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An Examination of Spacial Distribution of Greenland Halibut in the Labrador-Eastern Newfoundland Area of the Canadian Northwest Atlantic Based on Research Surveys

by

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Introduction

Greenland halibut are widely distributed throughout the Northwest Atlantic from as far north as Smith Sound (78 N latitude) on the West Greenland coast to as far south as the eastern Grand Bank of Newfoundland and eastward to the deep slopes of the Flemish Cap. A comprehensive study of the distribution of Greenland halibut throughout this area was published by Bowering and Chumakov (1989) based upon combined survey data from both Canada and the former Soviet Union collected during 1977-86. It was shown that there was no established break in the continuity of the distribution throughout the range and that there was a clear trend in abundance by depth as well as a distinctive difference in the size and age structure as the surveys went progressively deeper.

It had been concluded for some time that the Greenland halibut resource from Davis Strait and West Greenland to the Newfoundland Grand Bank is a likely to be a single self sustaining stock with the major spawning component located in the deep waters of Davis Strait to which fish migrate upon approaching maturity. It has been hypothesized that there may very well be some localized spawning along the continental slope area of Labrador and eastern Newfoundland based upon stock delineation studies (Khan et al 1982; Misra and Bowering 1984) although fully mature fish have only been encountered on rare occasions.

The purpose of this paper is to examine more detailed spatial distribution of Greenland halibut in the Labrador and eastern Newfoundland area on an annual basis from available Canadian survey data collected during the 1978-92 period.

Materials and Methods

The spatial distribution is examined by overlaying a representative size symbol of each individual catch by survey on a geographic map of the survey area. The symbol is plotted according to its actual position of catch. The plotting program known as ACON was developed and made available by G. Black, Marine Fish Division, Bedford Institute of Oceanography. Four sets of survey data are evaluated as follows:

1) For Divisions 2J and 3K, the data were provided from annual stratified-random fall surveys conducted by the research vessel *Gadus Atlantica* during the period 1978-92. Fishing sets were conducted down to depths of 1,250 meters although there were few sets beyond 1,000 meters. Distribution maps are shown in figure 1.

2) In Division 3L, similar type surveys were conducted by the research vessel *W. Templeman* or its sister ship *A. Needler* and were carried out annually during the fall of 1981-92. Prior to 1991 the maximum depth surveyed was 366 meters whereas during 1991-92 coverage was extended to include depths of 732 meters. Distribution maps are also included in figure 12.

3) Surveys were conducted in Divisions 2GH in the late summer of 1978, 1979 and 1981 as well as 1987 and 1988. The earlier surveys were carried out over all depths using fixed station design, however, in the later period only depths greater than 200 meters were fished. Again, attempts were made to fish down to 1,250 meters but few successful sets were conducted beyond 1,000 meters. These particularly sets of surveys were designed to investigate the distribution and abundance of both Greenland halibut and grenadiers. Distribution maps are shown in figure 2.

4) During the summer of 1991, the Canadian government chartered two large commercial fishing vessels to survey for Greenland halibut from Division 0B to Division 3M in depths of 750-1500 meters. One vessel, the **Northern Kingfisher** surveyed Divisions 0B, 2G, 2H and 2J while the **Cape Adair** conducted fishing operations in Divisions 3K, 3L and 3M. All fishing was carried out based on predetermined line transects. Numerical results of these surveys were presented at last year's meeting in Brodie et al (1992) and further analysis will be presented in Bowering et al (this meeting). Distribution maps are shown in figure 3 for the **Northern Kingfisher** and Figure 4 for the **Cape Adair**.

With the exception of the **Northern Kingfisher**, all surveys were carried out using an Engel 145 high-rise ground trawl. The **Northern Kingfisher** used a modified Alfredo #3 ground trawl. This trawl plus that of the **Cape Adair** were also equipped with rockhopper footgear any extra heavy trawl doors for ease of fishing on rough bottom at great depths. The nets were also equipped with Furuno electronic sensors in order to monitor the gear during fishing operations.

Divisions 2J,3KL

During the earlier period Greenland halibut were relatively abundant in the deep channels running between the shallow fishing banks especially in Divisions 2J and 3K (Fig 1). Fish were also plentiful along the slope of the continental shelf throughout the extent of Division 2J and the more northerly portion of Division 3K. This distribution pattern remained fairly consistent through to about 1986-87 and any variation was associated with total abundance more likely to be a result of differences in year-class strengths as well as natural variability in survey estimates. By 1988, Greenland halibut in Division 2J was clearly disappearing at a rather rapid rate followed by a similar event in Division 3K by 1990. By 1992, catches in Divisions 2J and 3K were extremely low and the highest catch in the area was taken in thew very southeast end of Division 3K near the edge of the continental slope.

Throughout the time period, there were no large catches in Division 3L (Fig 1), however, most catches were taken on the "nose" of the Grand Bank in the area known as the Sackville Spur. It is noteworthy that the highest catches in Division 3L came during the earlier period when surveys only covered depths of 366 meters whereas during the last two years when coverage was complete to over 700 meters catches were negligible.

