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DEFINITION OF JUVENILE AREAS FOR THE 4T-Vn (JANUARY-APRIL) COD STOCK

by

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ABSTRACT

One of the conservation measures that can be used to protect fishery resources is the closure of areas of juvenile concentration. The purpose of this study was to determine whether such areas could be identified for the southern Gulf of St. Lawrence cod stock (4T and 4Vn (January-April)) and to determine the impact of such a closure on fishing effort. Examination of the results of previous studies and of surveys conducted in area 4T indicated that young cod (3 years and less) were primarily found in the Miramichi Bay - Shediac Valley and in an area north of the Magdalen Islands. They appeared to be present in these areas from May to November. Juvenile cod were also found in significant numbers in the Baie des Chaleurs and the eastern end of Prince Edward Island, however in those areas they are mixed with older fish. Older juvenile cod (4 and 5 years), although present in all areas where younger fish are found, are more widely distributed. For the 4Vn area (January to April), no specific area of juvenile concentration could be identified from an analysis of observer data. In total, less than 5% of the effort of mobile gears (vessels > 50') is expended over the two main juvenile areas in the southern Gulf.

RÉSUMÉ

Une mesure de conservation qui peut être employée pour protéger les ressources halieutiques est la fermeture des aires de concentration de juvéniles. Le but de la présente étude était de déterminer si de telles aires pouvaient être identifiées pour le stock de morue du sud du golfe du St. Laurent (4T et 4Vn (janvier à avril)) et de déterminer l'impact d'une fermeture sur l'effort de pêche. L'examen d'études antérieures et des résultats de relevés menés sur la zone 4T ont révélés que les jeunes morues (3 ans et moins) se retrouvent principalement dans les régions de la Baie de Miramichi - Vallée de Shédiac ainsi qu'au nord des Iles de la Madelaine. Ces juvéniles semblent se retrouver dans ces régions sur toute la période de mai à novembre. Des morues juvéniles étaient nombreuses aussi dans la Baie des Chaleurs et sur la région à l'est de l'Ile de Prince Edouard, cependant, sur ces régions on retrouve aussi des nombres importants de morues plus vieilles. Les morues juvéniles plus âgées (4 et 5 ans), bien que présentes sur toutes les aires identifiées, semblent avoir une distribution plus étendue. Pour la zone 4Vn (janvier à avril), aucune aire de juvénile n'a pu être identifiée à partir d'une analyse des données recueillies par les observateurs. En tout, on estime que moins de 5% de l'effort de pêche (navire de plus de 50') est employé sur les deux aires principales de juvéniles du sud du Golfe du St. Laurent.

INTRODUCTION

In fisheries management, many tools can be used to control fishing effort in order to preserve the resource and ensure that a reasonable yield is obtained. These tools include regulation of effort (number of licenses, seasons, size of gears and vessels), regulation of landings (TAC's, fleet allocations, ITQ's) and regulation of the size of animals caught (mesh sizes of nets, minimum sizes of fish). In spite of all these measures, significant numbers of fish of small size may still be caught because selectivity of fishing gear is not an exact process. One way to avoid exploiting small fish is to establish closed areas where these small fish are concentrated. "Nursery" areas have been defined in many fisheries and access by fishing gear is restricted in these areas. For example, in the North Sea, plaice and cod "boxes" have been established to protect juvenile fish.

The capture of small cod (< 41 cm) is often considered a problem in the southern Gulf of St. Lawrence mobile gear fisheries. For example, in 1987, the spring fishery for cod near Chéticamp, N.S., was closed on three occasions when large numbers of small fish were observed in the landings. There have also been reports from fishermen that large numbers of undersized fish occur around St. Paul's Island during the winter cod fishery.

In the fall of 1990, a special committee on the Conservation and Protection of the Gulf of St. Lawrence groundfish stocks was established to recommend measures to ensure the preservation of cod stocks in the area. One of the recommendations of the special committee was to examine the spatio-temporal distribution of juvenile cod to determine whether areas of concentration could be identified.(Martin 1990).

The 4T-Vn (January-April) or southern Gulf of St. Lawrence cod stock usually inhabits NAFO area 4T from about the end of April to late November-early December. In late fall, these cod migrate to the Sydney Bight area (4Vn) where they overwinter; the return migration occurs the following April. Larger fish are thought to migrate further (Halliday and Pinhorn 1982) than smaller fish and cod less than 2 years of age are thought to overwinter in the Gulf (Jean 1964). Cod spawn in late April-early May through to September with peak spawning occuring in May and June.

According to Lett (1980), 4T-Vn (January-April) cod mature at a size of 40-45 cm. Juvenile fish (by definition fish that are not sexually mature) therefore include cod up to 4-5 years old. The objective of the study was to determine whether any areas containing primarily cod less than 5 years could be identified and to estimate the amount of effort that would be displaced if these areas were closed to the mobile gear sector.

IDENTIFICATION OF JUVENILE AREAS

A) Southern Gulf of St. Lawrence (4T)

Since 1971, the annual groundfish surveys conducted in the southern Gulf of St. Lawrence have followed a standard protocol (Hurlbut and Clay 1990). The survey is conducted in September when most groundfish species tend to be less aggregated that at other times in the year. Tremblay and Sinclair (1985) analyzed the data covering the period 1971-1981 and found that cod 1 and 2 years old were mostly concentrated in the following areas: the mouth of the Miramichi River, Baie des Chaleurs, an area north of the Magdalen Islands and the eastern end of P.E.I. (Figure 1). A later analysis by Chouinard and Sinclair (1989) using the data from 1971 to 1988, confirmed these results (Table 1). This latter study also revealed

that although the upper Baie des Chaleurs (stratum 19, see map Figure 2)) and eastern P.E.I. areas (stratum 33) were important in terms of numbers of juveniles; significant numbers of older fish of commercial size (> 41 cm) were also found in these areas. Fish from the two most important areas (Miramichi - stratum 22 and Magdalen Islands - stratum 28) were predominantly juveniles (Figure 3). The 1989 survey results (Figure 4; from Chouinard et al. 1990) illustrate well the pattern observed. The greatest concentrations of 1 and 2 year-olds occurred near Miramichi Bay and north of the Magdalen Islands with much lower densities occurring in the Baie des Chaleurs and near the eastern end of P.E.I. In addition, it is apparent that three year-old cod are more widely distributed than 1 and 2 year-olds. Thus, there appears to be a gradual spreading out of the distribution over the 4T area as fish grow older (Figure 4). Fish older than 9 years of age are distributed widely throughout 4T during September (Tremblay and Sinclair 1985).

The results outlined above are based on the annual September research surveys. Results from other surveys were also examined to determine whether juvenile cod were found in these areas at other times of the year. A juvenile cod survey was conducted in 1987 from May 27 to June 13 (Cruise H173) over the southern Gulf (4T). The largest catch of juvenile cod from this survey occurred at 47° 44' N 64° 22' W just north of the Miramichi Bay area. Juveniles were also found in the Miramichi Bay area. A juvenile survey conducted in July 1988 in the western Gulf of St. Lawrence (Baie des Chaleurs and northeastern N.B.) indicated that the highest numbers of cod < 30 cm (ages 0, 1, and 2) were found off Miramichi Bay (Figure 5). Comparatively few cod < 30 cm were collected from the Baie des Chaleurs during this survey. Significant numbers of cod < 30 cm were also found near Miramichi Bay in a survey of the Miramichi Bay - Shediac Valley area in August 1990 (Figure 6).

Seasonal surveys conducted in northwestern 4T in 1990 in June-July (Figure 7) and September (Figure 8) also indicated that juveniles are found in the Miramichi area during these periods. The survey conducted in November 1990 (19th to 29th) was conducted after much of the migration had occurred and revealed a low abundance of cod except along the Laurentian Channel, where catches were composed mainly of adults (Figure 9). Cod catches in the Miramichi area were low and composed exclusively of juveniles (< 30 cm).

In summary, the Miramichi Bay area consistently has significant numbers of juvenile cod present from May to November. For the Magdalen Islands area, the evidence of its importance as a juvenile area is derived mostly from the September surveys as the area has seldom been surveyed at other times of the year. When juvenile cod are present in the Baie des Chaleurs and off the eastern end of P.E.I., their abundance is usually much lower than that observed at the same time near Miramichi Bay and they are usually mixed with significant numbers of older fish. Thus, the areas near Miramichi Bay and north of the Magdalen Islands (Figure 10) appear to be prime candidates for designation as juvenile or nursery areas.

B) Sydney Bight (4Vn)

Cod < 41 cm (from the southern Gulf cod stock) that are found in Sydney Bight in winter should primarily be 3 to 5 years old because younger fish are not thought to migrate to this area to overwinter. A survey that includes the 4Vn area is conducted in March by Scotia-Fundy Region but because of ice conditions at this time of the year, the entire area is seldom covered. The International Observer Program (IOP) has been collecting information on catches from vessels fishing in this area since the late seventies. We used data collected between 1980 and 1990 in our analysis. The area was divided into three zones: 1) north or 47° (primarily the area around St. Paul's Island); 2) the area between 46° and 47° N; and 3) south of 46°. No differences in the length composition of the catches (before any discards) from the three areas were apparent (Figure 11; 1989). The proportion of fish less than 43 cm (17 inches) in catches was then examined by 10' X 10' areas. The percentage of fish less than 43 cm varied between 0 and 61 percent by numbers. However, there were no patterns with respect to the areas; for example an area could have a high

percentage of fish less than 43 cm one year and the lowest during the next year (Figures 12 to 16). Almost none of the fish caught were less than 30 cm (12 inches) and most were greater than 35 cm (15 inches) in length.

