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Discards of Cod (Gadus morhua) and American Plaice
(Hippoglossoides platessoides) in NAFO Division 4T during 1984.

by

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Abstract

Discarding at sea of Atlantic cod (Gadus morhua) and American plaice (Hippoglossoides platessoides) in NAFO Division 4T was investigated in the fall of 1984. Ten trips were made on commercial vessels during normal fishing operations. Results indicate that the discarding of small cod and especially plaice is still important despite a recent increase in the codend mesh size in 1981. Discard rates of cod were 14.15% (by number) and 6.03% (by weight) while discards of American plaice represented 61.26% (by number) and 39.55% (by weight). Most of the plaice discards were between 6 and 10 years of age while 80% of cod discards were 3 and 4 years of age.

Résumé

Une étude des rejets à la mer de morue (Gadus morhua) et de plie canadienne (Hippoglossoides platessoides) dans la division OPANO 4T a été effectuée à l'automne 1984. Dix voyages de pêche sur des bateaux commerciaux ont été effectués pendant leurs activités normales. Les résultats indiquent que les rejets à la mer de petites morues et surtout des plies demeurent importants malgré une augmentation de la maille réglementaire des culs de chalut en 1981. Les taux de rejets de morue s'élèvent à 14,15% (en nombre) et 6,03% (en poids). Les taux correspondants pour la plie canadienne sont de 61,26% et 39,55%. La plupart des plies rejetées étaient âgées de 6 à 10 ans alors que 80% des morues rejetées avaient entre 3 et 4 ans.

INTRODUCTION

Discarding of small unmarketable fish is a serious problem for some stocks in the Gulf of St. Lawrence. Discarding is defined here as selective removal of undersized individuals from the catch, and occurs when the fishery does not avoid catching undesirable components of a species (Kulka 1985). Studies (Powles 1965, 1969) have indicated that almost all discarded plaice and cod are dead when returned to sea from commercial boats. The mortality due to discarding is not quantified and estimates are not incorporated in analytical assessments of Gulf stocks.

Discards of plaice can be as high as 70% (by number) (D.F.O. Unpublished study (1977)), while those of cod however, were estimated as less than 10% by weight. Indications are that despite a series of mesh size regulation changes to increase codend mesh size from 76 mm to 130 mm, discarding still occurs in substantial quantities. This study was initiated in order to estimate the discard rate of plaice and cod in 1984.

In the southern Gulf of St. Lawrence, it is the cod fishery which is commercially the more important, plaice are mainly caught as a by-catch.

Jean (1963) estimated that between 1957-1959, 40-60% catch (by weight) of plaice was discarded. A mesh regulation change from codend 76 mm (3 inches) to 114 mm (4.5 inches) occurred in the period 1957-1959. In 1961, estimates of plaice discards by weight were 50%.

The minimum mesh size regulation of codends remained in effect at 114 mm until 1977 when it was increased to 120 mm. Cliche (1981) conducted a study of plaice and cod discarding practices during 1980. Only the Magdalen Island fleet was studied and estimates of plaice discards were shown to amount to 25% (by weight) and 50% (by number). Cod discards were estimated to be 4% (by weight) and 7% (by number).

Using research vessel surveys and similar procedures as outlined by Mayo *et al.*, (1981) estimates of plaice discards were theoretically obtained by Clay *et al.* (1984) for the Gulf of St. Lawrence stock. The results indicated that since 1977 a progressive increase in the length at which 50% of the plaice are discarded had occurred.

The data presented here is based on a field study of cod and plaice discarding practices conducted in the fall of 1984.

MATERIALS AND METHODS

Cod and plaice discards were sampled by observers on commercial fishing vessels in the southern Gulf (NAFO Division 4T) from the latter part of September to the middle of December 1984. The study comprised a total of 10 trips with 134 sets, of which 9 trips were sampled for plaice and 8 for cod (Table 1a, b). Only one species per set was sampled at a time. Thirty percent of (134) sets were sampled, 14% for plaice and 16% were sampled for cod. The study area covered NAFO Subdivisions 4Tn, k, l, g, f (Figure 1). Seven trips took place in Subdivision 4Tg.

Eight trips were made on board Danish seiners ranging from 42 to 85'. One trip was made on a stern otter trawler (42') and another on a side otter trawler (65'). Although the study was not conducted during peak fishing season, coverage of the major gear components was complete. Total weights (estimated by the captain) of kept and discarded plaice and cod were noted for all sets in pounds and later converted to kilograms.

A random sample of each portion of the catch (discarded and kept) was taken from each sampled set. Fish were measured to the nearest centimeter using an off-set groundfish measuring board. The estimated sample weights were recorded along with information pertaining to the fishing operations (position, tow duration, time etc.)

Length frequencies for the discarded and kept catch were weighted by their respective sample weight to obtain representative frequencies. Length frequencies for each set were then combined per trip and weighted by the total discarded and kept catch for each trip. Selection patterns for landed fish were calculated as follows:

$$\frac{NK}{NK + ND} \times 100$$

where NK = number of kept fish (in numbers per cm).
ND = number of discarded fish.

Numbers at age were obtained by applying the age-length keys derived from the R/V E.E. Prince fall groundfish survey to the length frequencies for both species. Plaice data were separated by sex.

RESULTS

a) Cod

Cod were sampled on two trips in Subdivisions 4Tkln and on six trips in Subdivisions 4Tfg. The discard rates varied from 5.45% to 37.69% by number and from 1.72% to 18.61% by weight for the trips sampled (Table 1a). The overall discard rates were 14.15% by number and 6.03% by weight, discarding being higher in Subdivisions 4Tkln than Subdivisions 4Tfg. Subdivisions 4Tkln correspond to a major fishing ground of the southern Gulf cod stock.

The length frequency distribution of the discarded and kept cod for the study is shown in Figure 2. Length frequency distributions (Figure 3 and 4) for the two areas indicate that there were proportionally more small cod (35 cm) in Subdivisions 4Tkln. Discard patterns for landed fish indicate a length at which 50% of the fish are discarded of 40 cm for the overall study (Figure 5), and 40 and 44 cm for Subdivisions 4Tfg and 4Tkln respectively (Figure 6). Mean age of the discarded fish was 3.99 years old and 6.25 for the kept fish.

b) Plaice

Plaice were sampled on three trips in Subdivisions 4Tkln and on six trips in Subdivisions 4Tfg (19 sets in total). The overall average discard rate for plaice was estimated to be 61.3% by number (39.6% by weight) (Table 1b).

