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American Plaice Distribution on the Nose and Tail of the Grand Bank

by

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Introduction

The greatest abundance of American plaice (Hippoglossoides platessoides) occurs on the Grand Bank off Newfoundland in NAFO Div. 3L, 3N, and 3O. The fishery occurs mainly on the northwestern section of the bank (Div. 3L) in depths of 70-185 m and on the southeast edge of the bank (Div. 3N) in depths of 70-275 m.

In April 1987, several large catches of American plaice were taken on the northeast slope ("Nose") of the Grand Bank by the research vessel W. TEMPLEMAN, fishing in depths of 520 m. The magnitude of these catches, as well as the depth at which they were obtained, had never been observed in previous surveys (Walsh and Brodie, 1987). In September of 1986, several large catches of 1-4 year old juvenile plaice were caught by the research vessel W. TEMPLEMAN, using a small mesh shrimp trawl, on the southern part ("Tail") of the Grand Bank in shallow water. This prompted re-examination of the historical database on distribution of juvenile American plaice on the southern Grand Bank (Walsh and Brodie, 1987).

This paper will report on the further investigations on depth distribution on the Nose of the Bank and the juvenile flatfish nursery on the Tail of the Bank from surveys conducted in 1987 and 1988.

Material and Methods

Line transect survey of the Nose of the Bank

In April of 1988, the research vessel W. TEMPLEMAN directed a survey in the area of the northeast slope of the Bank using line transects in depths 350-700 m (Fig. 1). This is the same area where the large catches were taken in 1987. The fishing gear used was an Engel 145 high-rise otter trawl. All sets were of 30-minute duration at a towing speed of 3.5 knots and a towing distance of 1.75 miles.

Juvenile surveys

A stratified random survey was conducted aboard the W. TEMPLEMAN in November of 1987 on the southern Grand Bank, NAFO Div. 3NO. The fishing gear used was a Yankee 41 (80/104) shrimp trawl and the survey was conducted inside the 91 m depth contour. All fishing hauls were of 30-minute duration at a towing speed of 2.5 knots and a towing distance of 1.25 miles.

Results and Discussion

Line transect Survey

The catch results for American plaice are shown in Table 1, and, as can be seen in

Fig. 2, large catches were obtained on Lines B and C, primarily in depths between 475 and 520 m. This is the same area where the largest concentrations of American plaice were observed in the 1987 survey. As was the case in 1987, large catches of other species, mainly redfish (up to 16,700 kg) and thorny skate (up to 7,000 kg), were common in most sets.

Preliminary analysis of the basic biological data collected showed many similarities in both years. The length frequency distribution and average weight in the larger catches are similar. In both years, virtually all sampled fish showed no food in the stomachs, and the sexual maturities observed ranged from immature to pre-spawning to post-spawning, with very few individuals actually in a spawning condition. A further similarity appears to exist in the time the fish were in this area in 1987 and 1988. In 1987, the large catches were taken in the April 14-16 period, after which the research vessel left the area. The commercial fishery was able to take some good catches of American plaice and other species in the same area for a short period. Two sets conducted by the same research vessel about a month later, in the same area, caught no American plaice at all. As well, a set in this area in July also resulted in no American plaice. In 1988, the line transects were conducted between April 7 and 11, after which time the vessel left this area. Between April 14 and 26, several commercial vessels were in this area and reported very poor catches of all species, often from the exact positions where large catches had been taken in the survey. On May 20 and 21, 6 positions along Line C, in depths from 420-557 m, were occupied by the research vessel W. TEMPLEMAN. A total of 3 American plaice (2.1 kg) was caught. The bottom temperature averaged about 3.2°C at this time, compared to 3.4°C in April 1988 and 3.3°C in April 1987.

To determine the extent of the American plaice concentration observed in the April 1988 survey, biomass estimates were calculated based on the stratification scheme used in Canadian stratified random surveys in Div. 3L. With the exception of 2 sets (11 and 31), post-stratification showed that all the sets on Lines A-D fell within the boundaries of Stratum 735, which ranges from depths of 368 to 549 m, and Stratum 736, which ranges from depths of 550 to 732 m (Fig. 1). Given a standard trawl wingspread of 45 feet, a towing distance of 1.75 nautical miles, an assumption of constant catchability at 1.0, and areas of 272 square nautical miles (Stratum 735) and 175 square nautical miles (Stratum 736), the number of trawlable units in Stratum 735 is 20,417 and in Stratum 736 is 13,136. In Stratum 735, there were 16 sets, with catches of American plaice ranging from 9.0 kg to 2698.0 kg per 30-minute tow (Table 1), and an average of 406.3 kg. Multiplying this average by the number of units produces a biomass estimate of 8295 t. This is likely to be an overestimate, given that the catches clearly are not uniformly distributed and the larger ones appear to be confined to an area around Lines B and C between 476 and 517 m. If one assumes that the number of trawlable units is distributed evenly by depth in Stratum 735, and that the area of highest density of American plaice covers ½ of the area between the depths of 476 and 517 m in Stratum 735, then the following formula can be used to calculate the number of trawlable units in this area:

