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Analysis of data from deepwater surveys in Div. 0B, 2GHJ, and 3KLM in 1991

by

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Introduction

With the development of fisheries in the deep water in the NAFO Regulatory Area in Div. 3LM, it was decided to carry out research vessel surveys in this area to learn more about the distribution and abundance of several species, particularly Greenland halibut and grenadiers. As well as surveys in this area, Canada also conducted a research survey on the slope edge extending from Davis Strait to southern Labrador. This paper presents the results of this work.

Methods and Materials

Two separate surveys were carried out, using two different vessels - the Northern Kingfisher, which covered the northern areas, and the Cape Adair, which covered the southern ones. Both ships are commercial trawlers which were chartered by the Department of Fisheries and Oceans to conduct research. Both surveys used a line transect design and most fishing sets were in the depth range of 750 m to 1500 m (Fig. 1 and 2). Line transects were chosen at regularly spaced intervals and sets chosen at depth intervals along each transect. The Kingfisher survey ran from August 16-30 and the Adair from September 4-30, 1991.

The fishing gear used differed on each vessel with the Kingfisher using a modified Alfredo #3 bottom trawl, and the Adair using an Engels 145 otter trawl. Both sets of fishing gear, including doors and footgear, were modified to improve performance at the depths and bottom type fished in the surveys. As well, both vessels were equipped with Furuno CN-10A net sounding equipment to allow monitoring of the trawl during each tow. Both vessels towed at approximately 3.0 to 3.5 knots, with the Kingfisher tows covering about 2.0 nautical miles and the Adair 1.7 n.m. Because of these differences in gear and tow duration, the data from both surveys are not directly comparable.

From each fishing set, the usual information on catch numbers and weights was obtained, along with length frequency data for most commercial species. Otoliths were collected from Greenland halibut.

Sets with extensive trawl damage were excluded from analyses, and all tows in each survey were standardized to account for differences in tow duration before analysis.

Results and Discussion

Survey coverage in the northern areas was somewhat reduced as it was decided to survey as broad an area as possible. In the southern region, the survey area was much smaller, resulting in more tows per Division. A total of 29 sets were made on the Kingfisher survey, and 106 on the Adair survey. Table 1 shows the distribution of these sets by Division.

Greenland halibut

In the northern survey, mean number and weight per tow were highest in Div. 2H and lowest in Div. 2G (Table 1, Figures 3-4). The average weight per fish ranged from 1.26 kg. to 1.64 kg. In the southern survey, the mean number and weight per tow were highest in Div. 3K and lowest in Div. 3L. In all Divisions, the age compositions were dominated by ages 7 and 8 (Table 2). The mean age in the catches was quite similar in all areas, ranging from 7.76 years in Div. 2H to 8.42 years in Div. 3M.

Table 3 gives the mean number and weight per tow, by depth range, for G.hallbut caught in the southern survey. The highest mean numbers were in the shallowest depth zone in all 3 Divisions. The mean weight per tow was highest in the 951-1055 m range in both Div. 3K and 3L, and was about the same in all 4 depths in Div. 3M. In all 3 Divisions, the average fish weight increased with depth, which has been observed for this species in other surveys and areas.

Tables 4-6 contain the age composition, by depth range, for Div. 3K, 3L, and 3M respectively. The shift to larger fish with increasing depth can be seen easily with the progression in average age, and graphically in Figures 5-7.

Roundnose grenadier

The highest densities of roundnose grenadier in terms of both average number and mean weight per set (Table 7, Figure 8) were found in Div. 2G (696 fish, 335 kg). For each division surveyed there was a consistent pattern of increasing fish size with depth as indicated by the average weight per fish. The highest density of relatively small fish (an average 45 fish, 1.3 kg for four sets) occurred in Div. 3K in the less than 951 m depth zone. This depth zone was not sampled north of Div. 3K.

Roughhead grenadier

The highest density of roughhead grenadier in terms of both average number and weight per set was found in Div. 2H in the depth zone 1056-1300 m (Table 8). The densities were fairly consistent over the whole area with the average per set ranging between 20 and 40 fish and 10-25 kilograms.

