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ON SANDEEL IN 0-GROUP SURVEYS IN ICELANDIC
AND ADJACENT WATERS 1970 - 1979

by

Eyjólfur Friðgeirsson

Marine Research Institute

Skúlagata 4

Reykjavík, Iceland.

INTRODUCTION.

In the last three years an effort has been made in Iceland to develop a fishery on sandeel. The question of the sandeel stock size and the recruitment to the stock is therefore of much interest.

This paper deals with the occurrence of 0-group sandeel in trawl catches during 0-group surveys in Icelandic and adjacent waters in the period 1970 - 1979.

To begin with 0-group surveys in the Icelandic-East Greenland area were a multinational effort but since 1976 Icelandic research vessels have carried out those surveys alone.

Participation, timing and coverage of the various cruises are summarized in a review paper on the 0-group surveys for the years 1970 - 1975 (Vilhjálmsson and Friðgeirsson, 1976) and from then on in the annual 0-group reports to ICES (Anon., 1976 - 1979).

MATERIALS AND METHODS.

In the annual 0-group reports the main emphasis has been on the four most common and commercially valuable species found in the 0-group catches. These are cod, haddock, capelin and redfish.

Other species have, in most of the reports, only been briefly mentioned. Of these species the sandeel has always been most numerous.

The present paper is a review of sandeel data collected during the years 1970 - 1979.

The methods used are outlined in the annual 0-group reports to ICES and described in more details in the review paper on the 0-group surveys for the years 1970 - 1975 (Vilhjálmsson and Friðgeirsson, 1976).

THE SANDEEL AT ICELAND.

Einarsson (1951 and 1955) found three species of sandeels in Icelandic waters: *Ammodytes lanceolatus*, *A. tobianus* and *A. marinus*.

The present author (Friðgeirsson, 1979 and unpublished material) has, however, not found a single *A. tobianus* and only a few *A. lanceolatus* in several samples taken from commercial catches at S- and SW-Iceland in the years 1978 - 1980. Only one sandeel sample, collected with a bottom sledge in inshore waters at the S-coast in 1979, has contained relatively high numbers of *A. tobianus*. The frequency distribution of vertebrae in the specimen from that sample is shown in Table 1. In 1978 vertebrae were counted in 715 individuals sampled from commercial catches and in 315 specimen from 0-group material collected the same year. The results are also shown in Table 1.

TABLE 1. Frequency distribution of vertebrae of sandels.

| Number of vertebrae. | Sample from 1979. | Samples from commercial catches. | Samples from 0-group material 1978. |
|----------------------|-------------------|----------------------------------|-------------------------------------|
| 60 | 3 | | |
| 61 | 3 | | |
| 62 | 8 | | |
| 63 | 4 | | |
| 64 | | | |
| 65 | | | |
| 66 | | | |
| 67 | | | |
| 68 | 3 | 2 | 2 |
| 69 | 6 | 12 | 9 |
| 70 | 24 | 30 | 24 |
| 71 | 33 | 29 | 28 |
| 72 | 16 | 20 | 25 |
| 73 | | 6 | 10 |
| 74 | | 1 | 2 |
| 75 | | + | |

100% 100% 100%

Einarsson (1951) gives the following frequency distribution of vertebrae in sandeels in Icelandic waters (Fig.1.).