Divisions 2GH

The distribution pattern of Greenland halibut in Divisions 2GH was remarkably consistent in both the early time series and the later time series (Fig. 2). Most of the larger catches were associated with the outer deep continental slope area from the northern tip of Division 2G in Hudson Strait all the way down to the extent of Division 2H. Fish were particularly abundant (in relative terms) in the Hopedale Channel area which is located in the south western part of Division 2H. The only apparent difference between the two time periods is that the overall abundance in the earlier period is clearly much higher than in the later period. The details of the respective values, of course, have been discussed in detail in stock assessment reports and will not be repeated in detail here.

Deepwater Surveys, 1991

a) **Northern Kingfisher**

The extent of survey coverage was rather low considering the geographic distance required to travel by the vessel (Fig. 3). Nevertheless, for the transects fished catch levels were similar from Division 0B south to Division 2J. It is somewhat difficult to see clearly the variation in catches because the fishing sets were so close together as a result of the sharp decent of the continental shelf edge. It is unfortunate that it wasn't possible to survey the deep channel areas to compare catch levels were earlier surveys.

b) **Cape Adair**

This survey was much more comprehensive than that of the **Northern Kingfisher** and covered all of the deep slope area from northern Division 3K to the deep areas on the north side of the Flemish Cap in Division 3M (Fig. 4). The noticeable gap in the aerial coverage along the 1,000 meter contour in Division 3L is due to very poor trawlable bottom. Nevertheless, the sets that were possible clearly indicated that there is little reason to expect a break in the continuity of the distribution from Division 3K through Division 3M and likely south to Division 3N. The higher catches experienced in the survey occurred in the northern Division 3K. Catch levels were lower in the southern part of Division 3K and the northern part of Division 3L but were much higher consistently on average in the proximity of the Division 3L and 3M boundary (Fig. 4). It is of interest to note that every set fished had some catch of Greenland halibut.

Summary

Except that there have been substantial reductions in the biomass levels in Divisions 2GH from the late 1970's to the late 1980's there does not appear to be any significant change in the pattern of distribution throughout the area. In Divisions 2J and 3K the distribution is also rather consistent for many years until the late 1980's when Greenland halibut began to rapidly disappear in Division 2J followed within a couple of years by Division 3K. It is not readily apparent from the survey data that the fish moved progressively to deep water. However, considering the rapidity of which the events progressed it is not inconceivable that large scale seasonal movements may have taken place which may not have been precisely detected with 12 months between surveys.

It is also apparent that there is a continuity in the distribution of Greenland halibut along the continental shelf edge from within the Canadian fishing zone extending to the Flemish Pass and likely further on south. Considering the synchrony of timing as to when the Greenland halibut began to rapidly disappear from Divisions to the north and the discovery of high

concentrations in the Flemish Pass the question remains as to if this is fish that migrated there or fish that was always there and not detected? Given the observations on other species that have disappeared in large quantities and evidence of migrations to this area, the migration hypothesis is certainly realistic and practical. Furthermore, considering all the commercial as well as deepwater research activity that has been conducted in this area over decades it is difficult to accept that such a concentration in this area could go undetected for a long period of time.