The discard rates were 50.1% by number (30.6% by weight) in 4Tkln, whereas 57.9% by number (42.3% by weight) were obtained from Subdivisions 4Tfg. This is different from the cod discard rate since the higher discard rate for plaice is found in 4Tfg.

Discarding was found to be 38% by weight for seiners and 41% by weight for otter trawlers. Discarding by seiners was estimated on a monthly basis to be 12% by weight in October and 61% by weight in November. Since more samples were taken from Danish seiners (8 trips) during September to December, whereas samples from trawlers (2 trips) were only taken in October and November, the estimates obtained from seiners are probably more reliable.

The length frequency for kept and discarded plaice (Figure 7) show that most plaice (male and female) are discarded at 30 cm in 4T. The discard pattern, for landed fish indicate that the length at which 50% of the fish are discarded is 33 cm in Subdivision 4Tfg and 34 cm at 4Tkln with 34 cm for the entire study (Figure 8).

Discarded plaice males are 6 to 10 year old fish. Discarded plaice females are predominantly made up of 7 to 10 year old fish (Table 3). The mean age for both discarded males and females was 8.0 years. The mean ages for landed plaice are 9.3 and 11.9 years for male and female respectively.

DISCUSSION AND CONCLUSION

a) Cod

Although several studies have been conducted on discarding practices of fishermen in the Gulf of St. Lawrence, all except Jean (1963) were predominantly studying plaice discards. The only cod discard data available gives the rates by weight and numbers (Table 4); these are difficult to compare between years since the rate depends on the length composition of the population as well as both the selectivity of the gear and market acceptance of small fish. It can be assumed that the market acceptance of small cod has changed little since the early sixties. The size at which 50% of the fish were landed in northern New Brunswick (Subdivision 4Tkln) was 45 cm in 1959 (Jean, 1963) compared to 44 cm obtained during the present study (Subdivision 4Tkln). In the present study, it is evident that the 3 and 4 year olds were the most heavily discarded. Since the discarding of cod does not appear to have changed significantly in the past 20 years, these same year classes would have had a higher mortality rate with a smaller mesh size.

The discard rates of cod obtained in the present study are the highest since 1958. At that time, fishermen were in transition from nets of 3" (76 mm) to nets of 4½" (114 mm). One could expect that discard levels would be much lower with the present mesh size regulation of 5 1/8" (130 mm). The high discard level may be explained by the length or age composition of the population. In 1983, the recruitment of cod (age 3, 1980 year class) was estimated at 250 million fish (Lever and Waite, 1984), the highest ever obtained. Results of the 1981, 1982, and 1984 E.E. Prince Fall Groundfish Survey conducted in the Gulf of St. Lawrence since 1970 indicated that this year-class was the largest observed during this period. The large proportion of 4 years old in 1984 would contribute to the discard rate; 65% of all fish

discarded were in fact 4 years old (Table 2). This implies that an increase in mesh size will not automatically mean a decrease in the discard rate unless the population remains stable in its size distribution.

In 1982 and 1983, 62% and 68% respectively of the southern cod catch was landed by otter trawlers, Danish and Scottish seiners. The importance of these gears in the fishery is such that the discarded fish would represent a significant proportion. The results of this study indicate the removals at age 3 and 4 for otter trawlers and seiners would be 3.84 and 1.80 times the numbers calculated from the landed catch. At present, discards are not included when calculating removals for the southern Gulf cod stock. The data presented here suggests that discards should be considered in cod assessments since over 14% of all fish caught were discarded.

b) Plaice

The discard rate by weight for plaice from this study was estimated to be 39.5%. Despite a series of increases in codend mesh size which occurred up to 1981, no decrease in discards has been observed since 1976, when it was estimated that discards by weight were 41.9% (Table 5).

The smallest marketable size of plaice has not changed from the 32 cm in 1969 (Powles 1969). This study indicates that most plaice at length 33-34 are discarded, confirming results obtained from Clay et al (1984) that larger plaice are being discarded.

It is evident that the 3 to 6 year old fish were the most heavily discarded by numbers (100 to 91% respectively) in 1984 (Table 3). Removals at age are calculated to be 25.9 times at age 4, 26.6 times at age 5 for 1984.

In the late 1970's, mostly 6, 7 and 8 year old plaice were discarded (mean age 7.48 in 1979) (unpubl. data). Up to and including 1979, landings were predominantly composed of 8 and 9 year olds (in percent by number).

During the 1980's the age composition of the landings was the following; 1980 (9 - 12 year olds); 1981 (10 year olds); 1982 (10 - 12 year olds); 1983 (11 year olds) and 1984 (11 year old fish) (Metuzals 1985).

Powles (1969) predicted that increasing the mesh-size would reduce cod catches and have little effect in conserving plaice. This appears to be what occurred in 1984. Three years after the increase in mesh size, there is still a great amount of discarding of young plaice.

ACKNOWLEDGEMENTS

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REFERENCES

- Clay, D., G. Chouinard, T. Hurlbut, L. Currie and H. Clay MS. 1984. Stock report for American plaice (Hippoglossoides platessoides Fabricius) and other flatfishes in the Gulf of St. Lawrence including a discussion of discard levels and mesh selectivity of plaice. CAFSAC Res. Doc. 84/76.
- Cliche, G. MS. 1981. Rejets à la mer en 1980 des chalutiers Quebecois pechant en 4T. CSCPCA Doc. de Rech. 81/67.
- Jean, Y. 1963. Discards of fish at sea by northern New Brunswick draggers. J. Fish. Res. Bd. Canada: 20(2): 497-524.
- Kulka, D.W. 1985. Estimates of discarding by the Newfoundland Offshore Fleet in 1983. NAFO SCR Doc. 85/75.
- Lever, D., L. Waite MS. 1984. Assessment of cod in NAFO Division 4T and Subdivision 4Vn (Jan.-Apr.) for 1984. CAFSAC Res. Doc. 84/52.
- Mayo, R.K. et al. MS. 1981. A procedure for estimating rates of escapement and discard, based on research vessel bottom trawl survey catches. Int. Council Exp. Mer (Demersal Fish Committee) C.M. 1981/ G:62.
- Metuzals, K.I. MS. 1985. Biological Stock Update for 1984 for American Plaice in NAFO Division 4T. CAFSAC Res. Doc 85/88.
- Powles, P.M. 1965. Life history and Ecology of American Plaice (Hippoglossoides platessoides F.) in the Magdalen Shallows. J. Fish. Res. Bd. Canada: 22(2): 565-598.
- Powles, P.M. 1969. Size changes, Mortality, and Equilibrium Yields in an exploited stock at American Plaice (Hippoglossoides platessoides). J. Fish. Res. Bd. Canada: 26(5), 1205-1235.

