	8	4	24	46	5	39	128	13	141	1748
12 :										1	4	1	5	20	1	14	46	5	51	1840
13 :											1	1		7	2	6	17	2	19	2034
14 :																9	9	1	10	4338
15 :																				0
16+:																				0

Table 32 - Shrimp catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow mean	catch per tow s.deviat.	catch per mile towed mean	catch per mile towed s.deviat.
1 -	342	4	-	-	-	-
2 -	838	10	-	-	-	-
3 -	628	7	0.01	0.02	0.01	0.01
4 -	348	4	-	-	-	-
5 -	703	8	0.01	0.01	-	0.01
6 -	496	6	0.07	0.12	0.04	0.07
7 -	822	9	21.46	37.30	12.81	22.13
8 -	646	6	10.52	21.74	6.33	13.19
9 -	314	3	4.64	7.42	2.61	4.16
10 -	951	8	13.06	21.75	7.66	12.61
11 -	806	9	12.50	19.72	7.39	11.52
12 -	670	7	33.09	20.71	20.00	12.31
13 -	249	2	6.45	2.40	3.62	1.25
14 -	602					
15 -	666	6	35.54	10.44	22.85	6.95
16 -	634	7	2.51	2.55	1.58	1.63
17 -	216	1	2.00	-	1.25	-
18 -	210					
19 -	414	4	4.48	5.80	2.94	3.72
total	10555	101				

	catch per tow	catch per mile towed
mean	9.45	5.75
standard error	1.53	0.91

Stock biomass estimated by swept area method = 8,095 tons
Biomass estimated for missing strata = 1,068 tons