$$\frac{517-476}{549-368} \times 0.5 \times 20417 = 2312.$$

Applying the average catch from the 5 sets in Lines B and C between 476 and 517 m (1171.8 kg) to this value produces a biomass estimate of 2710 t. When this is combined with the biomass for the rest of Stratum 735, calculated in a similar fashion (1056 t), the total is only 3766 t, less than half of the previous estimate. The biomass in Stratum 736 is 1419 t, based on an average catch of 108.1 kg and 13,136 trawlable units. Therefore, it appears that despite the magnitude of the catches in this area, the estimate of trawlable biomass is in the range of 5-10 thousand tons only, compared to recent estimates for Div. 3L of 180-200 thousand tons.

Juvenile Survey

Figures 3 and 4 show the distribution of 1-year-old juvenile plaice on the southern Grand Banks (NAFO Div. 3NO) for 1986 and 1987. Stratum 353 was not surveyed in 1987. The majority of the largest catches during the 1987 survey occurred in the southern region of the Southeast Shoals (Stratum 376) and as far west as Stratum 360 outside the 200-mile limit (Tables 2, 3 and 4 Fig. 3 and 4). Tables 2, 3 and 4 also show catches of 2-, 3-, and 4-year-old juvenile plaice as well as numbers of plaice older than 4 years that were caught in the survey. In both 1986 and 1987, there was mounting evidence to support the hypothesis that the shallow waters of the Tail of the Bank serve as a large nursery area for 1-4-year old juvenile plaice for the southern Grand Bank population. Catch rates in Stratum 360 show that average catch per tow for 1- and 2-year-old plaice are fairly constant during 1986 and 1987 surveys, but there has been a large drop in the catch rate for 3- and 4-year-olds as well as the adult population (Table 2). This is also reflected in numbers-at-age abundance estimates in this Stratum (Table 5), with an overall drop of 40% from 1986 to 1987 and an 84% decrease in fully recruited plaice.

It is believed that this nursery area in the southern Grand Bank is not a recent development. The standard bottom survey trawls used in groundfish surveys of the Grand Bank

since 1971 were not efficient enough to catch young plaice in comparison with the juvenile flatfish trawl (Fig. 5; Table 6). Examination of catch data from surveys of the entire Grand Bank between 1971-80 showed very low catches of 1- to 4-year-old plaice anywhere on the Grand Bank (Walsh, 1982). This nursery was detected by use of the small mesh shrimp trawl presently being used in the juvenile flatfish surveys, which also catches sufficient numbers of adult plaice.

Most of the large catches of juvenile plaice in both years have been located in an area of a mud deposit. This mud deposit is a regionally continuous glaciomarine section of 30 m thickness, which occurs in water depths as shallow as 55 m along the entire southwestern edge down to the Tail of the Bank (Fader and Miller, 1986). Preliminary results of analysis of macro benthos caught by the travl in these areas of high abundance show a strong association between large catches of brittle stars (Ophiura sp.), juvenile plaice and the mud deposit which extends 20 miles inward from the shelf edge. Water temperatures in the area of these large catches of juveniles ranged from 0.7°C to 3.5°C in 1987. It is suspected that the nature of bottom sediments may be providing a large food resource base. Further work on feeding, distribution of macro-benthos, and bottom sediments will be continued in this area.

References

Fader, G. B. J. and R. O. Miller. 1986. A reconnaissance study of the surficial and shallow bedrock geology of the southeastern Grand Banks of Newfoundland. In Current Research, Part B, Geological Survey of Canada, Paper 86-1B; 591-604

Walsh, S. J. 1982. Distribution and abundance of pre-recruit and commercial-sized American plaice on the Grand Bank. J. Northw. Atl. Fish. Sci. 3: 149-157

Walsh, S. J. and W. B. Brodie. 1987. Aspects of American plaice distribution in NAFO Divisions 3L, 3N and 3O. NAFO SCR. Doc. 87/47: 12 p

Table 1. Catch numbers and weights (per 30-min. tow) of American plaice from the line transect survey done in April, 1988 on the northeastern Grand Bank.

