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Distribution of Juvenile American Plaice on the Grand Bank, NAFO Divisions 3LNO

by

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Introduction

Juvenile flatfish surveys on the Grand Bank have been conducted annually since 1985. The stratified-random sampling design covers only areas inside the 91-meter depth contour, primarily designed for juvenile yellowtail whose distribution rarely exceeds 91 meters. Walsh and Brodie (1988) highlighted distribution of American plaice on the Nose and Tail of the Grand Bank. These authors documented mounting evidence demonstrating that the area known as the "Tail of the Bank" was a possible nursery area for the southern Grand Bank A. plaice population. It was also noted that this nursery area lay outside Canada's 200-mile zone. This nursery area contained large numbers of plaice 1-4 years of age as seen in the 1986 and 1987 juvenile surveys.

This paper will report further investigation on distribution of juvenile plaice on the Grand Banks from additional studies carried out in the fall of 1988.

Materials and Methods

A stratified-random survey was conducted aboard the Canadian research vessel W. TEMPLEMAN in August/September of 1988 in NAFO Divisions 3LNO inside the 91-m depth contour. The fishing gear used was the standard juvenile flatfish trawl: Yankee 41 shrimp trawl with 38.1 mm mesh size and a 12-mm stretched mesh codend liner. All fishing hauls were of 30-minute duration at a towing speed of 2.5 knots and a towing distance of 1.25 miles. A total of 134 fishing hauls were made, distributed through all strata, with 11 additional exploratory hauls made in a stratum with a depth range of 91-183 m. These additional sets were made in stratum 359 in Div. 3N; strata 354, 331, 332, and 339 in Div. 3Ø; and stratum 364 in Div. 3L to explore new areas outside of the regular survey (Fig. 1).

Results

Table 1 shows the average catch (numbers and weights) of American plaice from juvenile surveys 1985-1988. Largest catches in terms of numbers were made in stratum 353 in Div. 3Ø, and stratum 360 and stratum 376 in Div. 3N during the 1988 survey. These strata usually accounted for the larger numbers of plaice during the other surveys in 1985, 1986, and 1987. Average weights associated with these catches are low and are indicative of small fish.

Table 2 shows the average catch per tow of juvenile plaice ages 1 to 4 years during surveys from 1985 to 1988. Largest catches of these juveniles have been taken in stratum 353 in Div. 3Ø, and stratum 360 and stratum 376 in Div. 3N in the area of the "Tail of the Bank."

Figures 2-5 show distribution of catches of 1-year-old plaice from 1985 to 1988. In 1985, the survey coverage in the southern area of the Bank was low in comparison to later years; and in 1985 and 1987, stratum 353 in Div. 3Ø was not sampled. High catches have been consistently seen in stratum 360 (Div. 3N). As well, large catches have been taken in strata 353 and 376. The distribution of 1-year-old plaice on the southern Grand Bank is overlapped by the distribution of 2-, 3-, and 4-year-old plaice (Tables 2-5). There have been smaller concentrations of 1-year-old plaice distributed in other areas of the Bank such as strata 362, 374, and 384 in Div. 3N and stratum 350 in Div. 3L. In this last stratum, one set, in 1988 near the 91-m contour line, resulted in a high catch of ages 1 to 4 which greatly inflated the estimate of average catch for this stratum in Table 2. An experimental set made

to the northwest of this station in stratum 364 (depth 160 m) in the area of the "Downing Basin," as well as other fishing hauls made in this area in another cruise in November, showed larger amounts of juvenile plaice in this area.

Figure 6 shows a length-frequency distribution of catches from the 1988 survey broken out into a frequency for Div. 3L, 3N, and 3Ø minus strata 353, 360, and 376 (Fig. 6a) and another for strata 353, 360, and 376 (Fig. 6b). Highest catches of juvenile plaice less than 26 cm were found in these three strata when compared to the rest of the Bank.

Tables 3-5 show the age composition on a set-by-set basis of catches in the strata 353, 360, and 376 broken down into ages 1-, 2-, 3-, and 4-year-olds as well as numbers of plaice greater than 4 years of age. The 1985 estimates were not included due to poor coverage in this area. In stratum 353, catches of age 1- and 2-year-olds decrease from 1986 to 1988 but 3- and 4-year-olds, as well as older fish, were increased. (No survey in this stratum in 1987.)

In stratum 376, the most notable changes were the increased catches of 3- and 4-year-olds, as well as older fish from 1987 to 1988. In stratum 360, where the coverage has been most intense, in 1986, 1987, and 1988, catches of 1-year-olds were high in 1986 and 1987 but were low in 1988, a small decrease in age 2 and an increase in ages 3- and 4-year-olds as well as older fish (Fig. 7).

Table 6 provides a comparison of numbers at age for stratum 360 during surveys of 1986, 1987, and 1988. Total abundance decreased in 1987 by 40%, from 1986, but increased by 18% in 1988. This increase in estimates for the last year is reflected in the abundance of 1- to 4-year-old plaice being dominated by 3-year-olds from the 1985 year-class. Fully-recruited plaice, age 7+, abundance decrease 84% from 1986 to 1987 but increase by 78% in 1988 consisting mostly of 7- and 8-year-olds from the 1979-80 year-classes.

Discussion

Again, another juvenile flatfish survey has provided more information to confirm a nursery area for plaice in the area of the "Tail of the Bank," outside Canada's 200-mile zone. During the 1988 survey, coverage was extensive for the whole of the Bank inside the 91-m contour; large amounts of juvenile plaice were not present in any other area of NAFO Div. 3N and 3Ø. It is believed that the nursery area covering stratum 353 in Div. 3Ø, and strata 360 and 376 in Div. 3N, is the nursery for the southern Grand Bank population. Fishing hauls made in strata 350 and 364 of Div. 3L yielded good catches of juveniles. Similarity in bottom sediment type in this area and the region of the "Tail of the Bank," consisting of silted mud, was noted. These areas may be providing a large resource food base for young settling plaice. It is hypothesized that the area in stratum 364 and other strata in the 91- to 183-m depth range is a nursery area for the northern Grand Bank plaice population.

In the fall of 1989, the juvenile flatfish survey will be expanded to include strata in the depth range of 91-183 meters in the northern section of the Bank, Div. 3L.

References

- Walsh, S. J. and W. B. Brodie. 1988. American plaice distribution on the Nose and Tail of the Grand Bank. NAFO SCR Doc. 88/28 Ser. No. N1464: 12p.