FISHING EFFORT IN THE MIRAMICHI AND MAGDALEN ISLANDS AREAS

The impact of a potential closure of these areas on the fishing effort expended by the fleet was then examined using logbook information. As vessels less than 45' are not required to complete logbooks, the impact on this fleet could not be examined. From the logbooks (Gulf and Quebec Region) that contained precise information on fishing location, the effort expended and the catches that were realized in the Miramichi Bay - Shediac Valley and Magdalen Islands areas were calculated. Results are presented in Table 2. Less than 5% of the mobile gear fishing effort for cod is expended in the two areas combined and would be displaced by a closure of these areas. In terms of landings, mobile gear vessels greater than 50' fishing in the two areas have caught between 30 and 580 t in the period. This represents less than 3% of the landings by this fleet.

DISCUSSION

Commercial catches of juvenile cod are usually composed of fish between 3 and 5 years of age (30 to 41 cm). Cod less than 30 cm will normally not be retained by trawls built with the regulated mesh size (130 mm). Although the two areas identified as juvenile areas in the southern Gulf contained high numbers of juveniles of all ages, it should be noted that the distribution of juveniles age 4 and 5 was not restricted to these two areas. These "older" juveniles are often mixed with commercial-size fish (> 41 cm). Consequently, although there are some potential benefits of a closure of these juvenile areas, it is clear that this measure will not by itself solve the problem of undersized fish in catches.

The level of effort presently being expended by mobile gear vessels > 50' over these areas is less than 5% of the total effort for this fleet. It was impossible to determine the level of effort for vessels less than 50' over these areas. If the proportion of the effort expended over the area by this fleet is small (< 5%) then the savings of small cod may be small. On the other hand, if discard rates in these areas are high, even a relatively low level of effort could result in significant mortality of juveniles. Because the level of effort appears to be small, the socio-economic costs may outweigh the conservation gains especially if most of the effort originates from only a few communities that are highly dependent on these areas. Other measures such as a strict enforcement of mesh sizes or close monitoring of catches by observers with temporary closures when the proportion of undersize fish is high could be considered.

It should be noted that the benefits of a closure should be reflected by an increase in the number of fish that survive to commercial size. However, recruitment in fish stocks can be highly variable, which would make the benefits of such a closure difficult to assess in the short-term. Attempts to assess the impact of the cod "box" in the North Sea after a few years, have encountered this difficulty (Anon. 1991).

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Table 1. **4T-Vn (January-April) cod mean catch per tow by strata for ages 0 to 7. Strata numbers correspond to Figure 2 (Adapted from Chouinard and Sinclair, 1989).**

Strata	Age							
	0	1	2	3	4	5	6	7
16	0.0	0.4	0.6	4.2	12.9	24.3	23.2	15.6
17	0.0	0.3	2.2	13.2	24.7	27.1	19.5	11.0
18	0.0	1.7	6.8	16.2	16.4	11.7	8.5	5.3
19	0.1	6.5	10.0	15.3	15.1	14.2	11.4	6.7
20	2.6	9.6	4.3	7.0	9.2	10.1	8.4	9.3
21	4.8	15.9	6.6	8.2	9.0	8.0	6.2	3.7
22	0.1	7.7	27.6	54.4	42.3	27.6	16.7	9.4
23	0.0	0.5	1.8	7.9	15.8	14.6	9.9	5.3
24	0.0	0.5	0.7	6.4	14.8	18.0	13.2	7.4
26	0.0	0.4	0.1	0.8	4.1	10.1	13.4	10.8
27	0.0	0.0	0.3	2.7	6.3	6.7	4.9	3.3
28	1.7	11.1	12.0	25.6	21.6	15.1	8.6	4.7
29	0.3	2.9	6.0	17.0	16.1	10.8	7.1	4.3
31	0.1	1.1	3.3	8.2	11.5	10.5	7.3	4.2
32	0.8	1.3	0.5	0.4	0.5	0.4	0.3	0.3
33	0.5	1.4	1.6	2.5	2.7	2.4	1.9	1.2
34	0.1	0.8	2.4	7.5	7.2	4.9	3.6	2.4
35	0.1	1.2	3.6	7.2	5.9	5.2	4.1	2.7
36	0.0	0.0	0.3	2.3	4.2	4.2	3.8	2.8
37	0.1	0.0	0.1	0.7	1.5	2.7	3.3	3.0
38	0.0	0.0	0.1	1.1	3.4	6.0	7.2	6.2

Table 2. **Fishing effort (hrs) and landings (t) over the Miramichi and Magdalen Islands juvenile areas compared to the entire area (4T) obtained from logbooks with detailed information on fishing location for the Gulf and Québec Region vessels. Numbers in brackets are percentages.**

a) Effort (hrs)

	Area			
Year	Miramichi	Magdalen Islands	Other	Total
86	95 (0.2)	770 (1.2)	60801 (98.6)	61666 (100)
87	4 (0.01)	834 (1.8)	44444 (98.1)	45282 (100)
88	175 (0.3)	1135 (2.2)	50954 (97.5)	52264 (100)
89	1649 (2.2)	664 (0.9)	72856 (96.9)	75169 (100)

b) Landings (t)

	Area			
Year	Miramichi	Magdalen Islands	Other	Total
86	14 (0.07)	61 (0.3)	19081 (99.6)	19156 (100)
87	1 (0.0)	29 (0.2)	14636 (99.8)	14666 (100)
88	77 (0.4)	64 (0.4)	17471 (99.2)	17612 (100)
89	508 (2.4)	70 (0.3)	20358 (97.2)	20936 (100)

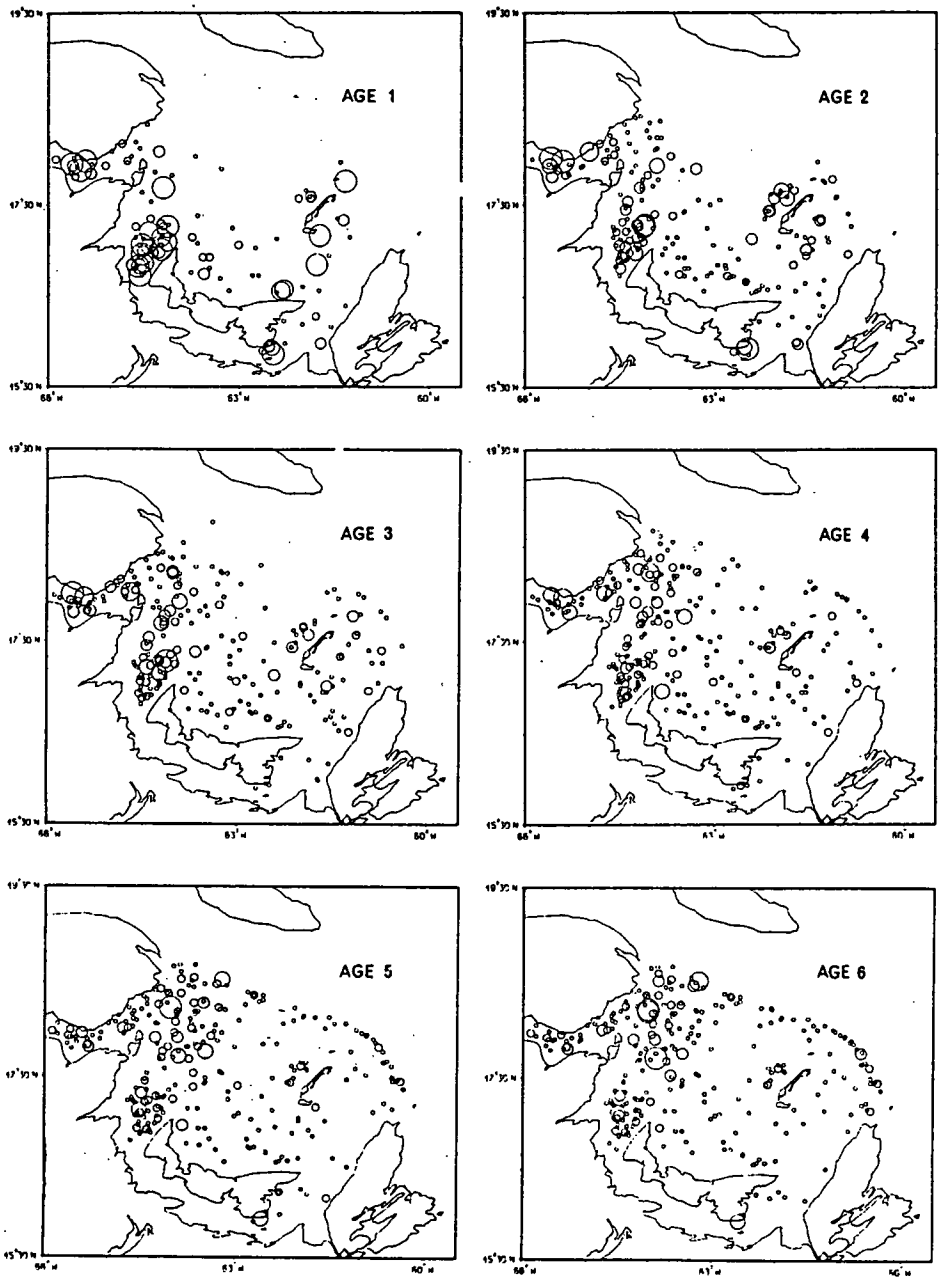

Figure 1. **Composite plots of geographic distribution for each age from 1971 to 1981 standardized by year for cod in the southern Gulf. Circles from the smallest, represent the percentage of the total numbers as follows: 1-5%, > 5-10%, > 10-15%, > 15-20% and > 25%. (Source: Tremblay and Sinclair 1985).**