Table 1a. Summary of discard study (cod) in NAFO Division 4T in 1984.

C O D														
TRIP #	DATE	AREA	GEAR	VESSEL LENGTH	NUMBER OF SETS	NUMBER OF SETS SAMPLED	TOTAL NUMBER SAMPLED	ESTIMATED NUMBER LANDED	ESTIMATED NUMBER DISCARDED	% DISCARD (BY NUMBERS)	ESTIMATED WEIGHT SAMPLED	ESTIMATED WEIGHT LANDED	ESTIMATED WEIGHT DISCARDED	% DISCARD (BY WEIGHT)
1	Sept. 29 - Oct. 1	4Tn	SDN	65'	22	3	475	2136	1203	36.03	1050	6450	1475	18.61
2	Oct. 7 - Oct. 12	4Tn	SDN	85'	34	6	1371	14069	2712	16.16	560	36560	3120	7.86
3	Oct. 9	4Tg	OTB-2	42'	4			NOT SAMPLED				NO	C O D	
4	Oct. 30 - Oct. 31	4Tk	SDN	65'	8			NOT SAMPLED				10000	900	8.26
5	Nov. 9 - Nov. 12	4Tg	SDN	42'	13	2	79	485	110	18.49	401	3150	55	1.72
6	Nov. 26 - Nov. 28	4Tg	SDN	65'	18	3	808	30469	2077	6.38	1410	59400	2260	3.67
7	Nov. 29 - Nov. 30	4Tg	SDN	65'	11	2	532	18861	1087	5.45	1125	48100	1190	2.41
8	Dec. 3	4Tg	SDN	65'	7	1	467	6989	4227	37.69	650	15600	2610	14.33
9	Dec. 11 - Dec. 13	4Tg	SDN	65'	12	3	1404	42706	6680	13.53	1850	82200	4400	5.08
10	Dec. 15 - Dec. 16	4Tg	OTB-1	65'	5	1	411	5325	1848	25.76	550	10000	1400	12.28
TOTAL					134	21	5547	121040	19944	14.15	7596	271460	17410	6.03

Table 1b. Summary of discard study (American plaice) in NAFO Division 4T in 1984.

AMERICAN PLAICE														
TRIP #	DATE	AREA	GEAR	VESSEL LENGTH	NUMBER OF SETS	NUMBER OF SETS SAMPLED	TOTAL NUMBER SAMPLED	ESTIMATED NUMBER LANDED	ESTIMATED NUMBER DISCARDED	% DISCARD (BY NUMBERS)	ESTIMATED WEIGHT SAMPLED	ESTIMATED WEIGHT LANDED	ESTIMATED WEIGHT DISCARDED	% DISCARD (BY WEIGHT)
1	Sept. 29 - Oct. 1	4Tn	SDN	65'	22	5	1983	5283	7033	57.10	1800	7500	6050	44.65
2	Oct. 7 - Oct. 12	4Tk 4Tn	SDN	85'	34	4	1380	8010	12397	60.75	1410	13350	7220	35.10
3	Oct. 9	4Tg	OTB-2	42'	4	1	410	638	344	35.03	348	645	198	23.49
4	Oct. 30 - Oct. 31	4Tk	SDN	65'	8	1	433	3920	1876	32.37	470	7000	950	11.95
5	Nov. 9 - Nov. 12	4Tg	SDN	42'	13	2	636	3485	5514	61.27	650	5760	3430	37.32
6	Nov. 26 - Nov. 28	4Tg	SDN	65'	18	2	555	3355	13139	79.66	390	4970	7650	60.62
7	Nov. 29 - Nov. 30	4Tg 4Tf	SDN	65'	11	1	494	1750	1740	49.86	450	2160	1040	32.50
8	Dec. 3	4Tg	SDN	65'	7			NOT SAMPLED				1650	1150	41.07
9	Dec. 11 - Dec. 13	4Tg	SDN	65'	12	2	266	1007	1093	52.05	260	1100	790	41.80
10	Dec. 15 - Dec. 16	4Tg	OTB-1	65'	5	1	322	400	899	69.21	330	550	760	58.02
		TOTAL			134	19	6479	27848	44035	61.26	6108	44685	29238	39.55

Table 2. Numbers of cod discarded and kept and percent discarded for the 1984 discard study.

Numbers			
Age	Discarded	Kept	% Discarded
1	8	-	100.0
2	434	17	96.2
3	3137	1104	74.0
4	12954	16102	44.6
5	2998	34253	8.1
6	321	16999	1.6
7	85	25928	0.3
8	5	10808	0.1
9		11515	-
10		3285	-
11		730	-
12		82	-
13		16	-
14		-	-
15		3	-
16		-	-
17		5	-
18+			
Total	19942	120847	14.2
Mean age	4.0	6.3	

Table 3. Numbers and Percentage of Plaice Discarded and Kept at Age in NAFO Division 4T, 1984.

AGE	MALE NOS	FEMALE NOS	TOTAL NOS	DISCARD %	MALES NOS	FEMALE NOS	TOTAL NOS	KEPT %	% DISCARDED
3	19	15	34	0.1	0	0	0	0.0	100
4	766	738	1504	3.4	22	36	58	0.2	96.14
5	1415	1380	2795	6.4	45	59	104	0.4	96.28
6	2406	2488	4894	11.1	127	277	404	1.5	91.74
7	3023	3376	6399	14.5	319	428	747	2.7	88.33
8	3092	3297	6389	14.5	358	834	1192	4.3	81.34
9	2914	4702	7616	17.3	570	2025	2595	9.3	65.93
10	3166	5272	8438	19.2	703	3816	4519	16.3	46.44
11	789	1839	2628	6.0	295	2811	3106	11.2	-
12	691	1702	2393	5.4	276	3659	3935	14.2	-
13	60	751	811	1.8	71	3048	3119	11.2	-
14	59	47	106	0.2	18	1933	1951	7.0	-
15	0	21	21	0.1	0	2077	2077	7.5	-
16	0	4	4	0.1	0	1063	1063	3.8	-
17	0	0	0		0	730	730	2.6	-
18+	0	0	0		41	2151	2192	7.0	-
TOTAL	18400	25632	44032	100%	2845	24947	27792	100%	
MEAN AGE	8.0	8.6			9.3	11.9			

Table 4. Summary of discard studies conducted on cod in NAFO Division 4T.

Study	Years	Discard Rates by number %	Discard Rates by weight %
Jean (1963)	1956	25	9
Jean (1963)	1957	24	6
Jean (1963)	1958	16	7
Jean (1963)	1959	13	6
Jean (1963)	1960	10	4
Jean (1963)	1961	6	2
D.F.O. Unpublished Study (1977)	1976	-	5.9
Cliche (1981)	1980	7.3	3.6
Present Study	1984	14.15	6.03

Table 5. Summary of discard studies conducted on American plaice in NAFO Division 4T.