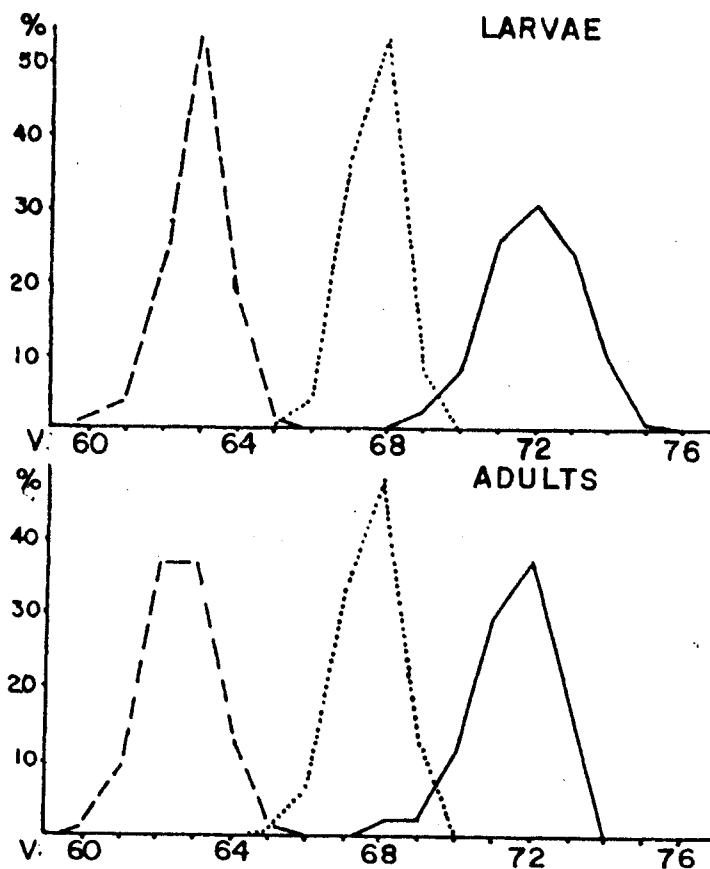


Fig.1. Frequency distribution of vertebrae of *A. lanceolatus* (.....), *A. lancea lancea* (---) and *A. lancea marinus* (—) in Icelandic waters.

Where *A. lancea lancea* refers to *A. tobianus* and *A. lancea marinus* to *A. marinus*. It is obvious that the lesser sandeel, *A. marinus*, is by far the most common sandeel species at Iceland, as it also is in the North Sea (Macer, 1966). In spite of much effort to find *A. lanceolatus* and *A. tobianus* in the 0-group material not a single specimen has positively been identified as belonging to these species. It is therefore concluded that the majority of the sandeel in the 0-group catches is *A. marinus*.

The length distribution of 293 0 and 1-group sandeels in the 0-group material from 1978 and sample of 131 sandeels from SW-Iceland taken in early september 1979 is shown in Table 2.

TABLE 2. Age-length relationship in sandeels.

| Length cm | 0-group material 1978 | | Sample from SW-Iceland 1979 | |
|--------------|-----------------------|---------|-----------------------------|---------|
| | 0-group | 1-group | 0-group | 1-group |
| 4 | 2 | | | |
| 5 | 4 | | | |
| 6 | 24 | | 12 | |
| 7 | 14 | | 14 | |
| 8 | 6 | 3 | 2 | |
| 9 | 3 | 30 | 5 | 2 |
| 10 | 1 | 11 | 4 | 2 |
| 11 | | 2 | | 4 |
| 12 | | | | 7 |
| 13 | | | | 17 |
| 14 | | | | 16 |
| 15 | | | | 13 |
| 16 | | | | 2 |
| | 100% | | 100% | |

From the 0-group sample of 1978 it is obvious that 1-group sandeel is present in the 0-group material. Its proportion is however, more doubtful. From Table 2. we see that sandeel - 9 cm is mostly 1-group and sandeel - 9 cm is mostly 0-group. The length distribution diagrams in Figs. 12. and 13. show that sandeel - 9 cm is found at S- and SW-Iceland and in some years at W-Iceland and in the Dohrn bank area.

TABLE 3. Stations with sandeels - 9 cm.

| Area | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 |
|--|-------------------------|------|------|-------------|------|------|-------|-------|------|------|
| S-,SW-Iceland, | 5 | 6 | 4 | 7 | 3 | 3 | | 7 | | |
| W-Iceland,Dohrn Bank | 3 | 2 | 1 | | | | | 1 | 2 | |
| N-, E-Iceland, | 4 | 1 | | | | | | 1 | 3 | |
| Inshore and shallow water stations, | 6 | 7 | 4 | 7 | 3 | | | 9 | 4 | |
| Possible effect on abundance estimate. | - - - - Minor or little | | | - - - -none | | | minor | minor | none | none |

The majority of stations with large sandeel are close to the shore inside fjords and in shallow waters. Other stations with sandeel - 9 cm are exclusively located at SW-Iceland. These most probably are large 0-group fish (Table 2.). A careful study of the situation and the possible effect of stations with - 9 cm sandeel on abundance estimates of the yearclass has shown that the prestige of 1-group sandeel in the 0-group catches is of minor importance if any.

