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Analysis of Catches of American Plaice, Cod, and Yellowtail Flounder From Research Vessel Surveys on the Tail of the Grand Bank From 1971 to 1989

by

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Introduction

This paper follows from Brodie (1987) in which groundfish catches from the area around the 200 mile limit in NAFO Div. 3NO were examined. At that time, data from a line transect survey conducted in 1986 were compared with data from stratified random surveys over the period 1971-86. It was concluded that increased commercial catches in the Tail of the Bank area from 1984 to 1986 contributed to the decline in abundance of some groundfish species in the area outside the Canadian 200 mile limit relative to the abundance inside 200 miles.

This paper will briefly review the analyses in the earlier paper and will examine additional survey data (from 1987 onward) with the purpose of determining whether the observed changes in groundfish abundance can be related to events in the commercial fishery outside the 200 mile limit. American plaice, cod, and yellowtail are major groundfish species on the Tail of the Bank and these three species are examined.

Methods and Materials

This paper concentrates on analysis of catch data from research vessel surveys only. Information from commercial fisheries is sometimes incomplete, and is usually of little use for analysis of distribution in localized areas.

1) Line transect surveys, 1986 and 1987

The line transect survey conducted by the research vessel WILFRED TEMPLEMAN in April 1986 (Fig. 2) was repeated by the research vessel LADY HAMMOND in March of 1987 (Fig. 3). The methodology was the same in both surveys, as described in Brodie (1987). Because of weather problems, Line A was omitted and Line B was not completed in the 1987 survey.

The few catches in the surveys which came from sets which did not cover the standard 1.75 nautical miles were adjusted by the appropriate factor. Although both surveys covered the same ground, they were conducted by different vessels which employed different otter trawls - the WILFRED TEMPLEMAN used an Engels 145 trawl and the LADY HAMMOND used a Western 2A. These trawls differ somewhat in the amount and size caught for some species, limiting the comparability between the two surveys.

In addition to the standard hydrographic measurements collected after each tow, catch numbers and weights were obtained for all fish species. American plaice, cod, and yellowtail were the most predominant groundfish species in the catches and were selected for analysis. Some biological information was collected for these species, but only on the 1987 survey.

2) Stratified random surveys, 1971-89

To examine the distribution of A. plaice, cod, and yellowtail in the vicinity of the 200 mile limit, data from stratified random surveys in Div. 3NO were chosen. These surveys were conducted in the spring of each year from 1971 to 1982 by the research vessel A. T. CAMERON and from 1984 to 1989 by the research vessels WILFRED TEMPLEMAN and ALFRED NEEDLER. The former vessel was a side trawler which fished with a Yankee #41-5 otter trawl, while the other two vessels are identical stern trawlers which towed an Engels 145 trawl. Figure 1 shows the area chosen by Brodie (1987) to correspond roughly to the area of the line transect surveys. Valid sets in this area were chosen, the catches of A. plaice, cod, and yellowtail were adjusted to the standard tow length where required, and each set was designated as being inside or outside the 200 mile limit.

Because the survey coverage in recent years has been more intense than in most earlier years, data for some periods were grouped into 3 years to give adequate sample sizes. The data for 1984-89 were kept separate by year for most analyses, as this is the period of greatest interest in this study. Non parametric statistics were conducted to test differences in catch levels on either side of the 200 mile limit, following the methods described in the earlier paper (Brodie 1987).

Results/Discussion

1) Line transect surveys, 1986 and 1987

A total of 80 successful tows was completed in the 1986 survey (Fig. 2), compared with 68 tows in 1987 (Fig. 3). Line A was not fished in 1987 and Line B was not completed and therefore was eliminated from the analyses presented here. In both surveys, American plaice, cod, yellowtail, and thorny skate were the species which occurred most often in the catches. Figure 4 and 5 show the catch numbers and weights for the first three species from the 1986 survey, while Fig. 6 and 7 show the same information from the 1987 survey. Line by line comparisons for these surveys can also be seen in Tables 1 and 2, for 1986 and 1987 respectively.

In both years, the largest catches of American plaice were taken on Line F, which has the greatest average depth. Average numbers per tow were higher on most lines in 1987 (particularly Lines F and G) but this is probably an artifact of the gear used in 1987 (Western 2A), which is better suited to the capture of small flounder than the Engels gear used in the 1986 survey. Both surveys showed that catch weight per tow was higher for sets inside the 200 mile limit on most lines, while catch numbers per tow were often greater outside 200 miles. In fact, there were few cases for American plaice where significant differences were observed (Table 3), although it is worthwhile noting that the weight per tow for all lines combined was significantly higher for sets inside 200 miles in both 1986 and 1987.

As can be seen from Fig. 4-7, cod were not as widely distributed over the survey area as the flounder species. It is interesting to note, however, that in both years, most of the tows without cod occurred outside 200 miles. Catches were relatively small, with the largest numbers in 1987 being taken on Line F; these consisted mainly of small fish (Table 2). In 1986 (Table 1), no cod were taken on this line, and the difference may be due in part to the different gear, at least for the results outside 200 miles, where the mean weight per fish was very low in 1987. The substantial change in temperature from 1986 to 1987 on Line F (-0.38°C to +3.71°C) is also likely to be part of the explanation. Line H also yielded catches of small cod in 1987, unlike 1986. As was the case for A. plaice, few of the individual lines showed significant differences in the catches across the 200 mile limit, although the totals for sets inside 200 miles for all lines were significantly higher for weights in both surveys, and for numbers in 1986 (Table 3).

As was the case in 1986, yellowtail flounder were caught on most lines in 1987, with the exception of lines F and G in the deeper water, which contained few yellowtail in both surveys (Fig. 4-7). Excluding these lines, 8 of the 9 sets in 1986 and all 4 of the sets in 1987 which contained no yellowtail were outside 200 miles. In both years, catches were highest on the lines in the middle of the survey area, those being C, D, E, H, and I (Fig. 2). As was seen for A. plaice and cod, catches of yellowtail in 1987 contained smaller fish on average than in 1986 (Tables 1 and 2). For most comparisons on the individual lines, catches were significantly higher, both in numbers and weights, from the sets inside 200 miles (Table 3). The totals for all lines combined were also significantly higher for the sets inside 200 miles in both 1986 and 1987.

To summarize the results from the transect surveys, it can be concluded that both surveys showed higher catch weights of all three species inside 200 miles in most areas. In 1987, there were greater quantities of small fish present in the catches particularly in some areas outside 200 miles. Possible explanations for the latter include differences in fishing gear and a substantial difference in bottom temperature on lines F and G. Other factors, such as tow distance, bottom depth, and survey timing were relatively constant between surveys.

2) Stratified random surveys, 1971-82 and 1984-89

Table 4 shows the breakdown of the 404 sets chosen from the spring surveys for comparison with the line transect data. For American plaice, the mean number per tow was greater from sets outside 200 miles for all 3 year periods except 1984-86 (Table 5, Fig. 8). These differences were significant in 1974-76 and 1977-79 (Table 5). Table 5 also shows a trend in the mean weights, with catches outside 200 miles being greater than or equal to catches inside 200 miles in most of the periods before 1983 (Fig. 9). However, after 1983, the opposite is true, with the results being statistically significant (Table 6). It should be noted that comparison of the mean/tow for years prior to 1983 with the mean/tow for years after 1983 is not particularly meaningful, as different

vessel-gear combinations were used in these periods. Figure 10, which shows the mean weight of individual A. plaice over time, indicates that the mean weight has always been greater and more variable inside 200 miles. This is not surprising, given the findings by Walsh (1989) which indicate that a substantial portion of the juvenile population of A. plaice in Div. 3NO is located outside 200 miles (Fig. 11). What is noteworthy in Fig. 10 is the decline in mean fish weight from 1984 onward, particularly in the area outside 200 miles. For cod, the mean number and weight per tow was almost always higher for sets inside 200 miles (Brodie 1987), with the differences being statistically significant from 1980 onward. Prior to 1980, the mean weight of cod per tow from sets inside 200 miles ranged from 9.8 to 21.9 kg/tow, but since then, has increased to between 63.0 and 115.5 kg/tow. For sets outside 200 miles, the mean has fluctuated between 3.3 and 18.6 kg/tow since 1971. In the case of yellowtail flounder, the mean number and weight per tow was greater for sets inside 200 miles in most of the time periods (Fig. 12 and 13). However, Table 5 shows that there are some periods (1980-82, 1985, 1989) where numbers are greater outside 200 miles. In all cases except 1985, mean weight per tow was greater inside 200 miles, being significantly so in 4 of the 6 time periods in Table 6. Fig. 12 and 13 also show that severe declines in mean number and weight per tow occurred from 1984 to 1986 in the area outside 200 miles. Figure 14 indicates that the mean weight per individual yellowtail was slightly lower outside 200 miles in all periods from 1971 to 1986. Again, this is expected, given the distribution of juvenile yellowtail in the Div. 3LNO stock (Fig. 15). However, there was a dramatic decline from 1986 to 1987, followed by a further decline in 1988. As indicated by the mean no./tow (Fig. 12), it was clearly something other than an influx of small fish which caused the decline in average weight outside 200 miles, i.e. a substantial decrease in the number of larger fish in the catches. However, in 1989, the mean no./tow increased substantially, as two strong year-classes recruited to the survey gear. Although the mean wt./tow also increased, the magnitude of the rise was much lower. Even though the stock as a whole has been in decline in recent years (Brodie et al. 1989), the changes in yellowtail abundance in the area inside 200 miles do not appear to have been as severe or abrupt as those outside 200 miles during the period of escalating catches (Fig. 16).

Examining these data, particularly for yellowtail and A. plaice, in conjunction with the line transect studies, suggests that changes in abundance relative to the 200 mile limit have occurred in the 1980's. Given the dramatic increases in catch which occurred on the Tail of the Bank in the mid 1980's (Fig. 16), this conclusion should not be surprising. Prior to 1977, the fishery was not restricted by the 200 mile limit. From 1977 to 1982, most foreign fleets did not direct effort towards flounder on the Tail of the Bank, as many continued to concentrate on salt cod. However, in the mid 1980's, many nations began fishing for groundfish with freezer trawlers, resulting in increased catches of many species. Evidence for the decline in the yellowtail stock has been documented in recent assessments (eg. Brodie et al. 1989), particularly for the area outside 200 miles. It is also evident from the historical survey data that the abundance of some groundfish species outside the 200 mile limit has changed substantially relative to the abundance inside 200 miles. The large changes in mean weight per fish, particularly for yellowtail, also correspond to the time when large increases in the catch outside 200 miles were occurring. Although the mid 1980's saw a period of very cold bottom temperatures (Fig. 17) over much of the Grand Bank (Wells et al. 1988), it is unlikely that this event, or any other physical influences could produce localized effects which would cause such changes in abundance to three species as diverse as A. plaice, cod, and yellowtail. Thus, it is the conclusion of this paper, in agreement with the earlier analysis, that the changes in abundance of some groundfish species on the Tail of the Bank were greatly influenced by the commercial fishery in recent years. However, analyses of factors such as juvenile abundance, growth rates, migration patterns, sizes of fish in commercial catches, and the physical environment will undoubtedly shed further light on the distribution of fish on the Tail of the Bank.

