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CAFSAC Research Document 86/77

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# Fishery and Biological Characteristics of the 4S Herring Stocks in 1985

by

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Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé au secrétariat.

## ABSTRACT

Herring landings in NAFO division 4S totaled 520 t in 1985, declining from 960 t landed in 1984. The late retreat of the spring ice and poor market conditions accounted for most of the reduction in catches in 1985. Gillnet catch rates for eastern 4S, where the majority of the landings have historically been reported, indicated a steady increase in abundance since 1982 for spring spawners and since 1981 for fall spawners. Age compositions of both spawning groups, calculated from commercial and research samples, showed strong similarities between the western 4S stocks and those in 4T, and between the eastern 4S stocks and those in 4R. However, research samples from southeast of Anticosti Island showed a different age composition pattern, indicating either an intermixing of various stocks or the presence of a separate population. Future research in 4S should be directed towards stock identification and delineation.

## RESUME

Les débarquements de hareng de la division 4S de l'OPANO ont été de 520 t en 1985, comparativement aux 960 t débarqués en 1984. Cette diminution des captures en 1985 a été surtout attribuable à la retraite tardive des glaces printanières et aux mauvaises conditions du marché. Dans la région est de 4S, où la majorité des débarquements a toujours été rapportée, les taux de capture des filets maillants ont indiqué une augmentation constante de l'abondance des reproducteurs de printemps depuis 1982, et des reproducteurs d'automne depuis 1981. Les distributions d'âge des deux groupes reproducteurs, calculées à partir des échantillons commerciaux et de recherche, ont montré une similitude entre les stocks de 4S ouest et de 4T, ainsi que entre ceux de 4S est et de 4R. Par contre, dans la région sud-est de l'Ile Anticosti, le patron des classes d'âge a été différent, ce qui indique soit un mélange de stocks de différentes régions ou encore la présence d'une autre population. Des programmes de recherche devraient être entrepris pour décrire et identifier ces stocks.

## INTRODUCTION

The herring stocks in NAFO division 4S have historically been exploited by a small inshore gillnet fleet which has supplied local trap and longline bait requirements. The major fishing effort has been concentrated on the spring (May-June) and autumn (July-September) spawning aggregations in both the eastern and western regions of 4S. However, due to the limited demand for bait, the small freezer-plant capacity, and a precautionary annual TAC of 1000 t, this fishery has not expanded appreciably over the last decade.

The commercial and research data were analysed separately for the eastern and western regions because of observed biological differences between the populations inhabiting these two zones (Tremblay and Powles, 1982). Western 4S (Figure 1) included unit areas 4Sz, 4Si and 4Sy (although 4Sy registers very few landings) while eastern 4S encompassed unit areas 4Sv and 4Sw.

## LANDINGS

Total landings for division 4S from 1975 to 1985 were compiled by the Statistics Branch of Fisheries and Oceans and are presented in Table 1. In addition, landings were available for eastern and western 4S separately from Courtois and Lamoureux (1983) between 1975 to 1980 and the Statistics Branch for 1984 and 1985. Given that the landings from Courtois and Lamoureux (1983) did not always correspond with the official landings from the Statistics Branch, they are shown for only those years where they did not differ from the total landings by more than 10%.

Herring landings from 4S in 1985 totaled 520 t (Table 1), 516 t (99%) being caught by gillnets and the remainder coming from shrimp trawls and purse seines. The majority of the landings (64%) were reported from eastern 4S.

a) Western 4S:

In western 4S, the volume of landings diminished slightly in 1985, from 224 t in 1984, to 185 t. The spring fishery took place mainly during the months of April and May and accounted for 49% of the total western 4S landings while the fall fishery covered the months of September and October (Table 2). Once again, markets and plant capacity were the major factors contributing to the low catches throughout the year in this region.

b) Eastern 4S:

In eastern 4S, landings dropped by a half between 1984 and 1985, from 736 t to 335 t. The late retreat of the spring ice and, above all, the closure of the fishplant in La Tabatière at the end of July, were the main reasons for this reduction in catches. The spring fishery was prosecuted mainly in the month of May while the fall fishery started in July and continued at a reduced level until the end of October (Table 2). Even with the closure of the fishplant, the autumn fishery accounted for 81% of the total landings from eastern 4S in 1985.

## BIOLOGICAL INFORMATION

a) Sampling:

In 1985, commercial sampling was rather sparse in western 4S and nonexistent in the eastern region (Table 2). Random samples from the commercial gillnet fishery were frozen and sent to the Quebec laboratory for analyses (length, weight, gonad weight, maturity stage and otolith collection). Several trap samples, collected during a tagging programme at Harrington Harbour (unit area 4Sv), were included for additional information.

b) Proportion of Spring and Fall Spawners:

Individual herring were assigned as either spring or fall spawners by relating the maturity stage to the date of capture and ages were determined from the otoliths (Cleary *et al.*, 1982).

The proportion of spring and fall spawners in both eastern and western 4S has been calculated for the two fishing seasons from commercial samples collected between 1980 and 1985 and research samples in 1982 and 1985 (Table 3).

The proportion of spring spawners in the May and June samples has been at least 68% (and most often above 90%) in both the eastern and western regions. The proportion of fall spawners in the July to September samples has always been high in western 4S although, in the eastern zone, this proportion has varied considerably. In 1985, over 93% of the fish sampled in the fall from both regions were fall spawners.

c) Age Composition:

Commercial Samples:

Age compositions were calculated for spring and fall spawners for both western (Table 4, Figure 2) and eastern (Table 5, Figure 3) 4S from 1980 to 1985. These results differ slightly from those presented by Tremblay (1985) as additional samples were incorporated into the data set.

Commercial samples from western 4S between 1981 and 1985 have been sporadic and small in number and therefore it was difficult to follow the dominant year-classes over time. These data do show, however, the strong dominance of the 1974 spring spawner year-class in the early part of the series and the importance of the 1981 year-class in 1985. In 1981, the 1973 year-class was the most abundant in the samples for the fall spawners and more recently, the 1978 and 1980 year-classes have become the most important. These age compositions resemble those of 4T spring and fall spawners (Chadwick and Nielsen, 1986).

In eastern 4S, the 1974 year-class completely dominated the spring spawners from 1980 to 1982. More recently, the 1980 cohort has become the single most important contributor to the catch although in 1985, the sample size was very small (12). The fall spawners were dominated by the 11+ age group in 1980 and 1981. Since 1982, there has been a series of dominant year-classes, notably the 1977 and the 1979 cohorts. The 1979 year-class appears to be much stronger than the other two as it has dominated in the samples for three years. The same pattern of dominant year-classes has been seen in division 4R spring and fall spawners (McQuinn, 1986).

Research Samples:

Winter random stratified groundfish surveys have been conducted in 4S on the Gadus Atlantica by the Quebec Region since 1983. The cruise track has included eastern 4S (unit areas 4Sy and 4Sv), southeast of Anticosti Island (unit areas 4Ss and 4Sx) and, in 1983, western 4S (unit area 4Si). Ice cover has prevented the sampling of the remainder of western 4S (unit area 4Sz).