Study	Year	Discard Rates by number %	Discard Rates by weight %
Jean (1963)	1957	70.0	40.0
Jean (1963)	1958	74.0	34.0
Jean (1963)	1959	81.0	60.0
Jean (1963)	1961	-	50.0
D.F.O. Unpublished Study (1977)	1976	69.3	41.9
Cliche (1981)	1980	50.9	25.1
Present Study	1984	56.1	39.5

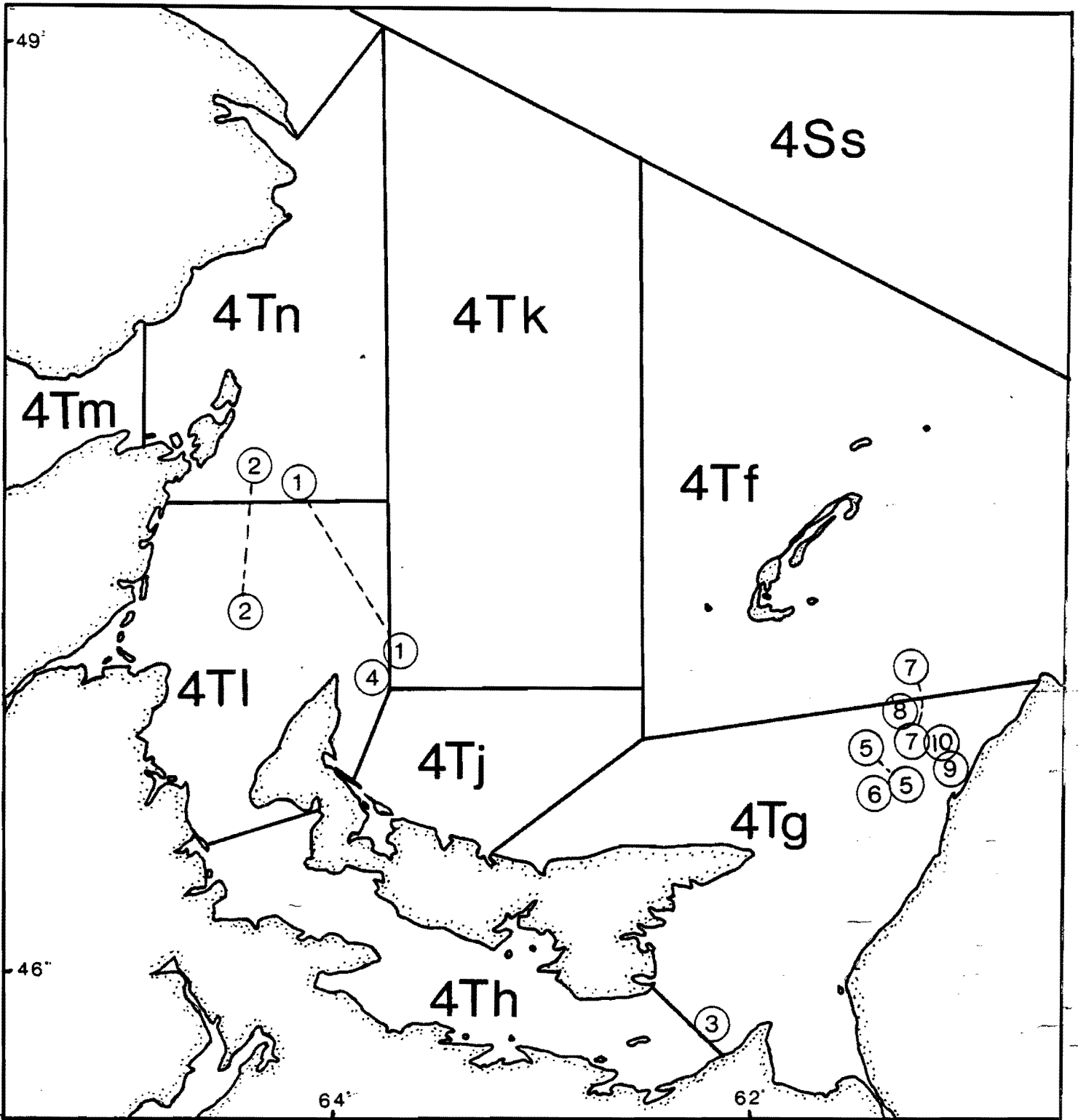


Figure 1. Map of the southern Gulf of St. Lawrence indicating the location of the fishing trips in the 1984 discard study. Numbers refer to the trip numbers in Table 1a and 1b. Circles joined by broken lines are of the same trip.