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Table 1. Average numbers and weights (kg) per tow for American plaice, cod, and yellowtail, and the average depth and bottom temperature of sets from the line transect survey conducted by the WILFRED TEMPLEMAN in April, 1986.

Line	Position of sets relative to 200 mile limit	Number of sets	Species: A. plaice Average number per tow	A. plaice Average weight per tow	Cod Average number per tow	Cod Average weight per tow	Yellowtail Average number per tow	Yellowtail Average weight per tow	Av. depth (m)	Av. temp. (°C)
A	inside	3	14.33	13.33	1.00	13.00	1.33	0.70	56.7	0.13
	outside	3	0.67	0.50	0.00	0.00	0.00	0.00	56.3	0.37
	all	6	7.50	6.92	0.50	6.50	0.67	0.35	56.5	0.25
B	inside	4	50.50	66.38	7.25	28.75	185.75	111.88	50.0	0.43
	outside	4	10.75	9.85	1.00	3.43	22.50	11.00	44.5	0.50
	all	8	30.63	37.62	4.13	8.38	104.13	61.44	47.3	0.46
C	inside	4	1.25	1.60	5.25	66.37	40.75	24.89	50.8	0.93
	outside	4	14.50	14.33	3.50	8.13	127.00	52.75	51.5	0.45
	all	8	7.88	7.97	4.38	37.25	83.88	38.82	51.1	0.69
D	inside	5	11.40	9.40	19.40	131.96	171.80	85.36	65.6	1.14
	outside	5	44.60	11.88	2.80	14.76	8.40	3.34	60.6	1.78
	all	10	28.00	10.64	6.98	73.36	90.10	44.35	63.1	1.46
E	inside	4	45.50	32.50	4.75	30.03	184.25	95.38	73.0	0.70
	outside	4	23.00	8.60	2.75	14.93	1.00	0.44	74.3	1.08
	all	8	34.25	20.55	3.75	22.48	92.63	47.91	73.6	0.89
F	inside	5	81.20	36.20	0.00	0.00	0.00	0.00	93.6	-0.32
	outside	5	14.80	3.14	0.00	0.00	0.00	0.00	102.4	-0.44
	all	10	48.00	19.67	0.00	0.00	0.00	0.00	98.0	-0.38
G	inside	3	45.67	19.83	0.33	4.50	0.00	0.00	79.0	0.73
	outside	3	22.00	6.40	0.33	0.02	0.00	0.00	87.3	-0.77
	all	6	33.84	13.12	0.33	2.26	0.00	0.00	83.2	-0.02
H	inside	4	30.00	19.25	14.75	136.13	146.50	69.75	66.5	1.18
	outside	4	36.75	11.30	2.25	6.25	18.75	9.38	68.8	1.90
	all	8	33.38	15.28	8.50	71.19	82.63	39.57	67.6	1.54
I	inside	5	16.60	18.90	17.80	266.26	77.60	35.90	60.0	1.12
	outside	5	46.60	21.32	3.00	20.49	34.40	9.60	58.0	0.86
	all	10	31.60	20.11	10.40	143.38	56.00	22.75	59.0	0.99
J	inside	3	3.00	5.68	6.67	47.82	21.67	14.94	47.3	0.50
	outside	3	22.00	20.40	0.33	10.50	65.00	25.17	44.3	0.33
	all	6	12.50	13.04	3.50	29.16	43.34	20.06	45.8	0.42
All lines	inside	40	31.10	22.85	8.45	80.80	88.63	45.39	65.4	0.72
	outside	40	25.10	11.00	1.73	8.47	27.15	10.86	65.4	0.61
	all	80	28.10	16.93	5.09	44.64	57.89	28.13	65.4	0.67

Table 2. Average numbers and weights (kg) for American plaice, cod, and yellowtail, and the average depth and bottom temperature of sets from the line transect survey conducted by the LADY HAMMOND in March 1987.

Line	Position of sets relative to 200 mile limit	Number of sets	Species: Am. plaice Average number per tow	Am. plaice Average weight per tow	Cod Average number per tow	Cod Average weight per tow	Yellowtail Average number per tow	Yellowtail Average weight per tow	Ave. depth (m)	Ave. temp. (°C)
C	inside	4	8.50	16.90	1.00	0.74	143.25	75.13	53.8	0.03
	outside	4	12.00	7.68	2.50	0.45	221.50	22.15	53.0	0.08
	all	8	10.25	12.29	1.75	0.60	182.38	48.64	53.4	0.05
D	inside	5	12.80	13.90	3.40	8.90	134.40	65.50	66.6	0.68
	outside	5	94.20	5.90	2.54	0.19	46.40	7.82	63.6	0.54
	all	10	53.50	9.90	2.97	4.55	90.40	36.66	65.1	0.61
E	inside	4	33.25	22.13	10.00	32.38	66.00	30.75	73.5	1.28
	outside	4	111.00	9.75	9.75	8.45	0.25	0.05	74.5	1.28
	all	8	72.13	15.94	9.88	20.42	33.13	15.40	74.0	1.28
F	inside	5	494.00	138.50	8.80	12.46	0.00	0.00	100.4	3.94
	outside	5	395.20	35.70	51.80	2.64	0.00	0.00	118.4	3.48
	all	10	444.60	87.10	30.30	7.55	0.00	0.00	109.4	3.71
G	inside	3	97.00	17.67	2.33	0.01	0.00	0.00	79.0	1.30
	outside	3	450.33	24.33	3.67	0.03	0.33	0.01	82.3	1.20
	all	6	273.67	21.00	3.00	0.02	0.17	0.01	80.7	1.25
H	inside	4	46.75	26.25	30.75	1.18	222.50	102.25	70.3	1.10
	outside	4	43.50	12.13	34.75	0.83	26.25	5.20	65.5	0.75
	all	8	45.13	19.19	32.75	1.01	124.38	53.73	67.9	0.93
I	inside	5	16.40	13.78	3.00	17.30	239.80	105.58	61.2	0.10
	outside	5	7.60	2.44	0.40	0.20	15.00	4.40	58.4	0.12
	all	10	12.00	8.11	1.70	8.75	127.40	54.99	59.8	0.11
J	inside	3	3.00	5.00	1.33	2.67	29.67	23.17	47.0	0.03
	outside	3	2.67	2.67	0.00	0.00	18.00	4.60	46.3	0.10
	all	6	2.84	3.84	0.67	1.34	23.84	13.89	46.7	0.07
All lines	inside	33	99.09	35.15	7.70	10.26	111.73	53.25	70.0	1.13
	outside	33	136.67	12.71	14.30	1.64	41.03	5.59	71.5	1.00
	all	66	117.88	23.93	11.00	5.95	76.38	29.42	70.7	1.06

Table 3. Results (p values) of the Wilcoxon 2-sample test for numbers and weights of A. plaice, cod, and yellowtail from the line transect surveys conducted in 1986 and 1987. The p values are for one-tailed hypothesis tests (H_o: inside>outside).

Line	Year	A. plaice		Cod		Yellowtail	
		No./tow	Wt./tow	No./tow	Wt./tow	No./tow	Wt./tow
A	1986	.04[a]	.04[a]	.10	.10	.10	.10
B	1986	.06	.03[a]	.12	.15	.03[a]	.01[a]
C	1986	.97	.94	.15	.048[a]	.94	.90
	1987	.62	.16	.27	.18	.77	.03[a]
D	1986	.46	.12	.03[a]	.07	.01[a]	.01[a]
	1987	.46	.03[a]	.46	.27	.03[a]	.01[a]
E	1986	.06	.06	.33	.16	.01[a]	.01[a]
	1987	.77	.16	.33	.16	.01[a]	.01[a]
F	1986	.01[a]	.01[a]	-	-	-	-
	1987	.20	.02[a]	.99	.42	-	-
G	1986	.04[a]	.04[a]	.40	.50	-	-
	1987	.96	.50	.50	.75	-	-
H	1986	.67	.10	.15	.16	.06	.04[a]
	1987	.44	.01[a]	.50	.24	.02[a]	.03[a]
I	1986	.66	.34	.03[a]	.01[a]	.02[a]	.01[a]
	1987	.07	.02[a]	.10	.08	.01[a]	.01[a]
J	1986	.87	.81	.04[a]	.09	.90	.87
	1987	.50	.33	.25	.25	.06	.04[a]
All	1986	.07	<.01[a]	<.01[a]	<.01[a]	<.01[a]	<.01[a]
	1987	.49	<.01[a]	.37	.01[a]	<.01[a]	<.01[a]

[a]Significant at 5% level.

Table 4. Number of sets selected from stratified-random surveys in NAFO Div. 3N and 30 from 1971 to 1989, and their position relative to the 200 mile limit.

Position	Year					
	1971-73	1974-76	1977-79	1980-82	1984-86	1987-89	Total
Inside	16	23	37	32	47	38	193
Outside	13	13	28	38	60	59	211
Total	29	36	65	70	107	97	404

Table 5. Average numbers and weights (kg) per tow, and average fish weight (kg) for American plaice and yellowtail taken in stratified random research vessel surveys from 1971 to 1989. The columns headed I and 0 refer to sets inside and outside the 200 mile limit respectively.

	Ave. No./tow		Ave. wt./tow		Ave. wt./fish	
American plaice	I	0	I	0	I	0
1971-73	50.1	60.6	45.6	31.1	0.91	0.51
1974-76	71.8	106.7	33.3	32.1	0.46	0.30
1977-79	68.3	257.9	31.2	78.5	0.46	0.30
1980-82	74.1	125.8	41.5	43.5	0.56	0.35
1984	46.4	65.5	58.5	35.3	1.26	0.54
1985	74.6	67.5	53.3	30.8	0.71	0.46
1986	37.5	22.0	32.8	9.8	0.87	0.45
1987	71.2	61.7	23.1	16.9	0.32	0.27
1988	19.1	30.3	15.6	10.8	0.82	0.36
1989	47.8	97.3	31.9	20.9	0.67	0.21
Yellowtail						
1971-73	181.5	47.5	89.8	21.4	0.49	0.45
1974-76	189.7	167.0	84.8	63.2	0.45	0.38
1977-79	142.5	80.9	69.8	34.5	0.49	0.43
1980-82	172.7	179.7	76.0	69.4	0.44	0.39
1984	215.6	198.4	91.7	85.9	0.43	0.43
1985	85.9	125.6	47.4	55.4	0.55	0.44
1986	157.5	16.6	88.1	8.5	0.56	0.51
1987	147.2	68.8	80.8	18.8	0.55	0.27
1988	67.5	12.1	34.5	1.7	0.51	0.14
1989	99.8	160.1	44.1	27.2	0.44	0.17

Table 6. Results of the Wilcoxon 2-sample test for numbers and weights of A. plaice, cod, and yellowtail from sets conducted during stratified random surveys in the period 1971-89. Mean ranks, rather than rank sums are shown because of the uneven sample sizes. The p-values listed are for two-tailed hypothesis tests, and underlined p-values indicate cases where values for sets outside 200 miles were significantly higher than values inside 200 miles.