Table 1. Average numbers and weights of American plaice caught during juvenile surveys 1985-1988.

Div.	Stratum	Category	1985 ^a	1986	1987 ^a	1988
30	330	No. of sets Av. no./set Av. wt./set	- - -	- - -	- - -	2 24.48 40.47
30	331	No. of sets Av. no./set Av. wt./set	- - -	- - -	- - -	2 6.99 2.50
30	338	No. of sets Av. no./set Av. wt./set	- - -	3 33.00 15.50	- - -	6 89.60 14.49
30	340	No. of sets Av. no./set Av. wt./set	- - -	- - -	- - -	3 19.79 6.09
3L	350	No. of sets Av. no./set Av. wt./set	5 43.60 39.80	6 106.67 93.92	- - -	5 273.99 69.25
30	351	No. of sets Av. no./set Av. wt./set	3 66.00 35.00	9 81.33 36.28	- - -	7 48.11 39.47
30	352	No. of sets Av. no./set Av. wt./set	- - -	13 88.62 37.30	- - -	11 120.09 28.22
30	353	No. of sets Av. no./set Av. wt./set	- - -	5 794.00 51.33	- - -	4 700.71 145.90
3N	360	No. of sets Av. no./set Av. wt./set	3 189.67 29.00	14 1823.93 86.67	19 1043.14 47.28	20 1271.32 83.37
3N	361	No. of sets Av. no./set Av. wt./set	6 31.50 24.17	8 29.88 19.69	8 59.08 41.80	6 64.12 24.90
3N	362	No. of sets Av. no./set Av. wt./set	9 63.78 37.72	7 62.57 34.71	2 201.84 84.19	6 135.76 45.55
3L	363	No. of sets Av. no./set Av. wt./set	5 161.00 56.30	5 119.40 42.61	- - -	6 53.79 27.65
3L	371	No. of sets Av. no./set Av. wt./set	4 252.00 102.13	- - -	- - -	5 74.34 41.45
3L	372	No. of sets Av. no./set Av. wt./set	9 98.28 72.09	8 108.50 90.38	- - -	8 97.80 55.02
3N	373	No. of sets Av. no./set Av. wt./set	10 399.80 313.34	7 182.93 139.68	- - -	8 51.59 35.93
3N	374	No. of sets Av. no./set Av. wt./set	4 147.25 62.63	4 408.50 218.25	- - -	4 166.12 53.98
3N	375	No. of sets Av. no./set Av. wt./set	7 57.71 67.43	5 24.38 31.98	7 48.96 69.54	9 23.54 17.45
3N	376	No. of sets Av. no./set Av. wt./set	2 60.00 45.50	4 221.75 284.31	10 347.63 18.75	12 674.98 52.81
3N	383	No. of sets Av. no./set Av. wt./set	4 236.00 75.63	- - -	- - -	4 106.42 42.59
3L	384	No. of sets Av. no./set Av. wt./set	4 282.25 105.45	- - -	- - -	5 191.45 88.33

Table 2. Average catch per tow of juvenile and adult American plaice on the Grand Banks, NAFO Div. 3LNO in juvenile surveys 1985-88.

Stratum	Category	1985	1986	1987	1988
Div. 3Ø 330	No. of sets	-	-	-	2
	Age 1				0.00
	Age 2				0.04
	Age 3				0.36
	Age 4				0.09
Div. 3Ø 331	No. of sets	-	-	-	2
	Age 1				0.08
	Age 2				2.11
	Age 3				2.17
	Age 4				0.48
Div. 3Ø 338	No. of sets	-	3	-	6
	Age 1		1.35		0.67
	Age 2		5.73		25.84
	Age 3		4.55		33.32
	Age 4		1.17		9.60
Div. 3Ø 340	No. of sets	-	1	-	3
	Age 1				0.85
	Age 2				8.04
	Age 3				4.19
	Age 4				1.31
Div. 3L 350	No. of sets	5	6	-	5
	Age 1	0.09	0.71		27.17
	Age 2	0.21	0.27		88.67
	Age 3	0.24	0.17		53.24
	Age 4	0.32	0.57		17.14
Div. 3Ø 351	No. of sets	3	9	-	7
	Age 1	4.09	10.93		0.88
	Age 2	4.20	9.04		5.86
	Age 3	3.39	6.94		4.26
	Age 4	2.32	5.08		1.37
Div. 3Ø 352	No. of sets	1	13	1	11
	Age 1		11.00		2.37
	Age 2		10.28		24.20
	Age 3		12.00		34.83
	Age 4		7.21		14.33
Div. 3Ø 353	No. of sets	-	5	1	4
	Age 1		280.19		5.90
	Age 2		191.35		124.76
	Age 3		132.70		240.18
	Age 4		54.65		105.48
Div. 3N 360	No. of sets	3	14	19	20
	Age 1	24.79	483.81	309.58	28.69
	Age 2	66.08	486.80	448.80	300.14
	Age 3	32.64	396.98	175.49	507.20
	Age 4	11.07	173.58	68.55	220.37
Div. 3N 361	No. of sets	6	8	8	6
	Age 1	0.76	3.44	3.21	4.54
	Age 2	2.57	1.93	4.78	15.28
	Age 3	2.25	2.92	4.41	14.08
	Age 4	0.91	2.02	3.55	3.20
Div. 3N 362	No. of sets	9	7	2	6
	Age 1	1.28	0.83	41.76	14.01
	Age 2	3.84	3.41	29.94	38.32
	Age 3	3.19	4.39	28.82	22.05
	Age 4	2.54	4.49	17.36	6.56

Table 2 (Cont'd.)