Total biomass = 9,163 tons
standard error = 1,450

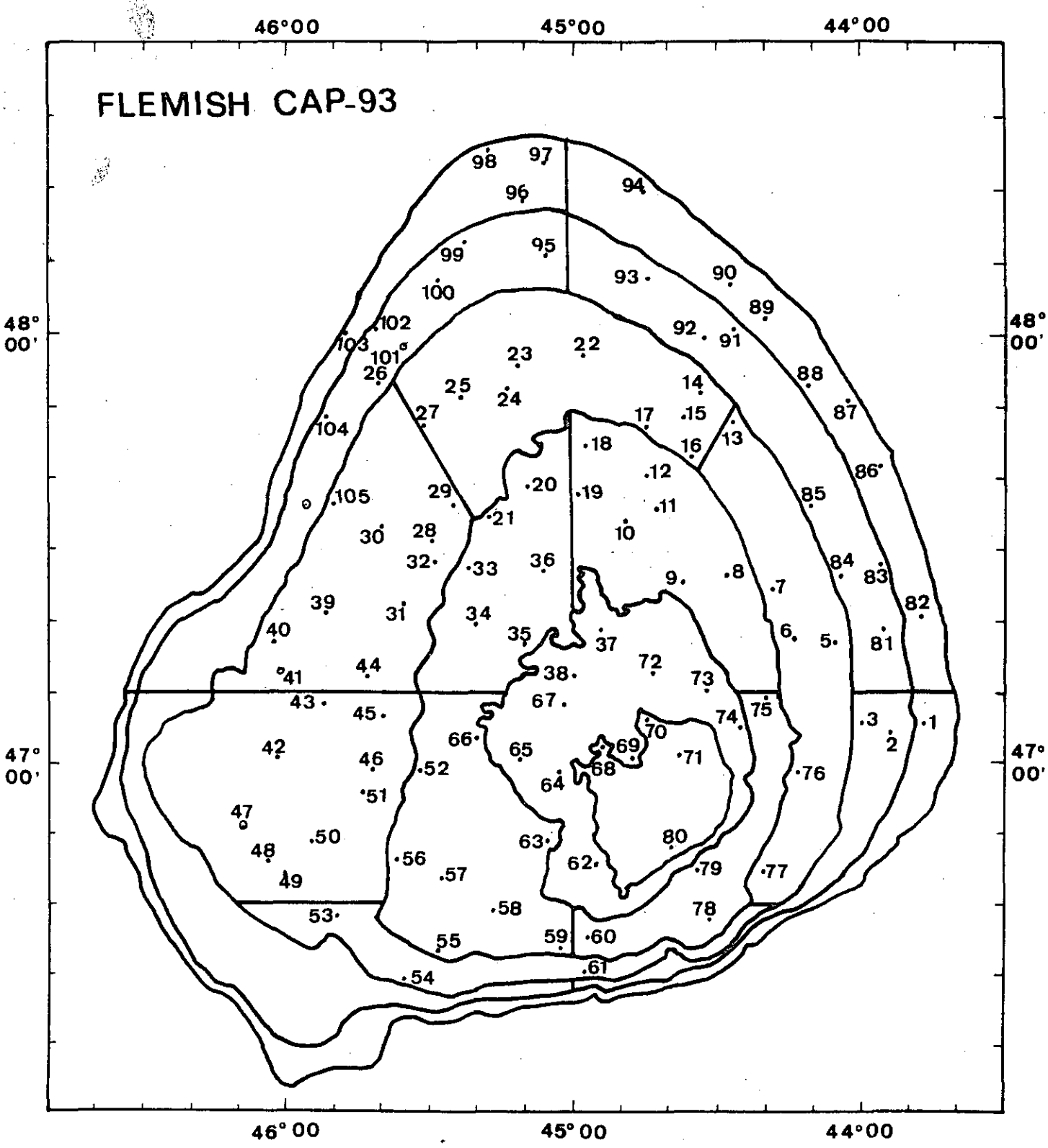
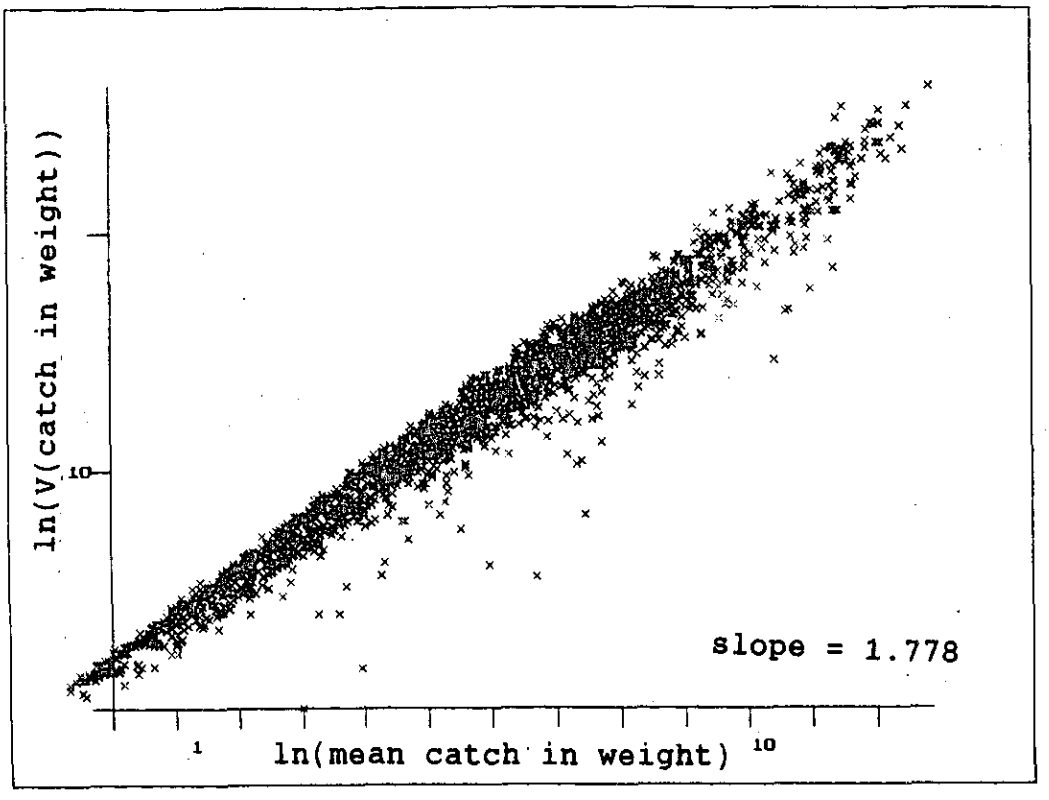


Figure 1 - Tow position of Flemish Cap-93 survey.