Time period	Position of sets relative to 200 mile limit	Species: A. plaice — Mean rank, number per tow	A. plaice — Mean rank, weight per tow	Cod — Mean rank, number per tow	Cod — Mean rank, weight per tow	Yellowtail — Mean rank, number per tow	Yellowtail — Mean rank, weight per tow
1971-73	inside	16.6	17.1	14.5	14.4	18.5	18.8
	outside	13.0	12.4	15.6	15.8	10.7	10.4
	p value	.27	.15	.74	.68	.01[a]	<.01[a]
1974-76	inside	15.9	17.9	18.8	20.3	20.2	20.0
	outside	23.2	19.5	18.0	15.4	15.4	15.8
	p value	.048[a]	.68	.83	.19	.19	.26
1977-79	inside	26.7	27.6	36.8	37.3	37.5	37.9
	outside	41.3	40.2	28.0	27.4	27.1	26.6
	p value	<.01[a]	<.01[a]	.06	.04[a]	.03[a]	.02[a]
1980-82	inside	31.3	34.7	44.2	45.2	35.8	38.1
	outside	39.1	36.2	28.1	27.3	35.3	33.3
	p value	.11	.75	<.01[a]	<.01[a]	.92	.33
1984-86	inside	56.5	67.3	70.4	75.5	62.4	63.5
	outside	52.1	43.6	41.2	37.2	47.5	46.5
	p value	.47	<.01[a]	<.01[a]	<.01[a]	.01[a]	<.01[a]
1987-89	inside	45.8	61.0	62.8	66.9	61.2	64.6
	outside	51.1	41.3	40.1	37.5	41.2	38.9
	p value	.37	<.01[a]	<.01[a]	<.01[a]	<.01[a]	<.01[a]

[a]Significant at 5% level.

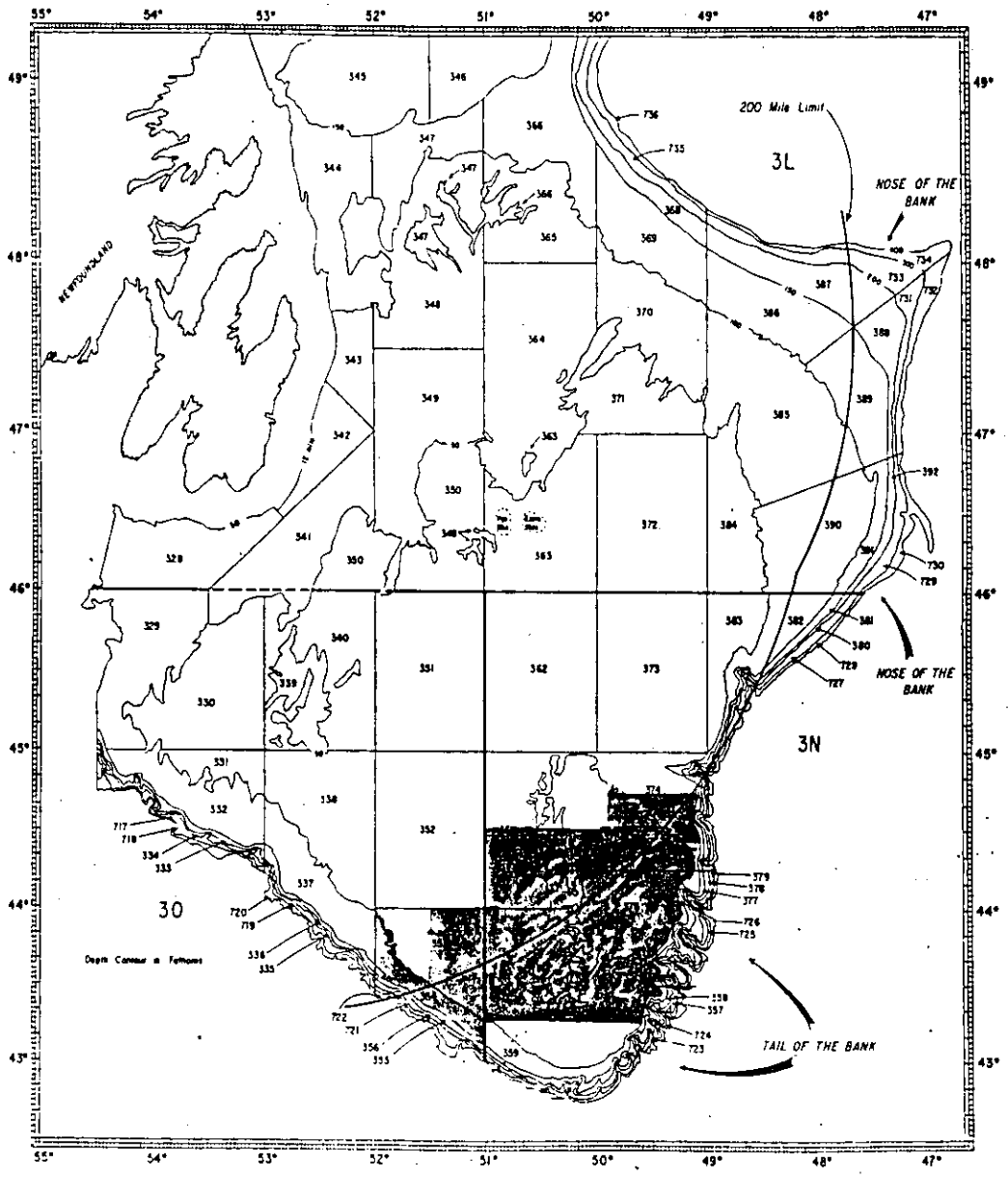
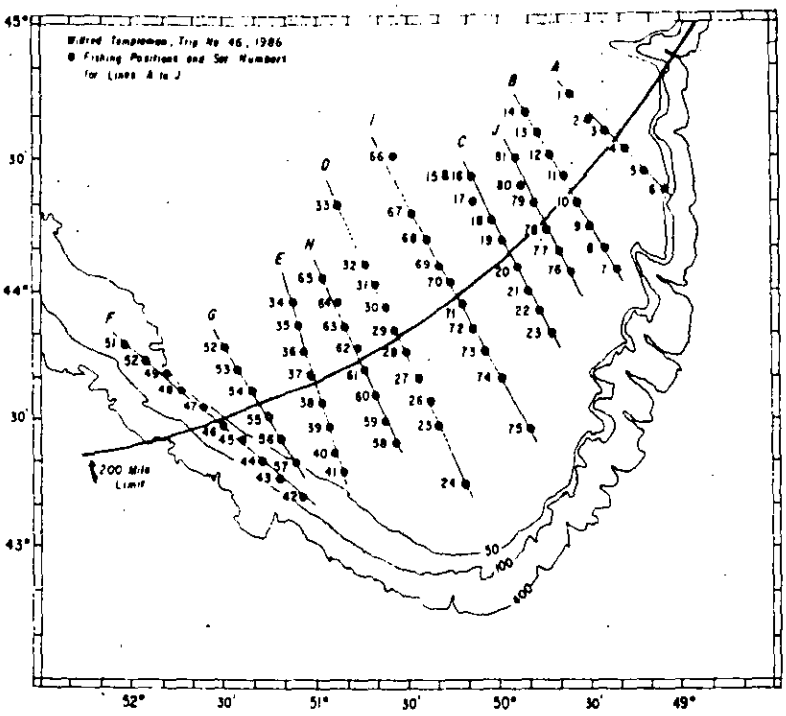


Fig. 1. Map of the Grand Banks, NAFO Div.3LNO, showing the Canadian 200 mile limit in rolation to the Nose and Tail of the Bank. Also shown are the stratification scheme used in the groundfish surveys and the area chosen for comparison of survey catches (shaded zone).



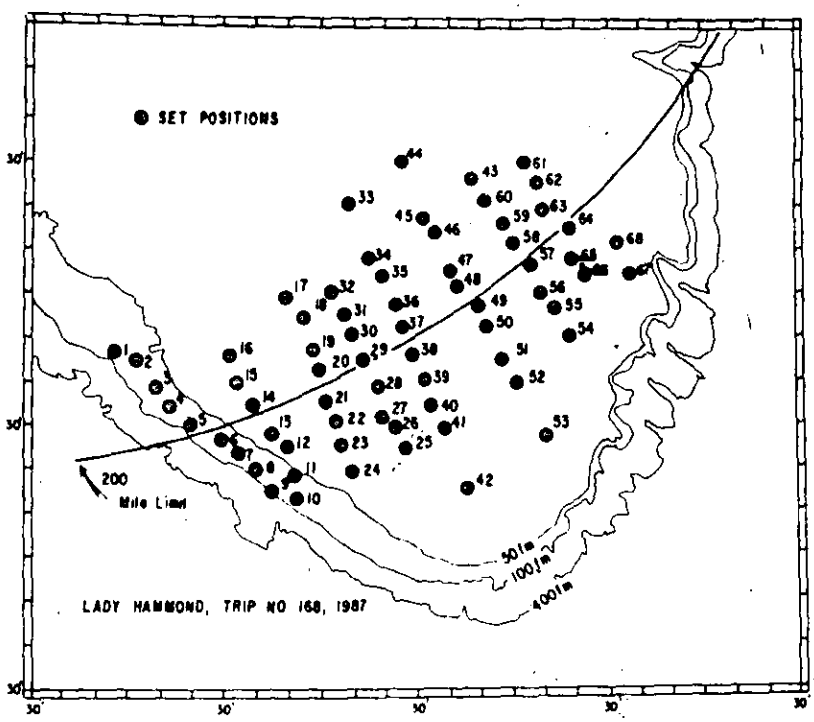


FIG.2. Location of sets in 1986 line transect survey (above).
FIG.3. Location of sets in 1987 line transect survey (below).