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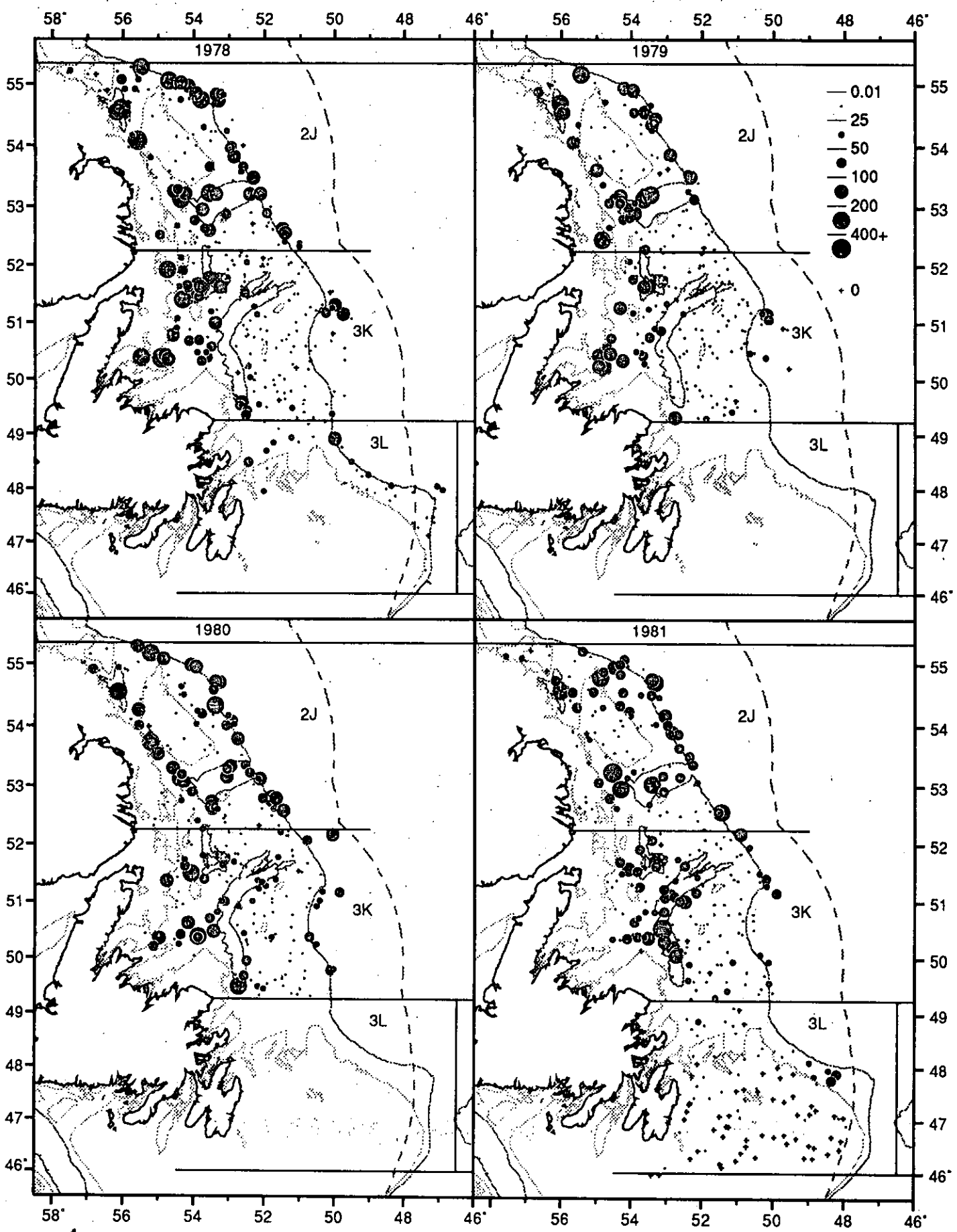

Fig. 1 Distribution of Greenland halibut catches from 1978-1981 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 400m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.