Line A Set	Depth	Catch No.	Catch Wt.
7	521	110	57.50
8	472	92	36.50
9	422	61	22.50
11	351	49	23.00
12	516	127	68.00
13	559	75	40.50
14	572	204	102.50
15	620	129	68.00
16	696	311	185.50
Line B			
17	514	2285	1232.63
18	507	1254	641.00
20	466	81	39.50
21	429	19	9.00
22	541	162	65.00
23	567	430	165.50
24	622	122	59.00
25	685	47	21.00
Line C			
27	517	400	177.00
28	493	4527	2698.00
29	476	1740	1110.21
30	421	52	21.00
31	359	172	60.00
32	521	313	118.50
33	573	605	312.50
34	626	176	70.00
35	688	125	56.00
Line D			
36	523	354	169.50
37	501	66	34.50

Table 2. Comparison of catch at age of American plaice in Stratum 360; NAFO Division 3N from juvenile surveys in 1986 and 1987.

Year	Set No.	No. Age 1	No. Age 2	No. Age 3	No. Age 4	No. > Age 4	Latitude	Longitude
1986	87	722	798	369	113	91	4319.9	5005.9
	88	35	36	39	50	287	4316.3	4939.4
	89	954	420	197	103	247	4330.7	4948.2
	90	952	750	559	275	415	4338.7	4947.8
	91	1981	1337	1194	559	315	4336.4	4959.1
	93	23	40	75	49	84	4341.6	5014.1
	94	31	42	70	62	169	4328.5	5020.1
	96	356	467	459	216	175	4308.4	5008.7
	97	185	714	704	287	375	4309.5	5020.5
	98	450	1032	864	271	190	4315.8	5032.7
	99	5	40	56	32	41	4336.9	5019.7
	100	871	873	732	313	378	4325.8	5052.4
	101	189	247	214	85	66	4343.1	5040.9
	102	21	19	24	13	43	4353.5	5057.7
Average No/Tow		483.81	486.80	396.98	173.58	205.43		
1987	15	16	34	19	13	8	4352.8	5028.1
	16	9	37	29	21	29	4340.3	5026.3
	17	1981	448	209	80	40	4335.9	5048.3
	18	192	468	202	82	45	4333.2	5055.2
	19	352	417	188	73	34	4328.4	5052.2
	20	138	119	60	27	21	4341.1	5040.4
	21	107	88	38	26	38	4342.2	5043.1
	22	34	28	13	14	36	4352.2	5032.7
	23	136	217	86	47	38	4346.7	5027.2
	26	187	1197	299	62	29	4332.7	5002.1
	27	376	1291	618	236	96	4320.5	5035.0
	28	348	261	71	25	48	4310.7	4945.8
	29	753	247	108	36	66	4302.9	4956.9
	30	456	1519	510	165	48	4259.1	5014.8
	31	81	73	31	19	111	4304.7	5008.0
	32	65	813	301	166	66	4306.4	5035.1
	33	399	1025	447	139	68	4315.8	5052.9
	34	60	55	25	15	24	4343.5	5058.3
	39	193	155	83	58	43	4344.1	5035.9
Average No/Tow		309.58	448.80	175.49	68.55	46.74		

Table 3. Comparison of catch at age of American plaice in Stratum 376; NAFO Division 3N from juvenile surveys in 1986 and 1987.

Year	Set No.	No. Age 1	No. Age 2	No. Age 3	No. Age 4	No. > Age 4	Latitude	Longitude
1986	53	0	0	0	0	11	4412.7	4943.0
	56	0	0	0	0	594	4413.9	5002.5
	85	23	29	25	13	22	4352.9	4952.9
	86	7	42	55	29	36	4319.9	5005.9
Average No/Tow		7.62	17.64	20.00	10.24	165.75		
1987	24	232	640	106	23	11	4340.5	5005.8
	25	1031	705	115	33	20	4340.9	5000.8
	41	0	3	1	0	23	4409.8	5006.6
	42	0	2	0	0	1	4412.5	4949.0
	43	0	2	0	0	6	4356.0	4933.8
	44	1	1	0	0	2	4401.0	4924.2
	45	0	0	0	0	0	4401.7	4927.3
	46	0	1	5	3	17	4353.6	4925.8
	47	6	63	23	5	8	4344.5	4939.0
	48	0	19	7	1	18	4353.2	4947.3
Average No/Tow		127.02	143.50	25.64	6.51	10.60		

Table 4. Catch at age of American plaice from Stratum 353; NAFO Division 3Ø from juvenile survey.