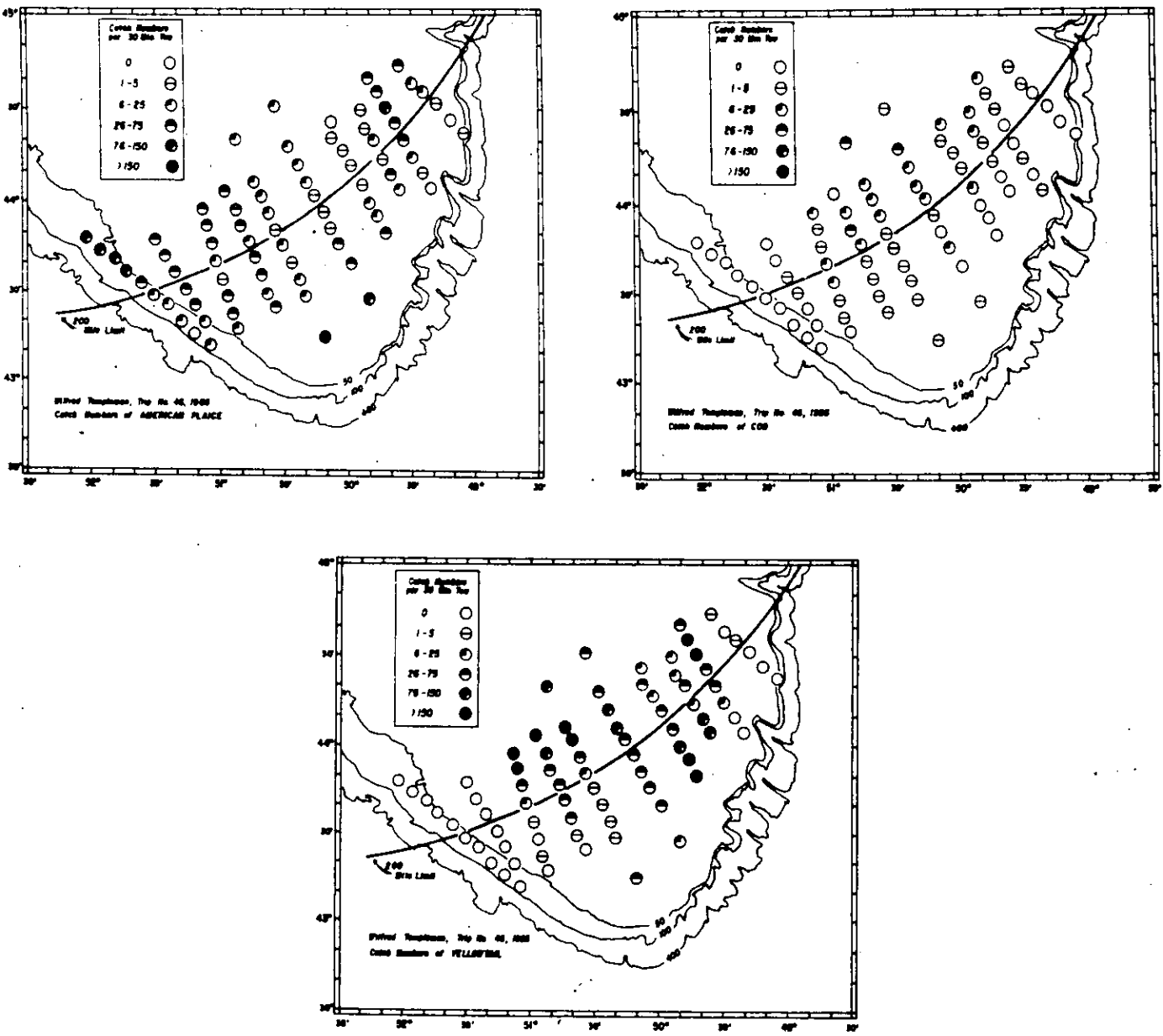


Fig. 4. Catch numbers of A. plaice, cod and yellowtail from the sets conducted during the line transect survey of April 1986 on the Tail of the Bank.

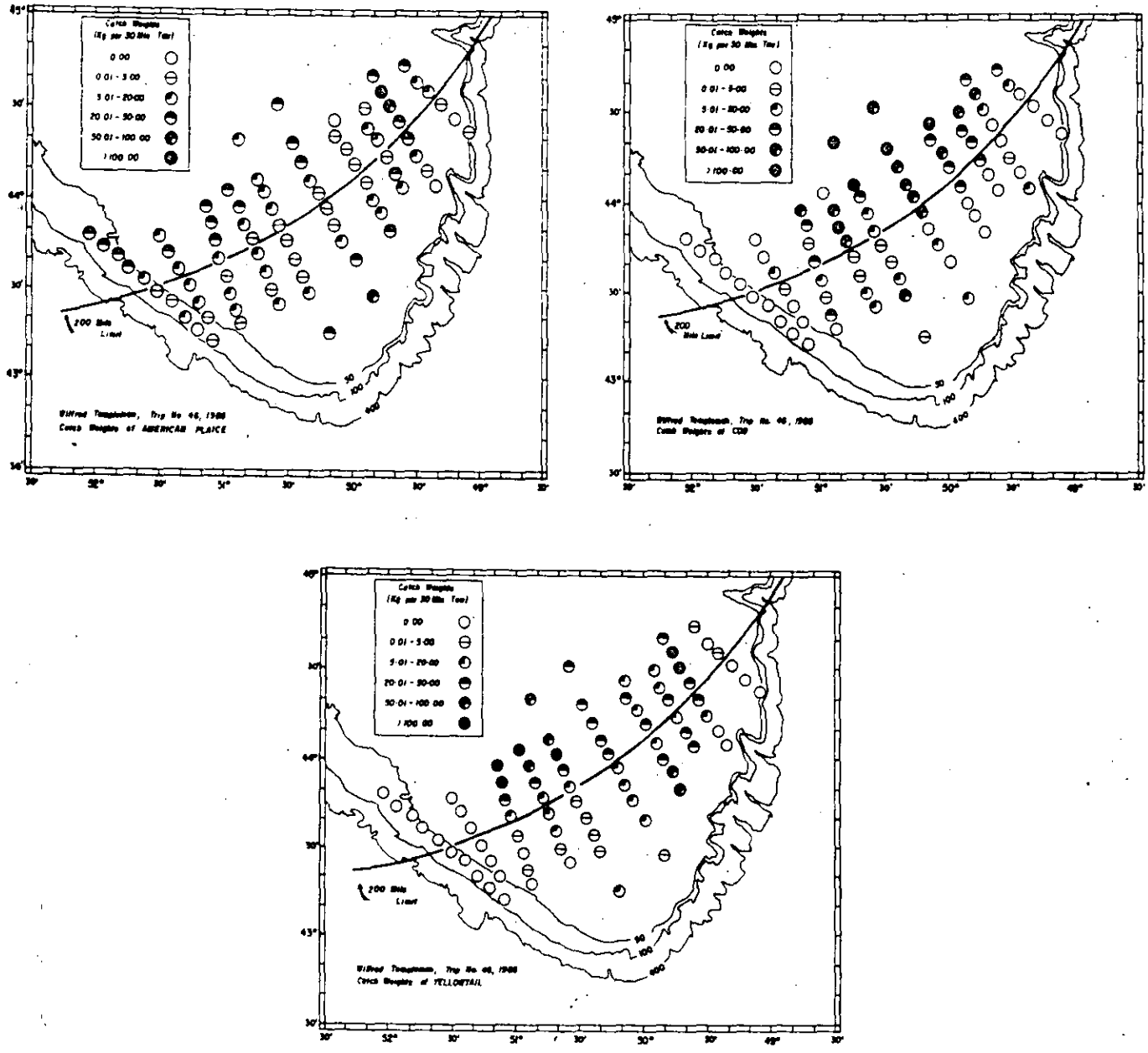


Fig. 5. Catch weights (kg) of A. plaice, cod and yellowtail from the sets conducted during the line transect survey of April 1986 on the Tail of the Bank.

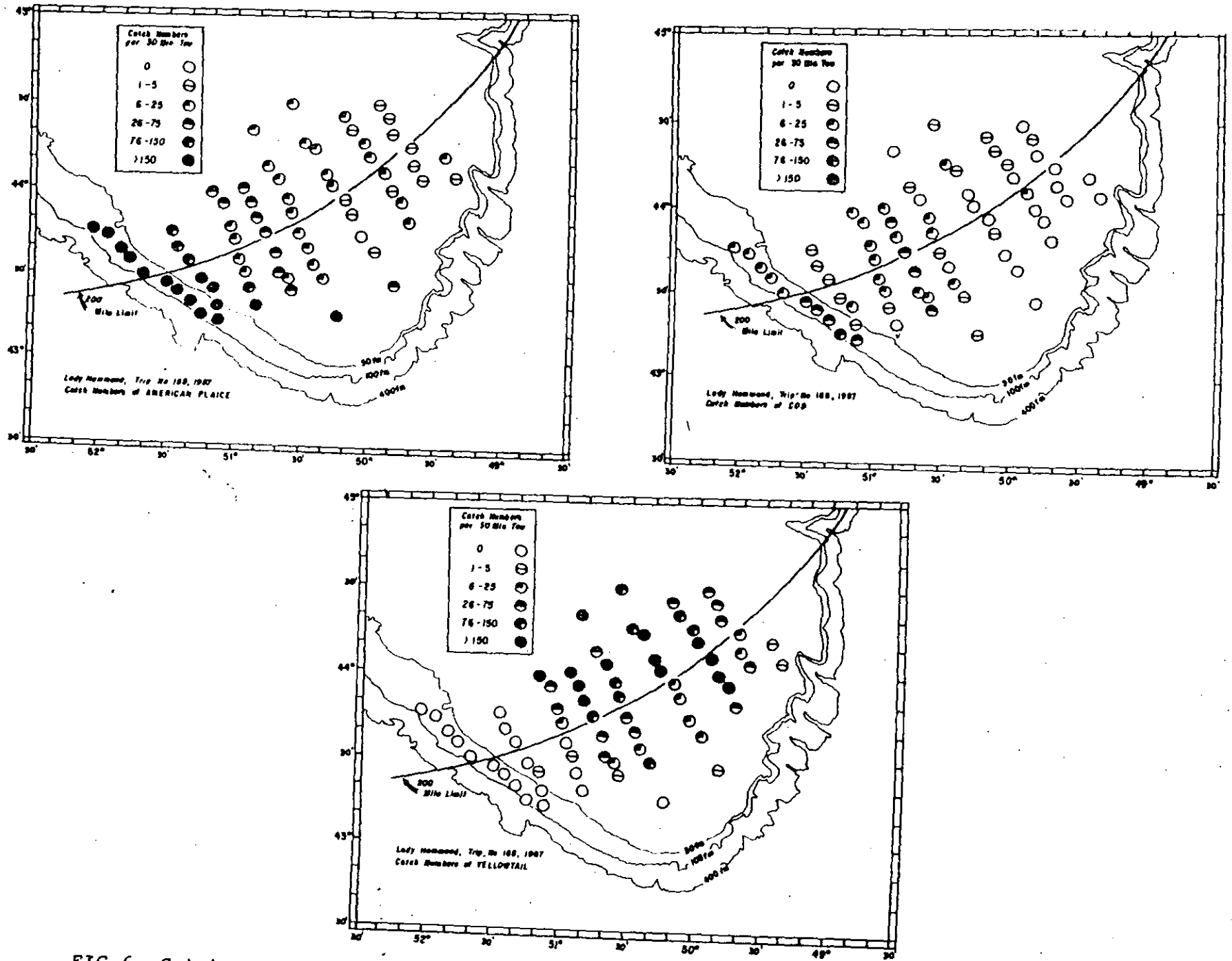


FIG.6 Catch numbers of A.plaice, cod and yellowtail from the line transect survey conducted in 1987.

