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Results from Bottom-trawl Survey of Flemish Cap in July 1988

by

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A fishing survey of Flemish Cap was carried out in July 1988 on board the Spanish R/V CORNIDE DE SAAVEDRA to estimate cod stock abundance, primarily, and also redfish and American plaice. The survey had a bottom trawl stratified random design following NAFO specifications (Doubleday, 1981). A total of 120 bottom trawls were made up to a depth of 720 meters (400 f.). A synoptic sheet of the survey with ship, and gear characteristics is presented in Table 1.

July was chosen as the appropriate month for the survey for two reasons: First, because summer is feeding season for cod and American plaice and presumably populations are dispersed. Secondly, because of good weather in July, necessary to achieve the proposed objectives.

As a additional foresight of bad weather conditions that would prevent complete sampling of all strata, the planned 120 tows were split in two groups of 80 and 40 tows. The sampling scheme was designed to cover the bank with 80 tows in the first group. After completion of this initial coverage of the area, the remaining 40 tows of the second group were made to complete the 120 tows design.

We note that the objective of maintain towing speed at 3.5 knots was not always achieved. Catch per nautical mile trawling data exhibit a smaller variance that catches per tow. We include both result for main species.

Gear used was the one named "Lofoten" and used by R/V CRYOS in bottom survey in NAFO area (Anon. 1986). The gear is quite similar in shape and size to that used in Spanish commercial ships in Flemish Cap because it is adequate to rough bottom. Foogear was equipped with 35 cm bobbins as used in commercial fishery. The use of a 35 mm liner in the codend allowed the catch of cod from 120 mm efficiently.

RESULTS

A complete list of species occurrence is presented in Table 2. Pelagic species included should be caught when gear goes through the water column and their presence are not considered to correspond to their abundance.

Cod

Mean catch by strata and whole bank data and its standard

error are presented in Table 3. Main error in bottom trawl abundance estimation arrives from gear efficiency. Our trawl gear had 3.2 meters of vertical opening according to technical specifications and cod shoals moves off the bottom more than that distance. Based on the 1987 USSR acoustic and bottom trawl survey on Flemish Cap, the ratio of cod abundance near bottom and off the bottom was estimated to be 12.3/9.1 (Bozovkov et al. 1988). This means that 43 per cent of cod biomass should be inaccessible to bottom gears. It was not possible in our survey to calculate this rate.

Another source of gear inefficiency for small fish in particular was the use of footrope bobins, but its use was necessary because of rough bottom on the bank.

It is our objective to repeat this survey in following years to set a annual series of abundance indices that can be considered independent from efficiency and accessibility conditions. But, in spite of these problems, based on sweep area method minimum exploitable biomass estimate was calculated:

Bank area	.....	10,555 sq. n. miles
Wing spread	.....	13.5 m
Area sweep per mile towed	....	0.0075 sq. n. miles
Mean catch per mile	.....	26.06 Kg
Sweep area estimate	.....	36,675 t

Tables 4, 5 and 6 show length frequency, age length key and age composition of the catch respectively.

American plaice

Mean catch by strata and whole bank data and its standard error are presented in Table 7. It was observed that American plaice was distributed in areas with depth less than 360 meters (200 f.), roughly the same area that cod.

Biomass estimated by sweep area method was 11,878 t., but, due to the reduced catchability for flatfishes due to the use of a gear with bobins on the footrope, this result underestimate total stock biomass in a unknown but presumable high degree.

Tables 8, 9 and 10 show length frequency, age length key and age composition of the catch respectively.

Redfishes

Redfishes catches were split into Sebaste marinus and Sebastes spp.. Scales were used for age determination of S. marinus following the technic described by Kosswig (1980).

Mean catch by strata and whole bank data and its standard error are presented in Table 11.

Biomass estimates by sweep area method were 15,467 t. and 155,032 t. for S. marinus and Sebastes spp. respectively. In the USSR survey previously mentioned (Bozovkov et al. 1988), the observed ratio between redfish biomass in the zone adjacent to the bottom and that off the bottom was 106.4/350.0. That means that 77 per cent of redfish biomass were inaccessible to bottom trawl gears.