Stratum	Category	1985	1986	1987	1988
Div. 3L 363	No. of sets	5	5	-	6
	Age 1	2.53	5.34		0.60
	Age 2	8.44	5.05		3.86
	Age 3	5.13	5.19		5.04
	Age 4	3.85	6.42		2.95
Div. 3L 371	No. of sets	4	-	-	5
	Age 1	5.13			1.84
	Age 2	9.49			4.08
	Age 3	5.33			2.86
	Age 4	4.84			2.05
Div. 3L 372	No. of sets	9	8	-	8
	Age 1	0.37	2.46		2.68
	Age 2	0.51	1.82		4.82
	Age 3	0.42	1.49		5.69
	Age 4	0.74	1.82		3.82
Div. 3N 373	No. of sets	10	7	-	8
	Age 1	3.43	1.83		0.49
	Age 2	12.23	2.57		2.74
	Age 3	9.87	3.76		2.37
	Age 4	7.23	4.88		1.12
Div. 3N 374	No. of sets	4	4	1	4
	Age 1	10.45	8.29		4.10
	Age 2	23.82	57.09		43.29
	Age 3	12.67	57.61		45.40
	Age 4	6.84	37.88		12.30
Div. 3N 375	No. of sets	7	5	7	9
	Age 1	0.0	0.28	0.78	0.17
	Age 2	0.05	0.33	1.07	4.93
	Age 3	0.11	0.17	0.52	5.22
	Age 4	0.07	0.14	0.40	1.35
Div. 3N 376	No. of sets	2	4	10	12
	Age 1	2.05	7.62	127.02	31.50
	Age 2	2.02	17.64	143.50	148.58
	Age 3	0.63	20.00	25.64	244.47
	Age 4	0.28	10.24	6.51	118.32
Div. 3N 383	No. of sets	4	-	-	4
	Age 1	10.78			6.60
	Age 2	26.03			19.40
	Age 3	17.71			14.76
	Age 4	11.26			6.48
Div. 3L 384	No. of sets	4	-	-	5
	Age 1	20.81			10.19
	Age 2	50.49			16.73
	Age 3	22.71			10.25
	Age 4	8.47			5.38

Table 3. Catch at age of American plaice from Stratum 353, NAFO Division 30 from juvenile surveys 1986 and 1988.

Year	Set No.	No. Age 1	No. Age 2	No. Age 3	No. Age 4	No. > Age 4
1986	103	21	38	48	30	84
	104	651	530	385	127	46
	105	51	64	57	29	83
	106	36	54	67	44	122
	107	641	272	107	44	320
Av. no./tow		280.19	191.35	132.70	54.65	131.00
1987		Not surveyed				
1988	124	2	26	38	12	44
	125	4	79	205	87	184
	126	12	255	382	153	322
	130	6	140	336	171	347
Av. no./tow		5.9	124.76	240.18	105.48	224.25

Table 4. Comparison of catch at age of American plaice in Stratum 376, NAFO Division 3N, from juvenile surveys in 1986, 1987, and 1988.

Year	Set No.	No. Age 1	No. Age 2	No. Age 3	No. Age 4	No. > Age 4
1986	53	0	0	0	0	11
	56	0	0	0	0	594
	85	23	29	25	13	22
	86	7	42	55	29	36
Av. no./tow		7.62	17.64	20.00	10.24	165.75
1987	24	232	640	106	23	11
	25	1031	705	115	33	20
	41	0	3	1	0	23
	42	0	2	0	0	1
	43	0	2	0	0	6
	44	1	1	0	0	2
	45	0	0	0	0	0
	46	0	1	5	3	17
	47	6	63	23	5	8
	48	0	19	7	1	18
Av. no./tow		127.02	143.50	25.64	6.51	10.60
1988	56	0	2	2	0	5
	79	0	0	1	1	12
	84	1	14	73	47	55
	89	43	295	1005	600	675
	90	95	694	626	214	210
	91	28	158	130	33	77
	92	0	2	4	2	16
	93	12	67	127	53	52
	94	0	4	29	24	24
	115	199	543	929	443	452
	116	2	5	7	4	2
	118	0	0	2	1	7
Av. no./tow		31.50	148.58	244.47	118.52	132.25

Table 5. Comparison of catch at age of American plaice in Stratum 360, NAFO Division 3N, from juvenile surveys in 1986, 1987, and 1988.

Year	Set No.	No. Age 1	No. Age 2	No. Age 3	No. Age 4	No. > Age 4
1986	87	722	798	369	113	91
	88	35	36	39	50	287
	89	954	420	197	103	247
	90	952	750	559	275	415
	91	1981	1337	1194	559	315
	93	23	40	75	49	84
	94	31	42	70	62	169
	96	356	467	459	216	175
	97	185	714	704	287	375
	98	450	1032	864	271	190
	99	5	40	56	32	41
	100	871	873	732	313	378
	101	189	247	214	85	66
102	21	19	24	13	43	
Av. no./tow		483.81	486.80	396.98	173.58	205.43
1987	15	16	34	19	13	8
	16	9	37	29	21	29
	17	1981	448	209	80	40
	18	192	468	202	82	45
	19	352	417	188	73	34
	20	138	119	60	27	21
	21	107	88	38	26	38
	22	34	28	13	14	36
	23	136	217	86	47	38
	26	187	1197	299	62	29
	27	376	1291	618	236	96
	28	348	261	71	25	48
	29	753	247	108	36	66
	30	456	1519	510	165	48
	31	81	73	31	19	111
	32	65	813	301	166	66
	33	399	1025	447	139	68
34	60	55	25	15	24	
39	193	155	83	58	43	
Av. no./tow		309.58	448.80	175.49	68.55	46.74
1988	78	0	8	15	7	37
	85	28	243	544	289	282
	87	13	88	86	58	124
	88	1	69	93	40	65
	95	9	616	1686	859	763
	96	8	115	213	89	77
	97	48	503	805	353	350
	98	2	37	59	36	47
	99	1	44	96	90	198
	100	1	75	122	59	162
	101	17	126	220	124	169
	102	20	566	553	209	319
	103	156	1077	2768	1251	769
	104	37	1134	1652	560	270
	109	122	905	628	137	70
110	16	141	243	92	74	
111	1	37	73	49	117	
112	22	59	82	33	104	
113	68	158	199	69	140	
114	5	4	8	4	50	
Av. no./tow		28.69	300.14	507.20	220.37	212.09

Table 6.. Comparison of abundance estimates (nos x 10⁻³) at age for Stratum 360 in 1986, 1987, and 1988.^a

Age	1986 Numbers at age	1987 Numbers at age	1988 Numbers at age
1	153,870	98,459	9,123
2	154,823	143,736	95,458
3	126,257	55,812	161,311
4	55,206	21,803	70,086
5	20,014	4,977	37,292
6	22,692	3,611	13,667
7	11,994	1,505	5,783
8	4,882	700	4,676
9	2,209	422	2,426
10	1,142	223	1,479
11	774	212	952
12	639	157	548
13	513	150	377
14	255	139	209
15	232	65	78
16	106	21	24
17	15	0	14
18	23	0	0
19	6	0	0
Unknown	0	714.92	0
Total			
1+	555,651	331,707	403,517
4+	120,701	33,985	137,625
7+	22,790	3,594	16,580
1 to 4	490,156	318,810	335,978

^aPoor coverage in 1985.