DISTRIBUTION AND ABUNDANCE OF THE SANDEEL.

The distribution and density(numbers/nm towed) of 0-group sandeel are shown in Figures 2 - 11.

Abundance estimates of 0-group sandeel for the ten year period 1970 - 1979 are given in Table 4.

TABLE 4. Abundance estimates of 0-group sandeel in 10^{-6} fish.

| Year class | SE-Iceland | SW-Iceland | W-Iceland DohrnBank | N-Iceland | E-Iceland | Total |
|------------|------------|------------|---------------------|-----------|-----------|-------|
| 1970 | 0 | 2786 | 55 | 450 | 0 | 3291 |
| 1971 | 1764 | 21560 | 1961 | 168 | 1 | 25454 |
| 1972 | 610 | 9200 | 2130 | 826 | 14 | 12780 |
| 1973 | 193 | 11515 | 1468 | 999 | 118 | 14293 |
| 1974 | 0 | 77 | 201 | 411 | 0 | 689 |
| 1975 | 6 | 702 | 1495 | 525 | 17 | 2745 |
| 1976 | 47 | 8459 | 9238 | 15002 | 121 | 32867 |
| 1977 | 174 | 77 | 322 | 246 | 10 | 830 |
| 1978 | + | 6 | 694 | 1087 | 30 | 1817 |
| 1979 | 1 | 1227 | 139 | 345 | 2 | 1714 |

The fluctation in abundance is similar to that of the 0-group cod. Thus the difference between the smallest and the largest yearclasses of 1974 and 1976 is about 1/150 for the 0-group sandeel, the corresponding figures for the cod in 1974 and 1976 being 54/2743 ($\times 10^6$) or 1/50.

There also is a great difference between years in the distribution pattern of the sandeel. During the poorest years of 1974 and 1977 very little was found at SW- and S-Iceland compared to the rich years of 1971, 1972, 1973 and 1976 when a considerable part of the yearclass was found there.

The overall distribution pattern of the 0-group sandeel is similar to that of the 0-group cod and haddock.

COMMENTS ON SANDEEL IN THE 0-GROUP REPORTS FROM 1970 - 1979 AND THE CHARACTERISTIC OF EACH YEAR.

The sandeel is mentioned in almost every 0-group paper during the period 1970 - 1979 while the stress on its significance differs from year to year.

1970

The 1970 report contains a distribution chart of sandeel and the text: "This species had a very similar distribution pattern to that of the capelin. The highest density was observed near station T-21 but on the whole the sandeels were rather scattered. The catches usually consisted of a mixture of 0-2 group fish."

In 1970 the main concentrations were at SW- and N-Iceland (Fig.2.). The length distribution (Fig.12.) indicates that most of the catches has been 0-group fish. No samples have been taken at S- and SE-Iceland and it is rather difficult to estimate how much this has affected the total abundance estimate of this yearclass (Table 4.).

1971

In the 1971 0-group report no distribution chart of sandeels is presented, but only the comment: "Sandeels occurred frequently in the catches in considerable numbers. A cursory look at

their length distribution suggests that these were mostly 1- and 2-group fish."

Total abundance estimate of this year is 25454 ($\times 10^6$) fish which is the second highest in the present 10 years series. The main concentrations were at S-, SW- and W-Iceland (Fig.3): The length distribution (Fig.12) does not indicate much 1- and 2-group in the catches except possibly at W-Iceland and in the Dohrn Bank area. The above comment on the age in the 1971 report must be considered incorrect.

1972

The 1972 report gives length distribution of sandeel at the Faroe Islands in July and at Iceland in July and August. This report states that: "0-group sandeels were numerous in shallow waters at the Faroe Islands and on the Faroe Bank. At Iceland they occurred mainly at the West and North coasts in waters of less than 200 m depth. The richest haul at the Faroe Islands yielded 23800 individuals and at Iceland 33 thousand specimen."

This year the abundance estimates are rather high or 12780 ($\times 10^6$) fish. Except at W-Iceland and on the Dohrn Bank the length distribution does not indicate significant numbers of other year-classes than the 0-group.

1973

The 1973 report contains the following comment on sandeel at the Faroe Islands: "Sandeels and Norway Pout were again the most abundant of all species over the continental shelf, and they were most numerous in the shallower waters." There are no comments on sandeels at Iceland.