COD

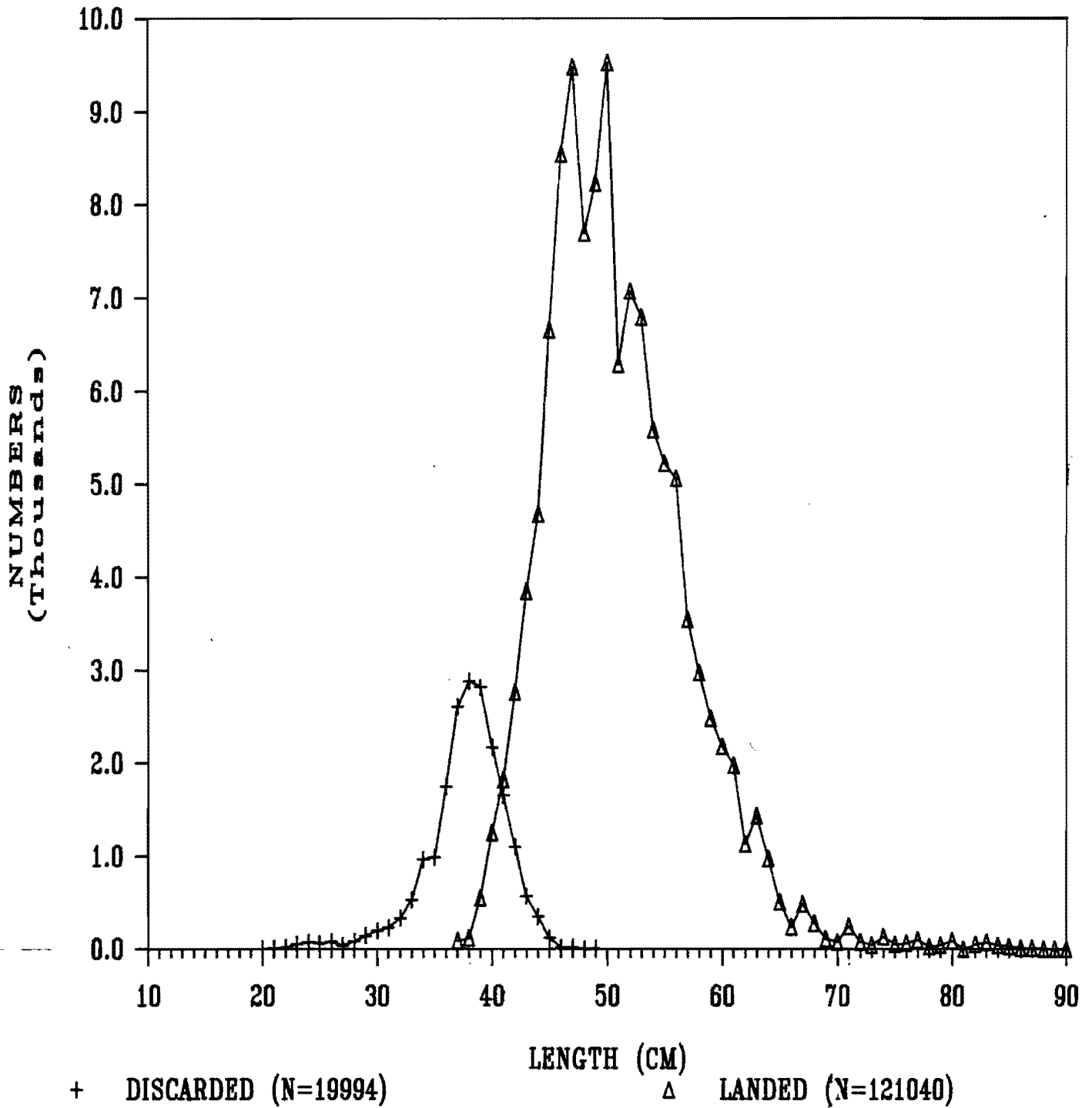


Figure 2. Length frequency distributions of the discarded and landed cod in the study.