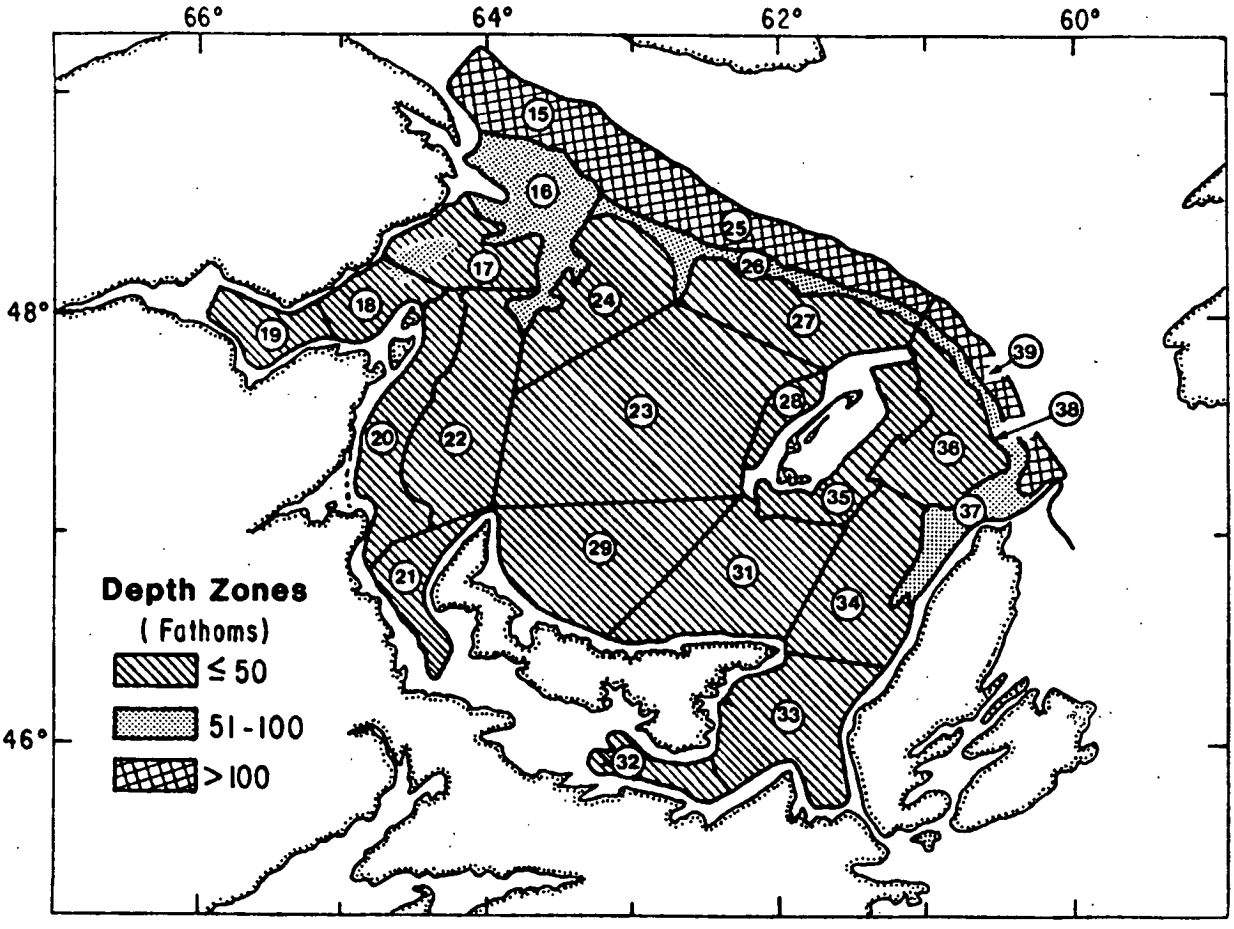

Figure 2. **Stratification scheme for southern Gulf of St. Lawrence groundfish surveys.**

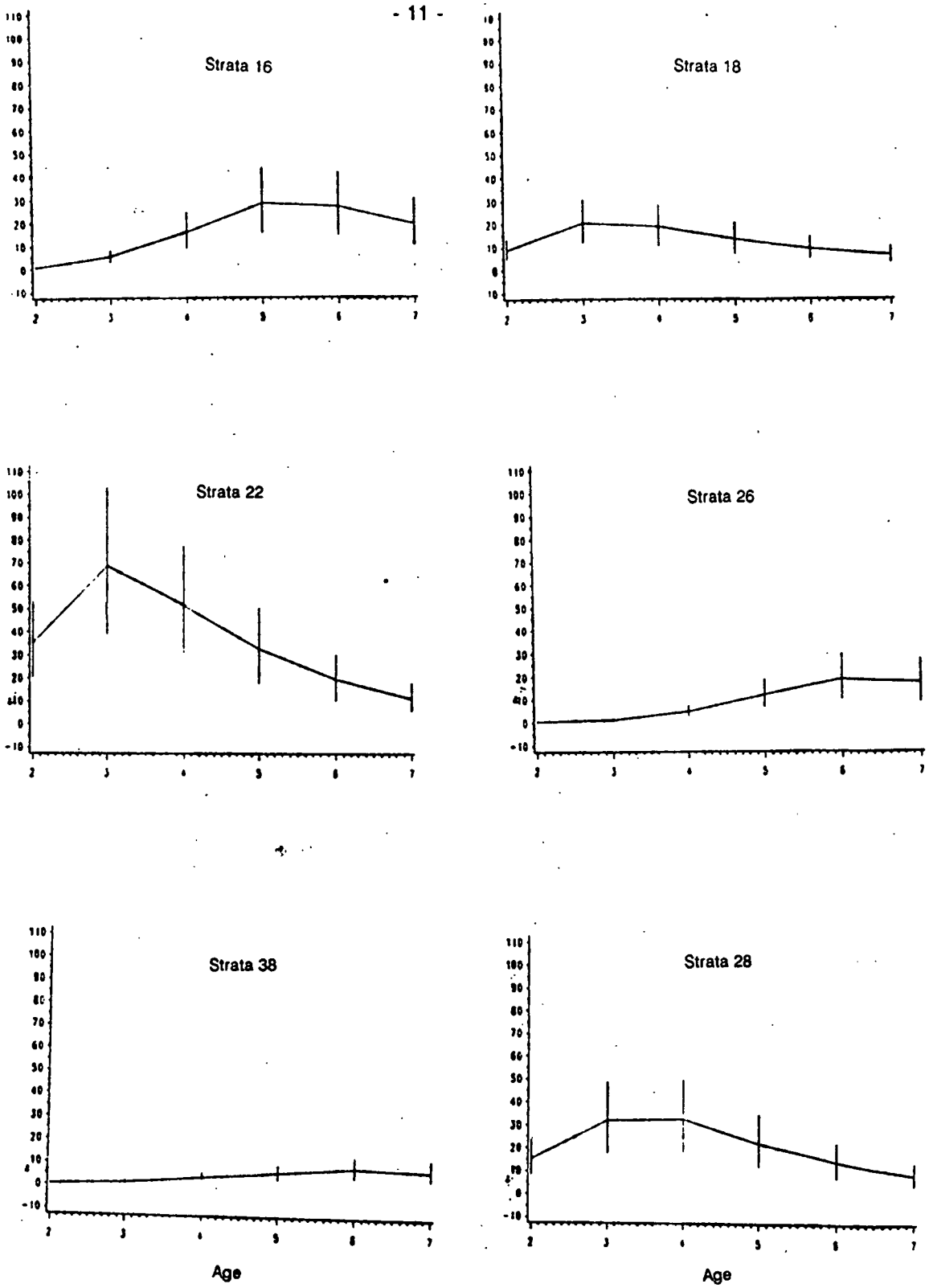

Figure 3. **Standardized mean catch-per-tow (from annual research surveys) for cod 2 to 7 years-old for six strata in the southern Gulf, 1971-1988 (Source: Chouinard and Sinclair 1989).**