Year	Set No.	No. Age 1	No. Age 2	No. Age 3	No. Age 4	No. > Age 4	Latitude	Longitude
1986	103	21	38	48	30	84	4349.0	5112.0
	104	651	530	385	127	46	4332.0	5118.9
	105	51	64	57	29	83	4340.0	5114.5
	106	36	54	67	44	122	4347.9	5103.2
	107	641	272	107	44	320	4349.1	5137.7
1987								
Average No/Tow		280.19	191.35	132.70	54.65	131.00		

* No survey in this stratum in 1987

Table 5. Comparison of abundance estimates at age for Stratum 360 in 1986 and 1987.

Age	1986 Numbers at Age	1987 Numbers at Age
1	153,870	98,459
2	154,823	143,736
3	126,257	55,812
4	55,206	21,803
5	20,014	4,977
6	22,692	3,611
7	11,994	1,505
8	4,882	700
9	2,209	422
10	1,142	223
11	774	212
12	639	157
13	513	150
14	255	139
15	232	65
16	106	21
17	15	0
18	23	0
19	6	0
Unknown	0	714.92
Total		
1+	555,651	331,707
4+	120,701	33,985
7+	22,790	3,594
1 to 4	490,156	318,810

Table 6. Comparison of gear selectivity of Catches of American plaice in NAFO Division 3N by various research trawls.

Age	Mean Catch 1980 ATC	Mean Catch 1987	Mean Catch 1987
	Yankee Otter[a]	Engel 145[b]	Yankee Shrimp[c]
1	0	0	117.54
2	0.1	0.05	154.21
3	0.35	0.55	61.69
4	1.10	1.38	25.42
5	2.88	1.95	8.47
6	5.83	3.12	8.88
7	5.10	3.56	4.92
8	3.92	3.44	4.50
9	3.60	4.11	4.96
10	2.62	3.36	4.10
11	1.47	2.48	2.75
12	1.17	2.64	1.87
13	0.95	2.55	1.72
14	0.78	2.04	2.20
15	0.53	1.81	1.89
16	0.47	1.03	0.94
17	0.55	0.41	0.25
18	0.11	0.24	-
19	0.04	0.04	-
20	.02	.02	-

[a] Standard Groundfish Bottom Trawl 1971-1982
[b] Present Standard Bottom Trawl since 1982
[c] Standard Juvenile Flatfish Trawl since 1983