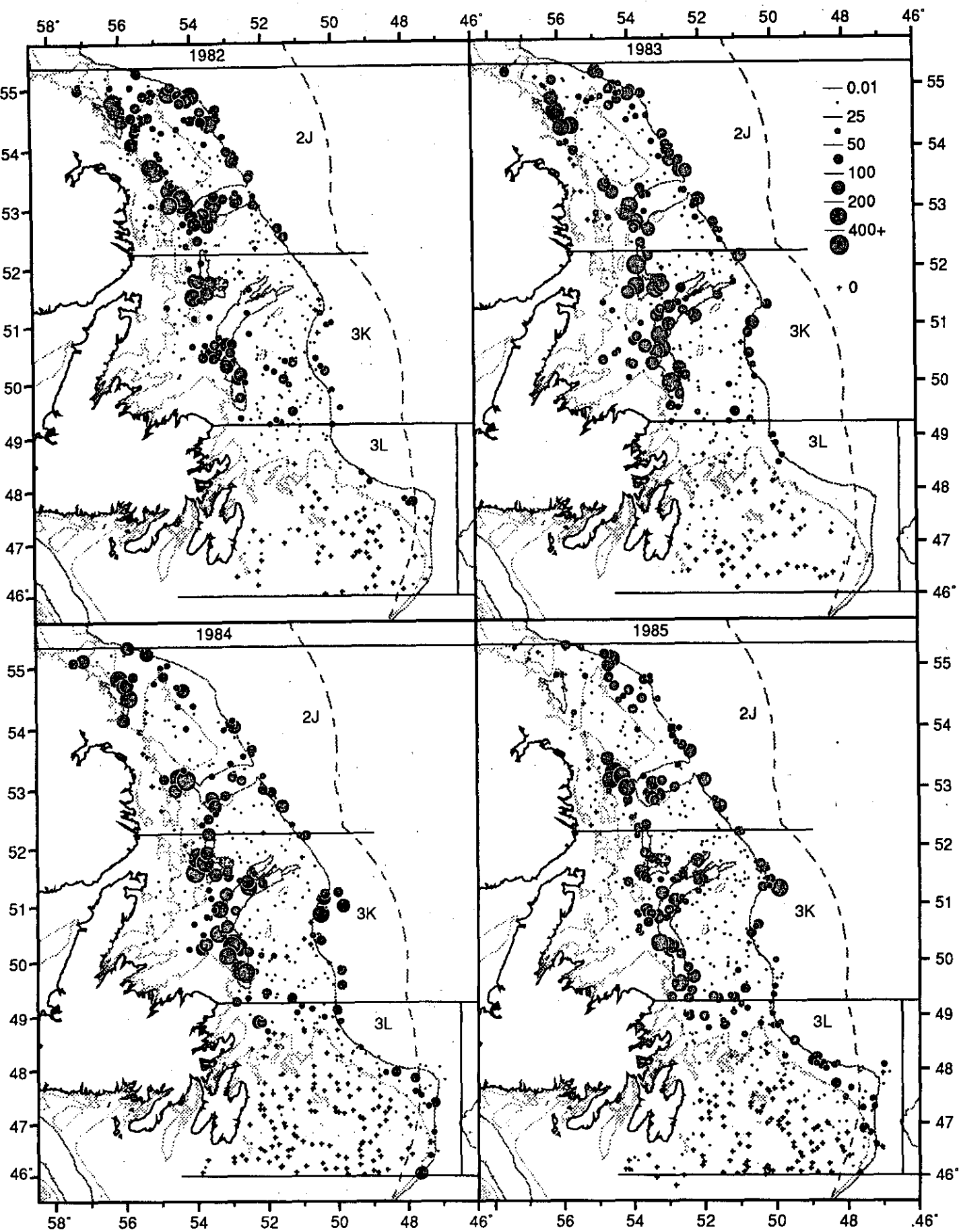

Fig. 1 Distribution of Greenland halibut catches from 1982-1985 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 400m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.

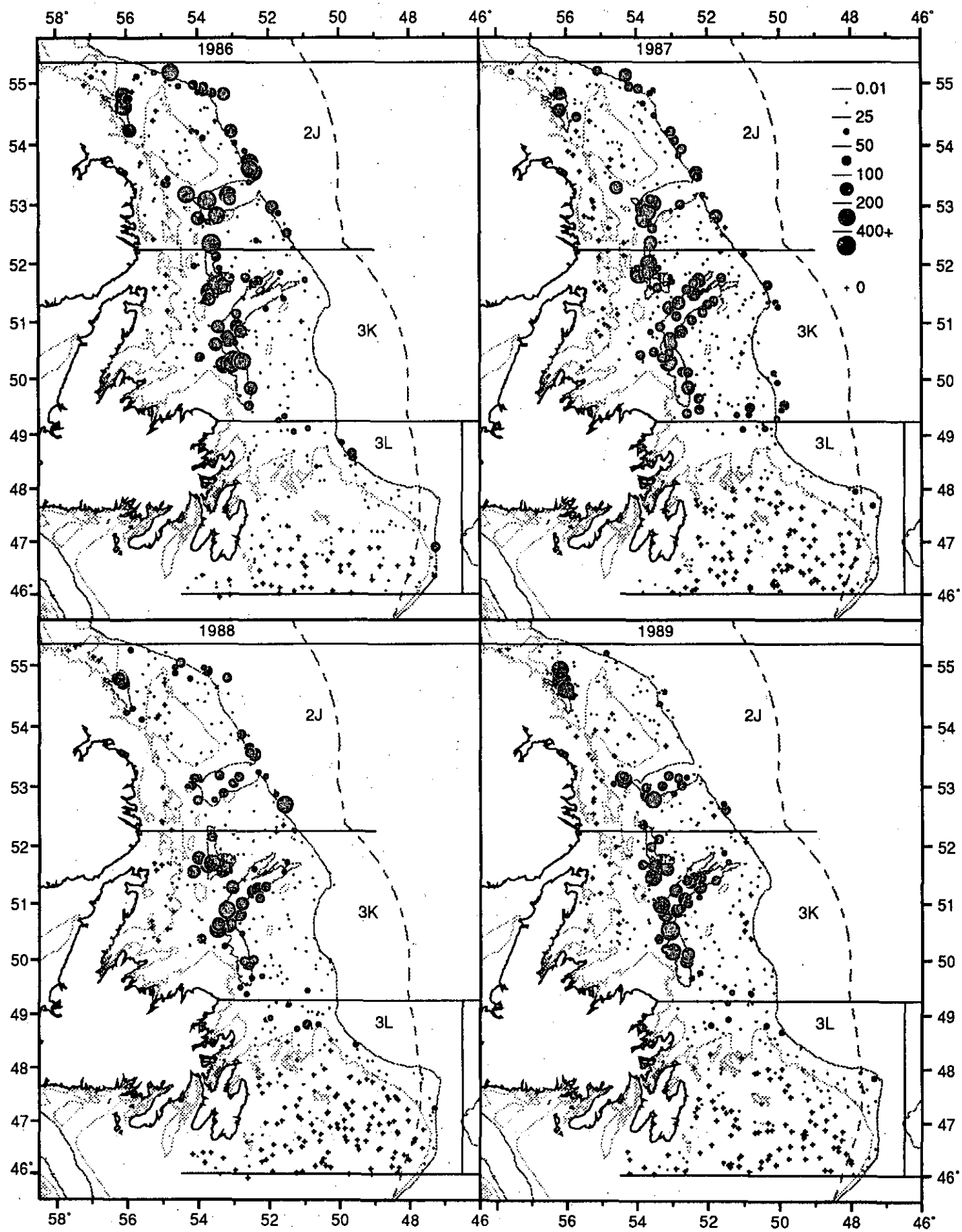

Fig. 1 Distribution of Greenland halibut catches from 1986-1989 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 400m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.