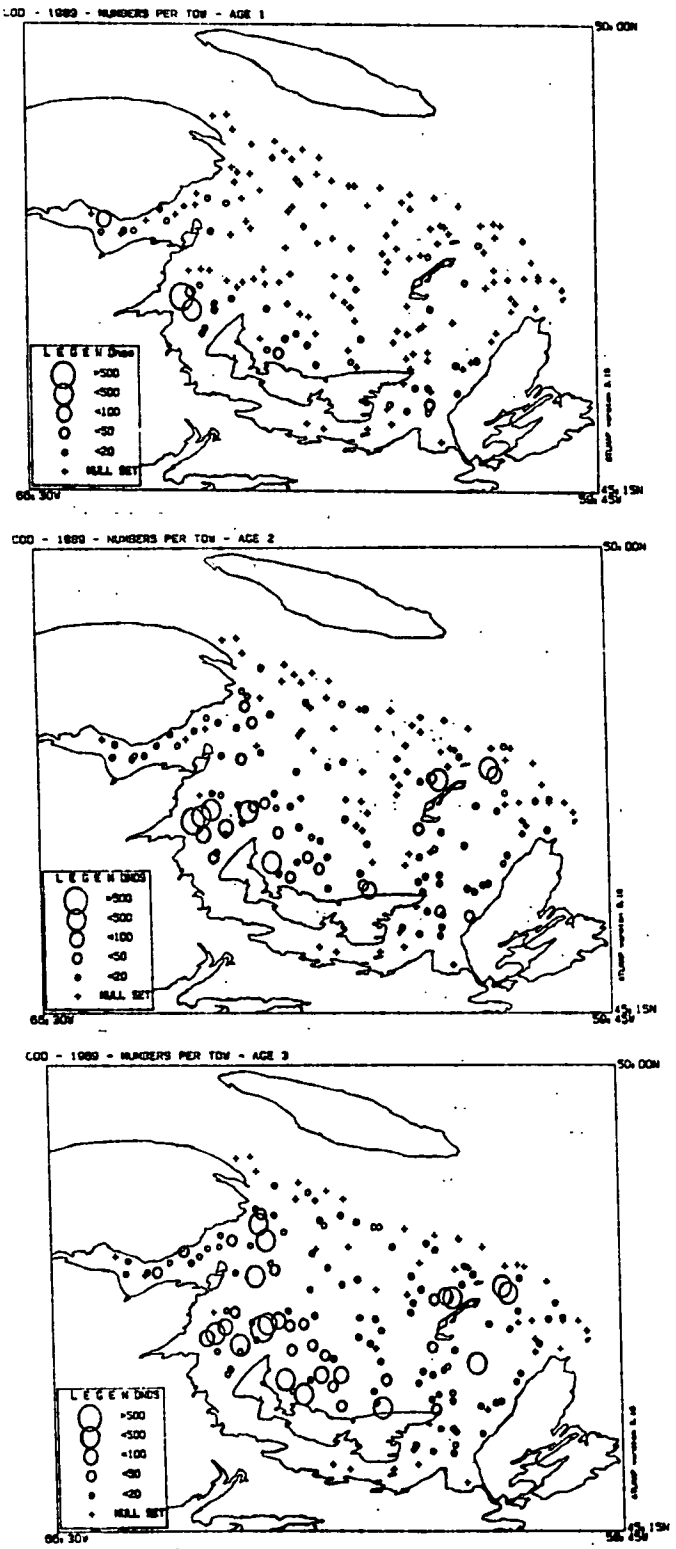

Figure 4. **Numbers per tow for cod of ages 1 to 3 observed in the 1989 groundfish survey in the southern Gulf of St. Lawrence (Source: Chouinard et al. 1990).**

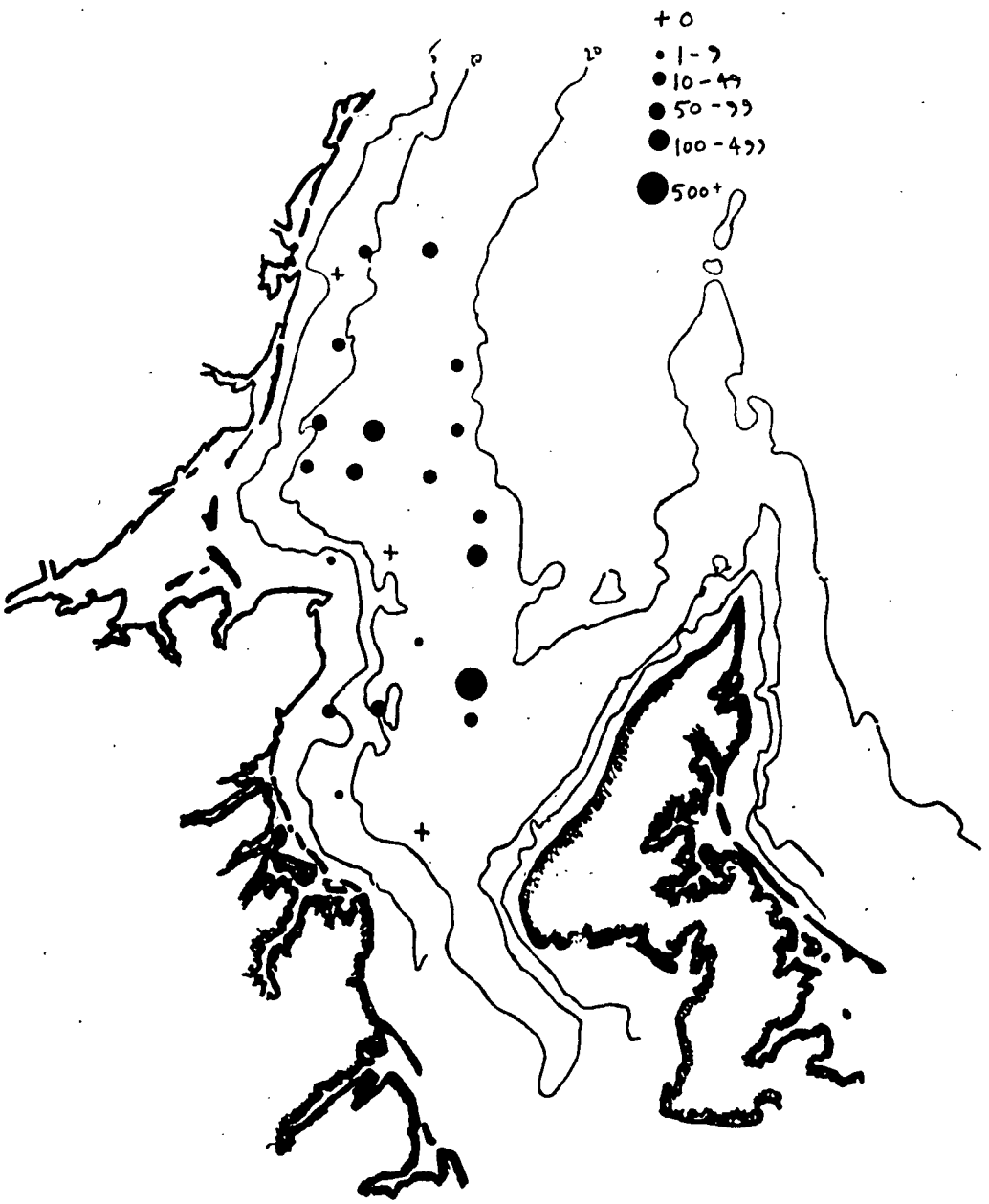

Figure 5. **Distribution and abundance (numbers/tow) of cod < 30 cm in the Miramichi Bay - Shediac Valley area during the juvenile survey conducted in July 1988.**

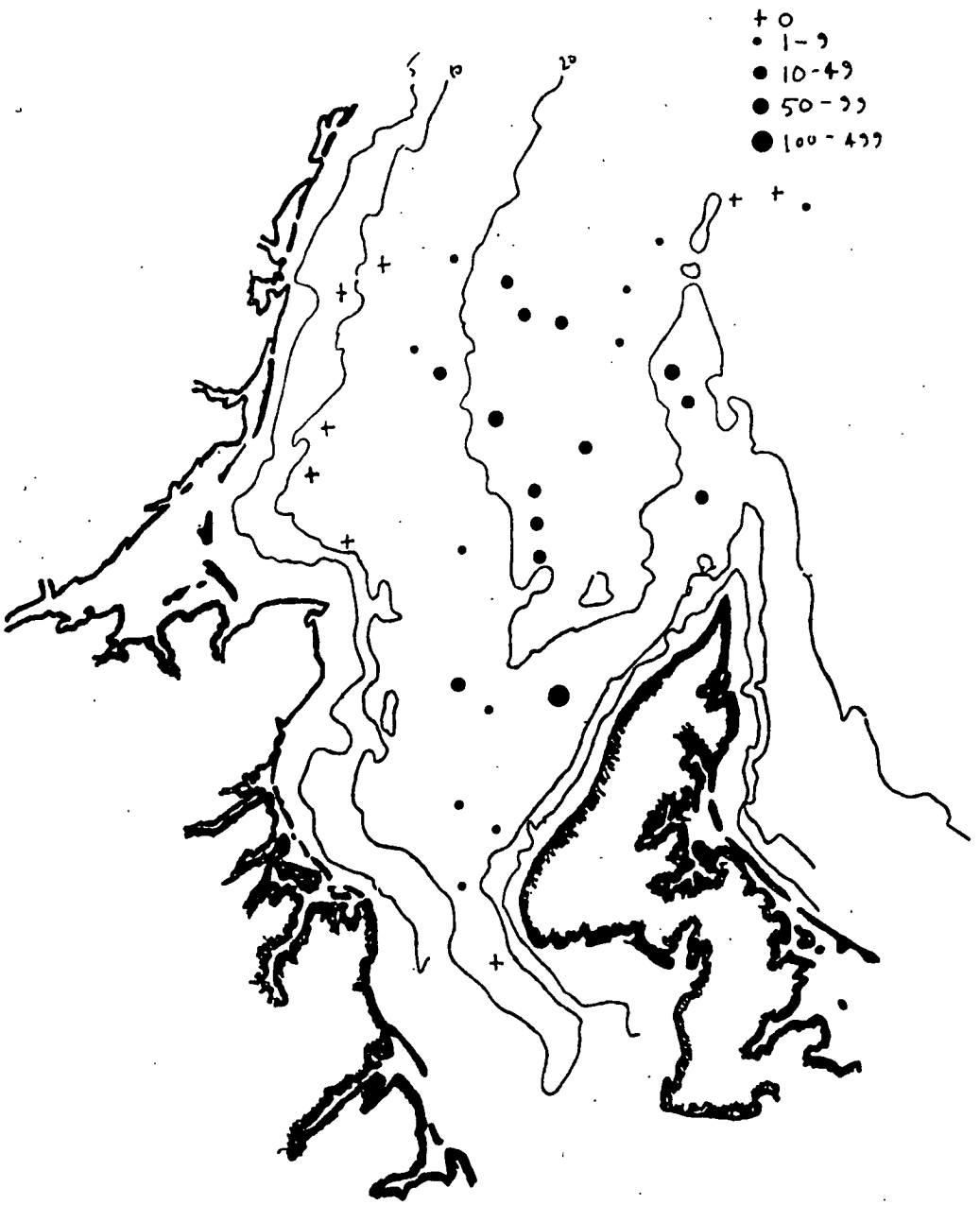

Figure 6. **Distribution and abundance (numbers/tow) of cod < 30 cm in the juvenile survey conducted in the Miramichi Bay - Shediac Valley area during August 1990.**