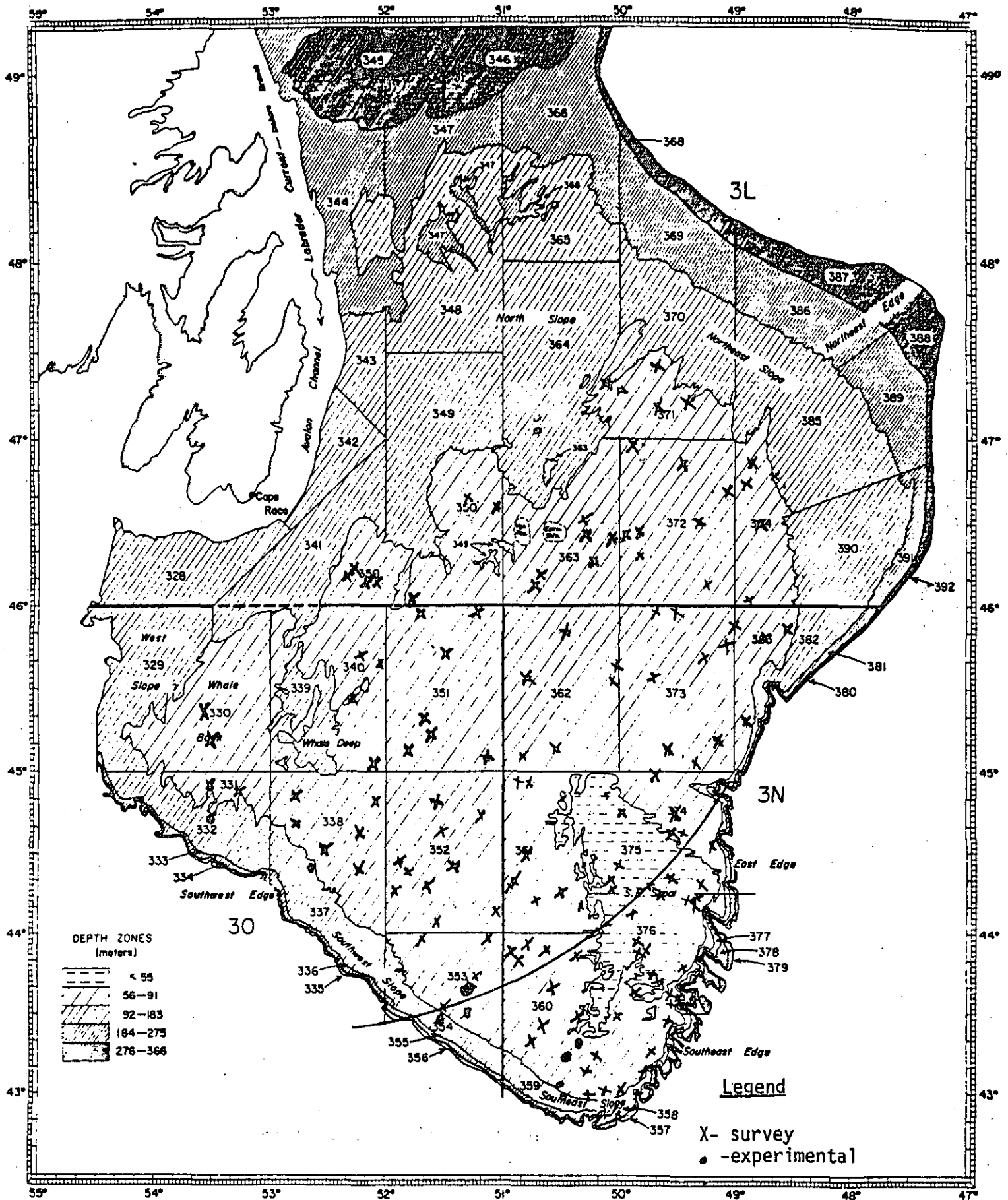


Fig. 1 Fishing hauls made during the 1988 juvenile flatfish survey

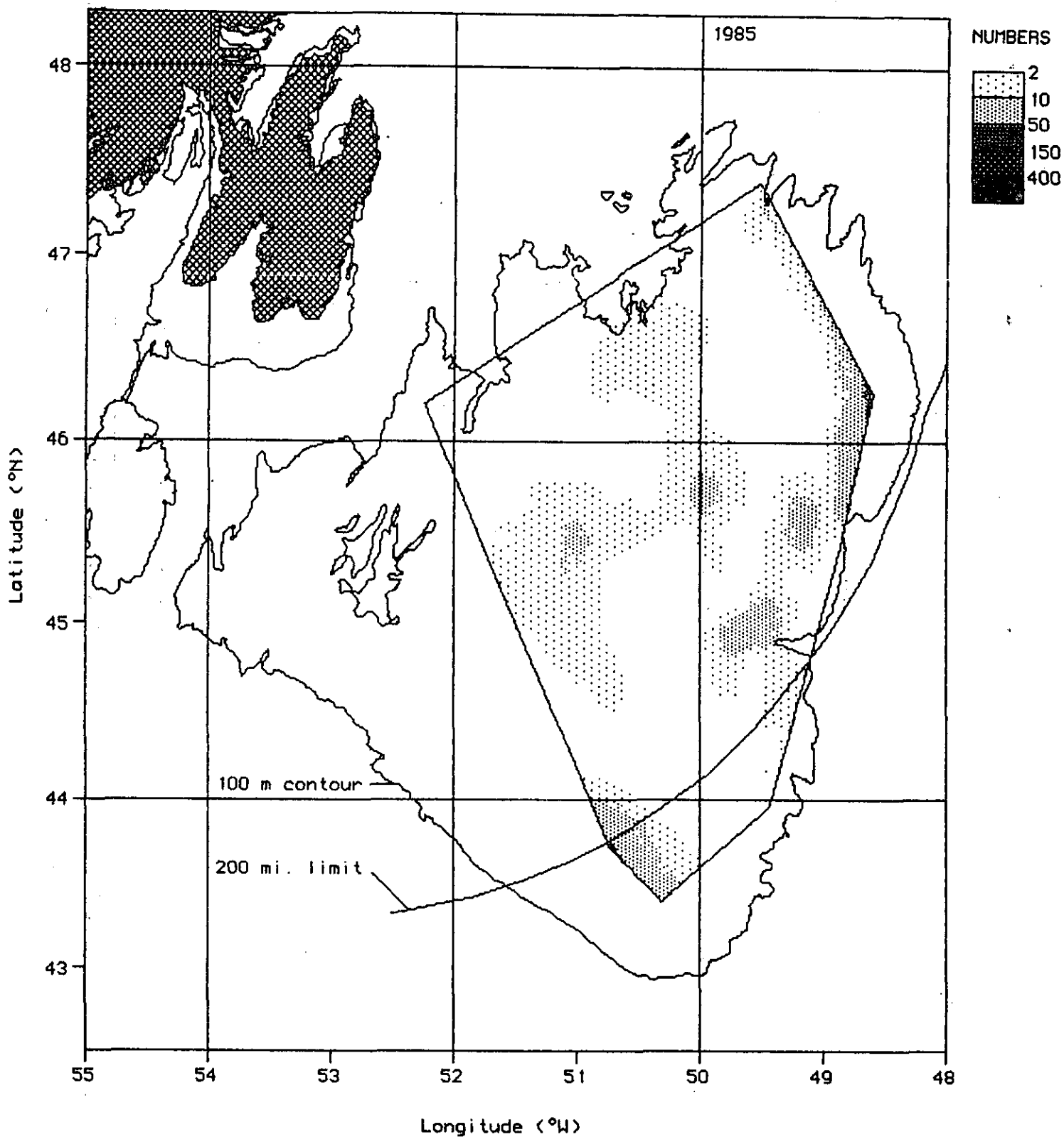


Figure 2: Distribution of age 1 American Plaice on the Grand Banks.