The age composition of samples collected in eastern 4S from 1983 to 1986 (Table 6, Figure 4) showed the same pattern of dominant year-classes as in the commercial samples, i.e. 1980 for spring spawners and 1977 and 1979 for fall spawners. Again, these age compositions reflected similar patterns of dominant year-classes as those seen in division 4R (McQuinn, 1986). It should be noted however, that some of the sets were made in the Esquiman Channel near the division between 4S and 4R, and therefore may have actually included samples of the 4R populations.

Although the sample sizes were small, the age compositions from samples in western 4S in 1983 (Table 7, Figure 5) also resembled those of division 4T (Chadwick and Nielsen, 1986). The 1979 and 1975 cohorts dominated the spring spawners and the 1977, 1978 and 1979 year-classes comprised the majority of fall spawners. The fall spawner age distribution was also notable for the lack of older year-classes, which was similar to the reduced presence of these cohorts in the 4T catches.

Samples obtained from southeast of Anticosti Island during the groundfish cruises of 1984 and 1985 were analysed separately (Table 8, Figure 6). The age composition of these samples did not show a pattern similar to either eastern or western 4S but rather seemed to be a composite of both, indicating that this is perhaps an overwintering area for several stocks or possibly a separate population.

## ABUNDANCE INDICES AND DISTRIBUTIONS

Gillnet purchase slips from the eastern 4S fishery were used to calculate abundance indices for 1984 and 1985, comparable to those for 1981 to 1983 from Tremblay (1985). The monthly mean catch per slip (t/slip) was calculated for the months of May to October (Table 9). The mean catch per slip in May and July were used as estimates of the spring and autumn spawner catch per unit effort (CPUE), respectively. These were the months when fishing was exerted, for the most part, on spawning concentrations, and for which a sufficient number of slips were available. The spring fishery has shown an increase in the CPUE index since 1982, after decreasing from the 1981 value. The fall fishery CPUE index has shown a constant increase since 1981.

Indices of abundance (kg/tow), calculated for each tow from the winter random stratified groundfish surveys between 1983 and 1986, consistently show annual overwintering concentrations of herring in the Esquiman Channel and southeast of Anticosti Island (Figures 7 to 10). Data collected from the winter groundfish surveys between 1978 and 1981 showed a similar distributional pattern (Moores and Lilly, 1982).

## DISCUSSION AND RESEARCH PRIORITIES

An analytical assessment of the 4S herring stock complex was not possible due to the lack of appropriate data. However, analyses of available biological data have afforded insights into the composition of these stocks. Biological differences (age compositions and distributions) observed between the stocks of eastern and western 4S strengthens the generally accepted belief that separate populations of both spring and fall spawners inhabit these two regions and that separate controls should be maintained for them.

Similarities observed in the age compositions between eastern 4S and 4R and between western 4S and 4T suggest possible biological links between the herring populations in these adjacent divisions. These connections may not be direct, however, but may simply be the result of similar environmental conditions acting concurrently on separate stocks which share the same water basin. However, because of the possibility of intermingling between the 4S stocks and those of adjacent divisions, and the biological problems inherent in fishing mixed stocks, a better understanding of this stock complex, with an emphasis on stock identification and delineation, would be required before an increase in the commercial fishery could be advised.

With these priorities in mind, a tagging programme was undertaken in eastern 4S in 1985 on concentrations of autumn spawning herring. The objectives of the project were (a) to determine the relationship between the fall spawning herring stocks along the Quebec lower north shore and the west coast of Newfoundland, and (b) to shed some light on their migration patterns.

Two (2) additional tagging programmes were initiated during the months of May and June 1986, one in unit area 4Sz (Sept-Iles) and the other in 4Tp (Isle Verte). The objectives of these projects were to tag spring spawning herring during the spawning period in these two areas in order to (a) determine possible relationships between these two stocks and (b) to map their migrations.

In addition to the tagging programmes already initiated, a stock identification project is planned for both eastern and western 4S in which samples will be analysed by electrophoretic techniques. This study is aimed at determining the genetic relationships between the 4S stocks and the other spawning components throughout the Gulf of St. Lawrence.

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Table 1. Total herring catches (t) from NAFO division 4S, 1975-1985.

| AREA | YEAR | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 |
| 4S West | 96[1] | 56[1] | | | 120[1] | 205[1] | | | | 224 | 185 |
| 4S East | 248[1] | 418[1] | | | 367[1] | 662[1] | | | | 736 | 335 |
| West + East | 364 | 468 | 321 | 539 | 481 | 892 | 1 000 | 1 025 | 1 075 | 960 | 520 |

[1]: Taken from "Courtois et Lamoureux (1983)".

Table 2. Monthly landings (t) and sampling coverage (no of fish) of herring from Div. 4S in 1985.

| AREA | MONTH | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 |
| West 4S | | | | | | | | |
| L | .7 | 25.7 | 64.3 | 12.8 | 2.8 | 45.1 | 33.9 | .1 |
| S | | | (50) | | | (85) | (42) | |
| East 4S | | | | | | | | |
| L | | | 61.5 | 3.0 | 164.8 | 43.1 | 42.6 | 19.5 |
| S | | | | | (12)[1] | (167)[1] | | |

L: Landings
S: Sampling
[1]: Trap samples (research)

Table 3. Proportion (%) of spring and fall spawner herring in the commercial samples (except [1] and [2]) from Div. 4S, 1980-1985.

| | FISHING ZONE | | | |
|---|---|---|---|---|
| | 4S West | | 4S East | |
| | May to June | July to Sept. | May to June | July to Sept. |
| SPRING SPAWNERS | | | | |
| 1980 | | | 92.0 | 49.8 |
| 1981 | 75.4 | 42.2 | | 63.5 |
| 1982 | | 21.4[1] | 95.7 | 21.7 |
| 1983 | | | | 6.9 |
| 1984 | 100.0 | 0.0 | 94.3 | 27.0 |
| 1985 | 68.0 | 2.3 | | 6.7[2] |
| FALL SPAWNERS | | | | |
| 1980 | | | 8.0 | 50.2 |
| 1981 | 24.6 | 57.8 | | 36.5 |
| 1982 | | 78.6[1] | 4.3 | 78.3 |
| 1983 | | | | 93.1 |
| 1984 | 0.0 | 100.0 | 5.7 | 73.0 |
| 1985 | 32.0 | 97.7 | | 93.3[2] |

[1]: Experimental gillnet samples (research).

[2]: Trap samples (research).