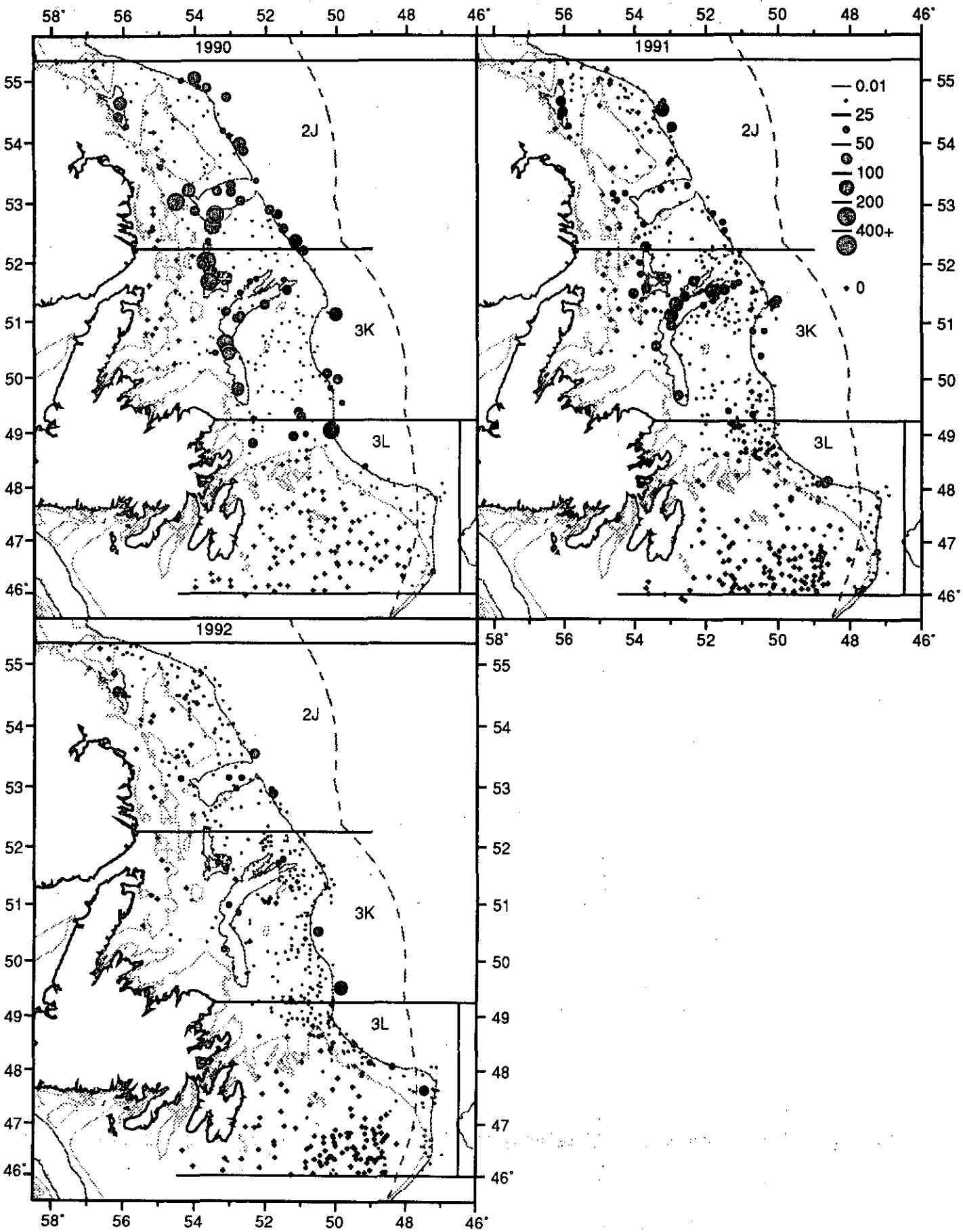

Fig. 1 Distribution of Greenland halibut catches from 1990-1992 Canadian autumn surveys to Div. 2J3KL showing 200m (light dotted) and 400m (dark dotted) depth contours. Dashed line represents division between the Canadian economic zone and the NAFO Regulatory area.