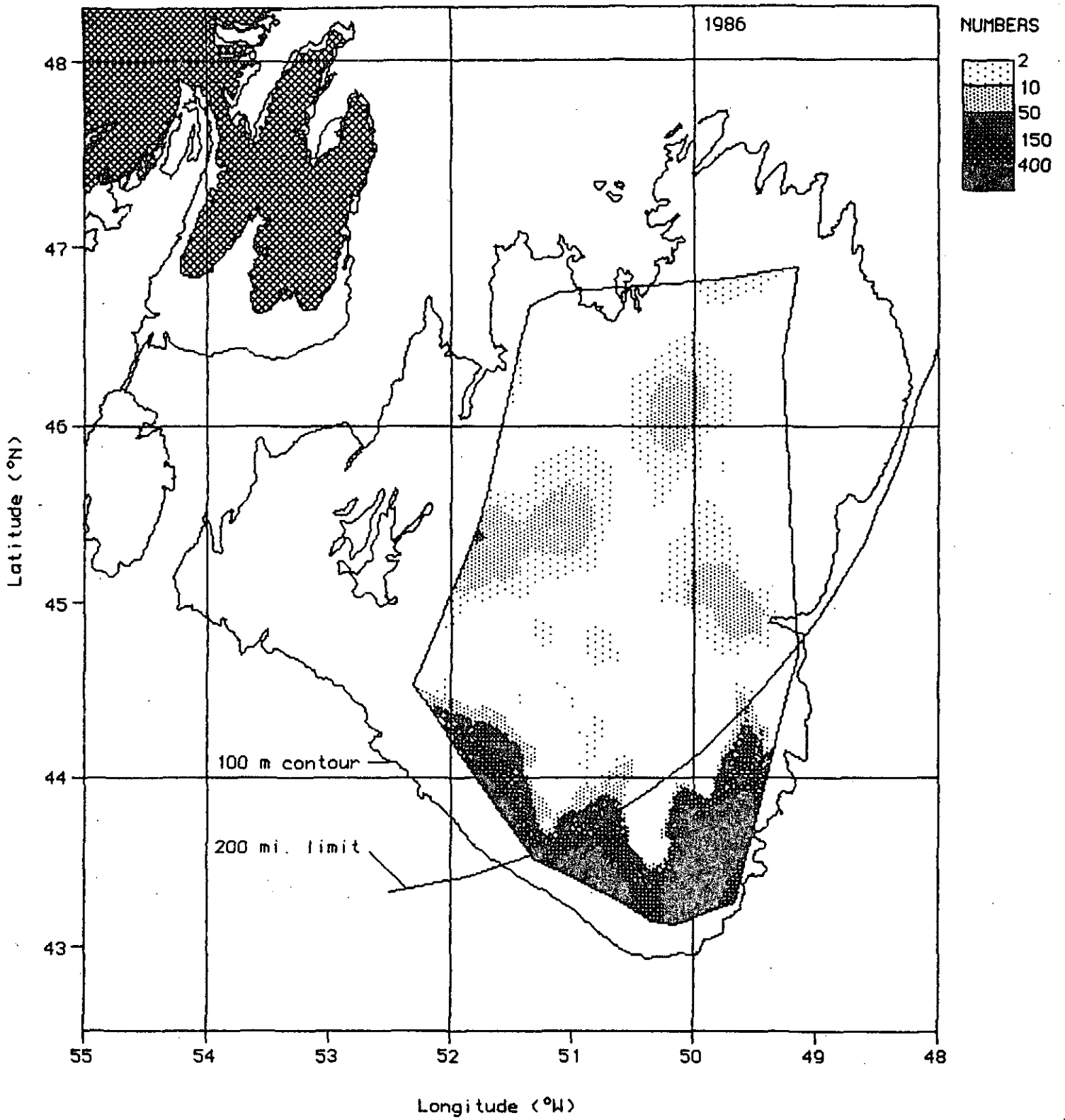


Figure 3 : Continued

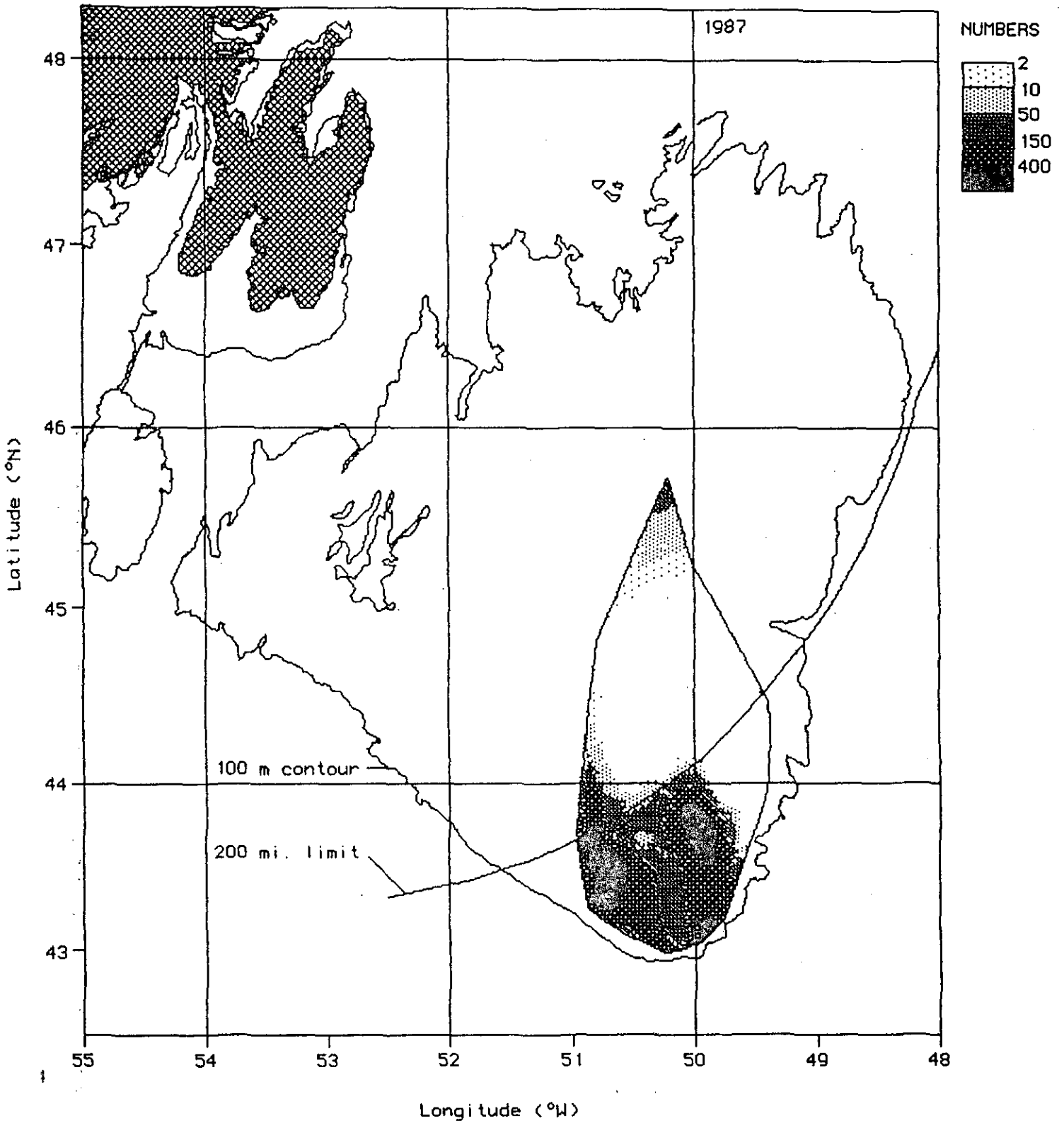