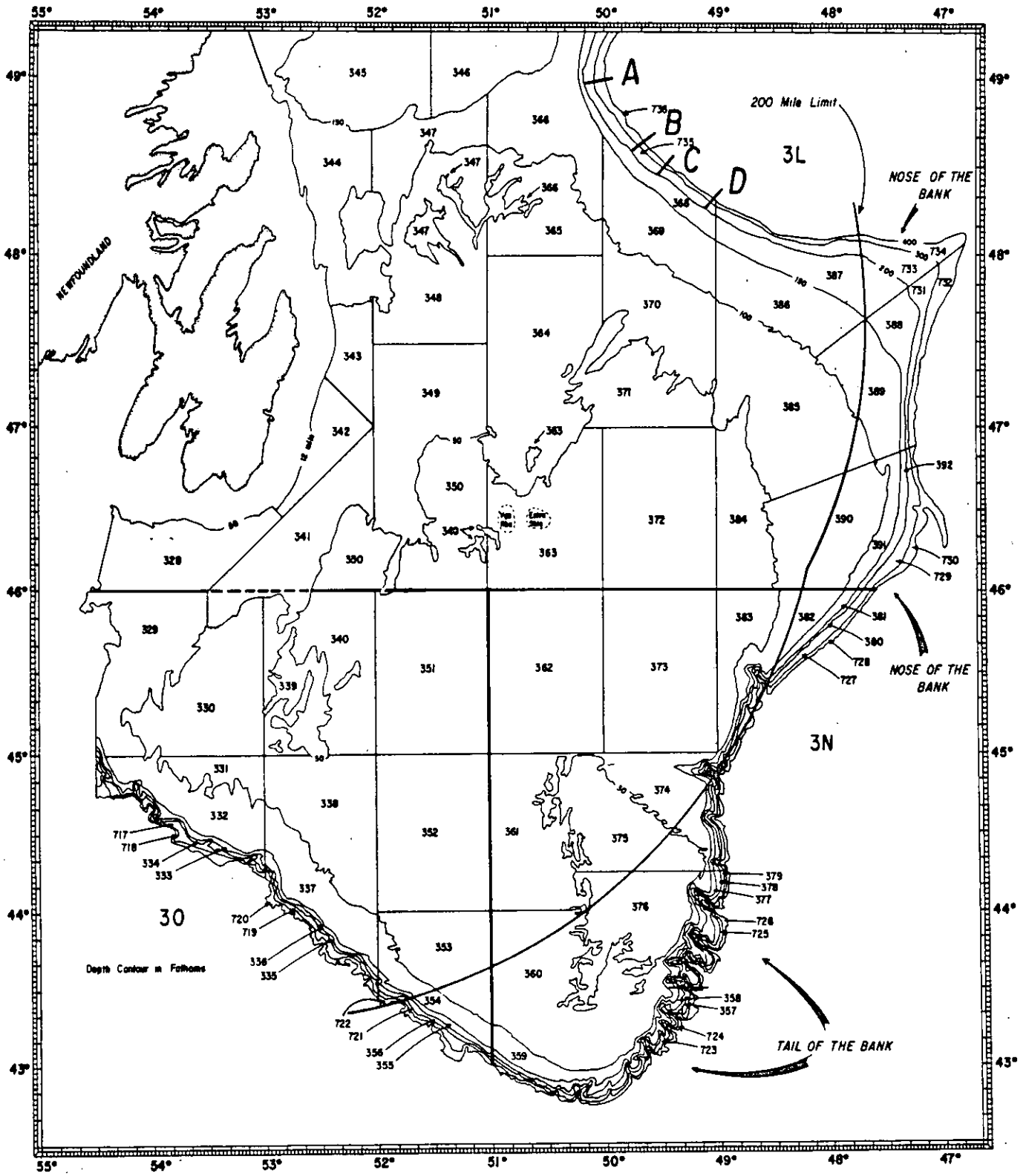

Fig.1 Stratification chart of the Grand Banks showing the 200 mile limit and Lines Transects A-D surveyed in 1988.