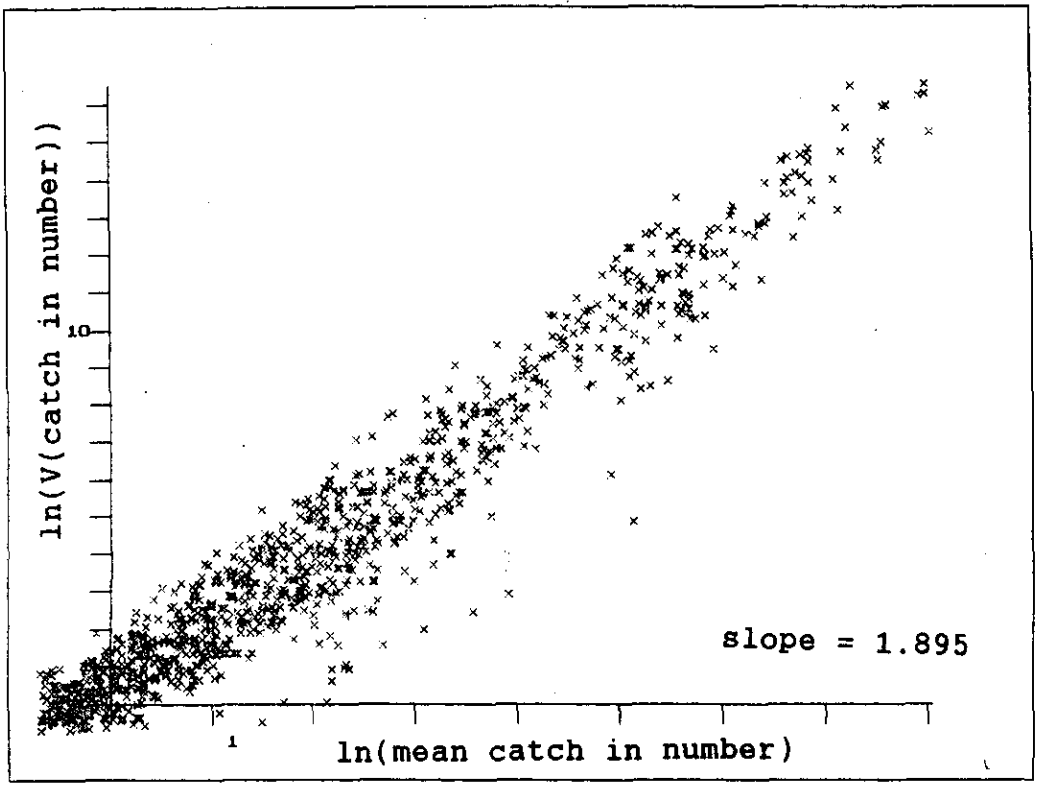


Figure 2 - Relationship between catch variance and mean catch. Each point corresponds to the value observed for one species, one stratum and one survey.