Redfish (*S. mentella*)

The largest concentration of redfish occurred in Div. 3K (Table 9) in less than 951 m (average of 222 fish, 139 kg for four sets). In depths greater than 951 they were practically non-existent.

Table 1 . Mean number and weight of Greenland Halibut per tow obtained from deep water surveys conducted during August and September of 1991.

Division	Number of Sets	Mean Number Per Tow	Mean Weight Per Tow	Average Weight (kg)
0B	6	148.33	242.67	1.64
2G	6	119.92	184.58	1.54
2H	6	257.50	325.21	1.26
2J	11	127.27	193.00	1.52
3K	27	71.41	119.80	1.68
3L	42	28.44	49.35	1.74
3M	37	40.95	76.44	1.87

NOTE - Surveys in the Northern most divisions (0B, 2G, 2H, 2J) were conducted with a different vessel and gear than the survey in the southern divisions.

Table 2 . Mean number per tow at age of Greenland Halibut by NAPO division from deep water surveys conducted during August and September of 1991.

AGE	NAPO DIVISION						
	0B	2G	2H	2J	3K	3L	3M
4	0.00	0.00	0.00	0.00	0.00	0.02	0.00
5	0.49	0.43	2.37	1.64	1.46	1.67	0.68
6	12.32	9.36	46.15	24.51	8.82	3.96	3.53
7	41.16	28.16	80.36	43.98	17.15	7.04	10.23
8	52.18	43.38	69.60	28.11	18.36	5.08	9.26
9	19.19	20.84	29.20	10.58	12.03	4.59	8.73
10	6.92	8.30	15.71	5.27	4.72	2.15	3.69
11	4.24	3.28	6.12	3.18	2.95	1.59	1.54
12	3.53	2.21	3.39	2.48	2.09	1.06	1.45
13	4.15	1.96	2.88	3.74	1.65	0.70	1.13
14	2.88	1.29	0.96	2.31	1.27	0.48	0.66
15	1.10	0.46	0.33	0.70	0.53	0.02	0.03
16	0.00	0.27	0.24	0.13	0.25	0.02	0.00
17	0.17	0.00	0.00	0.00	0.03	0.00	0.00
NK	0.00	0.00	0.70	0.64	0.00	0.05	0.03
TOTAL	148.33	119.92	257.50	127.27	71.41	28.44	40.95
AVERAGE AGE	8.27	8.26	7.76	7.85	8.29	8.16	8.42

Table 3 . Mean numbers and weights per tow by depth zone from deep water surveys for Greenland Halibut.

Div.	Depth Range	N	Mean Number	Mean Weight	Ave. Wt (kg)
3K	750-950	4	177.08	182.28	1.03
	951-1055	7	110.83	213.69	1.93
	1056-1300	8	44.98	95.09	2.11
	1301-1500	9	10.51	31.11	2.96
3L	750-950	16	37.65	39.06	1.04
	951-1055	11	31.82	68.88	2.16
	1056-1300	11	17.64	48.59	2.75
	1301-1500	4	12.00	38.88	3.24
3M	750-950	12	68.17	77.47	1.13
	951-1055	9	37.56	73.33	1.95
	1056-1300	14	23.43	79.05	3.37
	1301-1500	2	15.50	66.00	4.25

Table 4 . Mean number per tow at age of Greenland Halibut by depth zone from deep water survey in Division 3K during 1991.

AGE	750-950	951-1055	1056-1300	1301-1500
4	0.59	0.02	0.03	0.00
5	7.69	0.79	0.37	0.03
6	38.91	8.78	2.41	0.20
7	58.97	22.63	8.13	0.45
8	48.06	28.63	11.84	1.03
9	16.51	23.42	9.50	2.37
10	3.25	10.23	3.87	1.50
11	0.82	5.81	2.45	2.02
12	0.45	3.83	2.08	1.39
13	0.79	2.90	1.91	0.73
14	0.80	2.30	1.32	0.54
15	0.24	0.70	0.81	0.25
16	0.00	0.72	0.20	0.00
17	0.00	0.08	0.05	0.00
TOTAL	177.08	110.83	44.98	10.51
AVE AGE	7.30	8.72	8.96	10.35

Table 5 . Mean number per tow at age of Greenland Halibut by depth zone from deep water survey in Division 3L during 1991.