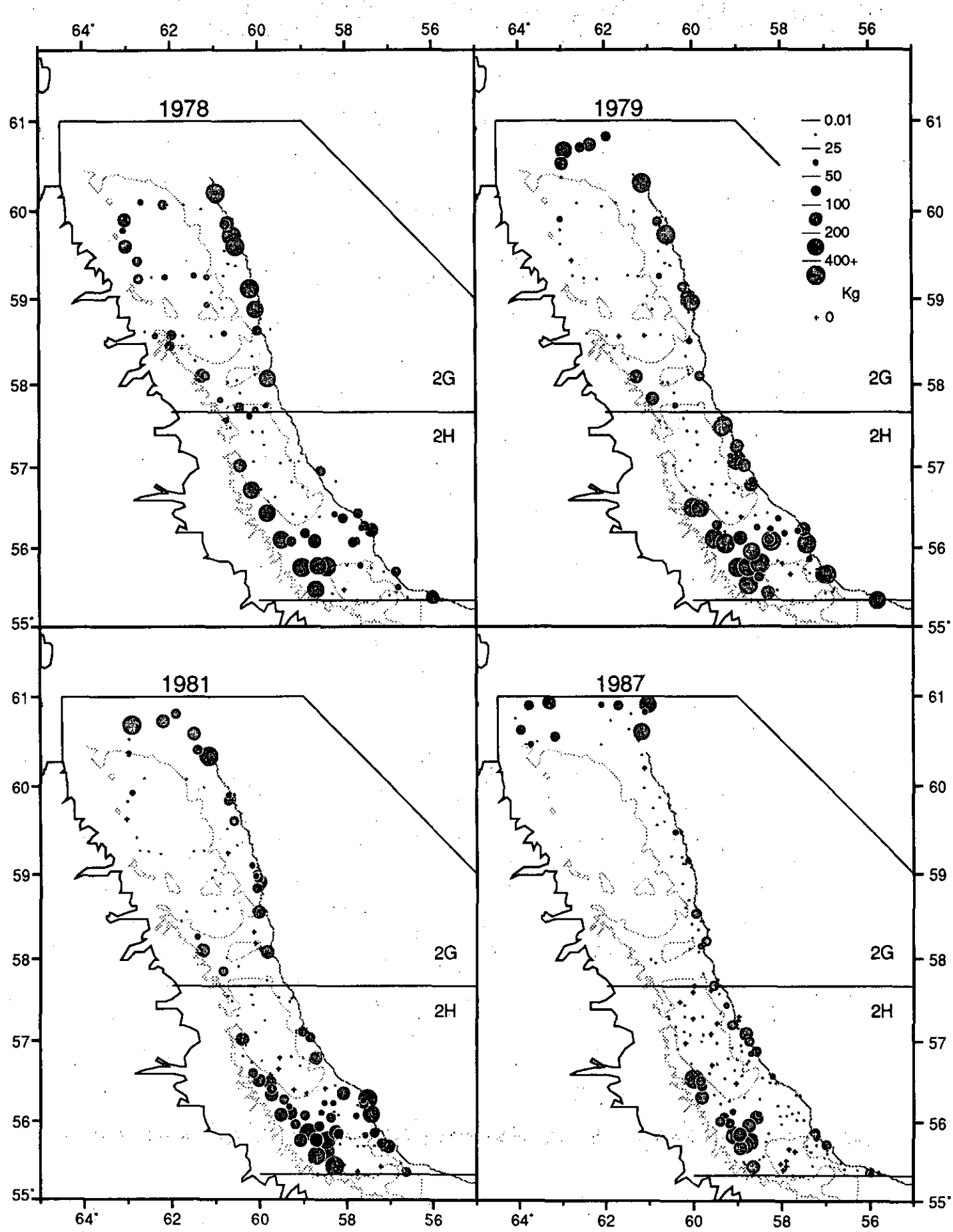

Fig. 2 *Distribution of Greenland halibut catches (Kg per standard tow) from periodic Canadian surveys of* Div. 2GH from 1978-1987 showing 200m (light dotted) and 800m (dark dotted) depth contours.