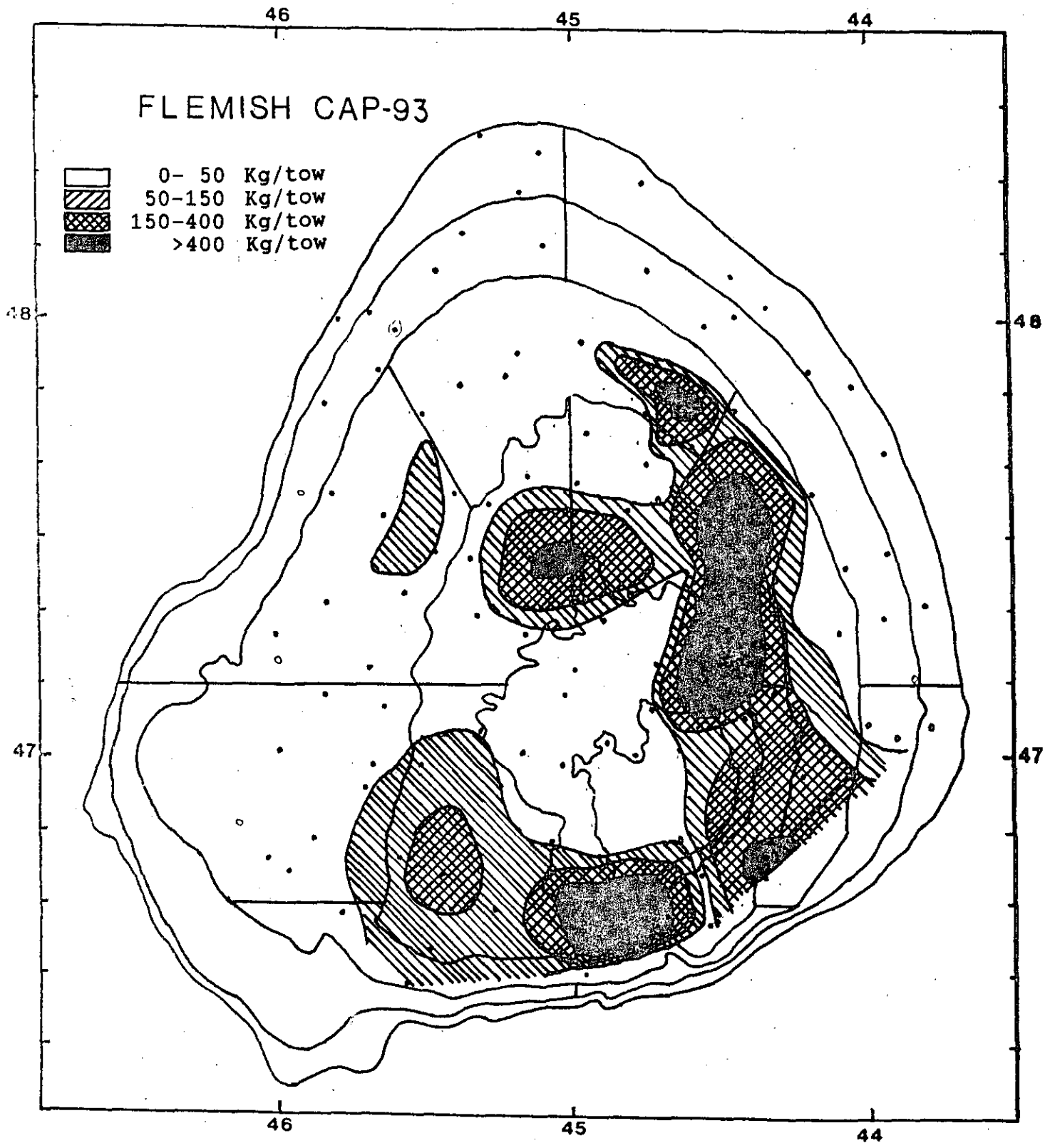


Figure 3 - Cod (Gadus morhua) catch distribution.