AGE	750-950	951-1055	1056-1300	1301-1500
4	0.05	0.00	0.00	0.00
5	3.99	0.37	0.18	0.07
6	8.62	1.55	0.88	0.38
7	12.85	5.65	2.32	0.62
8	7.12	5.67	2.89	1.30
9	3.42	8.36	3.22	2.65
10	1.02	4.26	1.77	1.93
11	0.29	2.81	2.15	1.96
12	0.16	1.53	1.90	1.06
13	0.02	0.86	1.54	0.71
14	0.04	0.68	0.74	0.97
15	0.01	0.04	0.00	0.10
16	0.00	0.05	0.05	0.00
NK	0.06	0.00	0.00	0.25
TOTAL	37.65	31.82	17.64	12.00
AVE AGE	7.07	8.97	9.63	10.14

Table 6 . Mean number per tow at age of Greenland Halibut by depth zone from deep water survey in Division 3M during 1991.

AGE	750-950	951-1055	1056-1300	1301-1500
5	2.01	0.12	0.01	0.00
6	9.53	1.34	0.30	0.02
7	23.39	7.36	2.19	0.45
8	17.56	9.41	3.22	0.96
9	12.98	9.44	5.52	2.46
10	2.32	5.36	3.83	3.38
11	0.29	1.73	2.45	1.90
12	0.08	1.60	2.32	2.81
13	0.01	0.85	2.16	1.91
14	0.00	0.37	1.28	1.62
15	0.00	0.00	0.07	0.00
NK	0.00	0.00	0.07	0.00
TOTAL	68.17	37.56	23.43	15.50
AVE AGE	7.57	8.74	9.96	10.90

Table 7. Mean number and weight per set of roundnose grenadier from deepwater Canadian surveys conducted in Aug-Sep 1991.

DIVISION	DEPTH ZONE	NUMBER SETS	MEAN NUMBER	MEAN WEIGHT (kg)	AVERAGE WEIGHT PER FISH (kg)
0B	<951	2	74.50	27.75	.372
	951-1055	2	336.50	183.50	.545
	1056-1300	2	54.00	48.50	.898
	>1300	2	155.00	86.58	.559
ALL	6	696.00	334.75	.481	
2G	<951	2	1077.00	313.50	.291
	951-1055	2	749.50	462.34	.617
	1056-1300	2	261.50	228.50	.873
	>1300	2	696.00	334.75	.481
ALL	6	2784.00	1339.09	.529	
2H	<951	2	57.50	18.50	.321
	951-1055	2	775.50	382.00	.493
	1056-1300	2	201.50	147.00	.730
	>1300	2	344.83	182.50	.529
ALL	6	1379.33	630.00	.457	
2J	<951	2	1.50	0.35	.233
	951-1055	3	93.33	38.33	.410
	1056-1300	4	278.00	182.25	.653
	>1300	2	103.50	89.50	.865
ALL	11	476.33	210.43	.440	
3K	<951	4	44.75	1.28	.028
	951-1055	7	94.14	27.25	.289
	1056-1300	8	352.88	147.57	.418
	>1300	8	139.63	90.70	.649
ALL	27	571.40	266.80	.464	
3L	<951	16	21.63	1.54	.071
	951-1055	11	59.18	7.53	.127
	1056-1300	11	90.82	24.28	.267
	>1300	4	58.25	36.32	.624
ALL	42	230.68	79.67	.345	
3M	<951	12	15.17	0.98	.065
	951-1055	9	253.67	44.88	.177
	1056-1300	14	148.21	54.50	.368
	>1300	2	117.50	81.16	.691
ALL	37	534.55	191.52	.356	

Table 8. Mean number and weight per set of roughhead grenadier from deepwater Canadian surveys conducted in Aug-Sep 1991.