This year however the sandeel is widespread at Iceland (Fig.5) and the abundance estimate is relatively high or 14293 ($\times 10^6$) fish. It is only at S- and SW-Iceland - 9 cm sandeels are found in significant numbers.

1974

This is the poorest sandeel year in the entire 1970 - 1979 series, the total abundance estimate being 689 ($\times 10^6$) fish. The 1974 report comments were as follows: "Sandeel, Norway pout, long rough dab, whiting and Greenland halibut were less common than before." The length distribution (Fig. 12) indicates that the catches at SW-Iceland might consist mainly of sandeels older than 0-group.

1975

The 1975 report states that: "The sandeel is not yet a commercially important species at Iceland. It is nevertheless a very important part of the food chain and as such worth attention. --" The above report also contains a distribution and abundance chart, length distribution diagrams and comments on those. The 1975 yearclass is poor, the abundance figures being only 2745 ($\times 10^6$) fish. Apart from the catches at SW-Iceland no fish possibly older than 0-group were recorded as can be seen from the length distribution diagrams (Fig. 13).

1976

The year 1976 is by far the richest in the series with an abundance figure of 32867 ($\times 10^6$) fish. Sandeel was found in high numbers at SW-, W-, N-, and NE-Iceland besides being for the first and only time found in the central Irminger Sea (Fig. 8). The 1976 report contains no sandeel illustrations, but the species is commented on as follows: "0-group sandeel was frequently caught, sometimes in great numbers, at Iceland. The highest concentrations were found off the W- and SW-coasts and off N-Iceland in higher numbers than usual. Apart from this, 1-group sandeel was recorded in quantities in the Breiðafjörður area, and lesser concentrations were registered off NE-Iceland as well as in the East-Greenland region." The length distribution (Fig. 13) does, however, not show many sandeels - 9 cm. Most of the sandeel in the Irminger Sea is less than 9 cm.

1977

The sandeel yearclass of 1977 is the second poorest yearclass in these series with abundance estimate figure of 830 ($\times 10^6$) fish. In many ways 1977 is reminiscent of the poor year of 1974. The distribution is similar (Fig. 6 and 9) and as in 1974 much of the sandeels at SW- and S-Iceland are - 9 cm and thus possibly belong partly to the 1- and 2- groups. The 1977 reports text on sandeel reads: "Sandeel of all yearclasses is generally in the 0-group catches at Iceland and the year 1977 was no exception. In addition it was now recorded in the Dohrn Bank region where the mean length was 75.6 mm. At Iceland the sandeel was smaller, the average size varying from 50 - 70 mm."

1978

This year sandeel was mainly found at NW-Iceland (Fig. 10). The yearclass was poor, the abundance estimate being 1817 ($\times 10^6$) fish. The species is commented on in the 1978 report as follows: "Sandeel of all yearclasses were quite numerous in the catches at the coast of Iceland. An exception is the S-coast where it appeared to be less numerous this year than before. It was also found in minor quantities in the shelf region off East Greenland. The main concentrations were, however, recorded in the N-Iceland area, especially off the western N-coast (more than 10000 indiv. per nm)." The length distribution diagrams (Fig. 13) show that the sandeel is rather large this year probably partly mixed with small numbers of sandeel of the 1- and 2-groups.

1979

The 1979 report comments on sandeels were: "As in the previous years 0-group sandeel appeared in catches off Iceland. The quantities were, however, small compared with most years in the present series. The main concentrations were recorded in Faxa Bay, Ísafjarðardjúp on the NW-peninsula and off the western N-coast. As in 1978 very few 0-group sandeel were recorded at the S-coast and in the shelf region off East Greenland." The sandeels caught in the 0-group survey in 1979 were rather small (Fig. 13) and the total abundance estimate figure was low, 1714 ($\times 10^6$) fish, indi-

cating a poor yearclass.

SOME CONCLUSIONS.

Of the 3 species of sandeel found at Iceland the lesser sandeel, *Ammodytes marinus* is by far the most common and the catches of sandeels in the 0-group surveys at Iceland consist mainly of that species. Although 1- and probably older fish are found in the sandeel samples from the 0-group surveys at Iceland they are not numerous enough to influence the total abundance estimate of any yearclass to a significant degree.