COD

4Tk, 4Tl & 4Tn

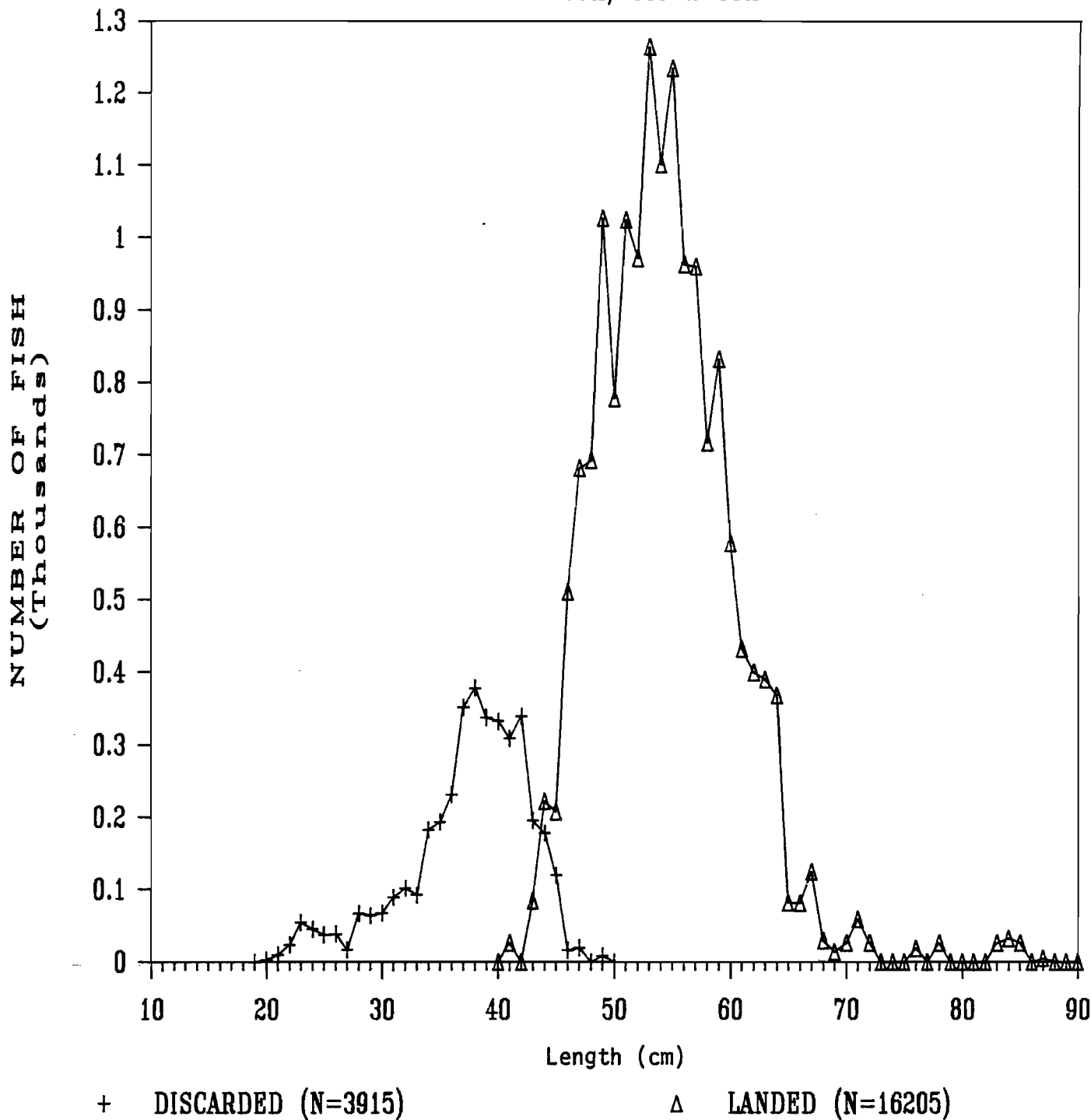
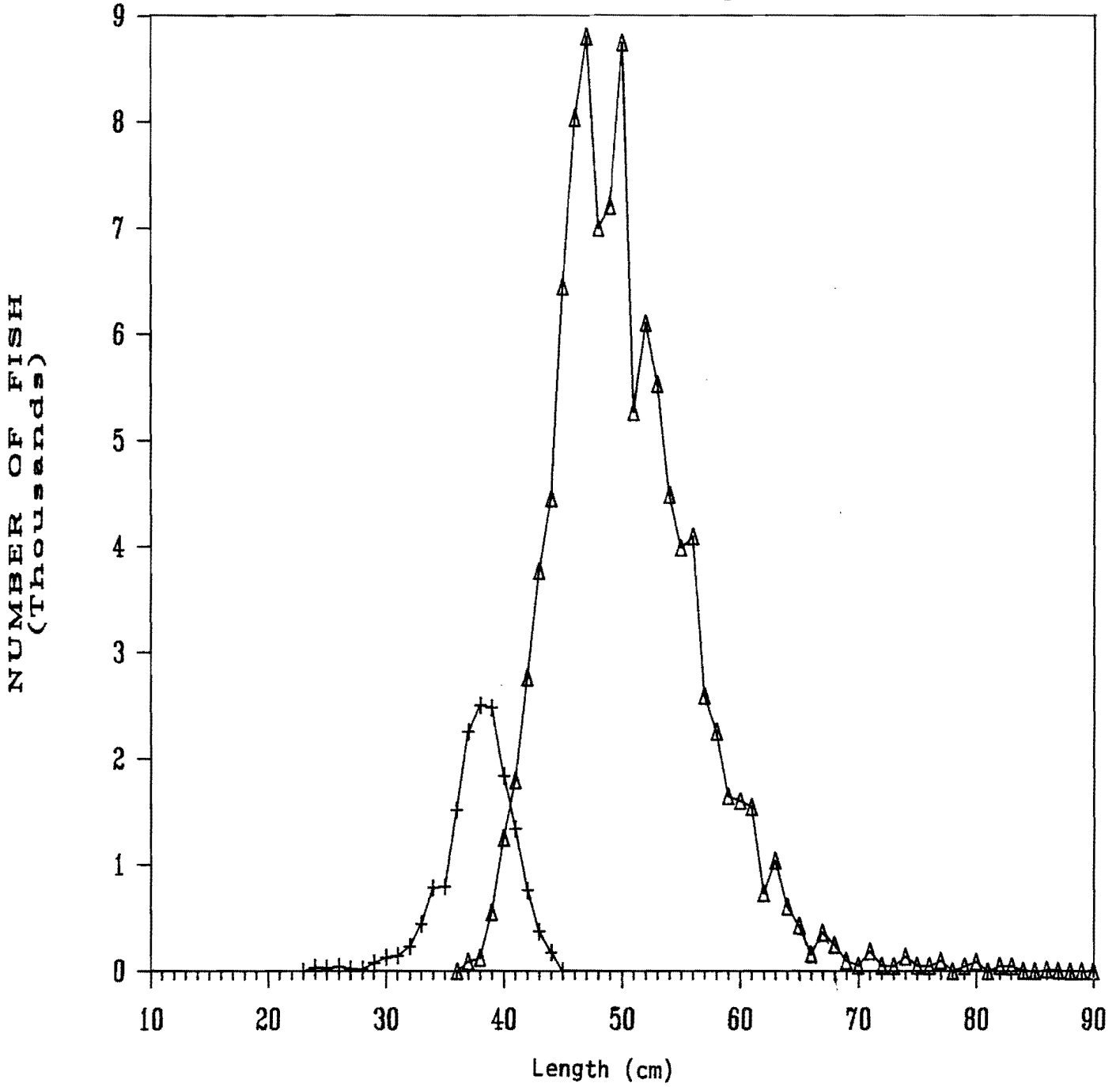