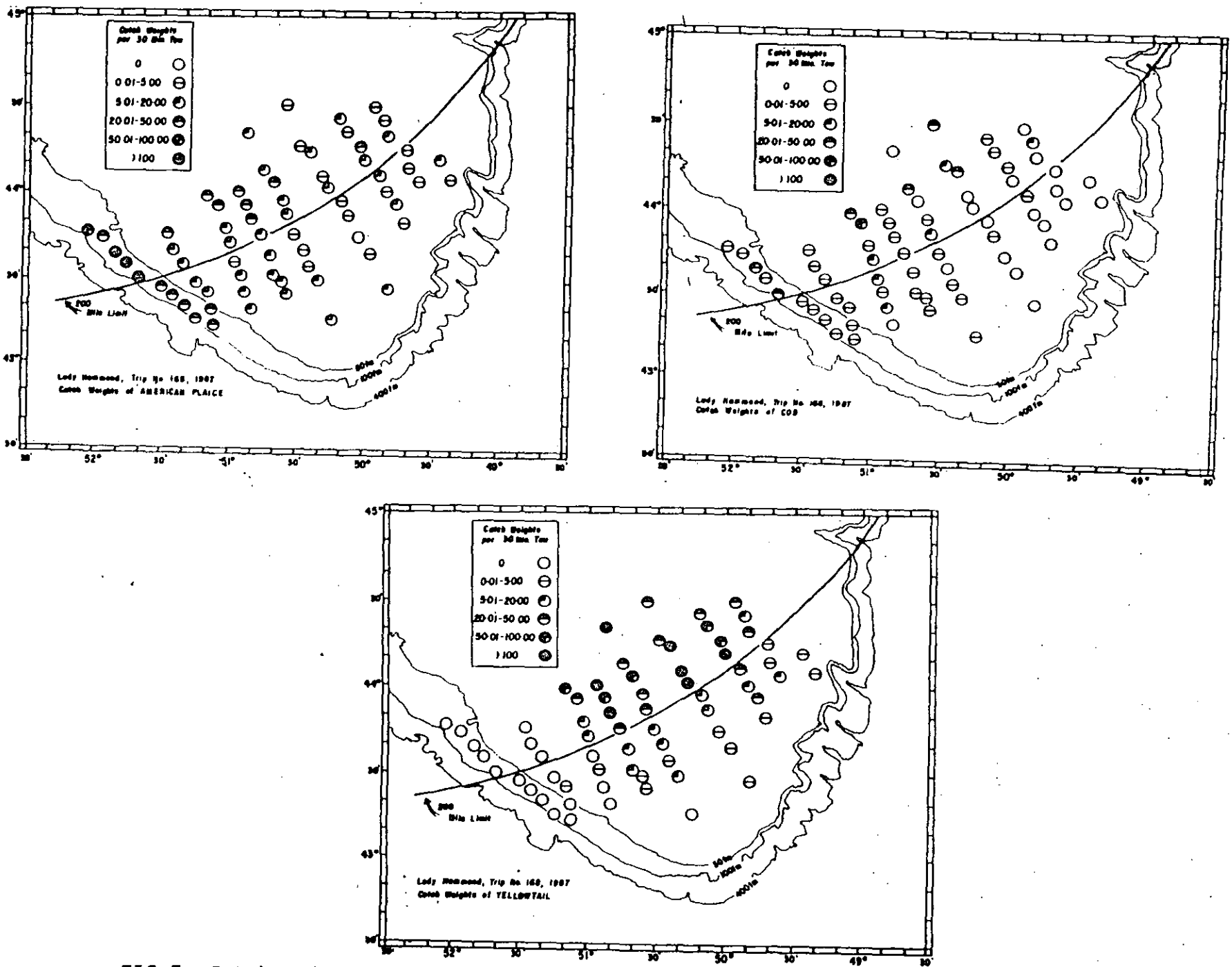


FIG.7 Catch weights of A.plaice, cod and yellowtail from the line transect survey conducted in 1987.