Figure 4: Continued

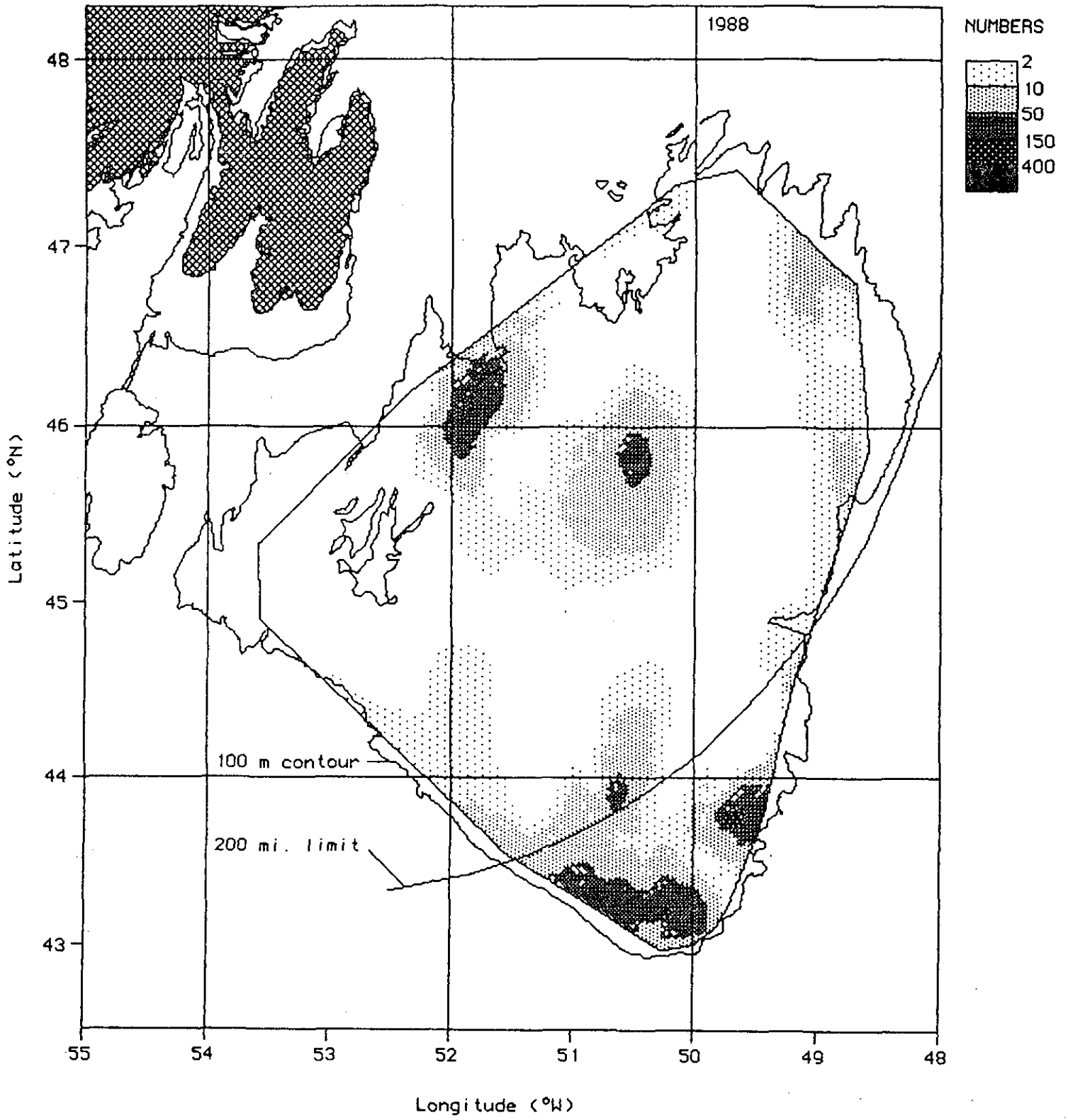


Figure 5 : Continued

AMERICAN PLAICE: 