Tables 12, 13 and 14 show length frequency, age length key and age composition of the catch respectively.

Shrimp (Pandalus borealis)

Shrimp catches reached 50 Kg in half hour. This indicates the occurrence of important concentrations of this species. In Table 15 mean catch by strata and whole bank data are presented. Length composition of the catch is presented in Table 16.

DISCUSSION

Among main species in Flemish Cap cod is a demersal species that moves off the bottom in an unknown degree, American plaice is a benthic species and redfishes behaves like a pelagic species. With such a group of species the efficiency of a bottom trawl remains unclear. Sweep area abundance estimates, that are considered in general to underestimate stock abundance, when they are applied to benthic and pelagic species as presented in this paper may be particularly skewed.

Bottom trawl catch series can reflect changes in abundance of species caught quite efficiently only if the vertical distribution of population does not change in time. The use of abundances indices necessitates evaluation of the gear efficiency.

The presence of a pelagic fish species with a higher abundance than all demersal and benthic ones is a common feature in bank fisheries. Although bottom trawls are not efficient for small size pelagic species, when such species are so abundant in the area they are often present in bottom gears. Considering the inventory of species caught in the survey, it is remarkable the absence of a small size pelagic species. Echosounders indicated the possible presence of a different species in dense shoals quite rarely. Redfishes and shrimp seem to dominate the pelagic domain. Stomach contents of three main species: cod, American plaice and S. marinus were analysed in 1423 individuals (Canalejo et al. 1989). A small size pelagic species were not present in them also. American plaice had a characteristic diet of benthic organisms. Redfish feeded on shrimp, Micthophyidae and unidentified fishes. Cod feeded on shrimp and unidentified fishes but also on redfish and other finfishes: dogfish and cod. The role of pelagic species for redfish is consistent with its great abundance.

Mean catch in half our tow of main species in the bank was:

cod	.....	46.74	Kgr
American plaice	15.01	"
<u>Sebastes marinus</u>	19.28	"
<u>Sebastes spp.</u>	188.22	"
Shrimp	2.5	"

REFERENCES

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Lilly, G.R.- 1986. A synopsis of research related to recruitment of cod and redfish on Flemish Cap. NAFO SCR Doc. 86/101, 18p.

Paz, J., J. Vazquez, A.F. Arroyo and M. Casas.- 1989. The feeding of American plaice (Hippoglossoides platessoides), redfish (Sebastes marinus) and cod (Gadus morhua) in the Flemish Cap during July, 1988. NAFO SCR Doc. 89/45, 4p.

Table 1. Technical data of the survey.

Procedure	specification
Ship	B/O Cornide de Saavedra
GT	1200 t
power	1500+750 HP
Trawling speed	3.5 - 4.0 knot
Trawling time	30 minutes
Trawl gear	type "Lofoten"
footrope / handrope	31.20 / 17.70 m
footgear	27 steel bobbins of 35 cm
vertical opening	3.20 m (according specifications)
footgear to trawl doors	100 meters
trawl doors	polivalent, 850 Kg
wire length	2.7 times the depth
Type of survey	stratified sampling
Tow selection procedure	random
Criterion to change position of a selected tow:	<ul style="list-style-type: none">- unsuitable bottom for trawling according to ecosoneder register.- information on from commercial fishing and Canadian surveys.
Criterion to reject data from tow	<ul style="list-style-type: none">- severe tears- less than 20 minutes tow
Daily period for fishing	24 hours
Species for sampling	all fishes and shrimp
Species for age determination	cod, American plaice and redfish (<i>S. marinus</i>)

Table 2. List of species caught.