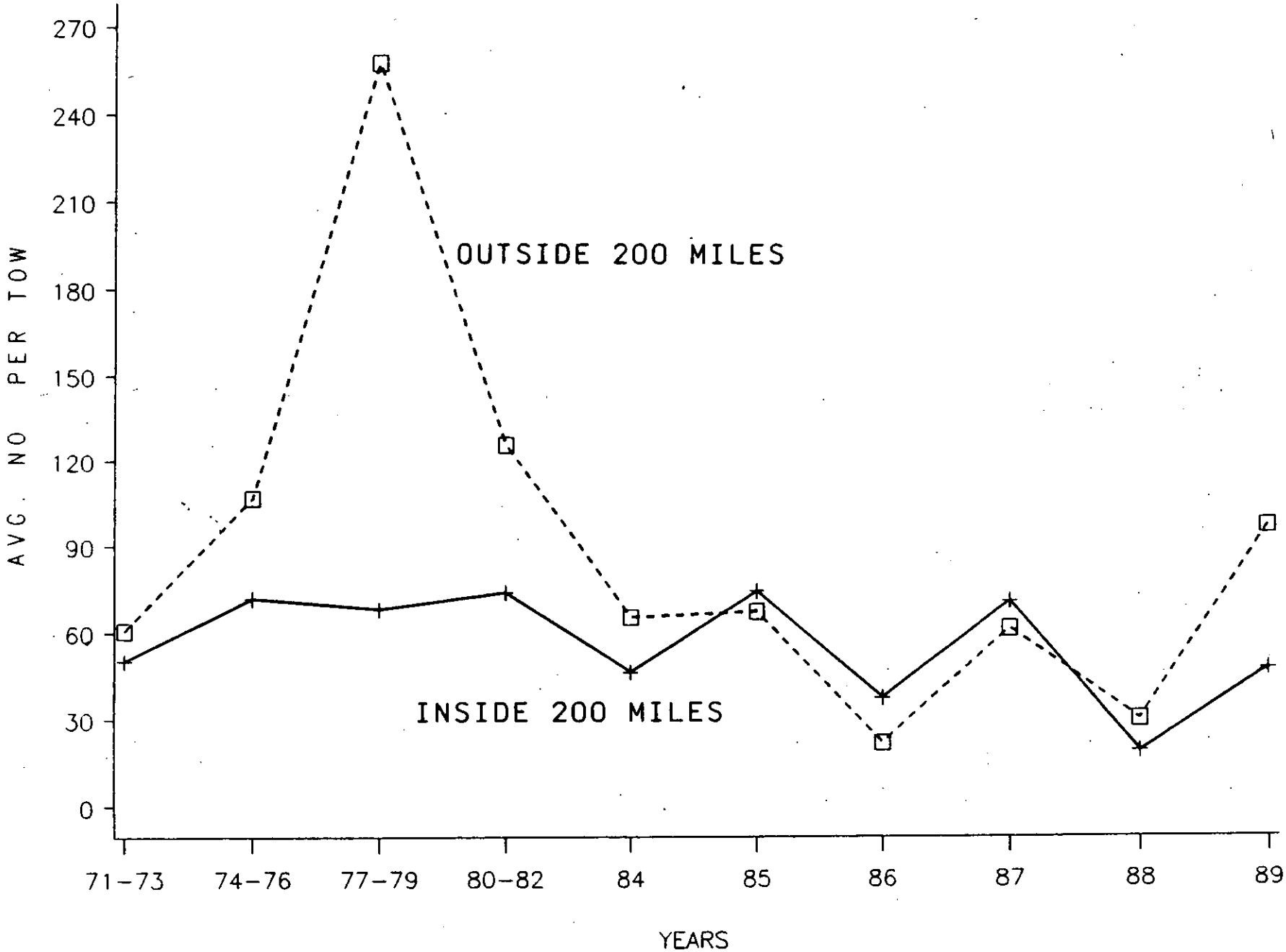


FIG.8. A.PLAICE, AVG. NO./TOW, INSIDE 200 MILES VS. VS OUTSIDE

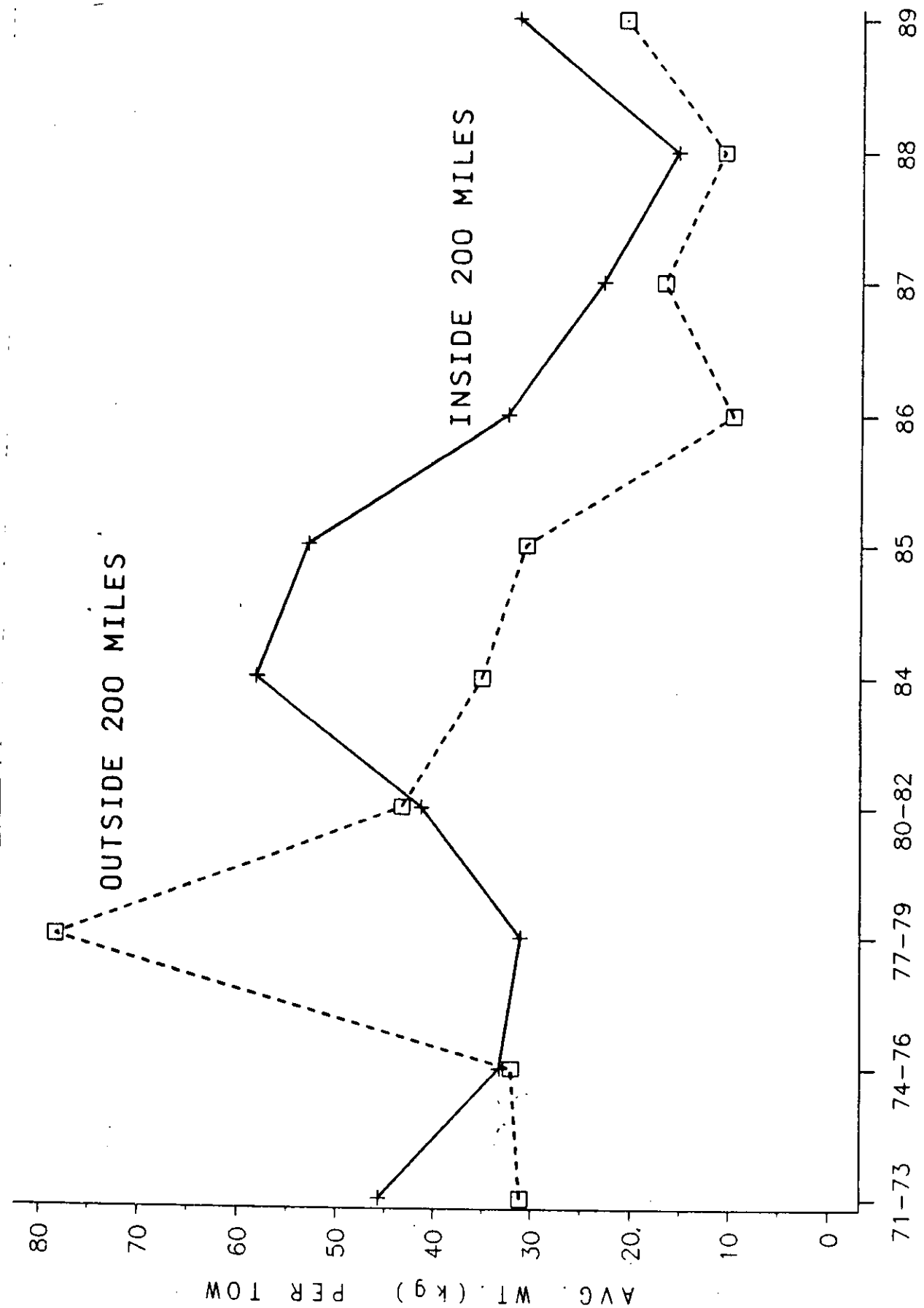


FIG.9. A.PLAICE, AVG. WT./TOW, INSIDE 200 MILES VS. VS OUTSIDE

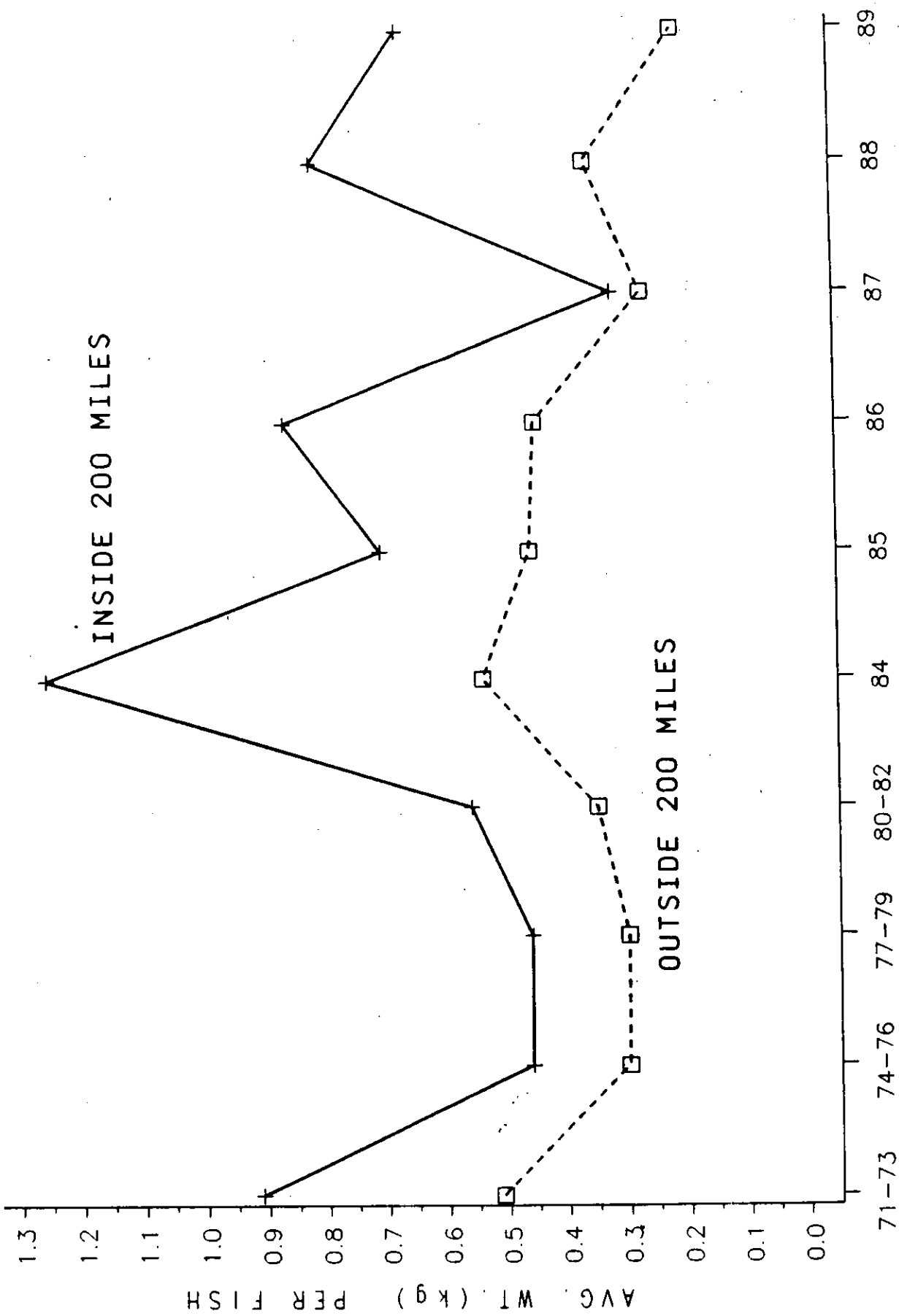


FIG.10 A.PLAICE, AVG. WT./FISH, INSIDE 200 MILES VS. VS OUTSIDE

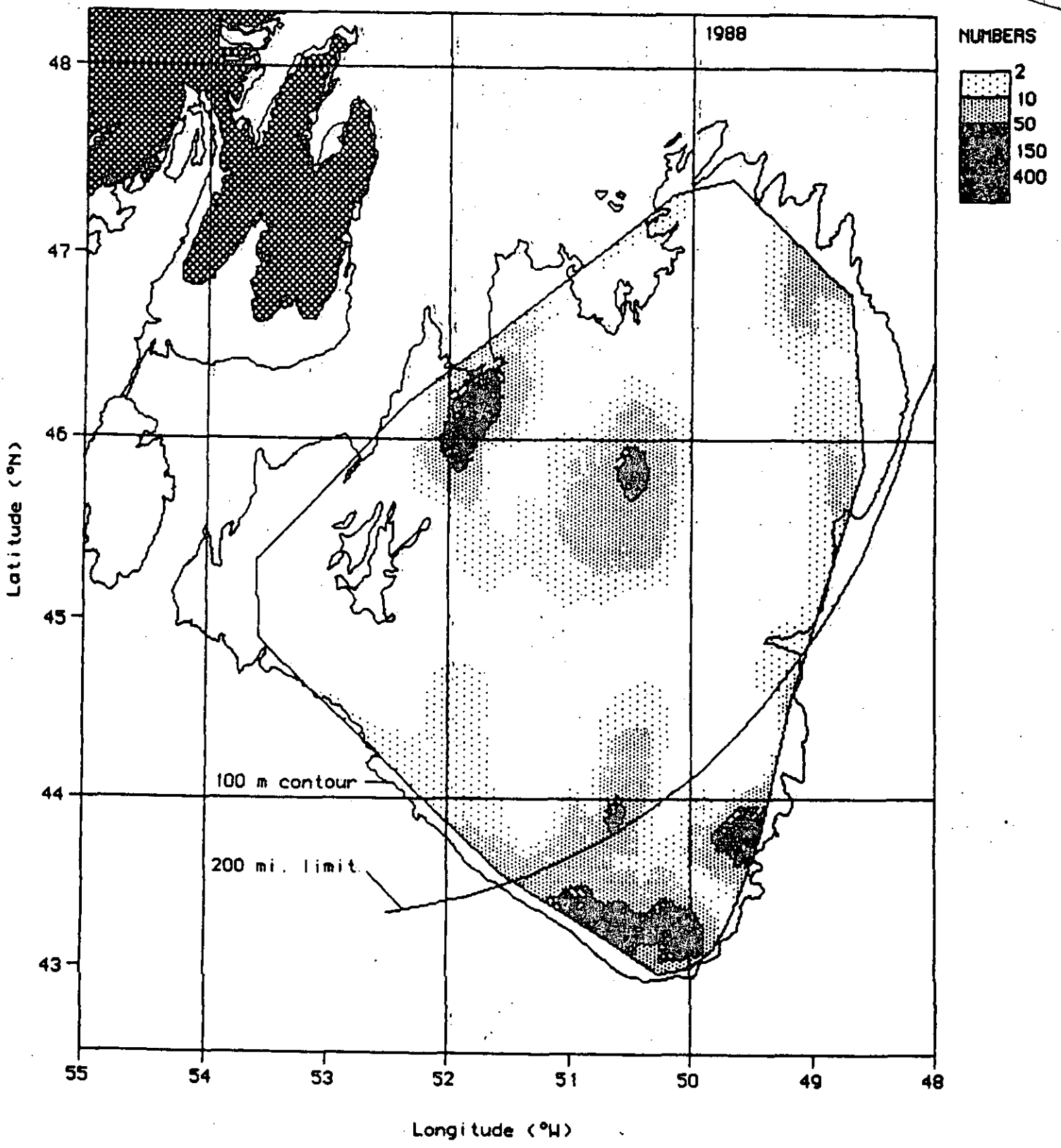


FIG.11. Distribution of 1 year old A.plaice in Div. 3LNO, from 1988 juvenile flatfish survey.