DIVISION	DEPTH ZONE	NUMBER SETS	MEAN NUMBER	MEAN WEIGHT (kg)	AVERAGE WEIGHT PER FISH (kg)
0B	<951	2	20.00	10.50	.525
	951-1055	2	40.50	28.50	.703
	1056-1300	2	24.00	11.00	.458
	>1300	2	28.17	16.67	.592
ALL	6	103.50	56.67	.569	
2G	<951	2	22.50	13.00	.578
	951-1055	2	28.50	18.50	.649
	1056-1300	2	18.50	6.50	.351
	>1300	2	23.17	12.67	.547
ALL	6	72.50	30.67	.511	
2H	<951	2	47.00	23.00	.489
	951-1055	2	98.00	61.50	.628
	1056-1300	2	30.50	22.00	.721
	>1300	2	58.50	35.50	.607
ALL	6	233.50	120.00	.511	
2J	<951	2	38.00	37.50	.987
	951-1055	3	20.00	9.00	.450
	1056-1300	4	30.75	22.83	.742
	>1300	2	16.00	14.75	.922
ALL	11	94.75	84.08	.766	
3K	<951	4	32.00	21.25	.664
	951-1055	7	29.00	15.61	.538
	1056-1300	8	30.00	17.78	.593
	>1300	8	22.13	19.24	.869
ALL	27	113.13	73.88	.666	
3L	<951	16	41.44	26.16	.631
	951-1055	11	40.09	20.30	.506
	1056-1300	11	51.91	30.50	.588
	>1300	4	29.00	16.27	.561
ALL	42	162.44	103.16	.656	
3M	<951	12	35.50	21.99	.619
	951-1055	9	39.78	29.93	.752
	1056-1300	14	27.21	14.97	.550
	>1300	2	14.50	8.71	.600
ALL	37	117.00	75.60	.637	

Table 9. Mean number and weight per set of *S. mentella* from deepwater Canadian surveys conducted in Aug-Sep 1991.

DIVISION	DEPTH ZONE	NUMBER SETS	MEAN NUMBER	MEAN WEIGHT PER FISH (KG)	AVERAGE WEIGHT PER FISH (KG)
0B	<951	6	0.67	0.27	.400
	>951	6	0.67	0.27	.400
2G	<951	6	0.17	0.13	.764
	951-1055	6	0.17	0.13	.764
2H	<951	6	0.33	0.11	.333
	951-1055	6	0.33	0.11	.333
2J	<951	2	82.50	28.43	.345
	951-1055	9	0.11	0.06	.545
3K	<951	4	222.00	139.11	.627
	951-1055	23	0.13	0.08	.615
3L	<951	16	10.69	7.79	.729
	951-1055	26	0.00	0.00	.729
3M	<951	12	2.08	1.05	.504
	951-1055	25	0.28	0.20	.714
ALL		37	0.86	0.47	.547