Figure 3. Length frequency distributions of the discarded and landed cod in Subdivisions 4Tkln.

COD

4Tf & 4Tg



+ DISCARDED (N=16029)

Δ LANDED (N=104935)

Figure 4. Length frequency distributions of the discarded and landed cod in Subdivisions 4Tfg.

SELECTION OF LANDED FISH

COD

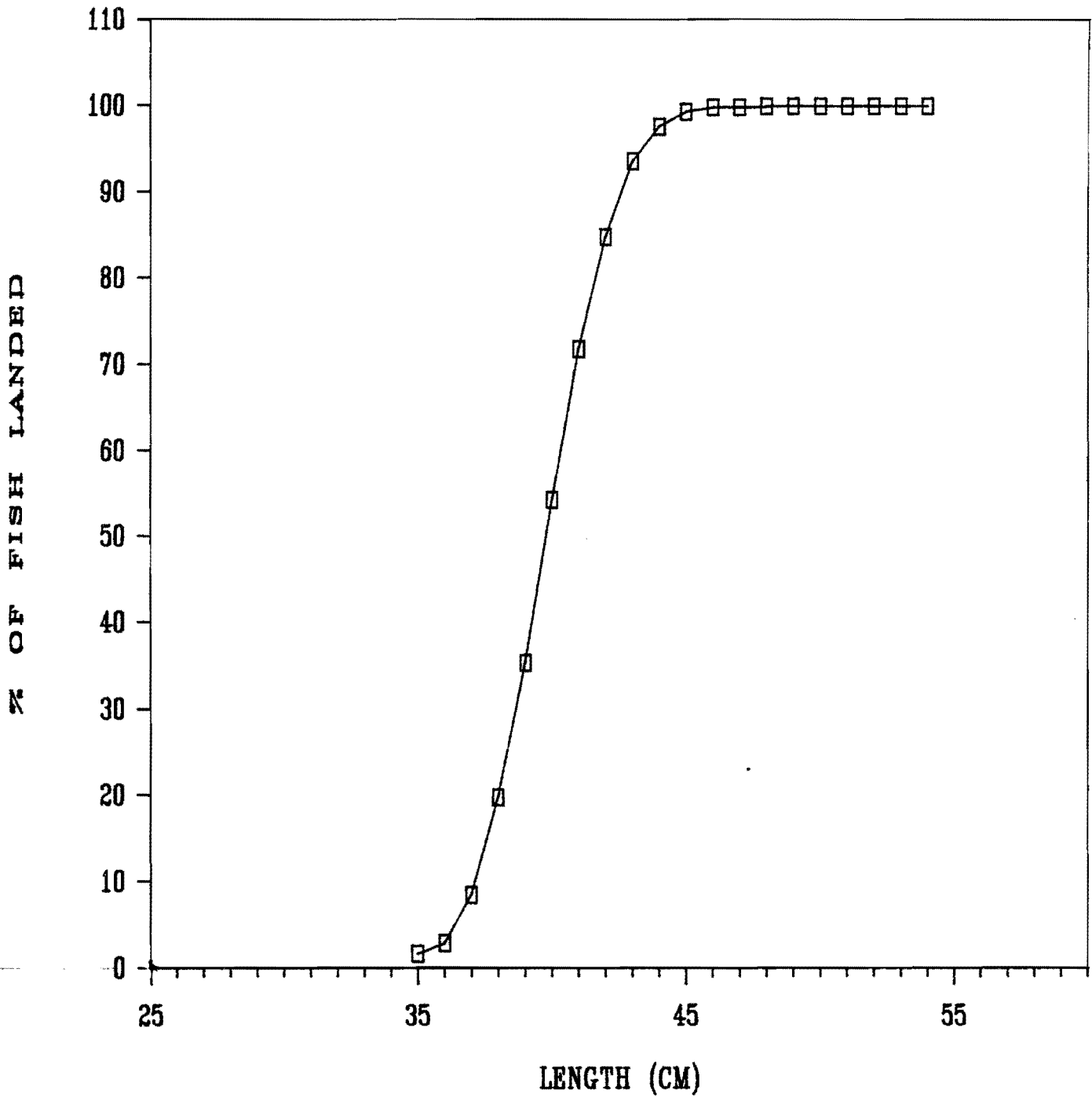


Figure 5. Selection pattern for landed cod in the study.

SELECTION OF LANDED FISH

COD

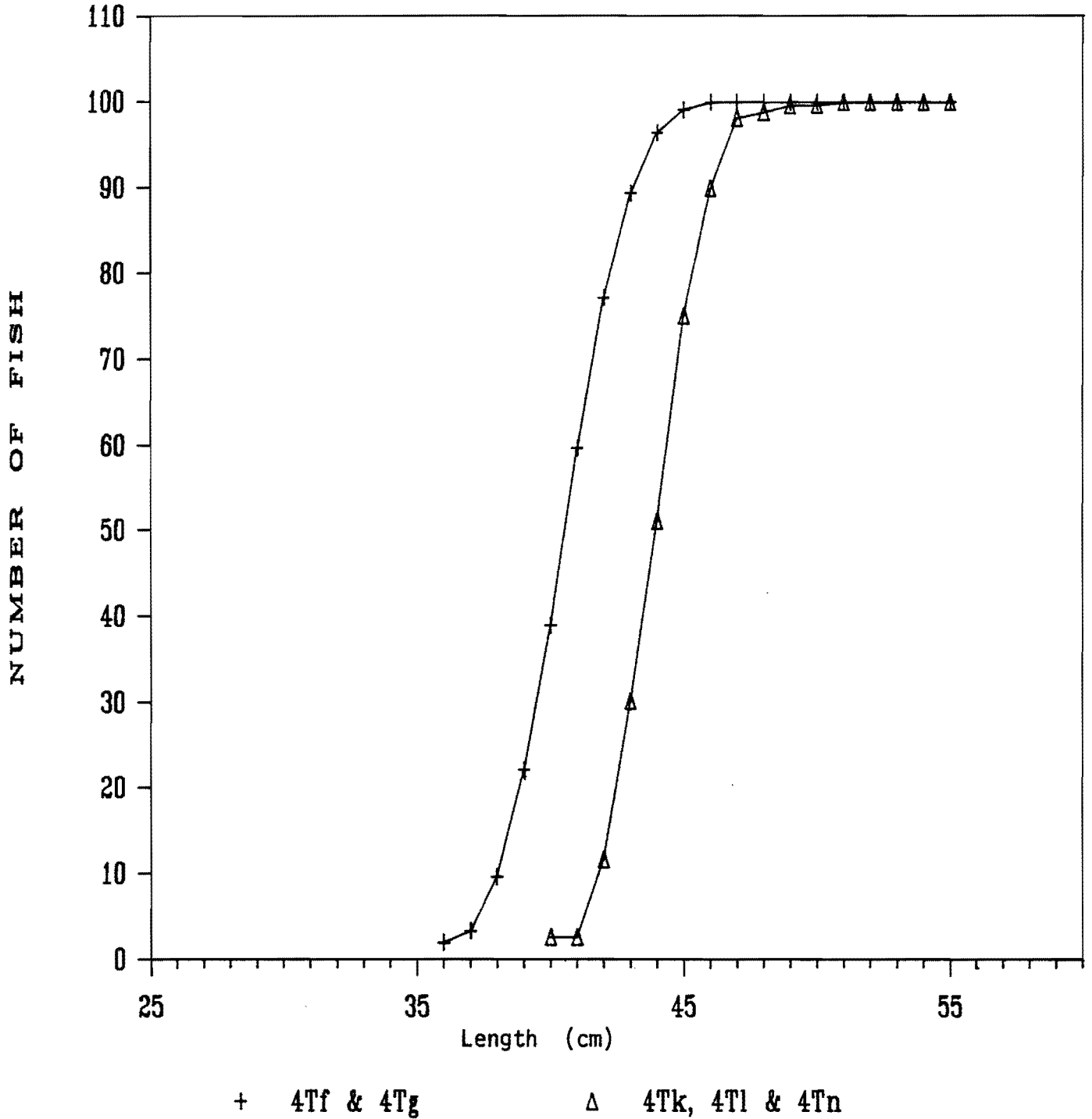


Figure 6. Selection pattern for landed cod in Subdivisions 4Tfg and 4Tkln.

AMERICAN PLAICE (MALES & FEMALES)