Species	sets	number	weight (gr)
Gadus morhua	88	20356	5649227
Melanogrammus aeglefinus	2	4	1150
Urophycis chus	31	187	33131
Urophycis tenuis	12	29	34000
Urophycis chesteri	19	204	25705
Urophycis sp.	3	2	1180
Merluccius bilinearis	2	2	404
Micromesistius poutassou	4	4	631
Gaidropsarus ensis	15	27	6850
Brosme brosmes	3	3	16440
Enchelyopus cimbrius	4	4	430
Antimora rostrata	13	564	51070
Macrourus berglax	40	615	317050
Coryphaenoides rupestris	52	1141	92511
Coelorhynchus carminatus	3	24	961
Trachyrhynchus murrayi	1	2	700
Chiasmodon niger	1	1	15
Ararhichas lupus	83	1310	699730
Anarhichas minor	53	154	310565
Anarhichas denticulatus	21	36	116390
Anarhichas sp.	1	16	15700
Lycodes reticulatus	11	41	8861
Lycodes sp.	58	367	67226
Sebastes marinus	68	6760	2151465
Sebastes sp.	88	88500	21302352
Triglops murrayi	2	7	80
Cottunculus microps	9	12	1160
Hippoglossoides platessoides	83	3224	1797150
Reinhardtius hippoglossoides	75	663	940011
Glyptocephalus cynoglossus	65	272	134445
Hippoglossus hippoglossus	2	2	28000
Paralepis brevis brevis	12	107	6690
Paralepis rissoi kroyeri	1	2	30
Nemichthys scolopaceus	1	1	15
Serrivomer beani	8	11	1760
Synaphobranchus kaupi	16	218	31510
Notacanthus nasus	17	95	66045
Scomberesox saurus	2	2	360
Notoscopelus sp.	5	14	150
Benthoosema glaciale	2	20	100
Myctophidae	1	5	100
Chauliodus sloani	11	99	3800
Bathylagus euryops	2	7	270
Argentina silus	2	2	1040
Raja radiata	64	145	270740
Raja spinicauda	25	30	265320
Raja senta	19	29	15120
Raja sp.	11	35	63700
Squalus acanthias	1	1	2450
Etmopterus princeps	1	4	4700
Squalidae	2	2	3000
Illex illecebrosus	6	6	880
Bathypolypus arcticus	5	7	1620
Aspidophoroides monopterygius	6	9	96
Rossia macrosoma	2	2	100
Histioteuthis reversa	2	2	245
Chiroteuthys picteti	1	1	50
Onychoteuthis bauksii	1	1	20
Cirromorpha	1	1	2100
Pandalus borealis	57	14183	301723

Table 5. Cod age-length key.

length (cm)	age										no id.	total	
	1	2	3	4	5	6	7	8	9	10			
9-11	2											2	
12-14	61	2										9	72
15-17	41	52										15	108
18-20	6	170										14	190
21-23		171	11									22	204
24-26		149	37									42	228
27-29		69	83	2								30	184
30-32		13	130	5								34	182
33-35		4	138	23								28	183
36-38		3	113	30								47	193
39-41			81	61								43	185
42-44		1	25	67	1							76	170
45-47			6	56	3							41	106
48-50			2	20								6	28
51-53				6	8							4	18
54-56			1	26	12							10	49
57-59				30	30	1						4	65
60-62				7	33	1						13	54
63-65				4	24	3						2	33
66-68				1	14	6	2					5	28
69-71					4	4	1						9
72-74					1	6	4					2	13
75-77						3	3					1	7
78-80								1					1
81-83						1	2						3
84-86						1	5	1					7
87-89						2	4						6
90-92							8						8
93-95							1	4				1	6
96-98							1	1					2
99-101								1					1

Table 6. Age composition of cod catches by strata.

stratum	age								
	1	2	3	4	5	6	7	8	9
1	1	72	310	94	6				
2	349	3393	2168	529	12	1			
3	50	1263	542	194	64	7	4		
4	59	851	858	132	5	1	1		
5	177	2443	232	34	5	2	1		
6	62	2270	701	58	7	1			
7	8	344	319	93	22	3	5	1	
8		112	678	446	23	1	2		
9	1	22	12	2	1	1	2		
10	3	118	120	38	9	3	4	2	
11	8	594	362	81	34	7	8	2	
12		2	27	37	7				
13			2	1					
14			1	1		1	1		
15			1	3	1	1	4	4	
16									
17									
18			1						
total	718	11484	6334	1743	196	29	32	9	

Table 10. Age composition of American plaice catches by strata.