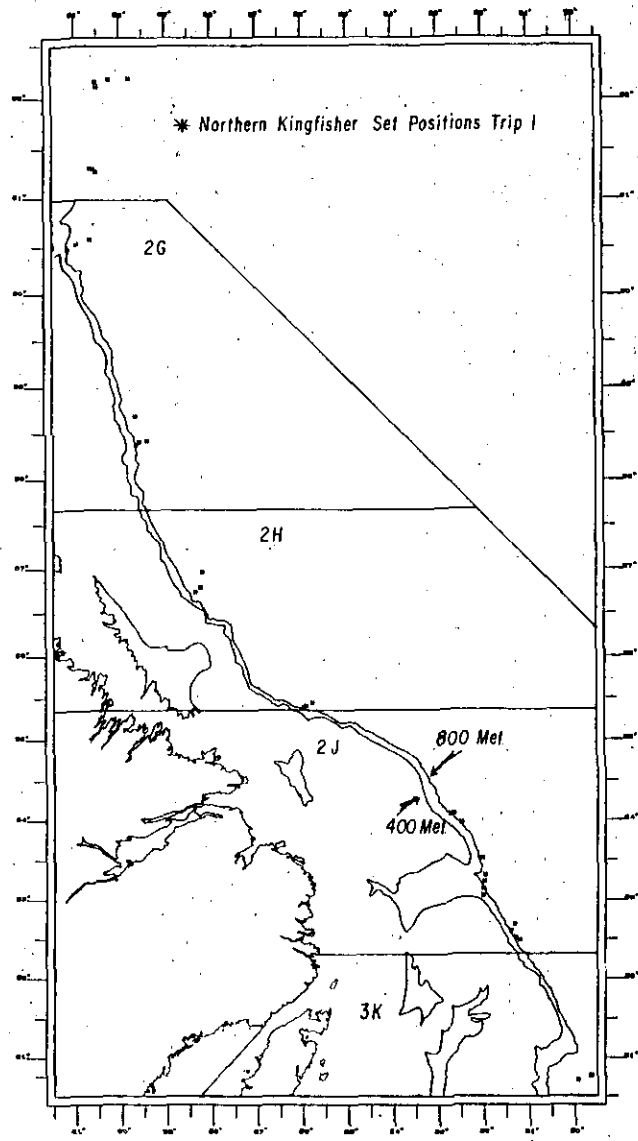


Fig. 1. Location of fishing stations for Northern Kingfisher survey in August, 1991.

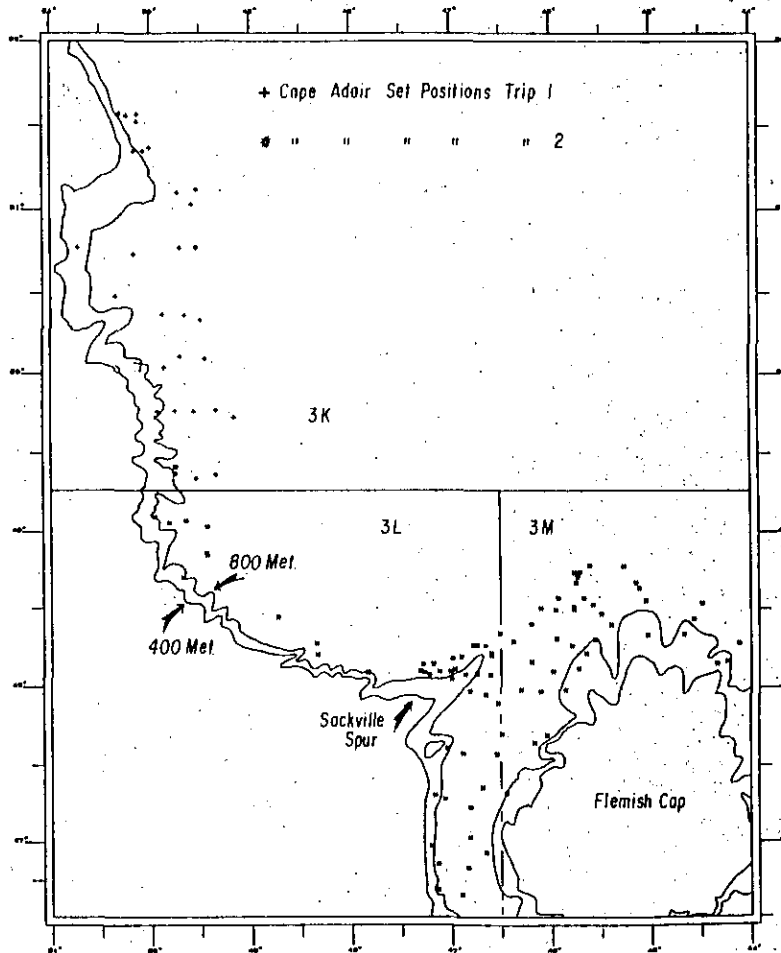


Fig. 2. Location of fishing stations for Cape Adair survey in September, 1991.