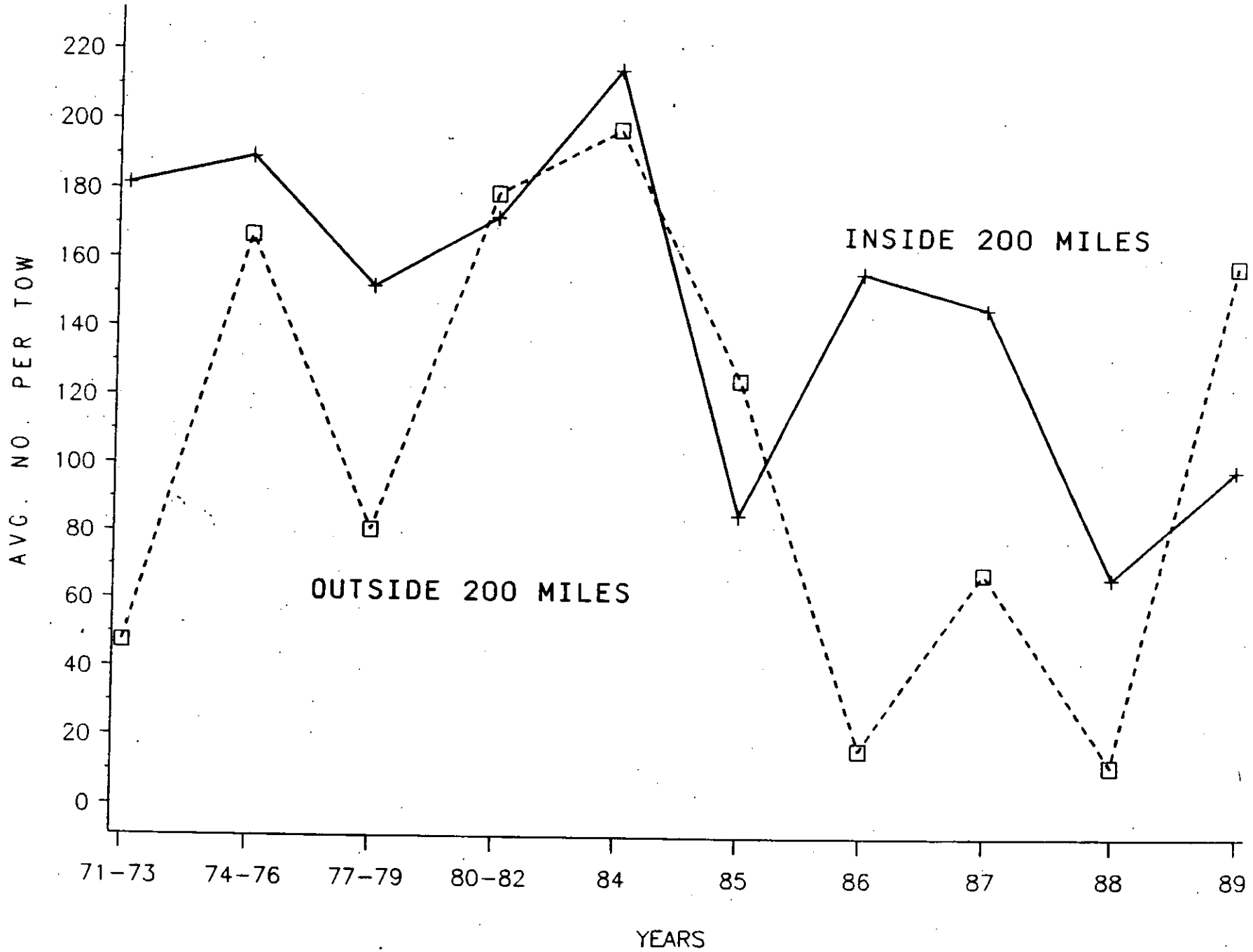


FIG.12 YELLOWTAIL, AVG. NO./TOW, INSIDE 200 MILES VS. VS OUTSIDE

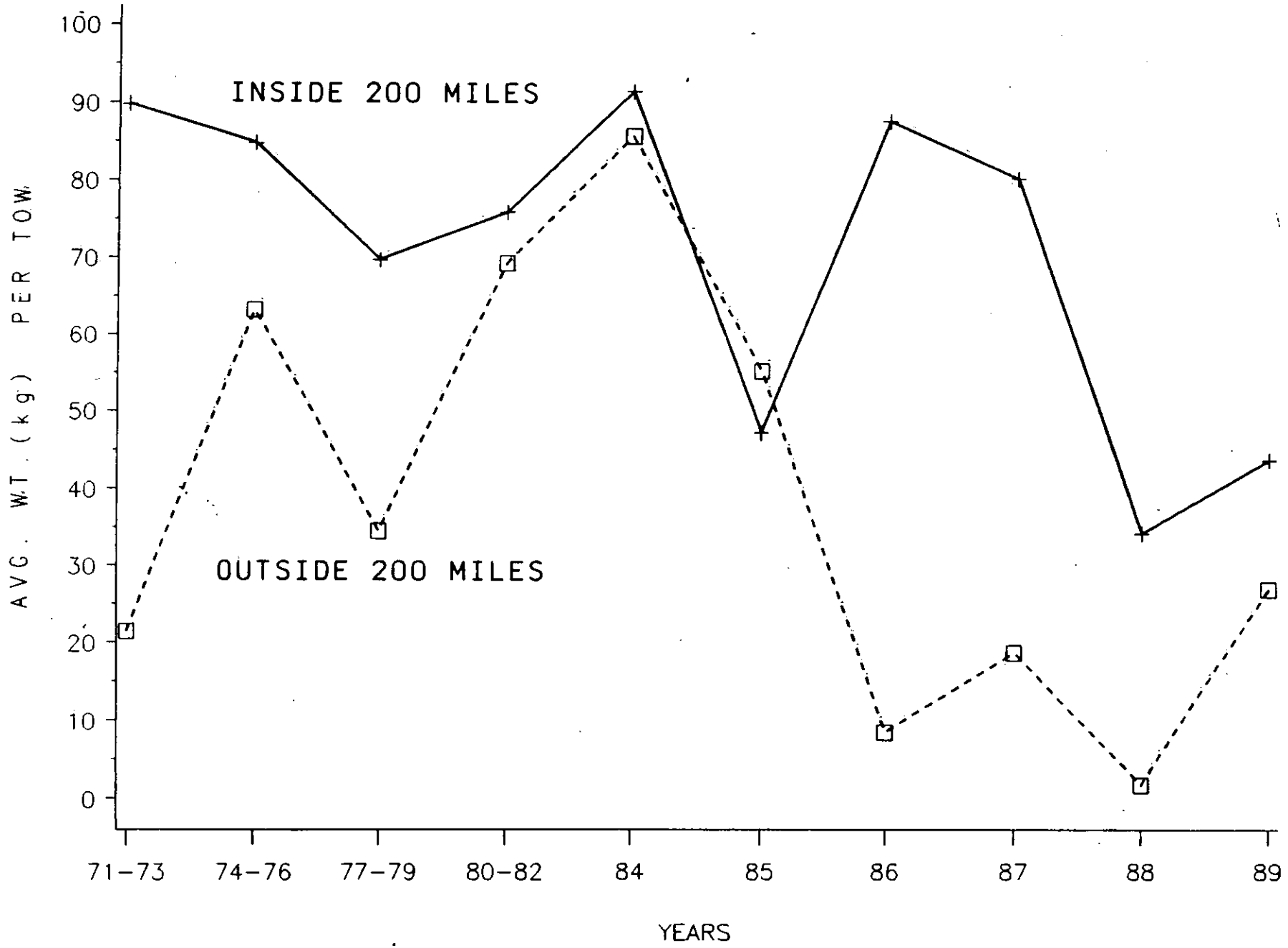


FIG.13 YELLOWTAIL, AVG. WT./TOW, INSIDE 200 MILES VS. VS OUTSIDE

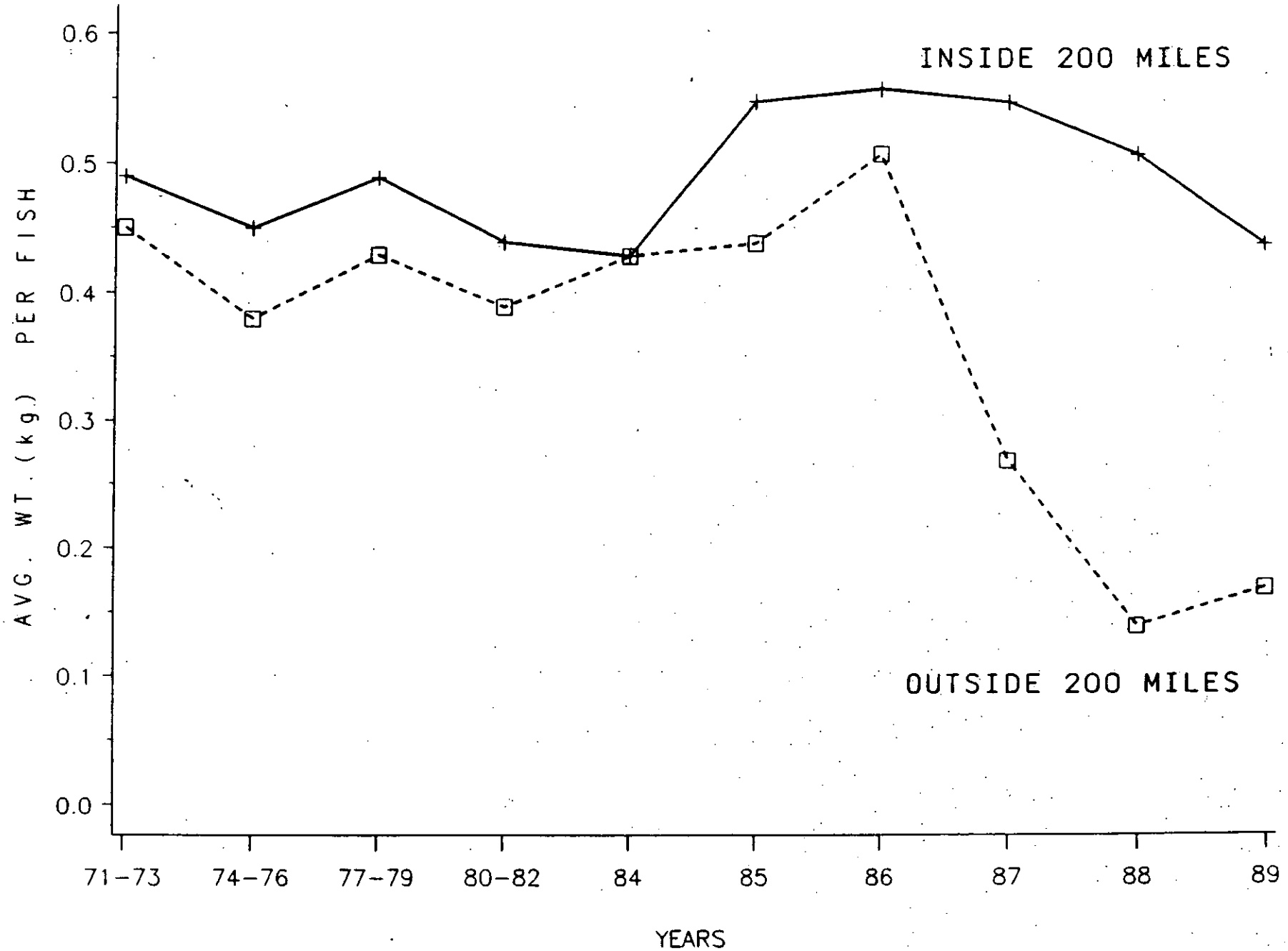


FIG.14 YELLOWTAIL, AVG. WT./FISH, INSIDE 200 MILES VS. VS OUTSIDE