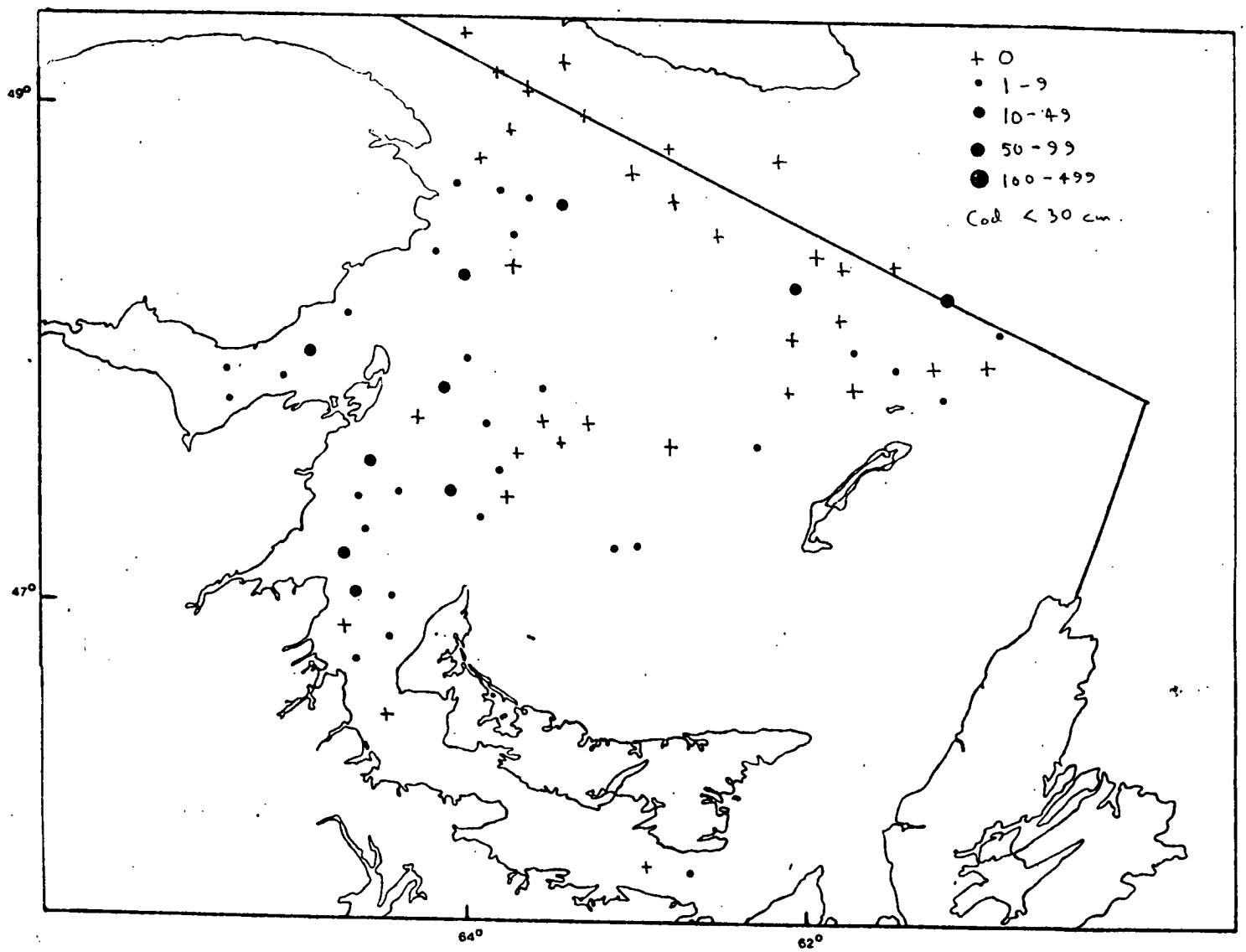

Figure 7. **Distribution and abundance (numbers/tow) of cod < 30 cm during seasonal survey conducted in July 1990.**

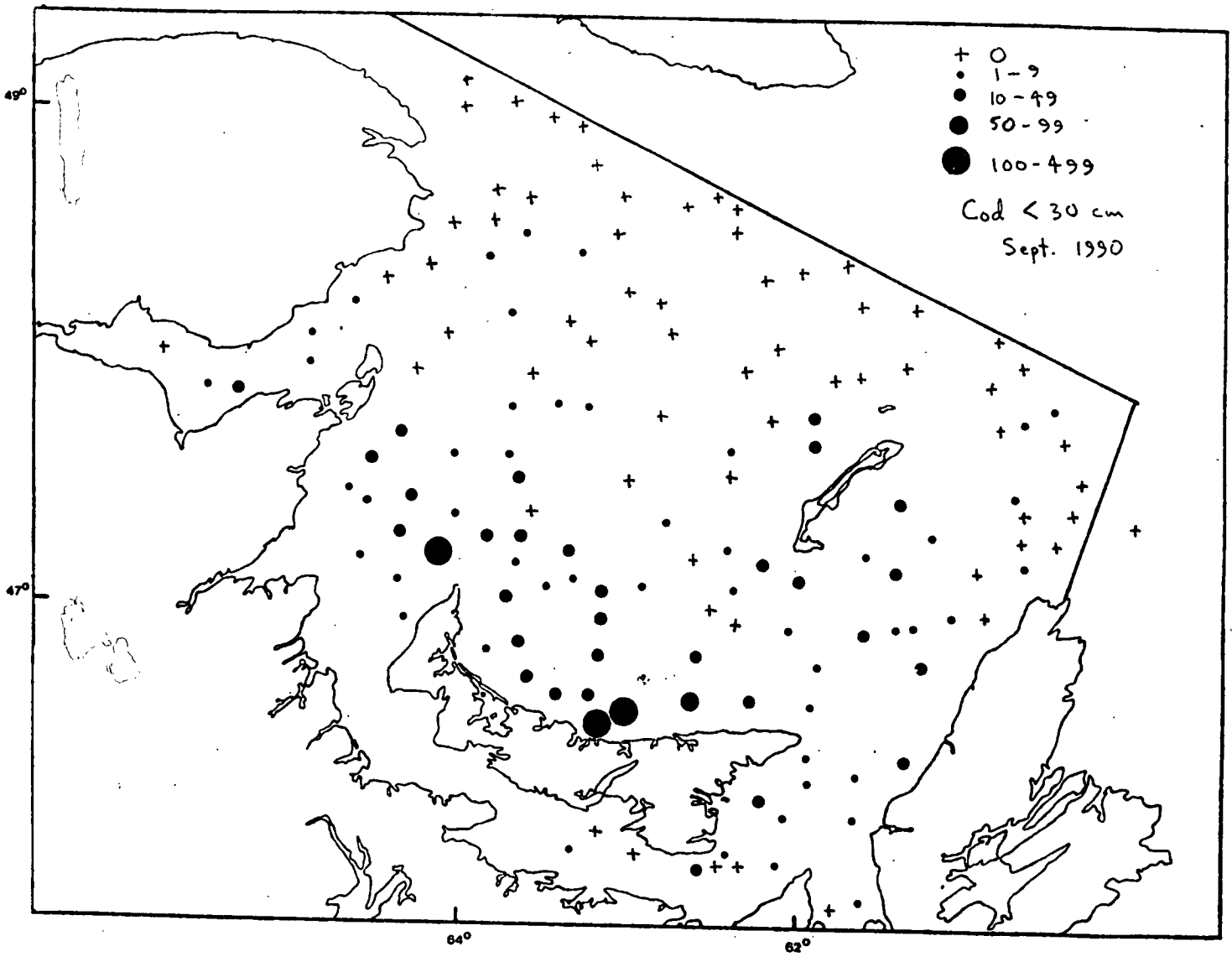

Figure 8. **Distribution and abundance (numbers/tow) of cod < 30 cm during annual groundfish survey conducted in September 1990.**