Table 4. Age compositions (%) from commercial herring samples from western Div. 4S, 1981-1985.

| Age | 1981 | 1984 | 1985 |
|---|---|---|---|
| SPRING SPAWNERS | | | |
| 2 | .2 | ---- | ---- |
| 3 | 1.5 | ---- | 10.8 |
| 4 | 3.1 | ---- | 45.9 |
| 5 | 1.5 | 4.1 | 2.7 |
| 6 | 4.2 | 4.1 | ---- |
| 7 | 66.9 | 10.2 | ---- |
| 8 | 3.3 | 2.0 | 10.8 |
| 9 | 5.5 | 53.1 | 18.9 |
| 10 | 4.9 | 14.3 | 10.8 |
| 11+ | 8.8 | 12.2 | ---- |
| (No of fish) | (453) | (49) | (37) |
| FALL SPAWNERS | | | |
| 2 | ---- | ---- | ---- |
| 3 | 5.8 | ---- | ---- |
| 4 | 12.0 | 15.5 | 9.3 |
| 5 | 10.7 | 25.2 | 29.3 |
| 6 | 4.0 | 35.0 | 17.9 |
| 7 | 2.2 | 13.6 | 20.7 |
| 8 | 45.3 | 2.9 | 10.0 |
| 9 | 3.6 | 3.9 | 1.4 |
| 10 | 4.4 | 1.0 | 2.1 |
| 11+ | 12.0 | 2.9 | 9.3 |
| (No of fish) | (225) | (103) | (140) |

Table 5. Age compositions (%) from commercial herring samples from eastern Div. 4S, 1980-1985 (except [1] which came from a research trap).

| | | YEARS | | | | | |
|---|---|---|---|---|---|---|---|
| | Age | 1980 | 1981 | 1982 | 1983 | 1984 | 1985[1] |
| SPRING SPAWNERS | | | | | | | |
| | 2 | ---- | ---- | ---- | | ---- | ---- |
| | 3 | ---- | .8 | 1.4 | | 1.6 | 16.7 |
| | 4 | .2 | 3.7 | 1.2 | | 22.0 | 16.7 |
| | 5 | 1.5 | 1.6 | 12.6 | | 25.8 | 41.7 |
| | 6 | 76.1 | 14.6 | .6 | | 5.4 | 8.3 |
| | 7 | 2.6 | 64.0 | 9.3 | | 8.6 | ---- |
| | 8 | 3.3 | 2.8 | 58.6 | | 2.7 | ---- |
| | 9 | 5.1 | 1.8 | 2.1 | | 10.8 | ---- |
| | 10 | 3.0 | 4.3 | 2.7 | | 10.2 | 8.3 |
| | 11+ | 8.1 | 6.3 | 11.5 | | 12.9 | 8.3 |
| (No of fish) | | (578) | (759) | (486) | | (186) | (12) |
| FALL SPAWNERS | | | | | | | |
| | 2 | ---- | ---- | ---- | ---- | ---- | ---- |
| | 3 | ---- | ---- | .4 | ---- | ---- | ---- |
| | 4 | ---- | 8.8 | 14.5 | 53.0 | 7.5 | 2.4 |
| | 5 | .2 | 15.5 | 47.4 | 15.8 | 62.5 | 8.4 |
| | 6 | 8.4 | 5.3 | 5.1 | 18.6 | 2.5 | 63.2 |
| | 7 | 18.8 | 6.7 | 2.1 | 3.2 | 7.5 | 7.2 |
| | 8 | 4.4 | 20.2 | 4.3 | 1.2 | 3.7 | 6.0 |
| | 9 | 9.2 | 2.8 | 7.9 | 2.8 | ---- | 1.2 |
| | 10 | 13.1 | 5.6 | 1.9 | 2.8 | 5.0 | .6 |
| | 11+ | 45.8 | 35.0 | 16.4 | 2.8 | 11.2 | 12.0 |
| (No of fish) | | (414) | (431) | (470) | (253) | (80) | (167) |

[1]: Trap samples (research).

Table 6. Age compositions (%) from research herring samples (GADUS ATLANTICA) from eastern Div. 4S in 1983, 1985 and 1986.

| | Age | YEAR 1983 | 1985 | 1986 |
|---|---|---|---|---|
| SPRING SPAWNERS | | | | |
| | 1 | ---- | ---- | ---- |
| | 2 | ---- | 7.7 | ---- |
| | 3 | 13.2 | ---- | 16.7 |
| | 4 | 7.9 | 2.6 | 5.6 |
| | 5 | 2.6 | 17.9 | 19.4 |
| | 6 | 10.5 | 2.6 | 38.9 |
| | 7 | ---- | 2.6 | 8.3 |
| | 8 | 21.1 | 5.1 | ---- |
| | 9 | 7.9 | 7.7 | ---- |
| | 10 | ---- | 12.8 | 5.6 |
| | $11^+$ | 36.8 | 41.0 | 5.6 |
| (No of fish) | | (38) | (39) | (36) |
| FALL SPAWNERS | | | | |
| | 1 | ---- | ---- | ---- |
| | 2 | ---- | ---- | ---- |
| | 3 | ---- | ---- | ---- |
| | 4 | 6.3 | ---- | 6.9 |
| | 5 | 6.3 | 5.8 | 24.1 |
| | 6 | 21.9 | 38.5 | 27.6 |
| | 7 | 3.1 | 7.7 | 31.0 |
| | 8 | ---- | 9.6 | 3.4 |
| | 9 | 6.3 | 3.8 | ---- |
| | 10 | 6.3 | 1.9 | ---- |
| | $11^+$ | 50.0 | 32.7 | 6.9 |
| (No of fish) | | (32) | (52) | (29) |
| SPRING + FALL | | (70) | (91) | (65) |
| % Spring | | 54.3 | 42.9 | 55.4 |
| % Fall | | 45.7 | 57.1 | 44.6 |

Table 7. Age compositions (%) from research herring samples (GADUS ATLANTICA) from western Div. 4S in 1983.

| AGE | SPRING SPAWNERS | FALL SPAWNERS |
|---|---|---|
| 1 | ---- | ---- |
| 2 | ---- | ---- |
| 3 | 10.7 | ---- |
| 4 | 21.4 | 35.3 |
| 5 | ---- | 29.4 |
| 6 | 3.6 | 29.4 |
| 7 | ---- | 5.9 |
| 8 | 32.1 | ---- |
| 9 | 17.9 | ---- |
| 10 | ---- | ---- |
| 11+ | 14.3 | ---- |
| (No of fish) | (28) | (17) |

Table 8. Age compositions from (%) research herring samples (GADUS ATLANTICA) from south-east of Anticosti Island, Div. 4S in 1984 and 1985.

| AGE | SPRING SPAWNERS | | FALL SPAWNERS | |
|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 |
| 1 | ---- | 2.2 | ---- | ---- |
| 2 | 3.6 | 15.6 | ---- | 5.0 |
| 3 | 28.6 | 20.0 | 11.5 | 30.0 |
| 4 | 10.7 | 17.8 | 69.2 | 5.0 |
| 5 | ---- | 26.7 | 15.4 | 25.0 |
| 6 | ---- | 11.1 | 3.8 | 25.0 |
| 7 | 14.3 | 2.2 | ---- | 10.0 |
| 8 | 28.6 | 2.2 | ---- | ---- |
| 9 | 10.7 | ---- | ---- | ---- |
| 10 | ---- | ---- | ---- | ---- |
| 11+ | 3.6 | 2.2 | ---- | ---- |
| (No of fish) | (28) | (45) | (26) | (40) |

Table 9. Herring gillnet CPUE (t/succ. trip) by month from eastern Div. 4S, 1981-1985.