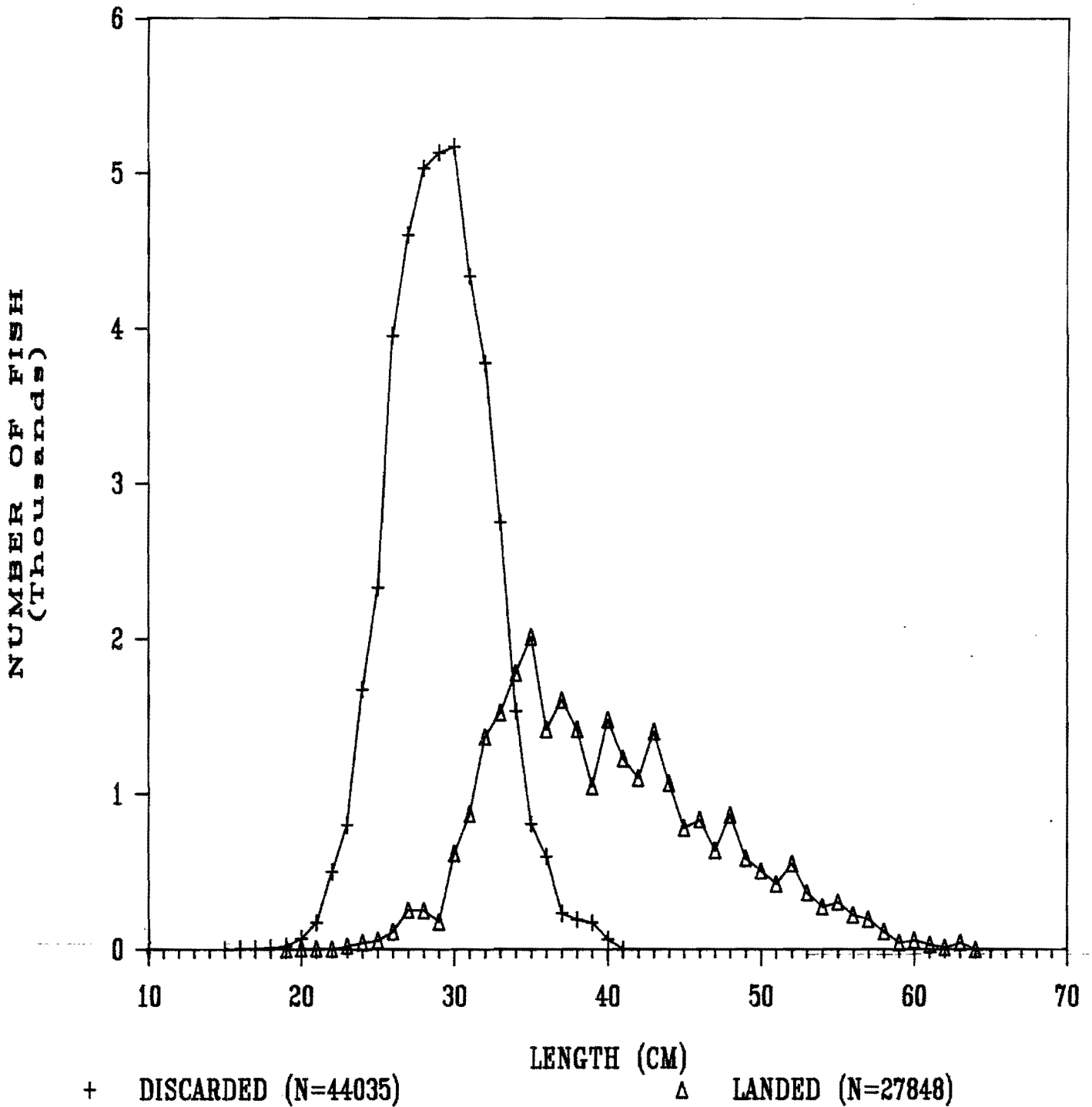


Figure 7. Length frequency distributions for discarded and landed American plaice (males and females)

SELECTION OF LANDED FISH

AMERICAN PLAICE (MALES & FEMALES)

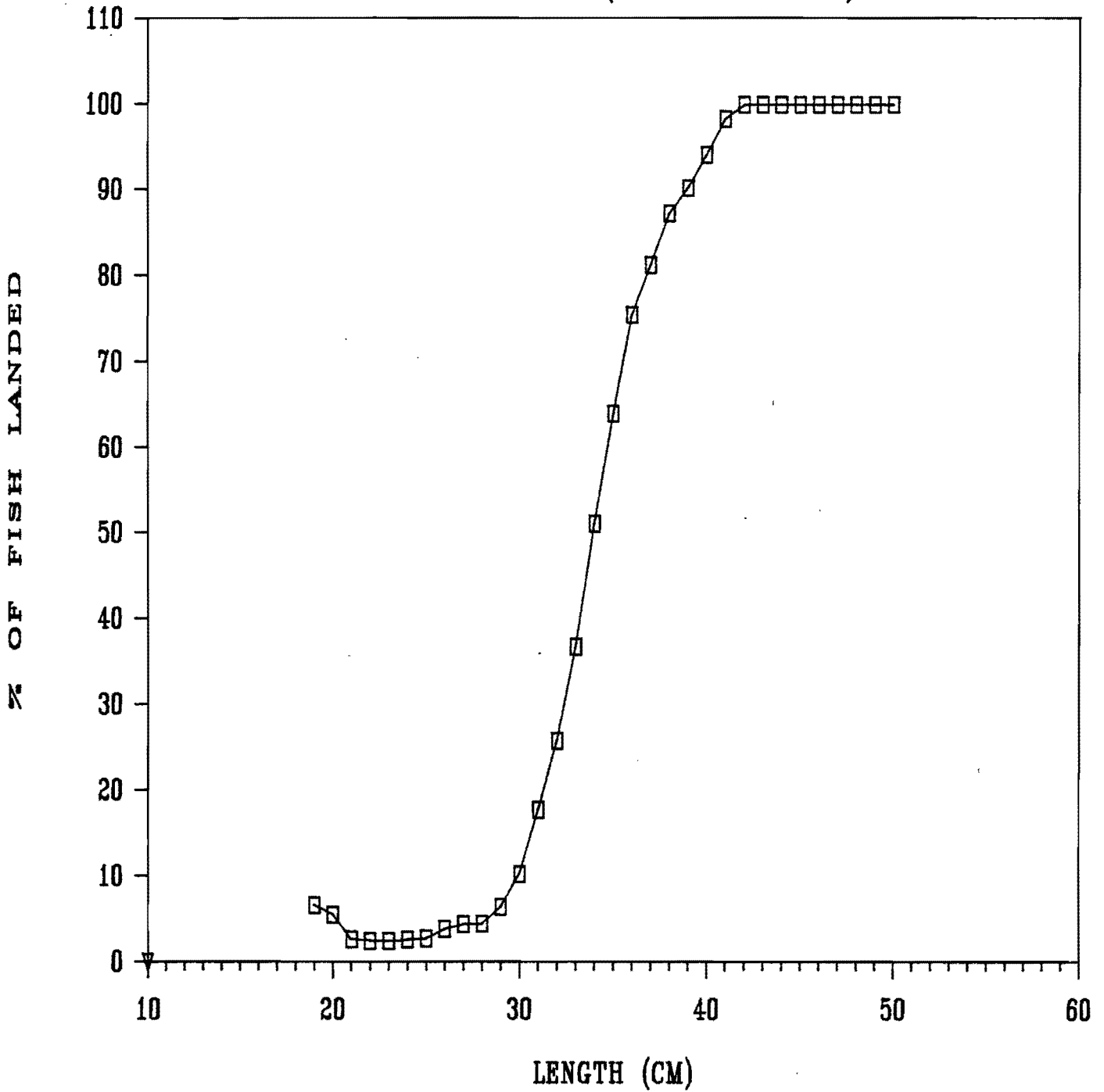


Figure 8. Selection pattern for landed American plaice (males and females) in the 1984 study.