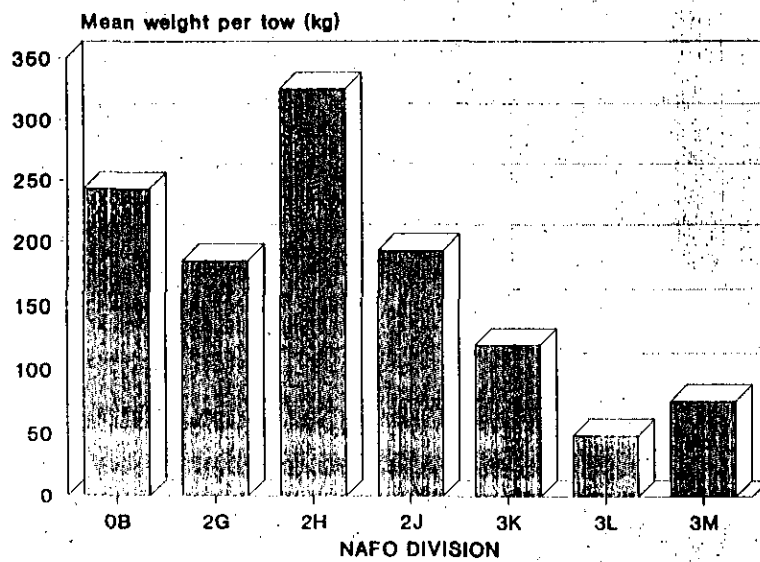


Fig. 3. Mean weight per tow of G. Halibut by NAFO Division.

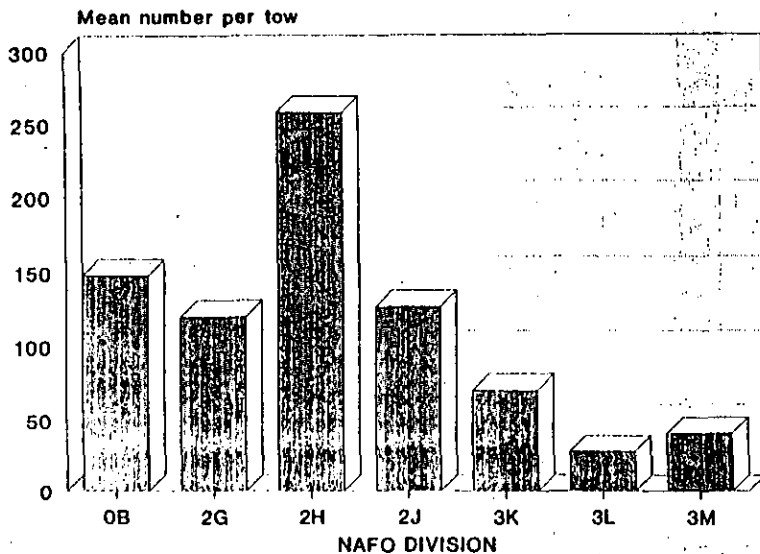


Fig. 4. Mean number per tow of G. Halibut by NAFO Division.

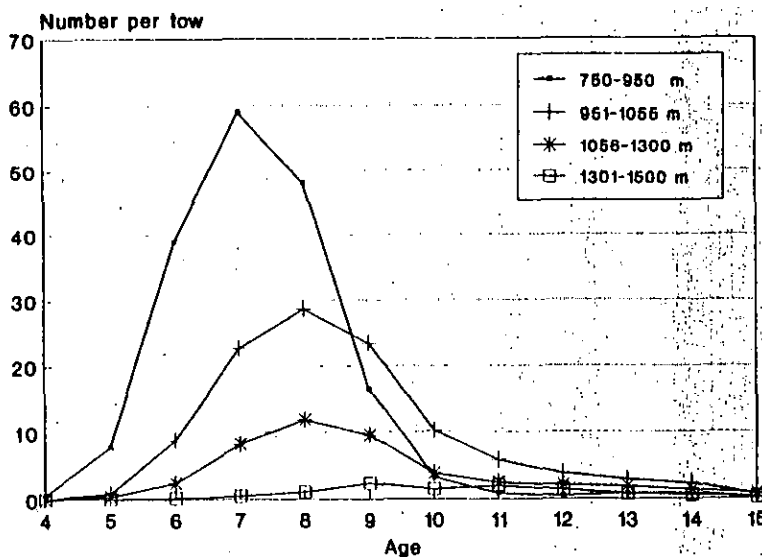


Fig. 5. Mean number per tow by depth zone for G. Halibut in Division 3K.