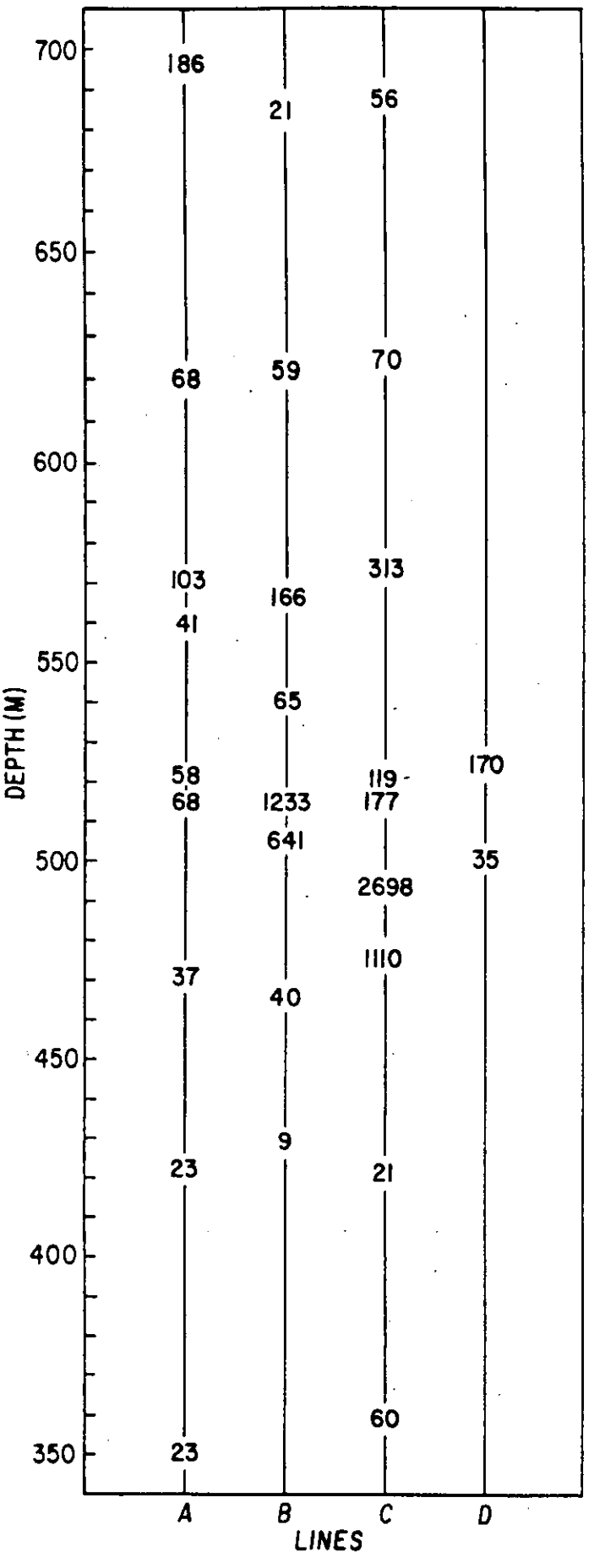

Fig.2 Actual weights of A.plaice caught during the 1988 line transect survey in Div. 3L.