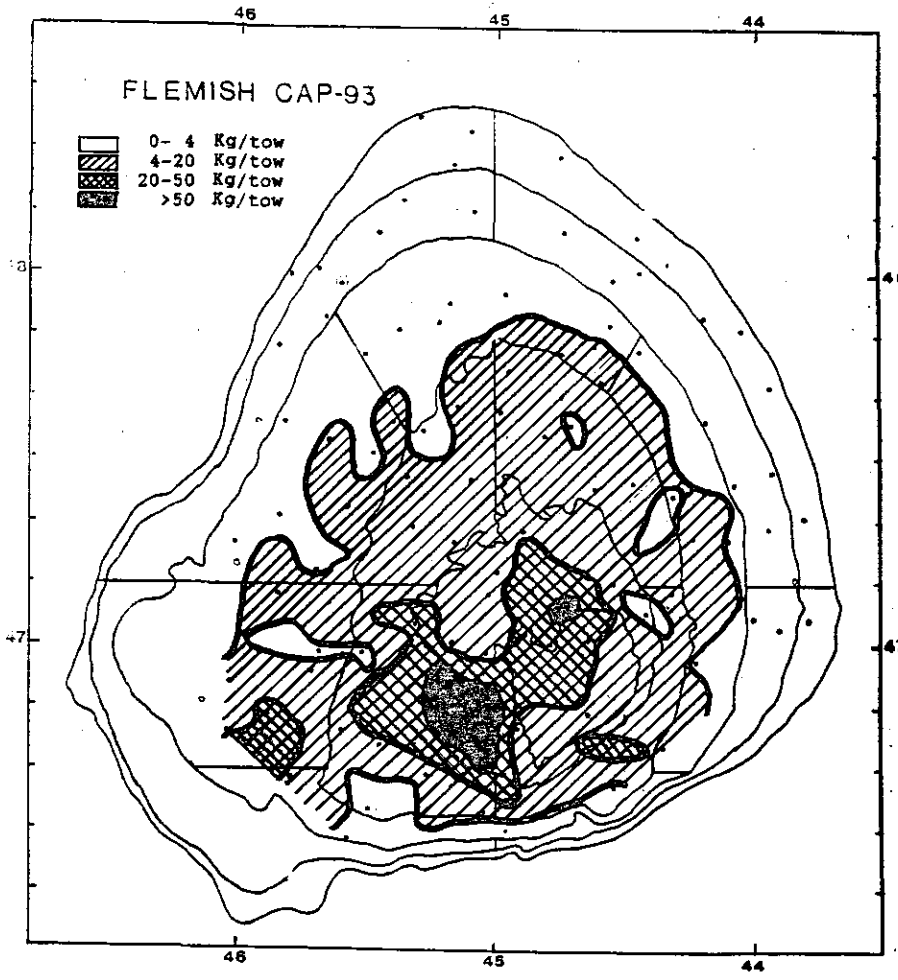


Figure 4 - American plaice (Hippoglossoides platessoides) catch distribution.

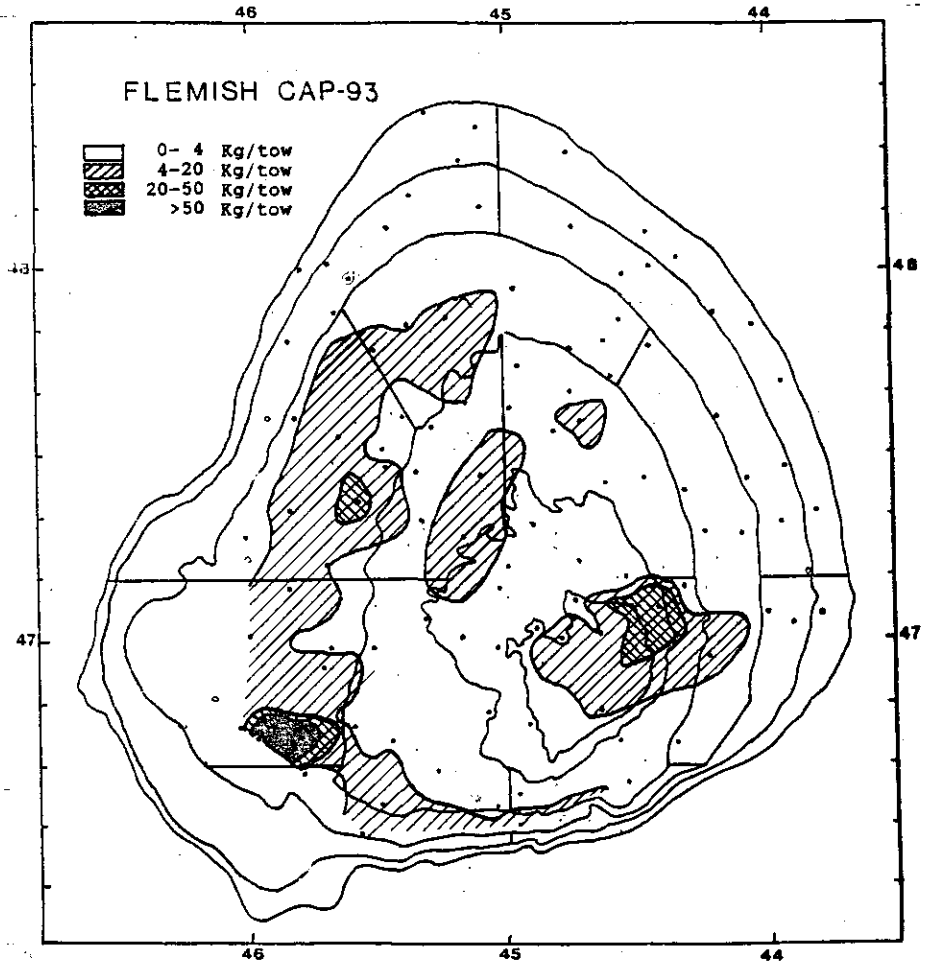


Figure 5 - Redfish (Sebastes marinus) catch distribution.