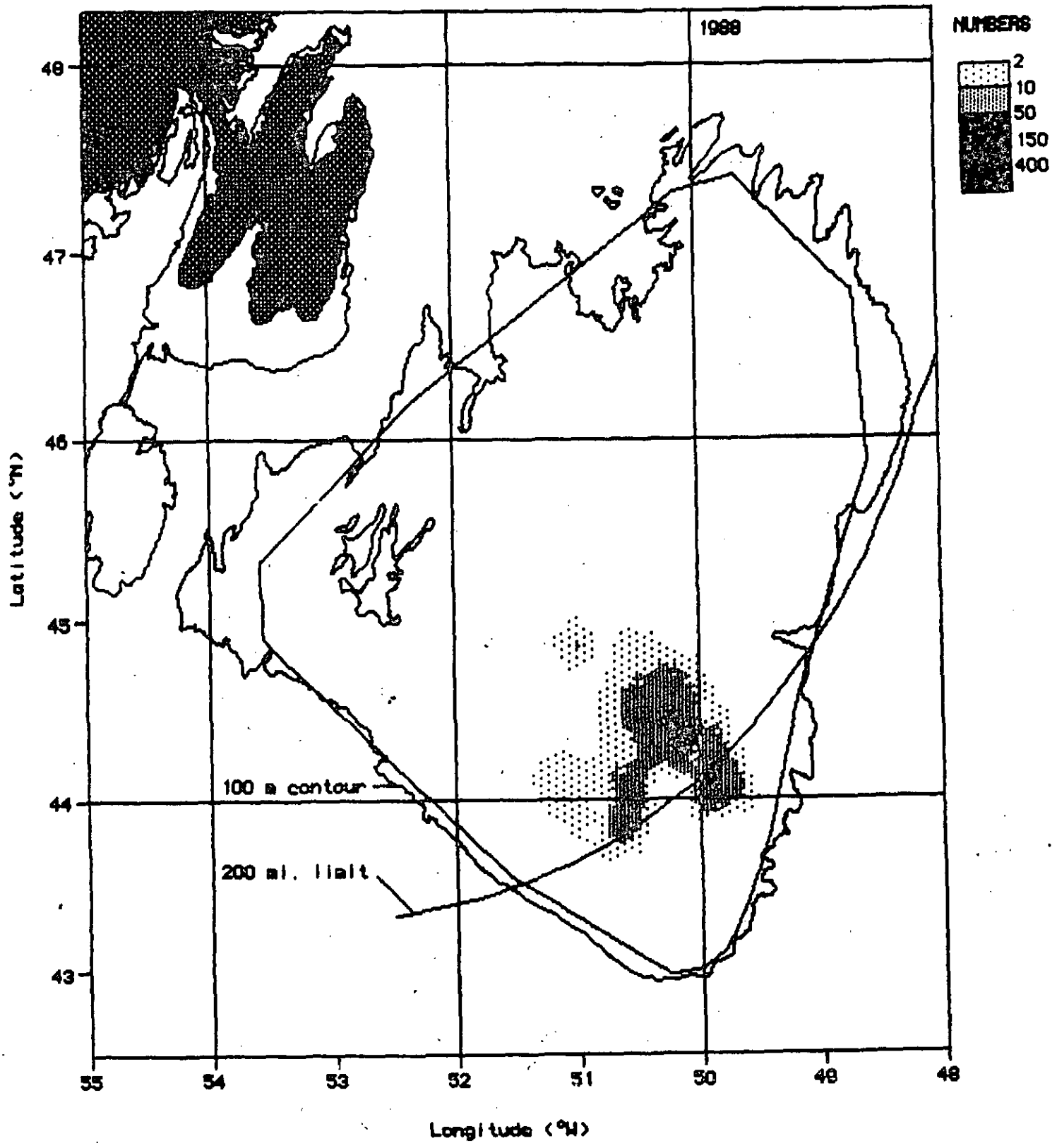


FIG.15. Distribution of 1 year old yellowtail in Div. 3LNO, from 1988 juvenile flatfish survey.

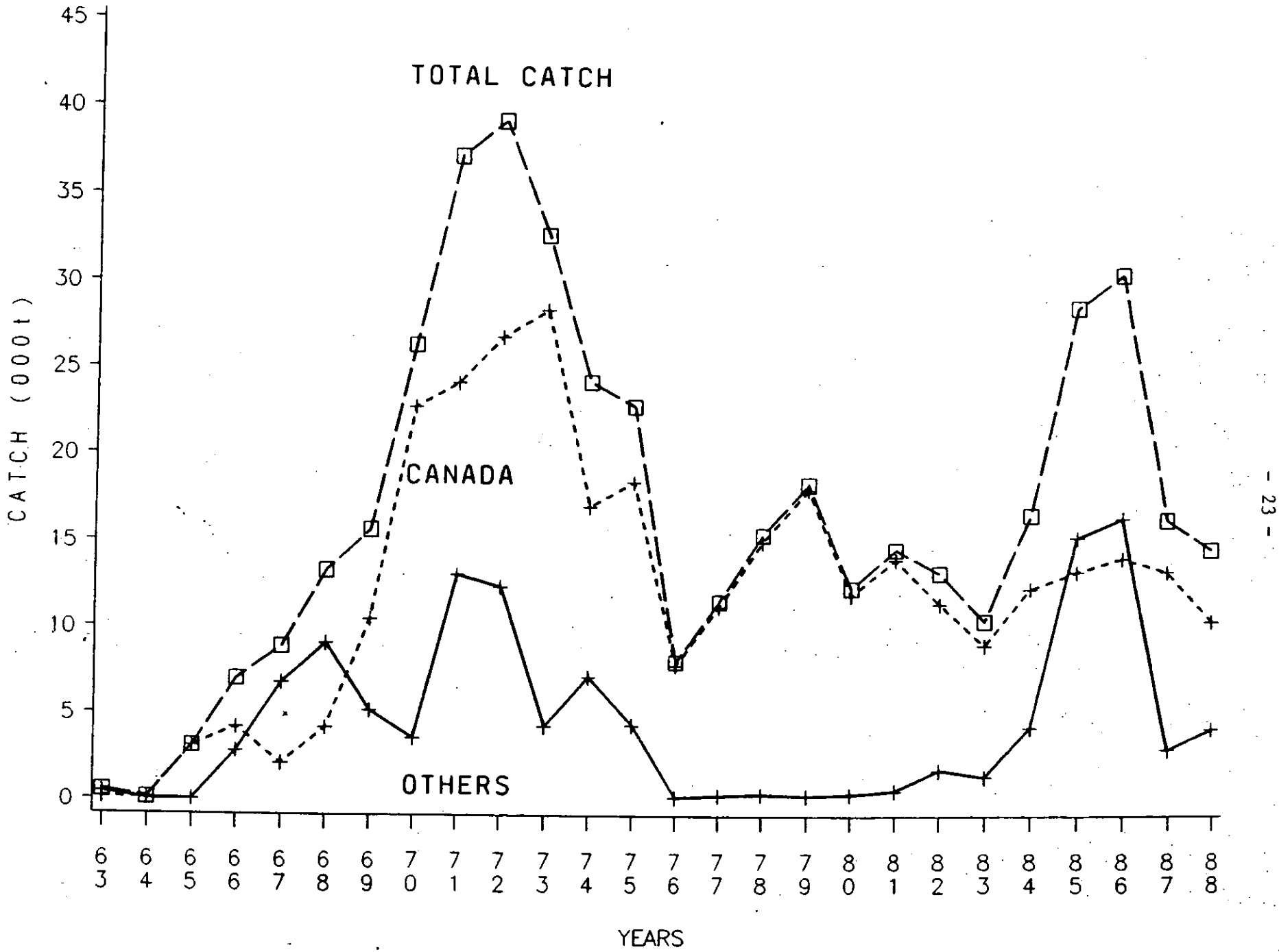


FIG.16. YELLOWTAIL CATCHES IN DIV.3LNO.

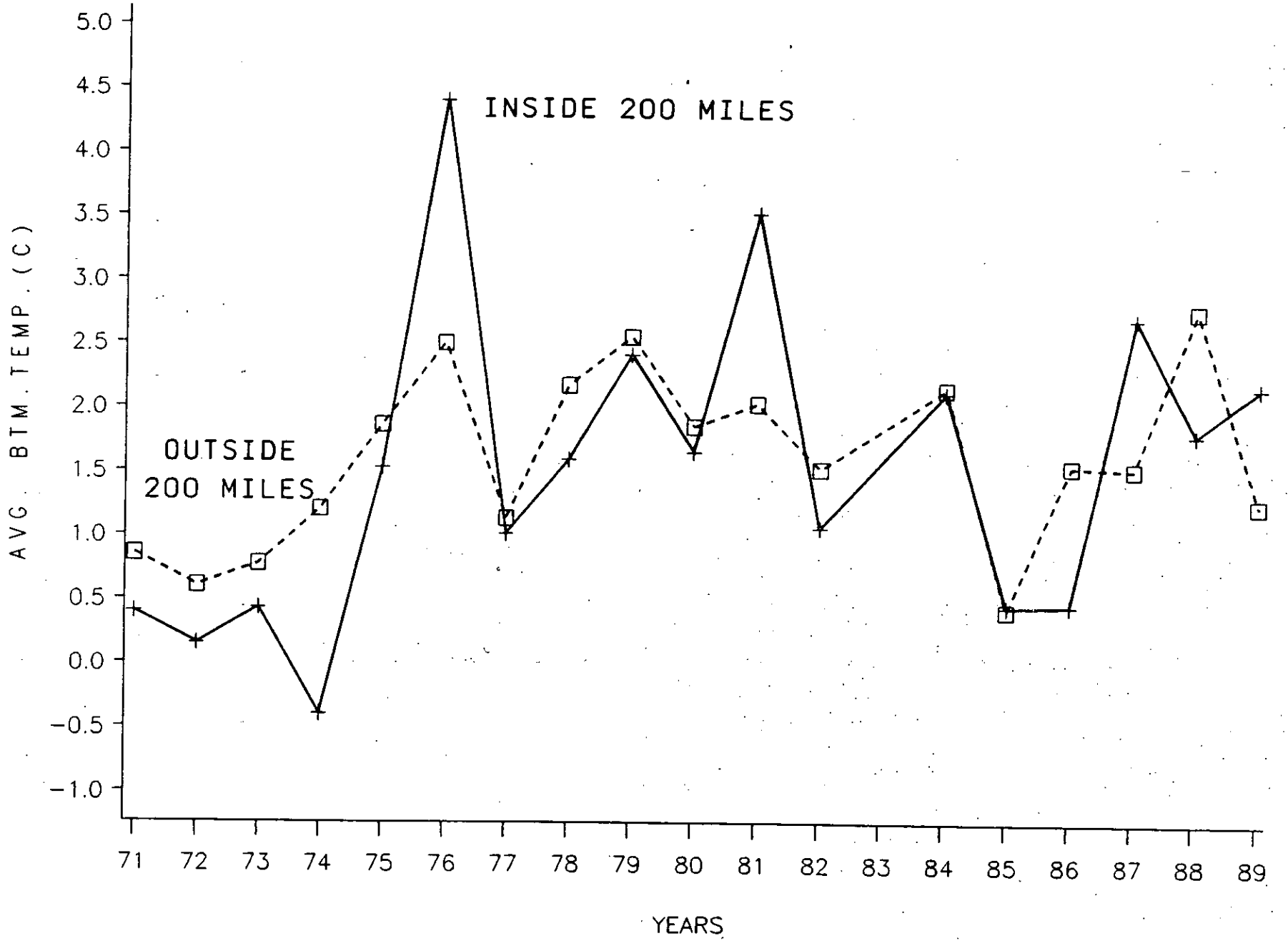


FIG.17. AVG. BOTTOM TEMPERATURES, INSIDE 200 MILES vs. OUTSIDE.