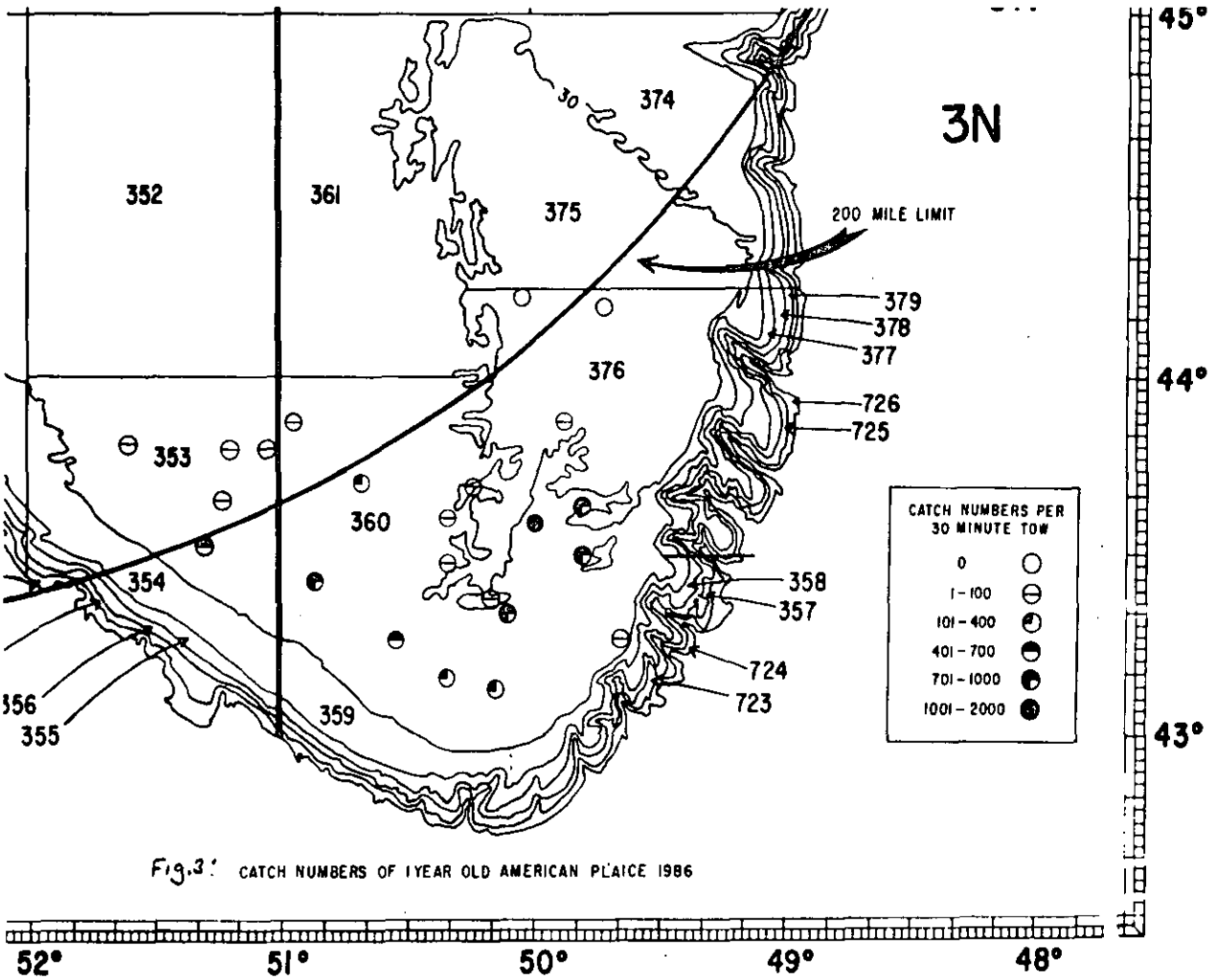

Fig.3: CATCH NUMBERS OF 1 YEAR OLD AMERICAN PLAICE 1986

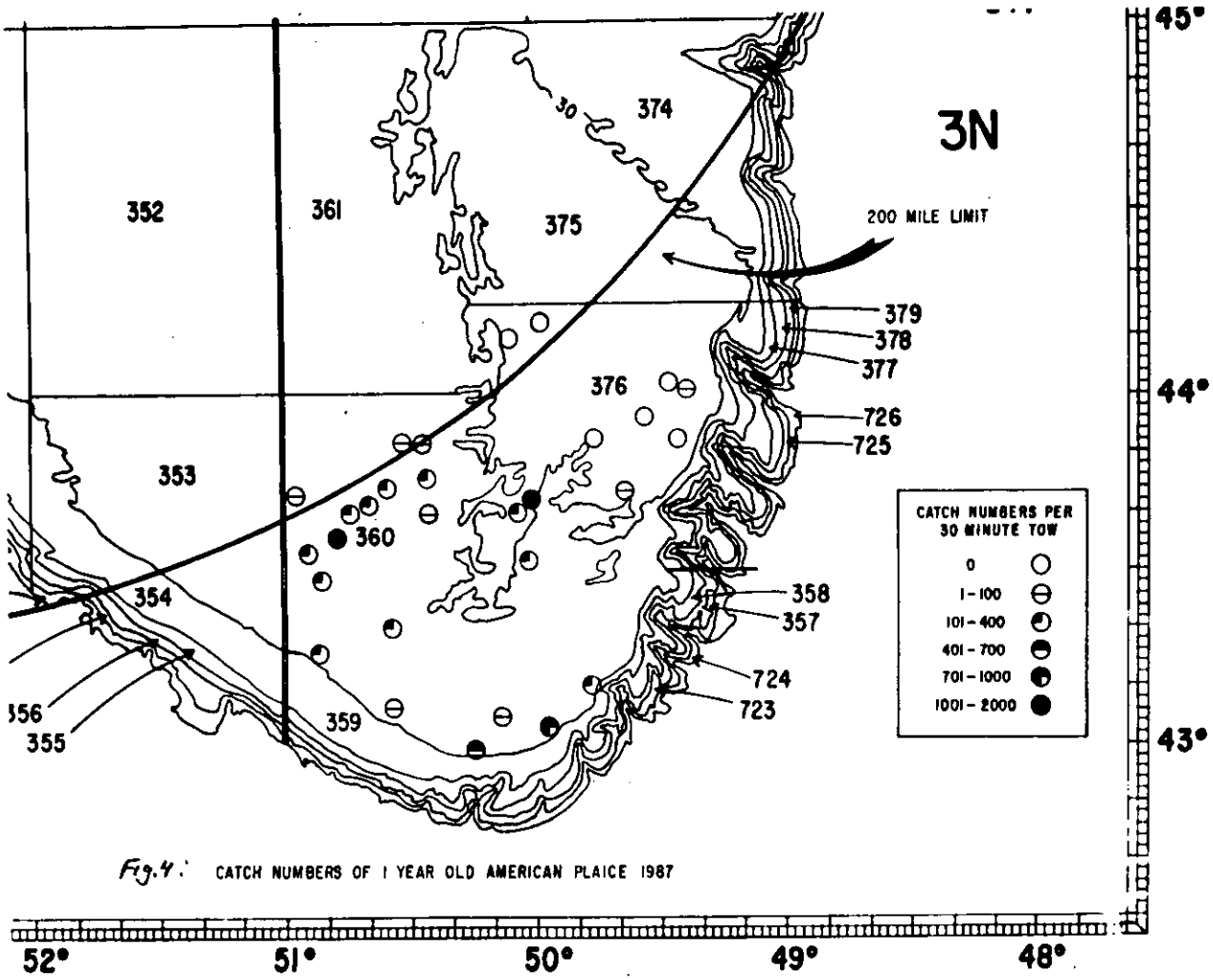