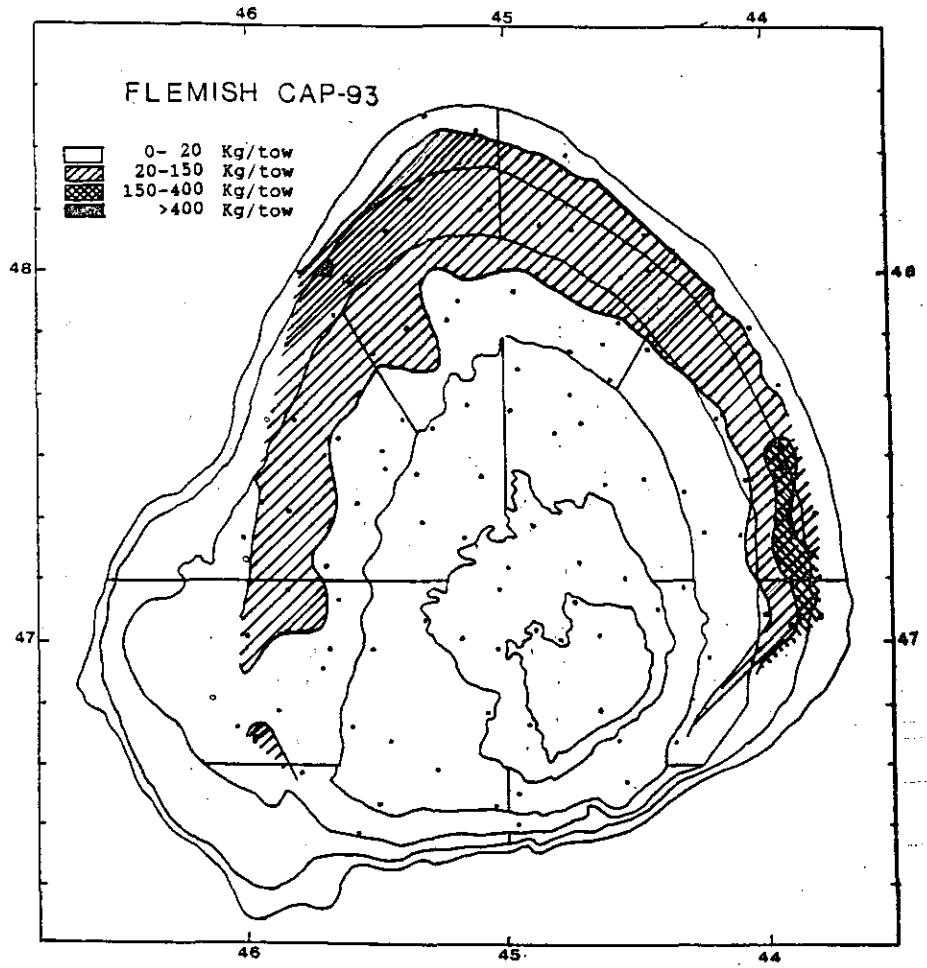


Figure 6 - Redfish (Sebastes mentella) catch distribution.