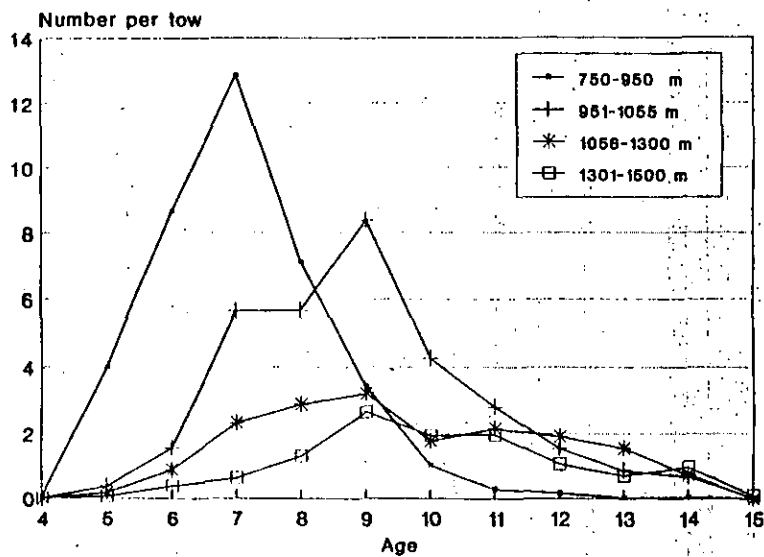


Fig. 6. Mean number per tow by depth zone for G. Halibut in Division 3L.

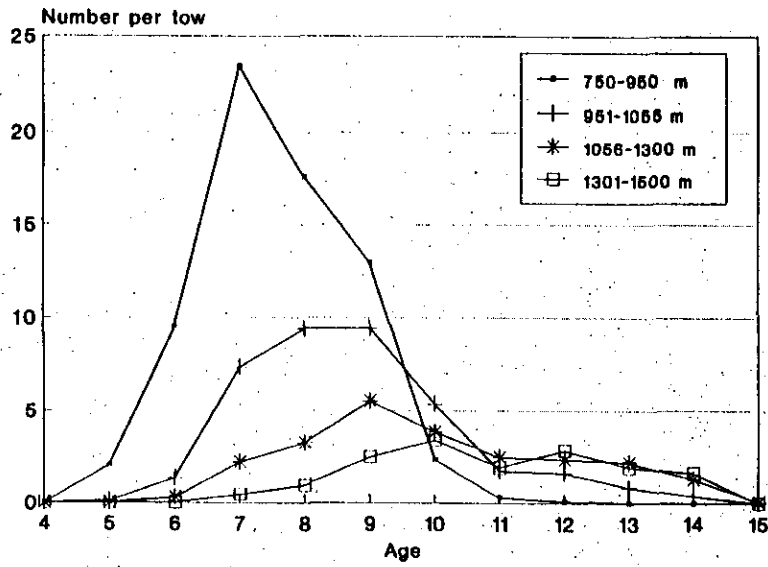


Fig. 7. Mean number per tow by depth zone for G. Halibut in Division 3M.

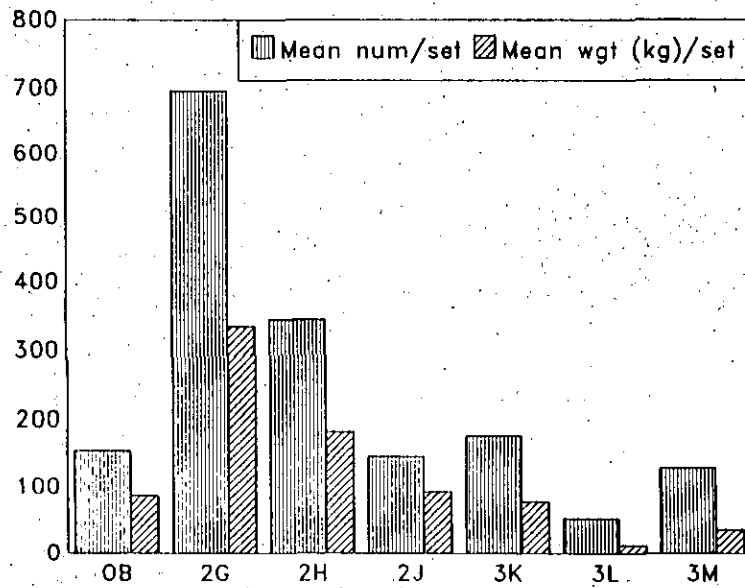


Fig. 8. Mean number and weight (kg) per set for Roundnose Grenadier