| MONTH | YEAR (Number of purchase slips) | | | | |
|---|---|---|---|---|---|
| | 1981 | 1982 | 1983 | 1984 | 1985 |
| May | .56 | .29 | .39 | .49 (360) | .57 (108) |
| June | .12 | .36 | .39 | .35 (99) | .33 (9) |
| July | .11 | .17 | .25 | .29 (818) | .44 (377) |
| August | .10 | .24 | .27 | .42 (533) | 3.59 (12) |
| September | .26 | .26 | .05 | 3.88 (11) | 3.88 (11) |
| October | 1.05 | 1.05 | --- | 1.78 (11) | 1.78 (11) |

FISHERIES AND OCEANS STATISTICAL CHART

CARTE STATISTIQUE DES PÊCHES ET OCÉANS

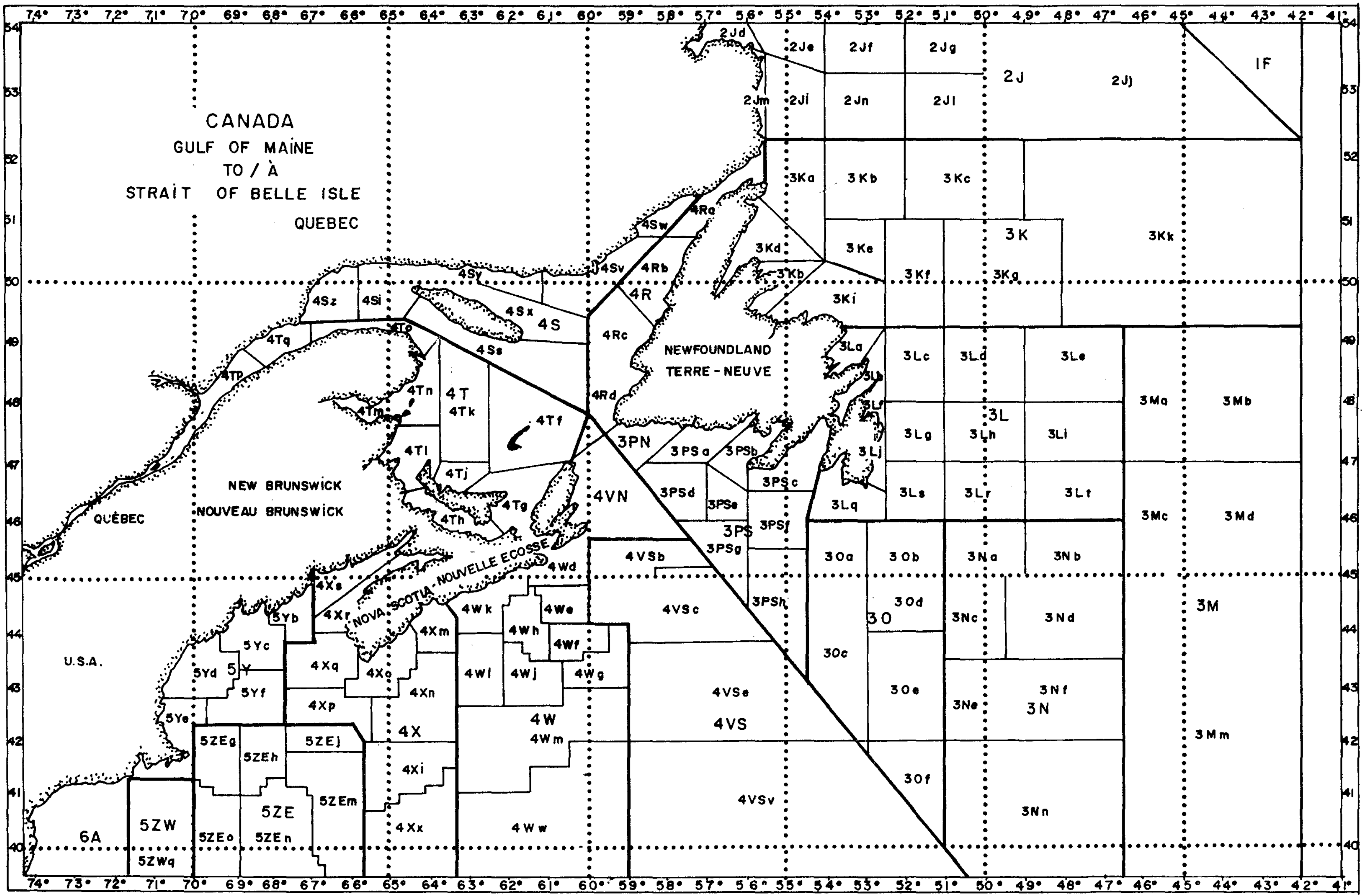



Figure 1.NAFO statistical subdivisions

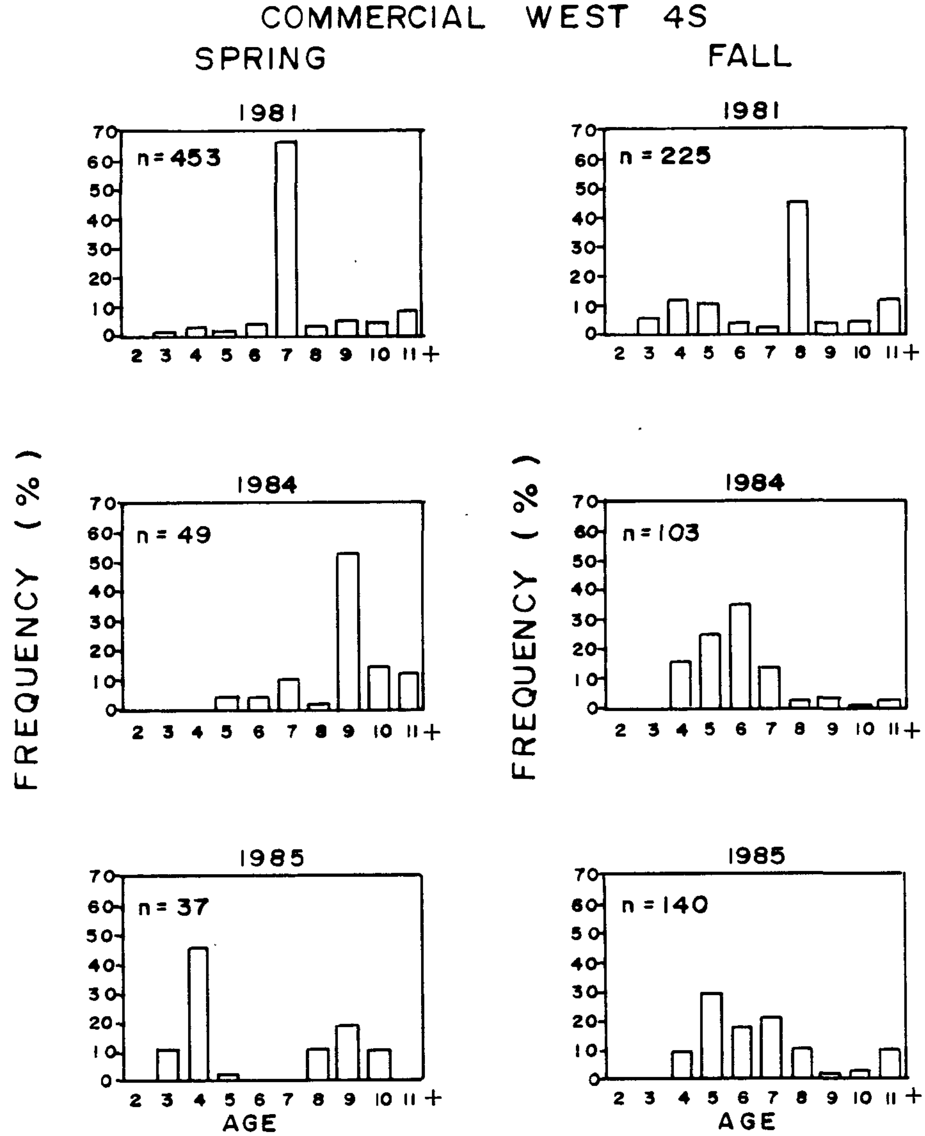
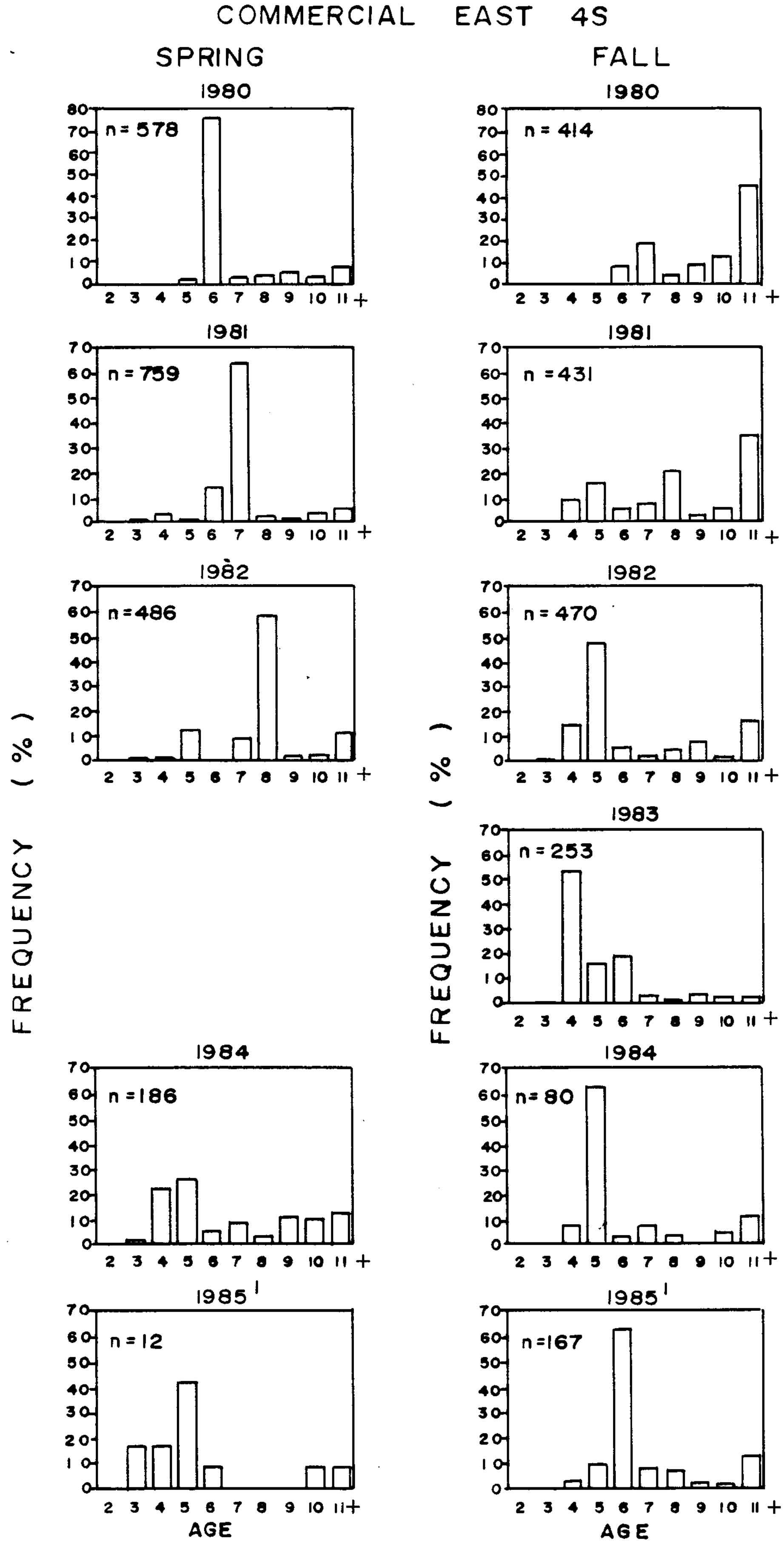



Figure 2.Age composition of commercial herring samples from Western Div. 4S in 1981,1984 and 1985.




[1]sample from a research trap.

Figure 3. Age composition of commercial herring samples which came from Eastern Div. 4S, 1980 to 1985.