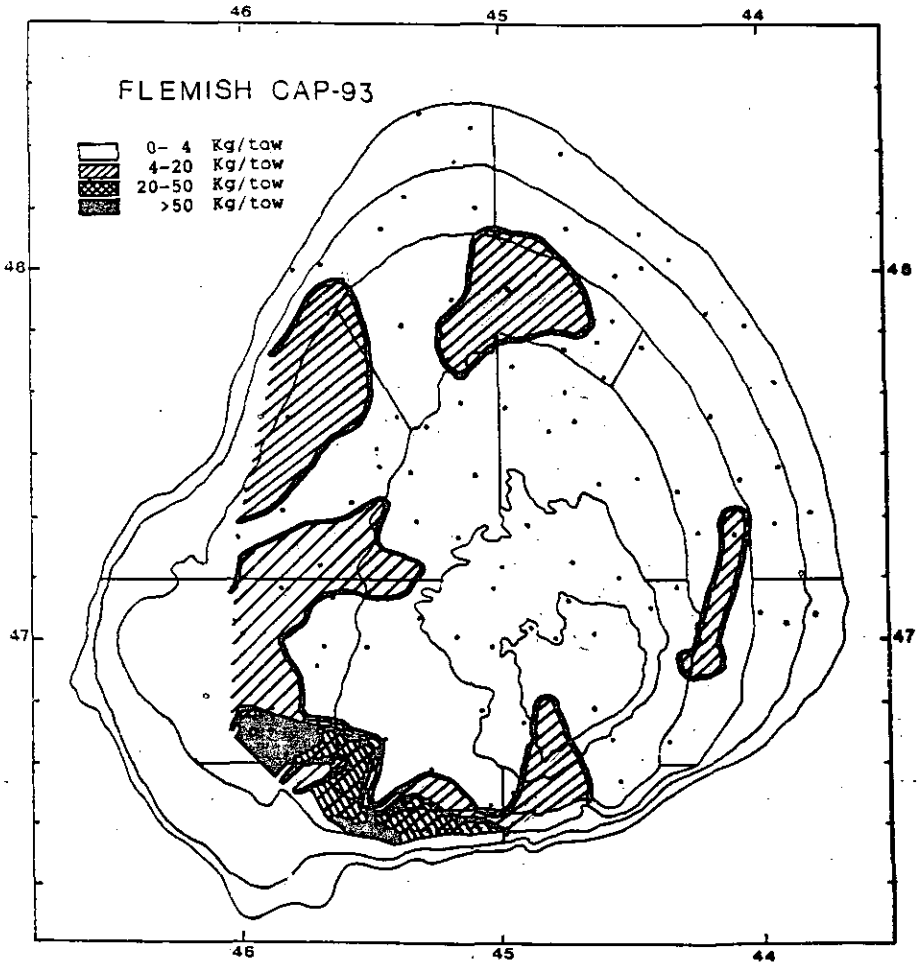


Figure 7 - Redfish (Sebastes fasciatus) catch distribution.