age	stratum																total
	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16		
1																	
2		11	8	5	6	9	6	1		2	1						
3	1	73	46	28	35	55	40	6		10	6					49	
4	9	49	21	12	35	15	11	1	1	11	4		1			300	
5	45	169	57	31	112	42	35	3	3	47	19		1			170	
6	108	180	65	49	128	33	50	6	5	119	49					564	
7	66	100	38	49	89	15	35	8	4	93	45	1				792	
8	28	78	56	91	97	12	38	18	2	64	56			1		543	
9	7	24	22	39	25	3	13	11	1	14	17			1		541	
10	2	6	5	13	4	1	3	4	1	3	4					177	
11		2	1	4	1		1	1								46	
12		2	2	5	2		1	1		1	1					12	
13		2	4	5	2		1	1		1	1					15	
14			1		2	1										15	
15		1	1	1	1		1									4	
16+		1	2	2	1	1										5	
																7	

Table 11.a. Redfish (*Sebastes marinus*) catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow		catch per mile towed	
			mean	s.deviat.	mean	s.deviat.
1	342	4	1,22	2,19	0,68	1,24
2	838	10	0,24	0,38	0,12	0,19
3	628	7	7,90	10,61	5,99	10,10
4	348	4	11,18	16,33	6,68	10,25
5	703	8	30,11	36,13	15,91	19,43
6	496	6	20,86	29,02	11,85	16,61
7	822	9	5,31	6,09	2,88	3,27
8	646	7	3,19	5,80	2,19	4,05
9	314	3	131,98	211,81	84,68	137,05
10	951	9	28,45	38,29	14,46	18,60
11	806	9	62,55	49,06	33,52	26,27
12	670	8	0,00	0,00	0,00	0,00
13	249	3	0,00	0,00	0,00	0,00
14	602	6	19,42	46,58	10,38	24,91
15	666	6	2,30	5,63	1,20	2,93
16	634	7	0,00	0,00	0,00	0,00
17	216	2	0,00	0,00	0,00	0,00
18	210	2	113,85	135,41	68,15	80,07
19	414	5	0,00	0,00	0,00	0,00

	catch per tow	catch per mile towed
general mean (Y)	19,28	10,99
standard error of Y	4,71	2,88

Table 11.b. Redfish (*Sebastes spp.*) catch (Kg) by strata.

stratum	area squa. miles	tow number	catch per tow		catch per mile towed	
			mean	s.deviat.	mean	s.deviat.
1	342	4	0,00	0,00	0,00	0,00
2	838	10	0,41	1,00	0,20	0,49
3	628	7	0,62	1,33	0,38	0,73
4	348	4	1,37	1,62	0,91	1,22
5	703	8	5,66	14,39	3,13	8,05
6	496	6	1,30	1,83	0,75	1,11
7	822	9	298,56	470,70	152,83	230,01
8	646	7	536,08	705,28	265,84	326,34
9	314	3	94,43	134,00	45,88	62,36
10	951	9	134,48	130,54	73,46	71,96
11	806	9	111,28	165,58	68,72	84,44
12	670	8	672,96	871,91	385,98	507,74
13	249	3	375,91	293,55	211,51	169,09
14	602	6	279,28	205,08	167,80	149,33
15	666	6	346,81	205,01	192,45	105,95
16	634	7	274,49	472,29	183,72	330,67
17	216	2	396,93	112,82	252,00	44,91
18	210	2	0,04	0,05	0,02	0,03
19	414	5	46,23	34,50	26,67	18,33

	catch per tow	catch per mile towed
general mean (Y)	188,22	110,16
standard error of Y	27,40	17,74

Table 12. Redfish (*Sebastes marinus*) length frequency by strata.