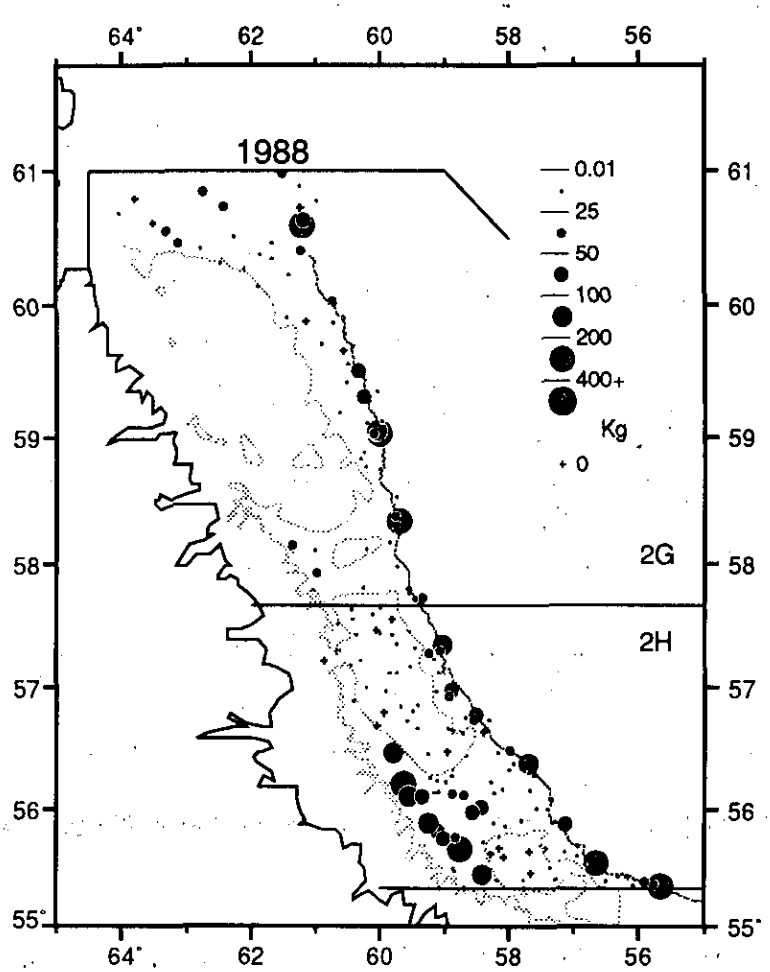

Fig. 2 Distribution of Greenland halibut catches (Kg per standard tow) from a 1988 Canadian survey to Div. 2GH showing 200m (light dotted) and 800m (dark dotted) depth contours.

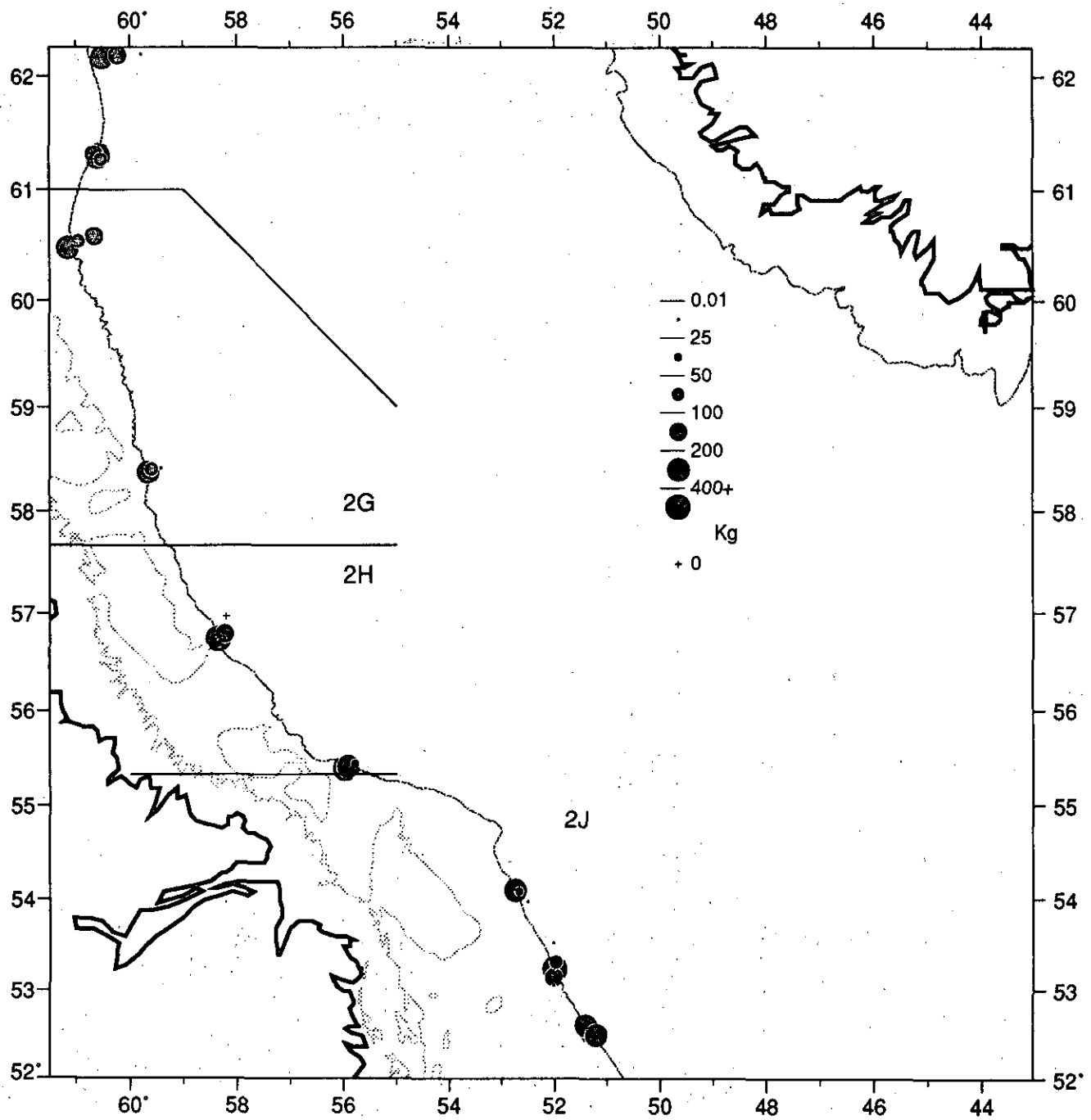

Fig. 3 Distribution of Greenland halibut catches (Kg. per standard tow) from a Greenland halibut directed deepwater Canadian survey by the Northern Kingfisher to Div. 0B2GHJ showing 200m (light dotted) and 1000m (dark dotted) depth contours