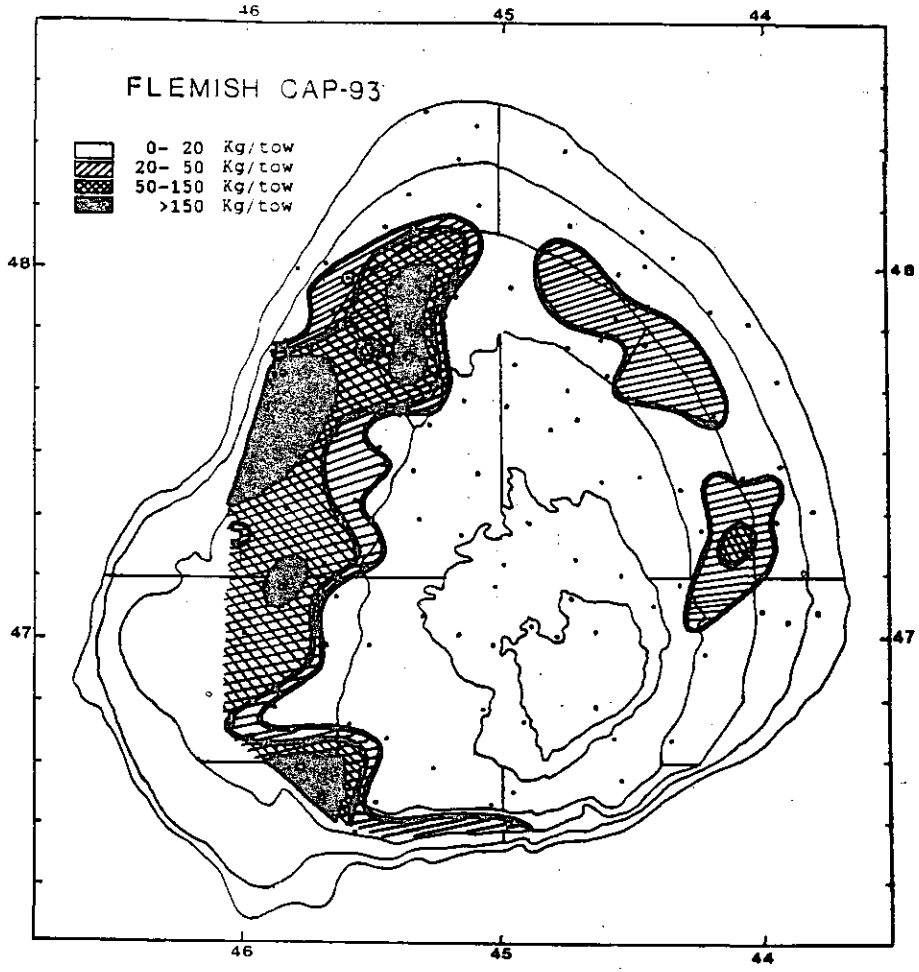


Figure 8 - Juvenile redfish (Sebastes sp.) catch distribution.

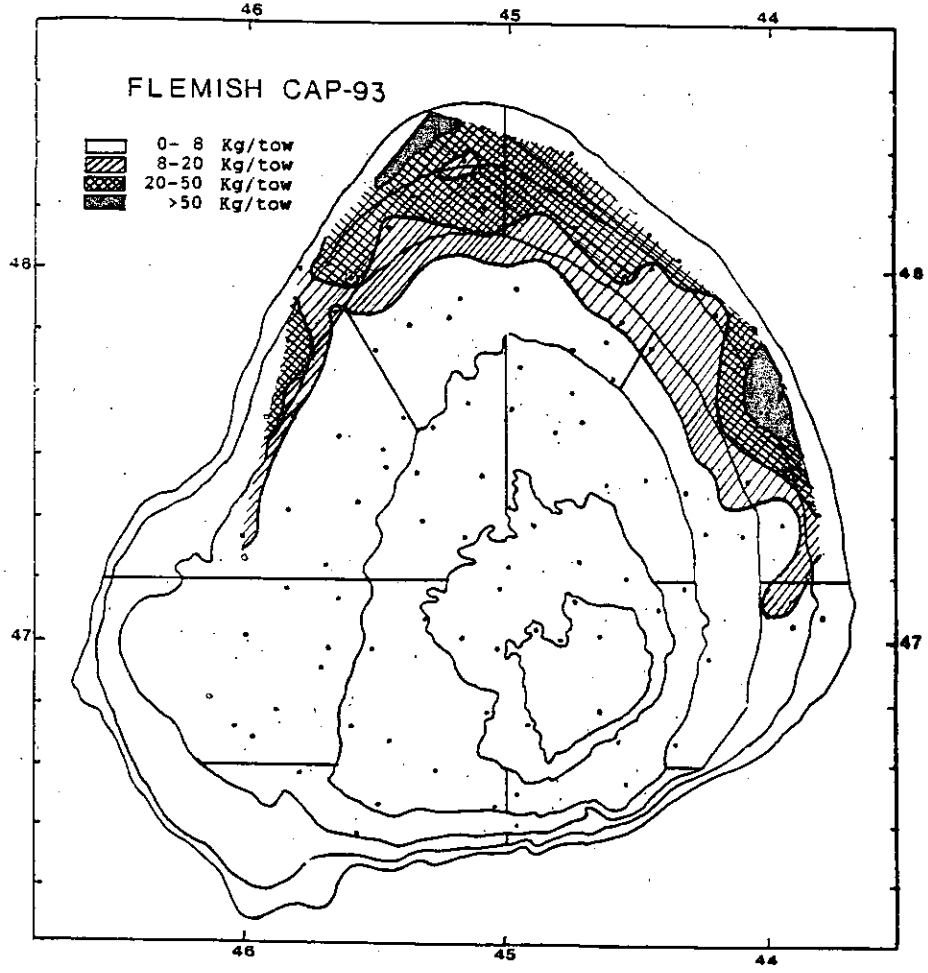


Figure 9 - Greenland halibut (Reinhardtius hippoglossoides) catch distribution.