1988 JUVENILE SURVEY

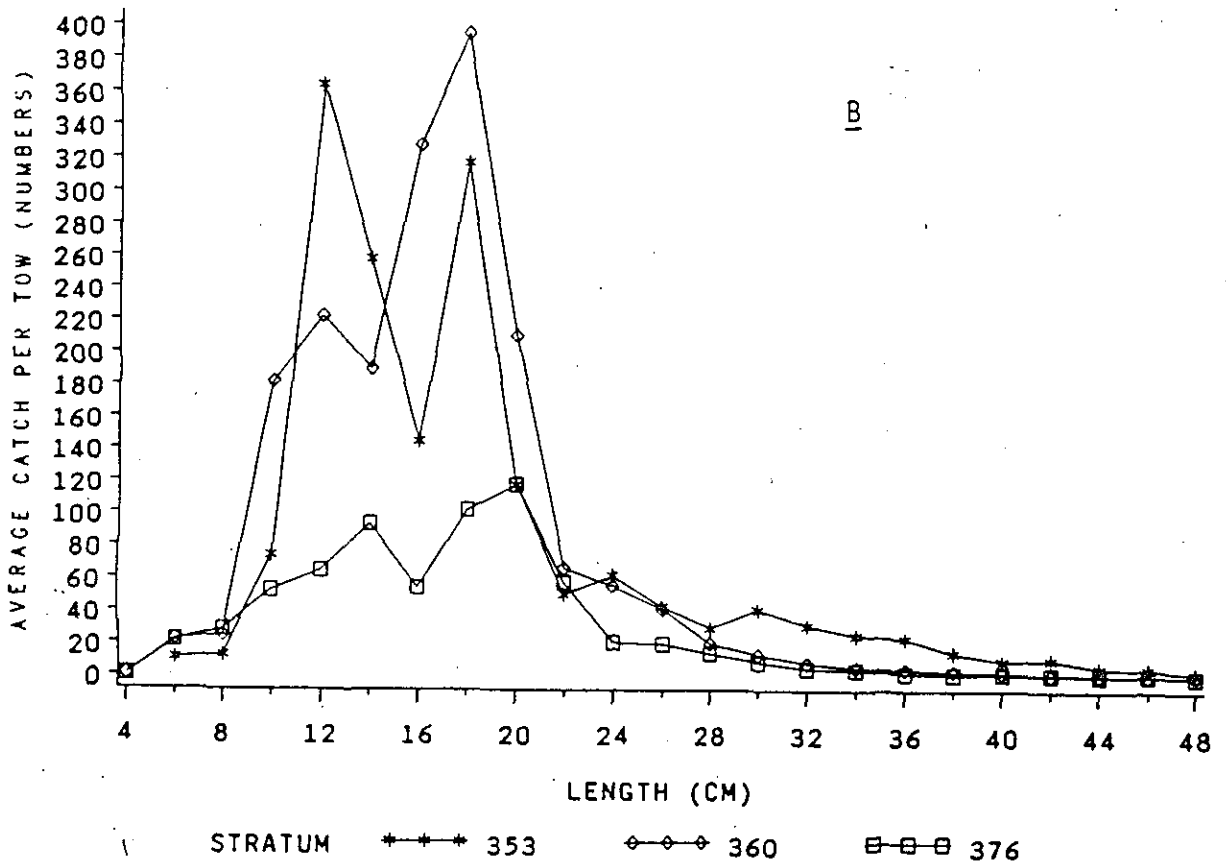
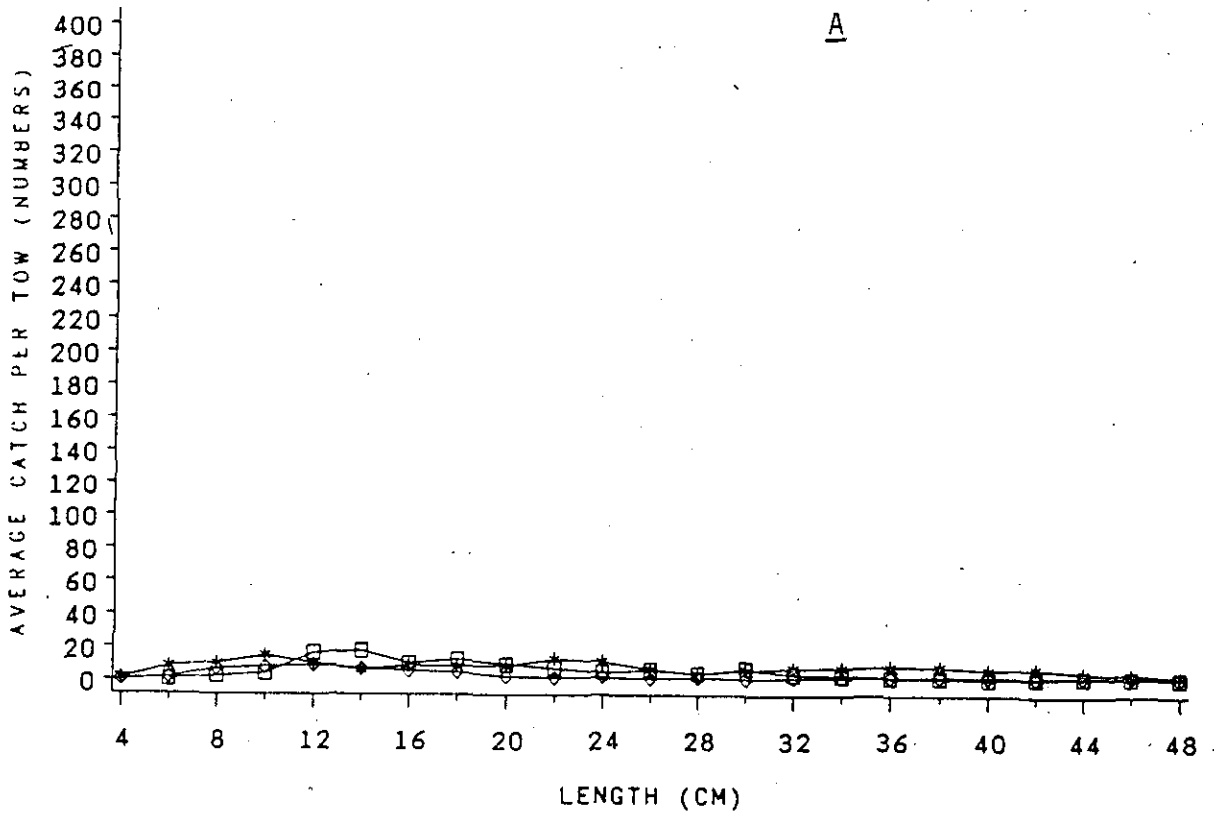