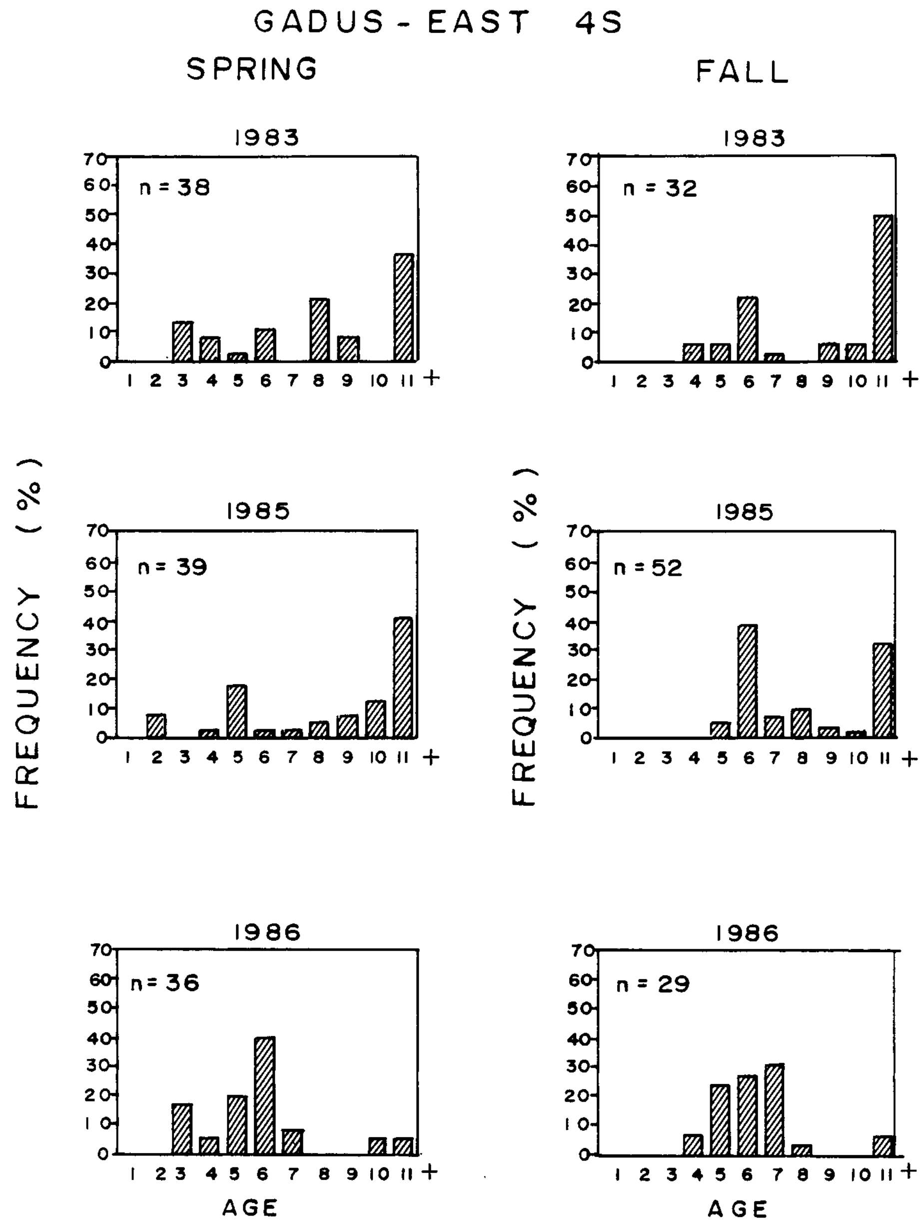



Figure 4.Age composition of research herring samples (Gadus) which came from Eastern Div. 4S in 1983,1985 and 1986.

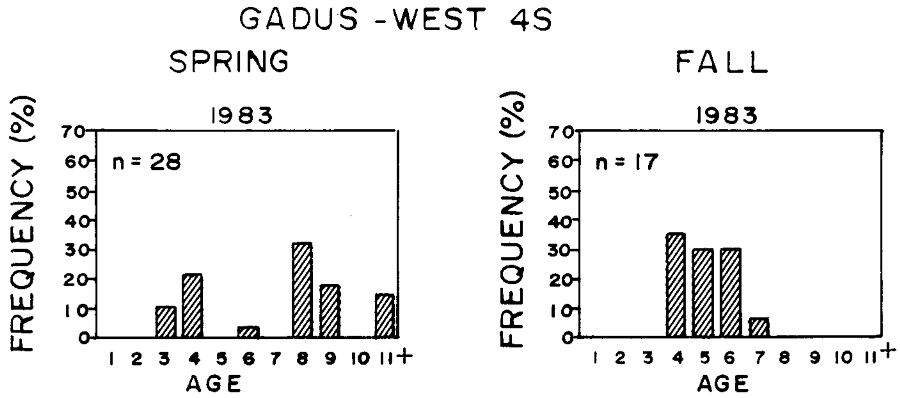



Figure 5.Age composition of research herring samples(Gadus) which came from Western Div. 4S. in 1983.

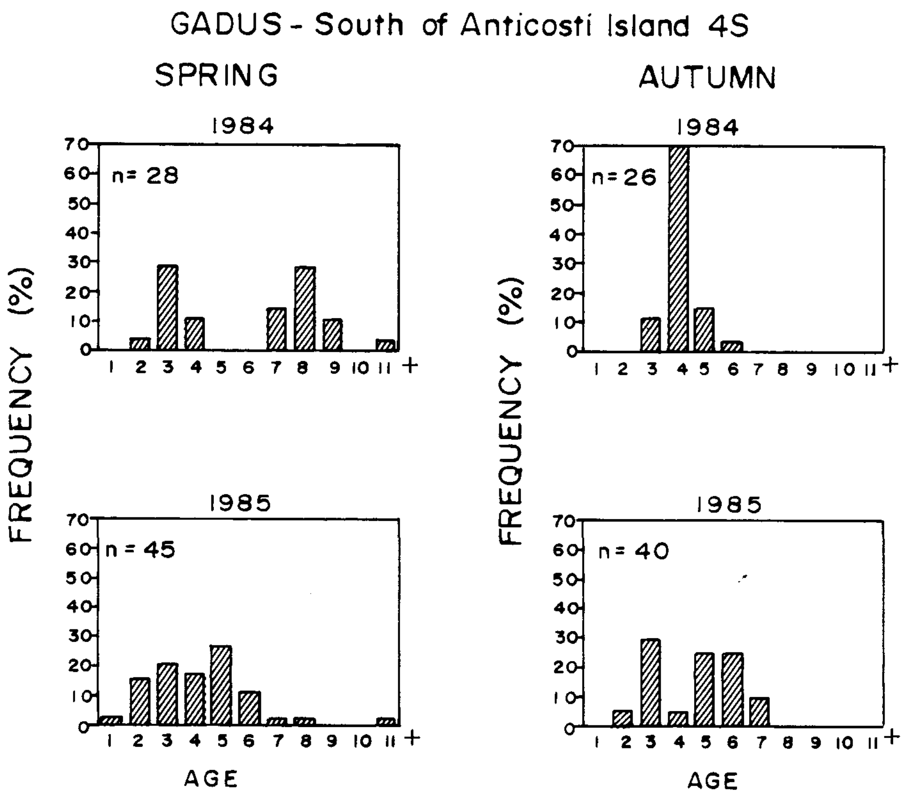



Figure 6.Age composition of research herring samples(Gadus) which came from south of Anticosti Island Div. 4S in 1984 and 1985.