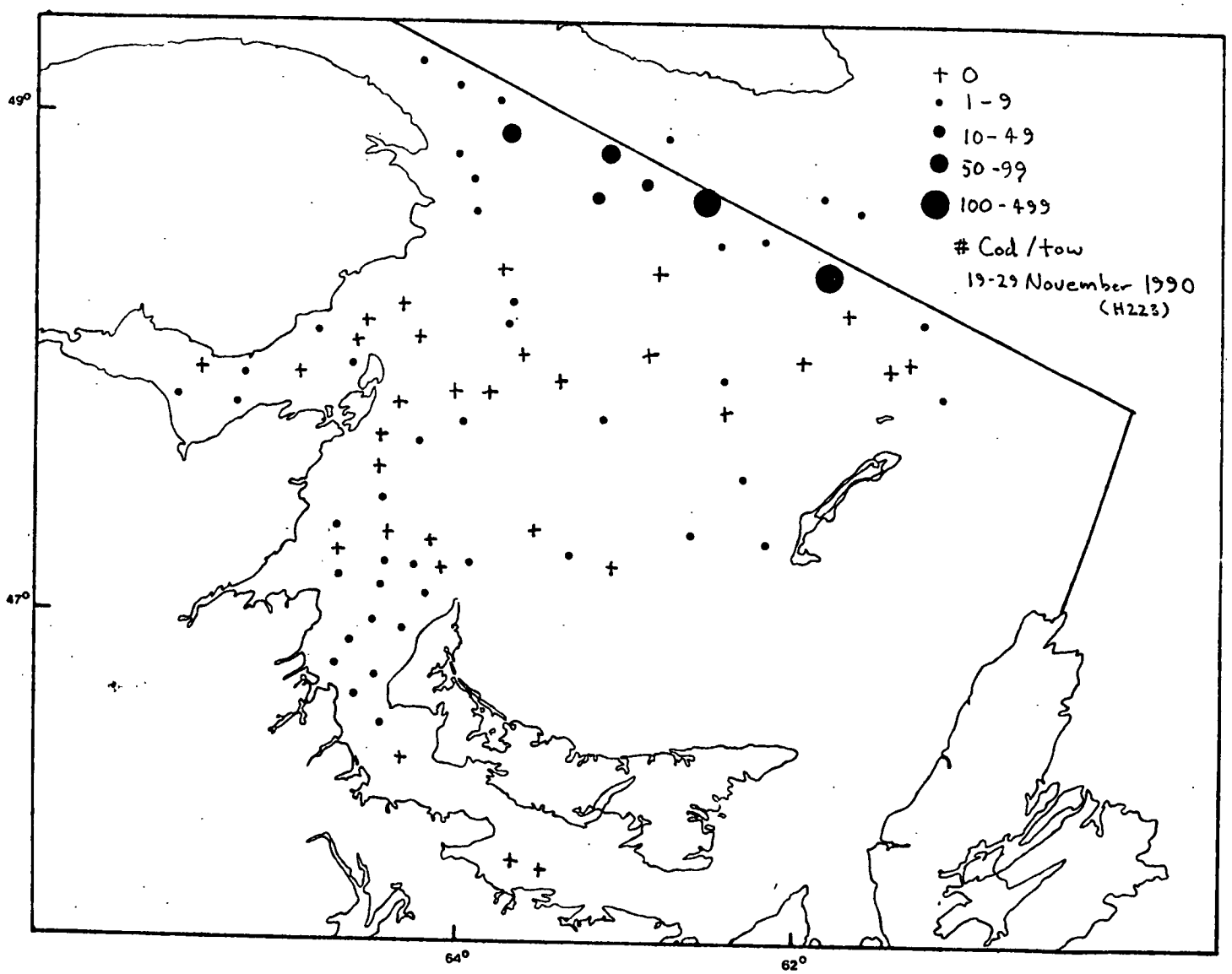

Figure 9. **Distribution and abundance (numbers/tow) of cod catches during seasonal survey conducted in November 1990.**

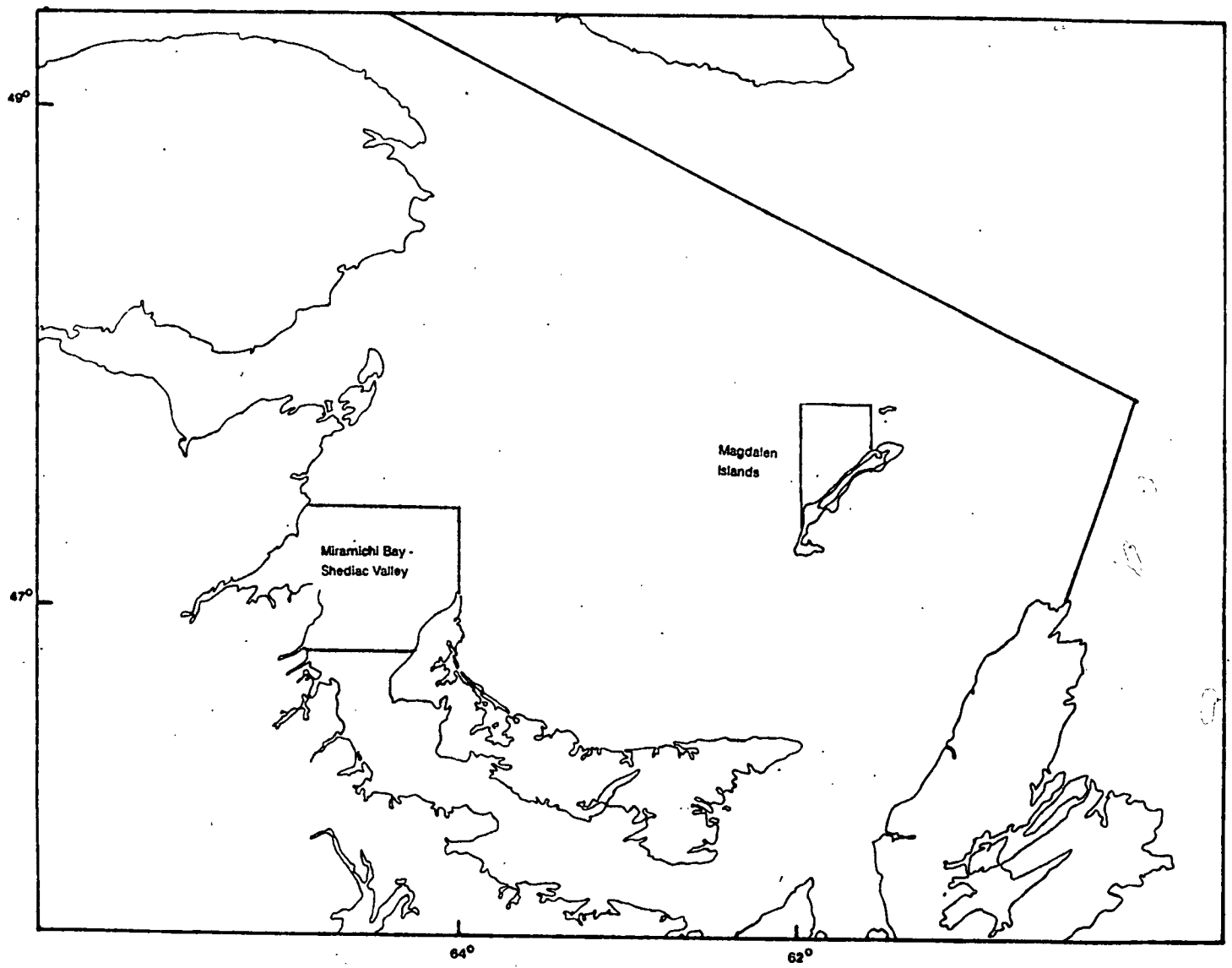

Figure 10. **Area of juvenile cod concentration in the Miramichi Bay - Shediac Valley area and north of the Magdalen Islands.**

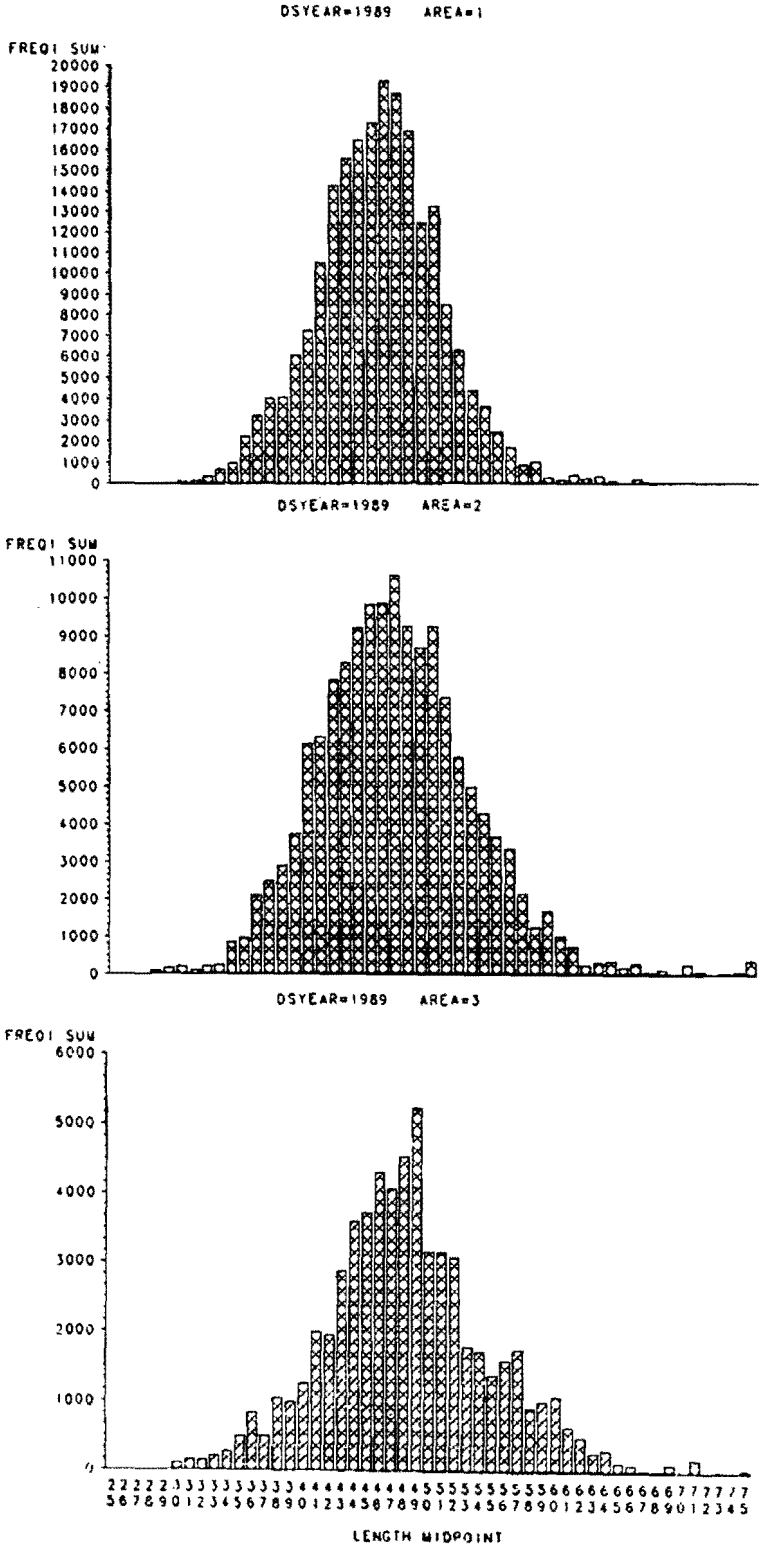

Figure 11. Length frequency distributions of un-culled cod catches in 4Vn from data collected by the International Observer Program (See text for area description).