Fig. 4: CATCH NUMBERS OF 1 YEAR OLD AMERICAN PLAICE 1987

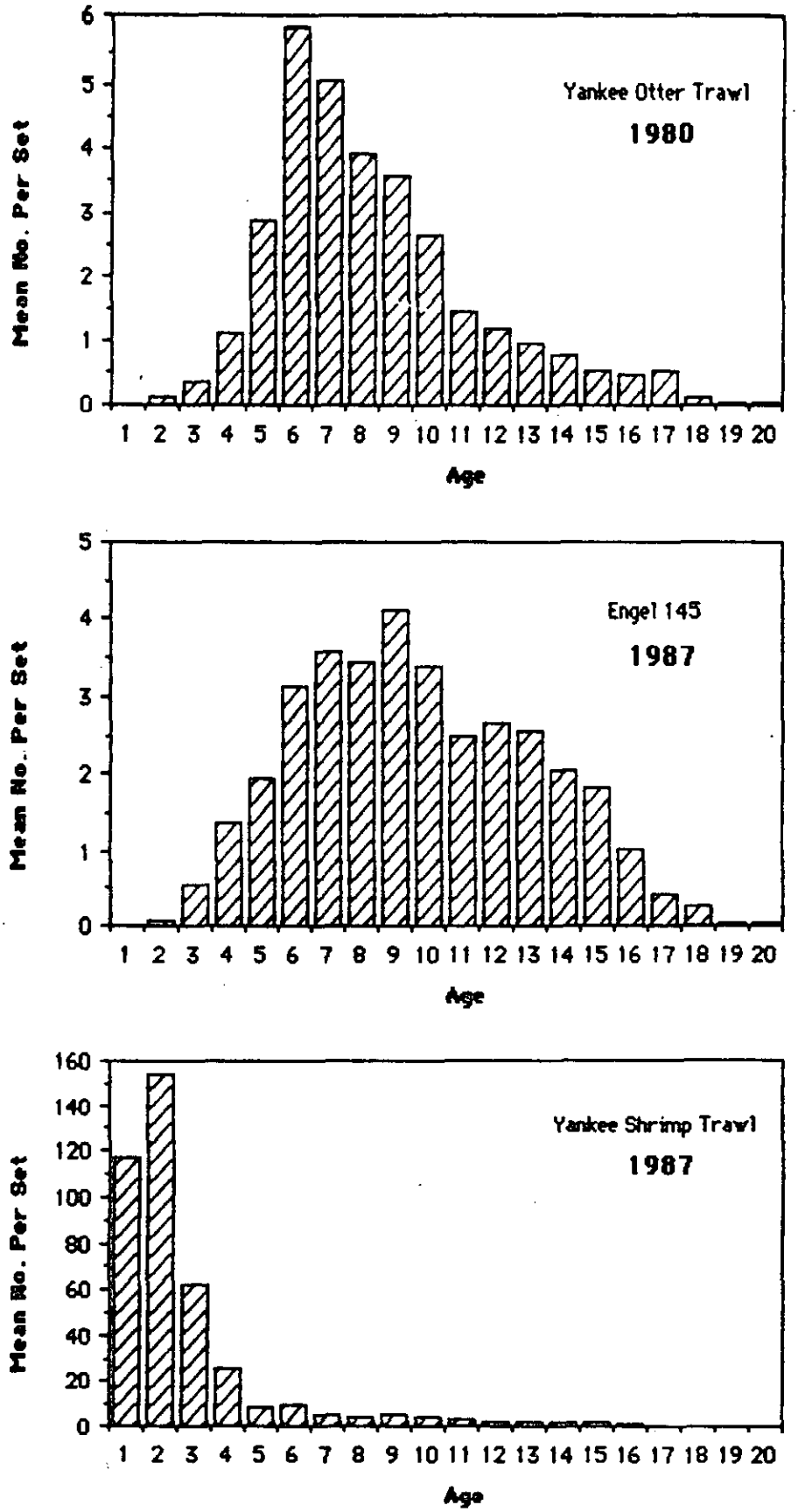

Fig. 5 Catch at age of A. plaice using different bottom trawls.