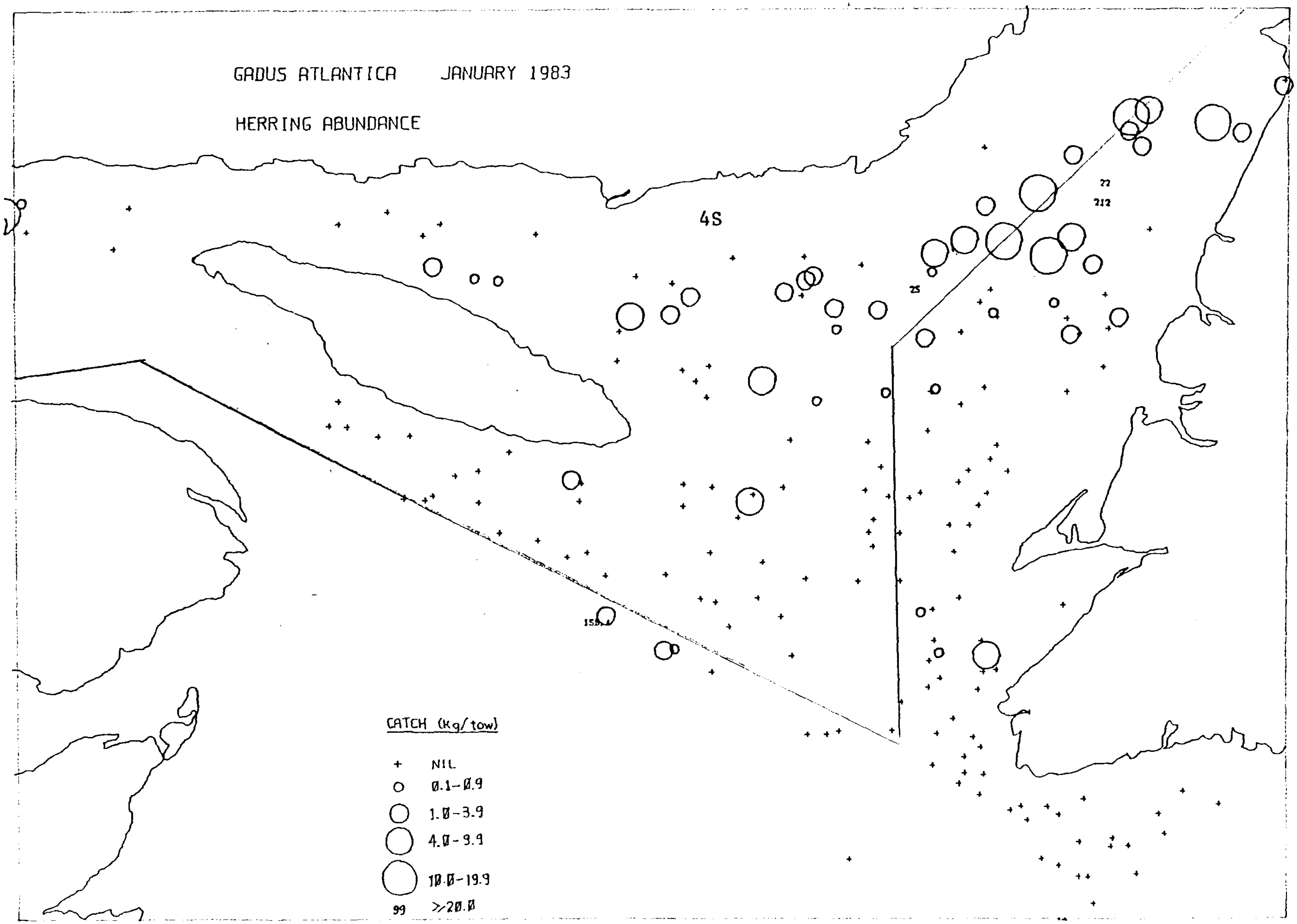



Figure 7. Distribution of herring in winter, 1983.

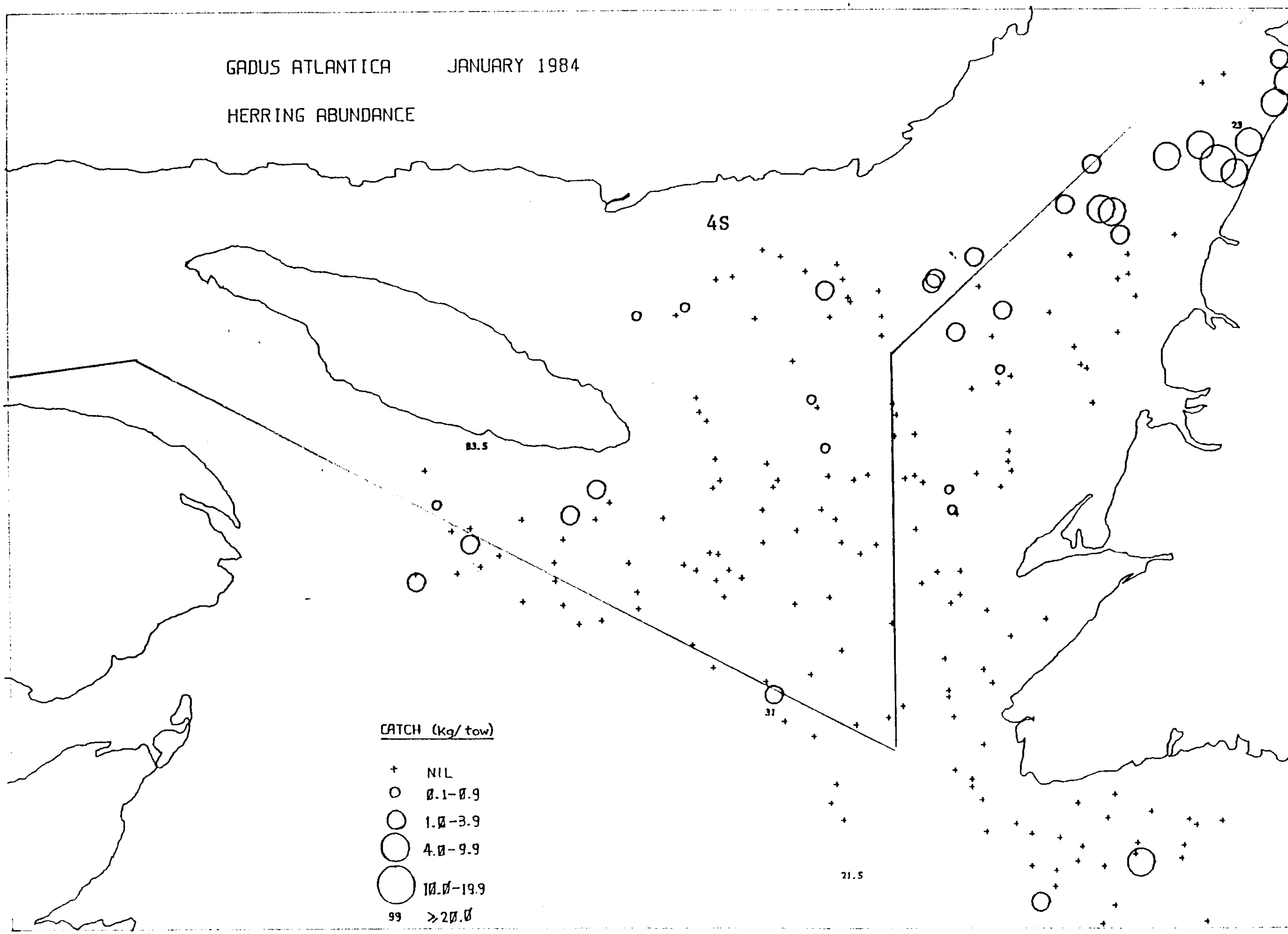



Figure 8. Distribution of herring in winter, 1984.