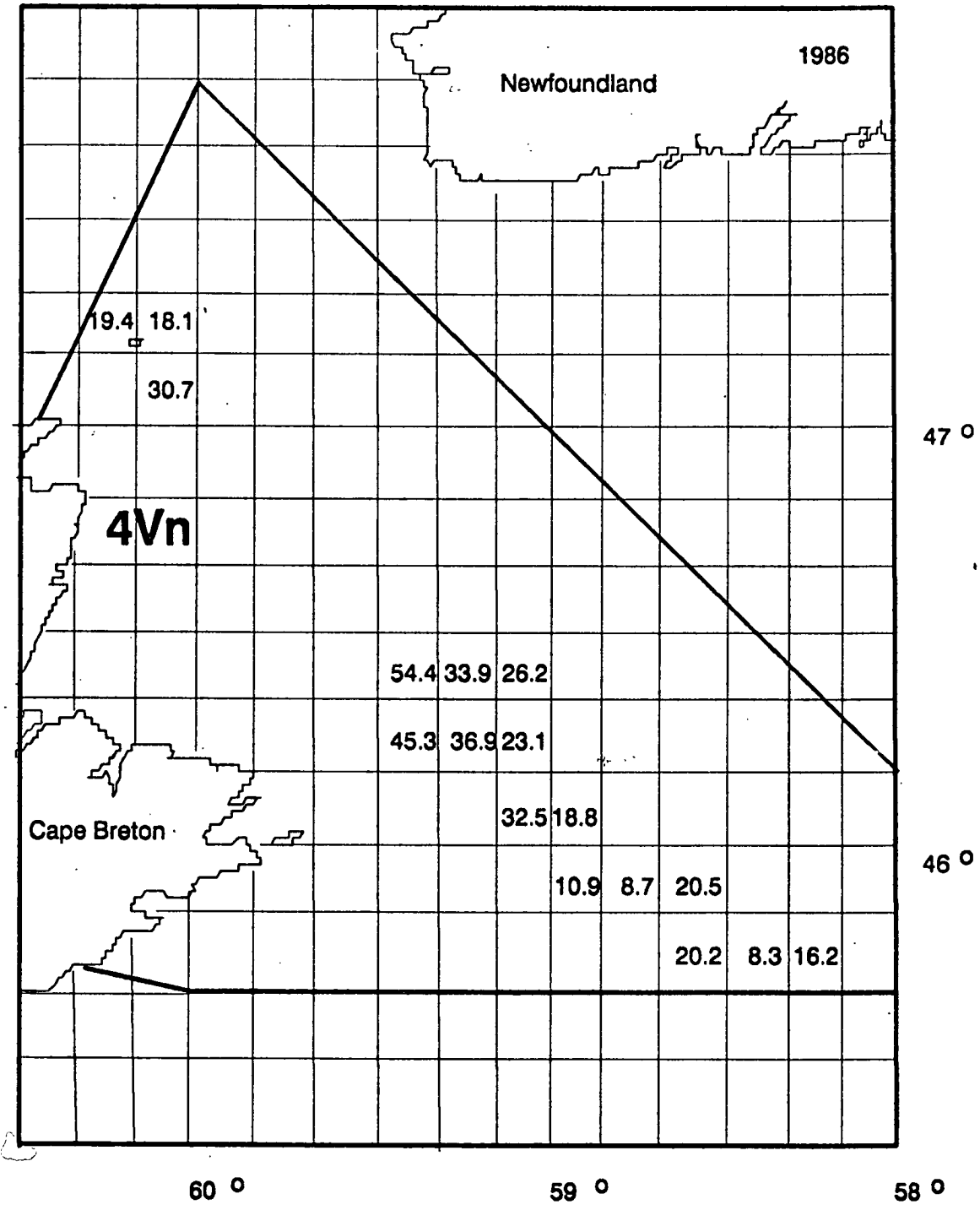

Figure 12. **Percentage of cod less than 43 cm (17 inches) in un-culled catches by 10' rectangles in 4Vn for 1986.**

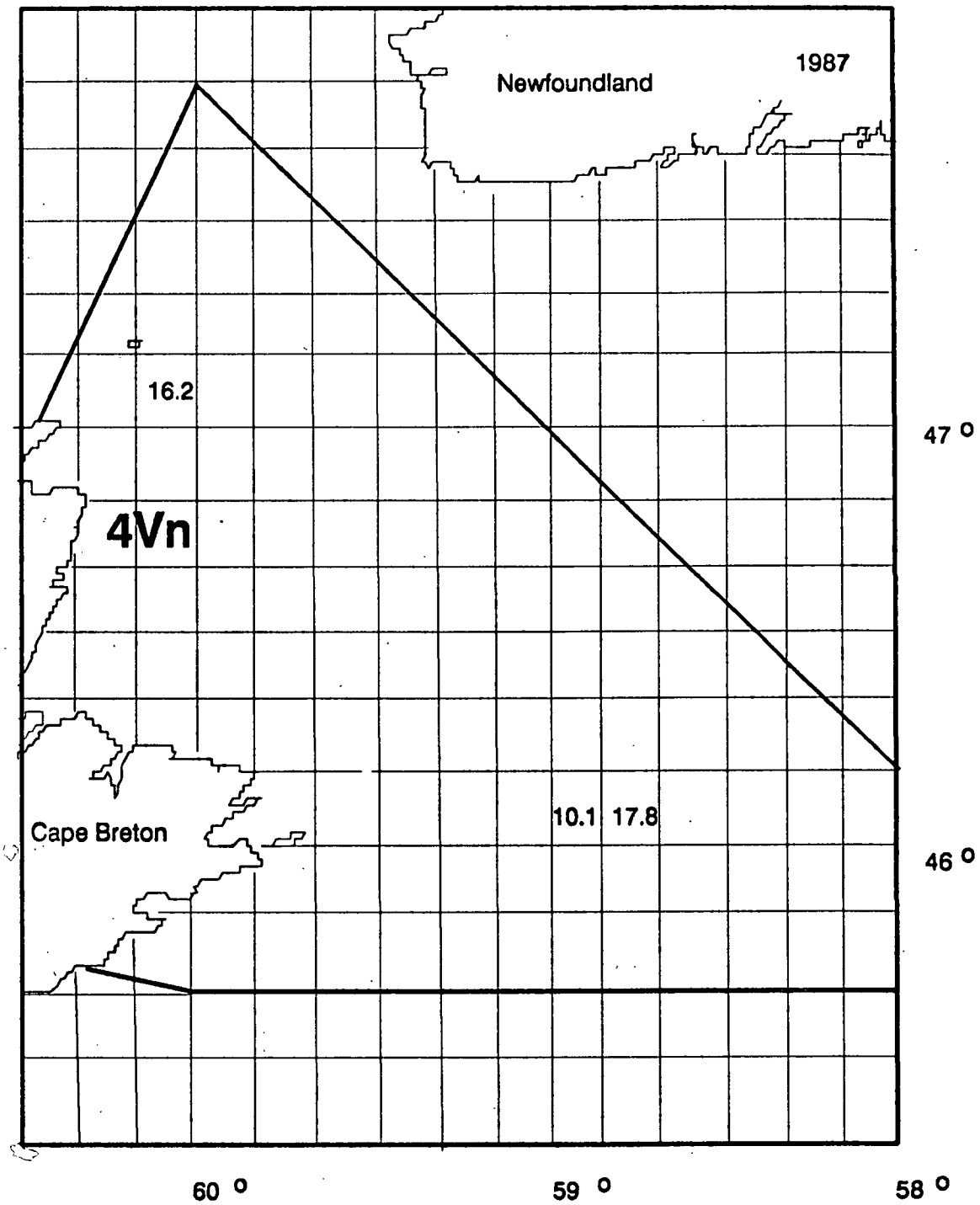

Figure 13. Percentage of cod less than 43 cm (17 in.) in un-culled catches by 10' rectangles in 4Vn for 1987.