Fig. 6A. Length frequency distribution of American plaice in Div. 3L, 3N, and 30; Strata 353, 360 and 376 not included.

B. Length frequency distribution of plaice in strata 353, 360 and 376.

Fig 6

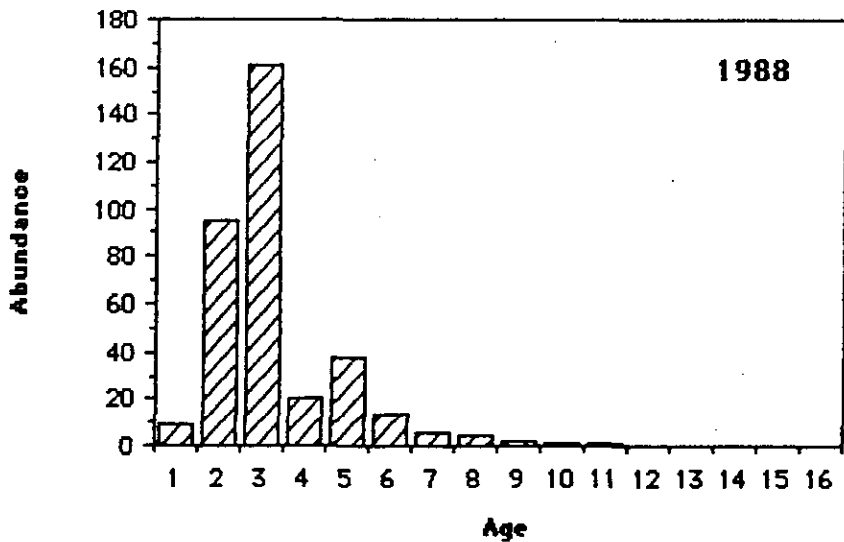
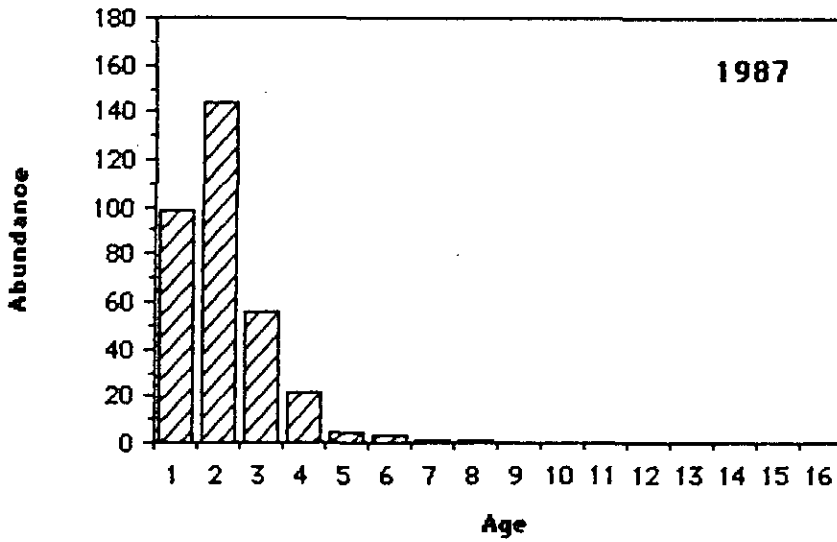
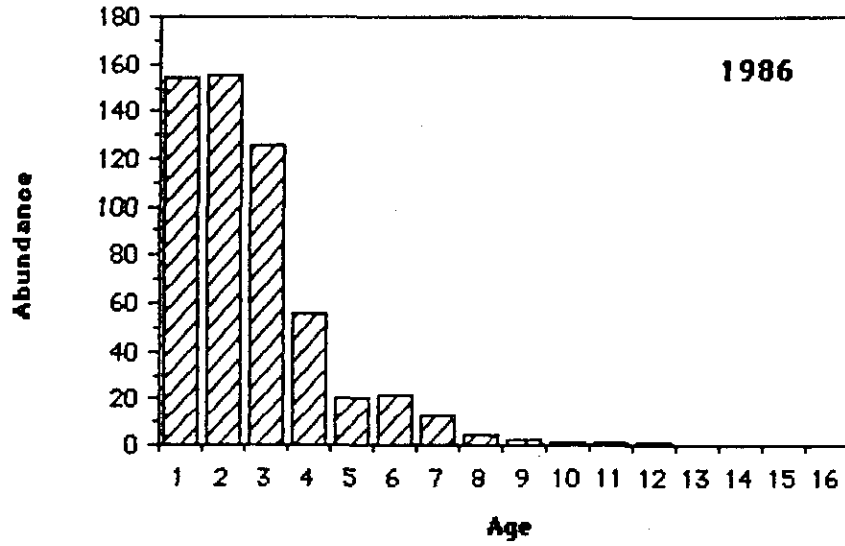


Fig.7 Abundance of A. Plaice from juvenile flatfish surveys in stratum 360 from 1986-88.