length (cm)	stratum													total
	1	2	3	4	5	6	7	8	9	10	11	14	18	
0- 1														
2- 3														
4- 5														
6- 7	2		2		10	3	1			2				20
8- 9	4	3	43		71	116	24	1		28	17	1		310
10-11		4	75	8	166	130	14	4		55	45	2		507
12-13	2	1	65	9	311	108	64	2		66	39	22		695
14-15	3	2	9	3	68	30	9			10	8			144
16-17	7	7	9	8	50	15		2	2	10	14			125
18-19	5	3	19	50	61	21	4		2	26	22			215
20-21	4	2	13	20	129	27	9		3	17	26	3		256
22-23	7	1	12	38	117	34	9	1	66	95	55	30		468
24-25	1	2	16	17	138	34	23	2	351	89	73	87	4	843
26-27	2	1	15	30	91	39	16	10	734	69	105	31	3	1153
28-29	1		26	15	91	24	12	3	201	42	122	6	7	554
30-31	1		19	9	40	13	12	8	105	60	115	3	9	397
32-33			18	7	46	9	6	4	94	56	159		18	421
34-35			11	3	20	2	5	1	23	51	108	1	64	292
36-37			4	1	8	8	7			24	97		77	226
38-39			2		10	8	3		1	30	89	1	88	233
40-41			2	1	7	4	7	1		20	46		40	132
42-43					8	2	3			13	23		18	68
44-45					3		4		1	4	15		5	31
46-47					1					7	7		2	18
48-49					1	2	1			1	1			6
50-51					1				1		5			7
52-53						1	2							3

Table 14. Age composition of redfish (Sebastes marinus) catches.

age	stratum														total
	1	2	3	4	5	6	7	8	9	10	11	14	18		
1															
2	1	1	14		24	39	8			9	6			102	
3	1	2	33	2	65	71	12	1		23	17	1		228	
4	2	2	41	3	104	85	20	2		31	22	4		316	
5	3	4	83	11	316	150	52	3		74	51	15		762	
6	11	9	36	28	187	64	22	3	29	45	40	8		482	
7	9	4	30	65	218	56	18	1	120	85	73	32	1	712	
8	6	3	31	54	203	62	27	8	591	136	148	68	5	1342	
9	3	1	38	30	159	45	27	10	457	123	219	45	18	1175	
10	1		26	16	79	22	15	6	264	85	203	10	49	776	
11			14	6	35	12	9	3	91	58	157	3	81	469	
12			7	3	22	8	10	1	23	42	114	1	75	306	
13			4	1	13	6	6	1	6	32	81	1	68	219	
14					4	2	2			9	22		21	60	
15			1		5	1	2		1	16	24		15	65	
16+					4	3	5		2	3	15		3	35	

Table 15. Shrimp catch (Kg) by strata.

stratum	area squa. miles	tow number	mctch per tow		catch per mile towed	
			mean	s.deviat.	mean	s.deviat.
1	342	4	-	-	-	-
2	838	10	-	-	-	-
3	628	7	-	-	-	-
4	348	4	-	-	-	-
5	703	8	-	-	-	-
6	496	6	-	-	-	-
7	822	9	0,33	0,82	0,17	0,41
8	646	7	0,31	0,39	0,25	0,25
9	314	3	2,50	2,29	1,35	1,18
10	951	9	1,50	1,98	0,91	1,36
11	806	9	1,52	3,86	0,83	2,12
12	670	8	14,85	14,40	8,60	8,43
13	249	3	3,51	3,48	1,94	1,97
14	602	6	4,33	5,44	2,49	3,19
15	666	6	7,31	8,65	4,54	6,06
16	634	7	5,51	6,99	3,50	4,33
17	216	2	6,12	0,02	0,08	0,02
18	210	2	-	-	-	-
19	414	5	1,49	2,09	0,85	1,20

	catch per tow	catch per mile towed
general mean (Y)	2,50	1,48
standard error of Y	0,46	0,29

Table 16. Shrimp length frequency in a 81.5 Kg sample.

length (cm)	female	male
17		32
17,5		27
18		46
18,5		101
19		161
19,5		303
20		409
20,5	1	346
21	-	285
21,5	16	156
22	-	79
22,5	-	91
23	32	75
23,5	1	141
24	26	131
24,5	81	117
25	215	291
25,5	324	277
26	596	190
26,5	592	107
27	730	21
27,5	464	11
28	766	5
28,5	444	4
29	695	8
29,5	453	2
30	716	-
30,5	181	1
31	329	
31,5	106	
32	146	
32,5	105	
33	56	
33,5	45	
34	13	
34,5	18	
35	15	
total	7166	3417

peso muestral 81,5 Kgr.