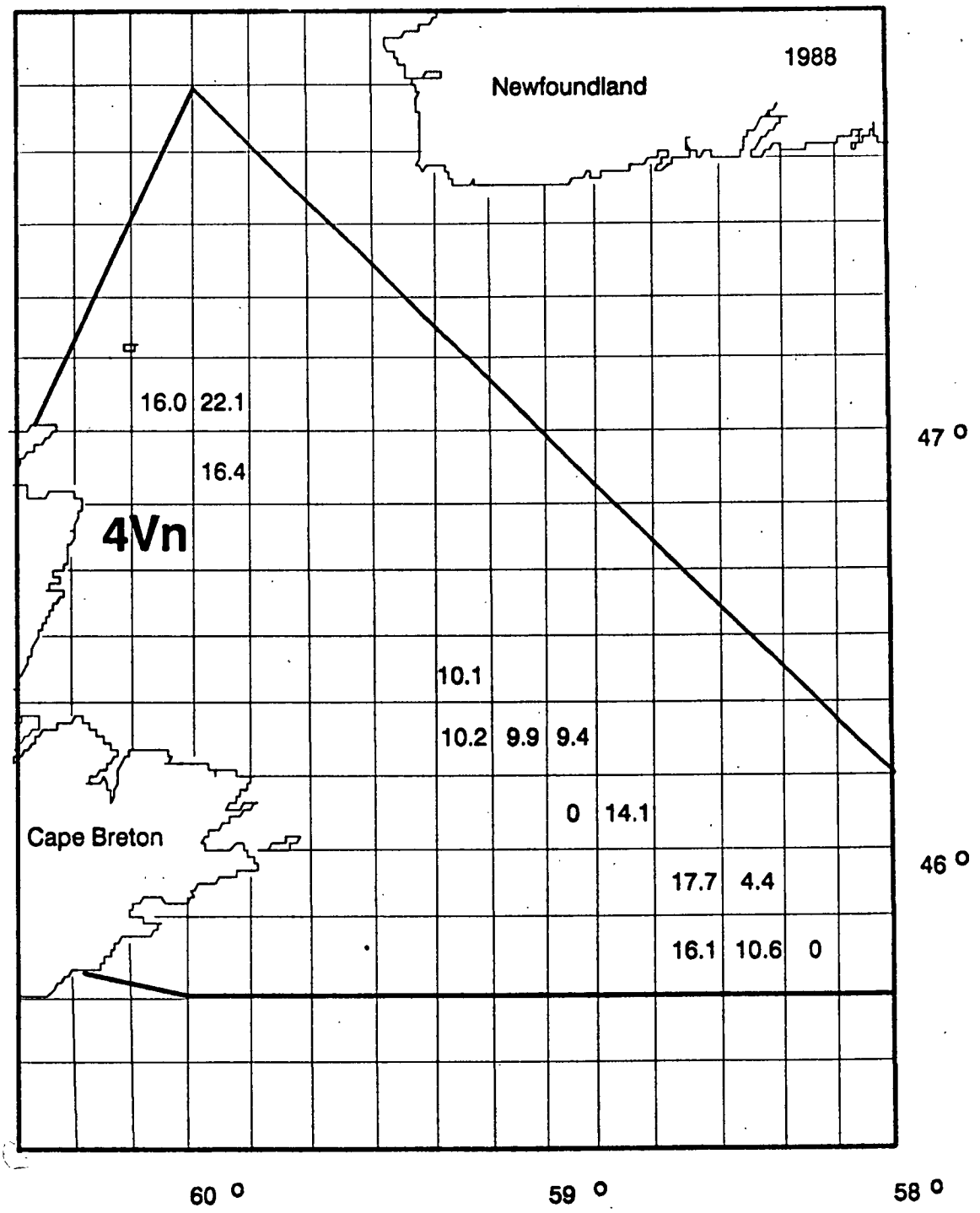

Figure 14. **Percentage of cod less than 43 cm (17 inches) in un-culled catches by 10' rectangles in 4Vn for 1988.**

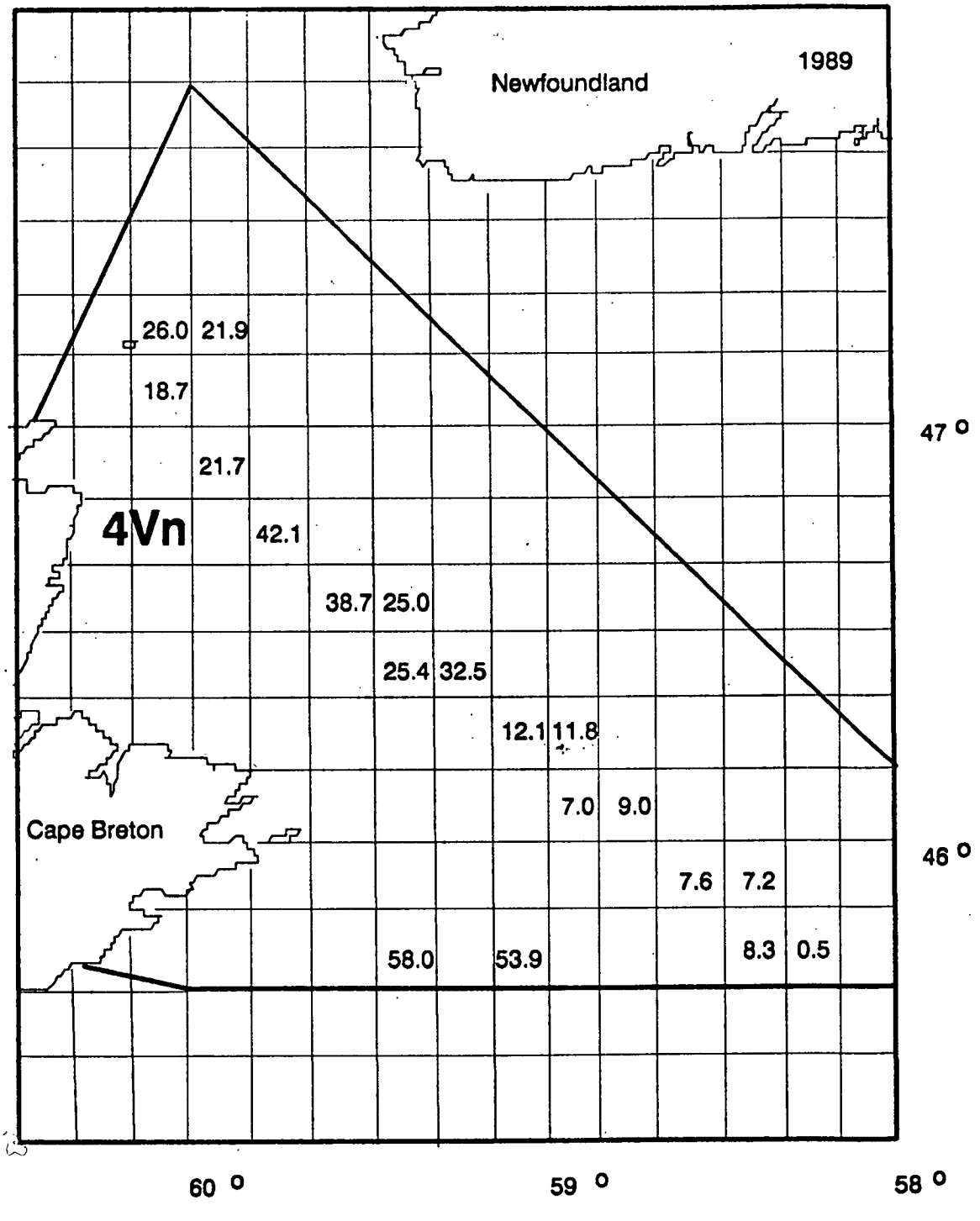

Figure 15. **Percentage of cod less than 43 cm (17 inches) in un-culled catches by 10' rectangles in 4Vn for 1989.**

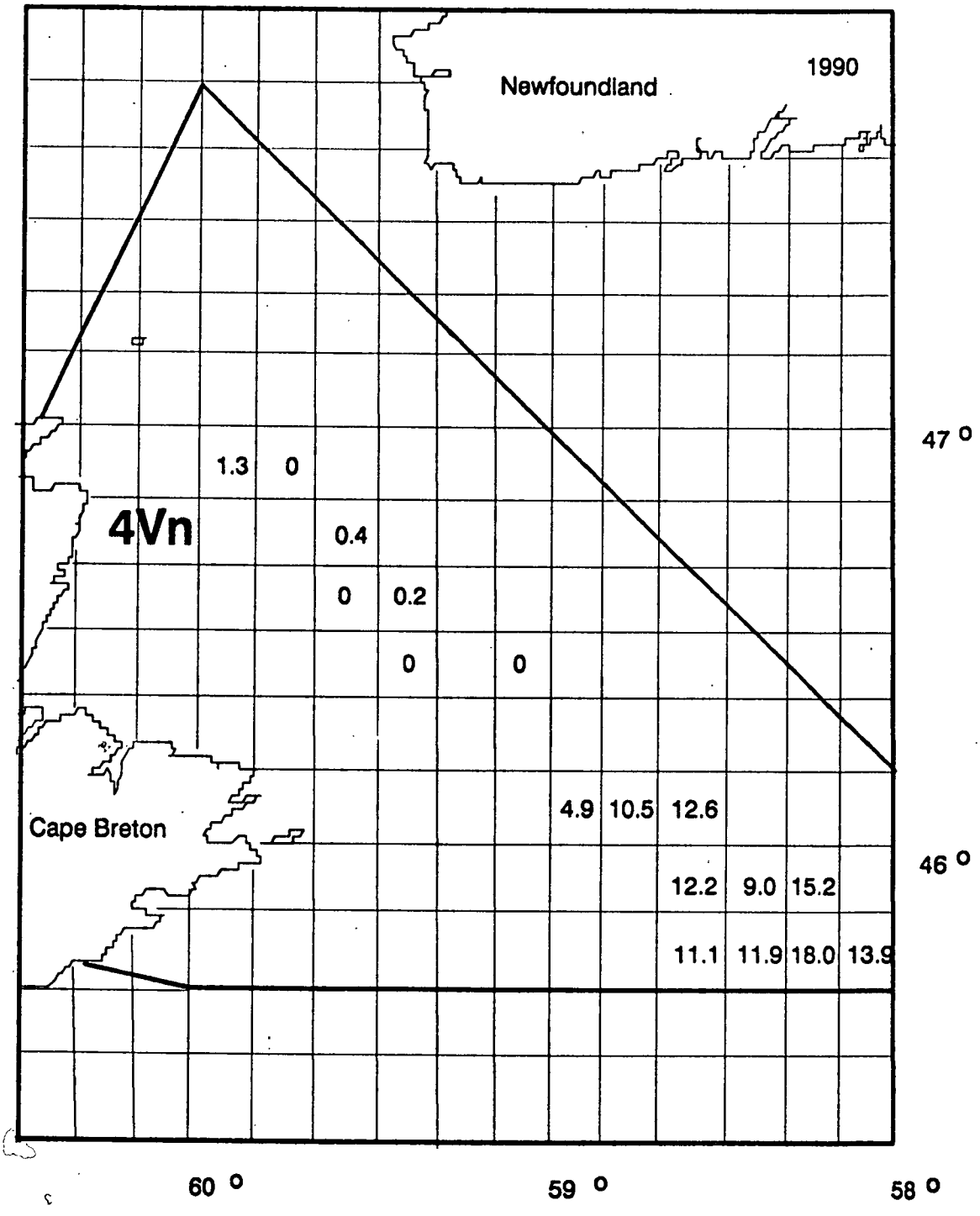

Figure 16. **Percentage of cod less than 43 cm (17 inches) in un-culled catches by 10' rectangles in 4Vn for 1990.**