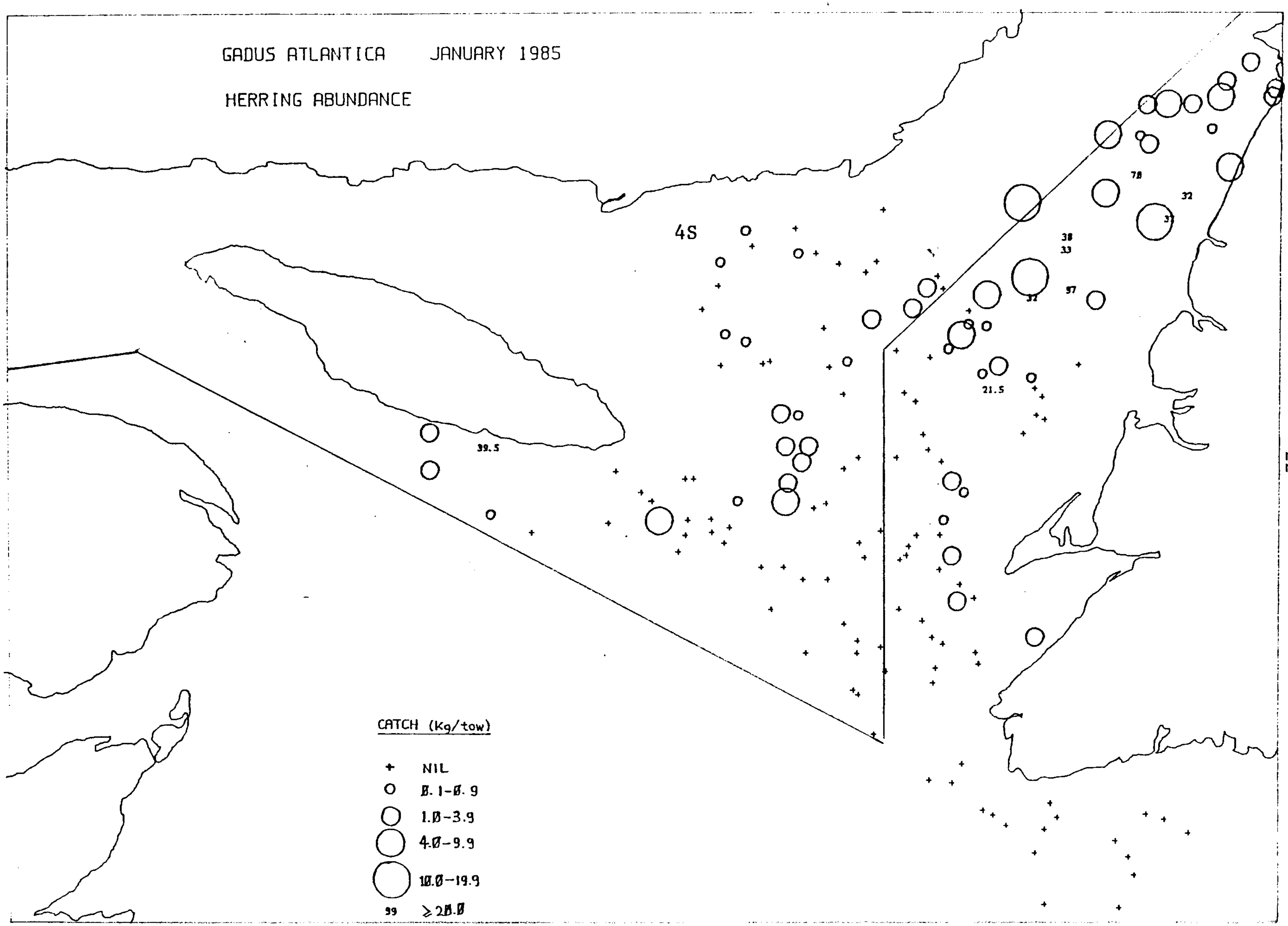



Figure 9. Distribution of herring in winter, 1985

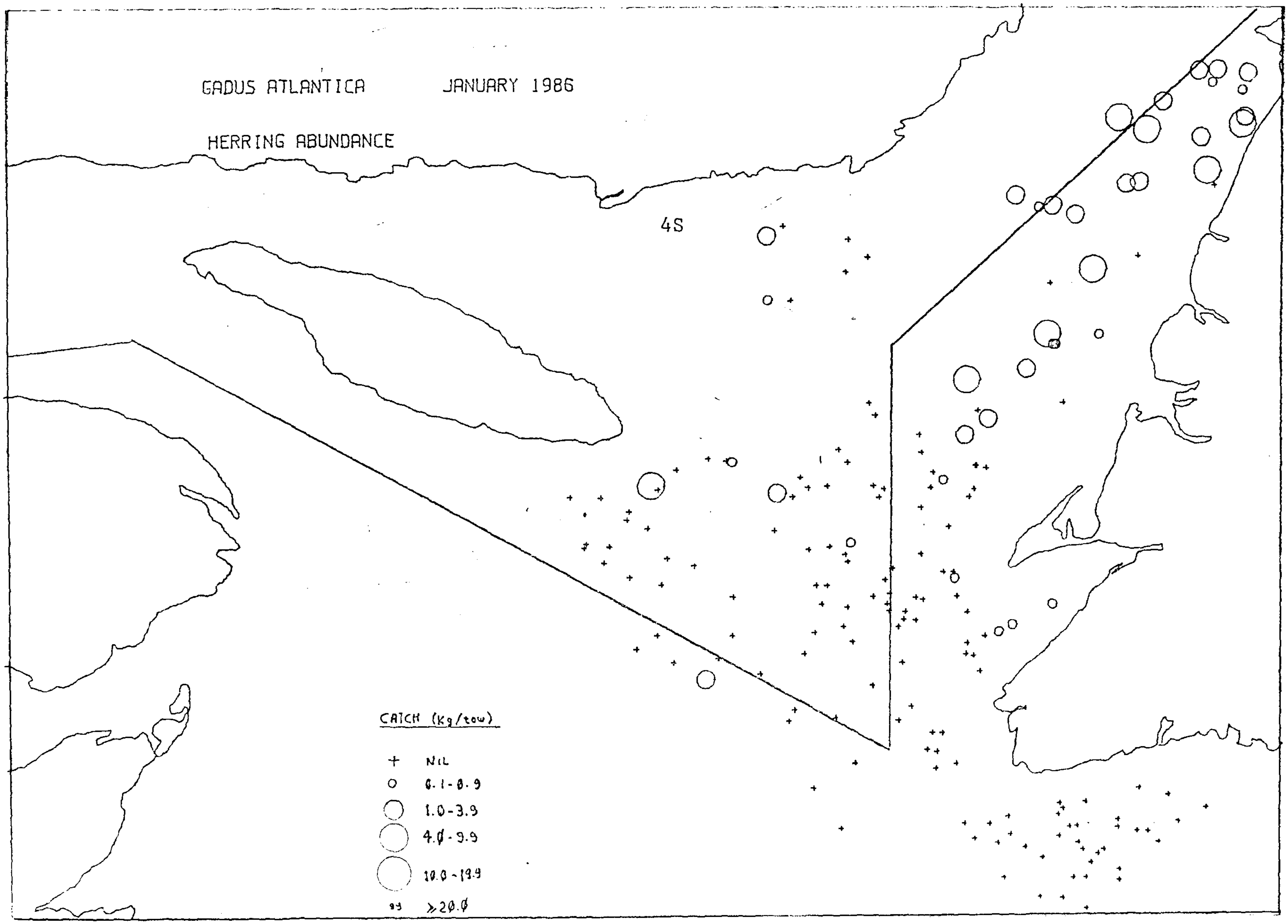



Figure 10. Distribution of herring in winter, 1986.