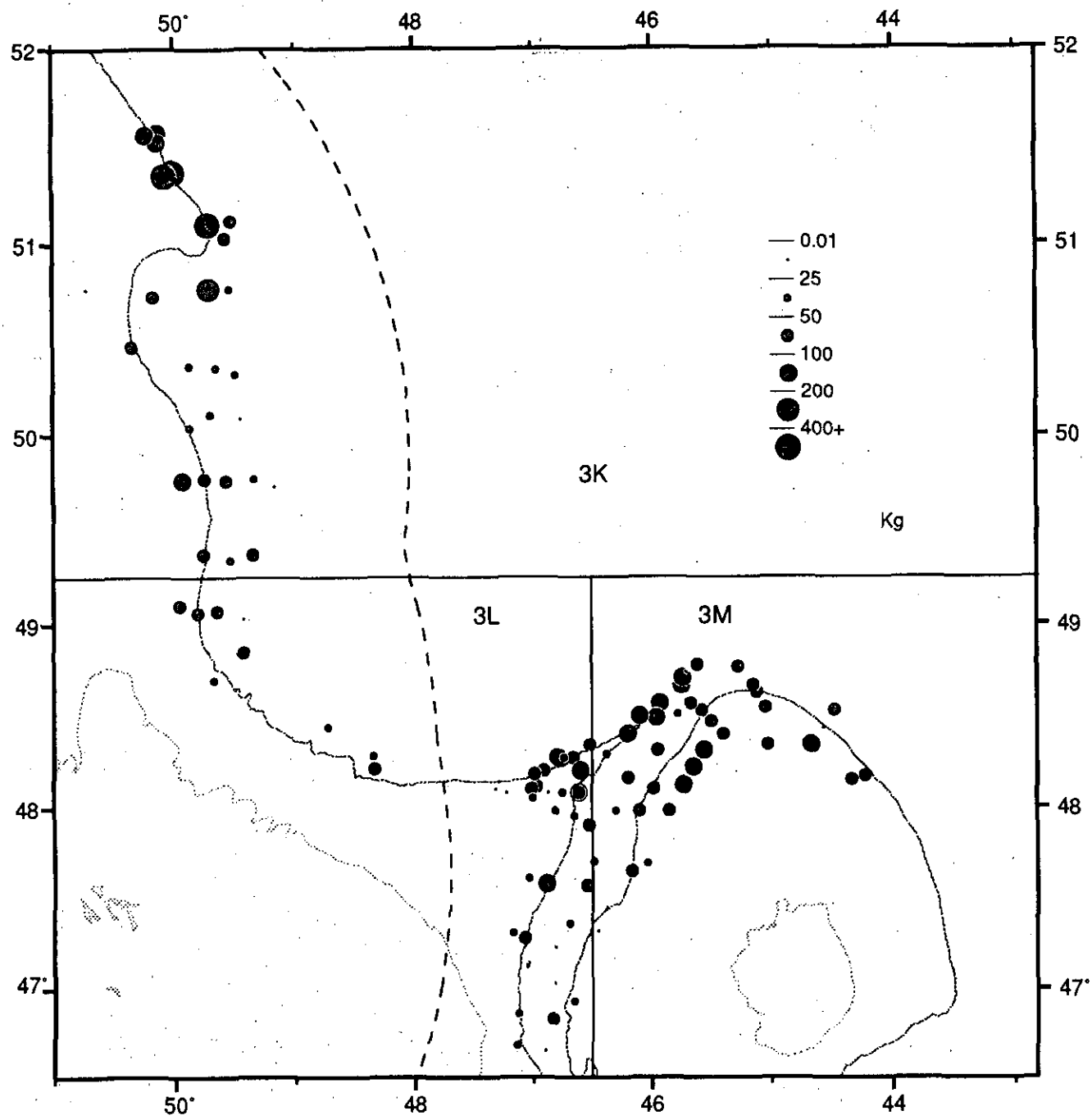

Fig. 4 Distribution of Greenland halibut catches (Kg. per standard tow) from a Greenland halibut directed deepwater Canadian survey by the Cape Adair to Div. 3KLM showing 200m (light dotted) and 1000m (dark dotted) depth contours. Dashed line represents division between the Canadian economic and the NAFO Regulatory area.