The 0-group surveys probably give equally good estimates of the yearclass strength of the sandeel as of that of cod and capelin, and they have shown that the sandeel is a very common species at Iceland indeed.

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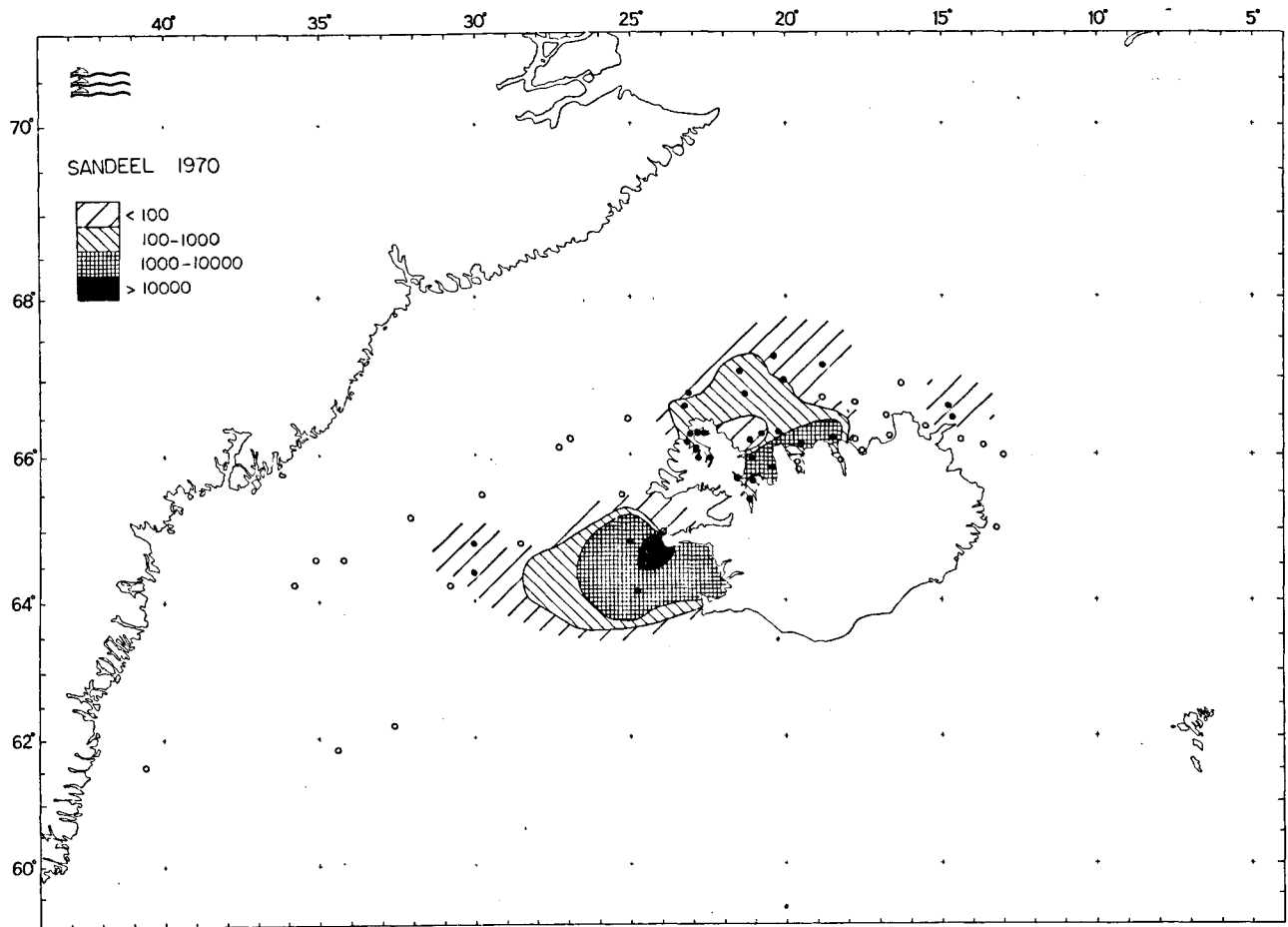


Figure 2. Quantitative distribution of 0-group sandeel 1970.

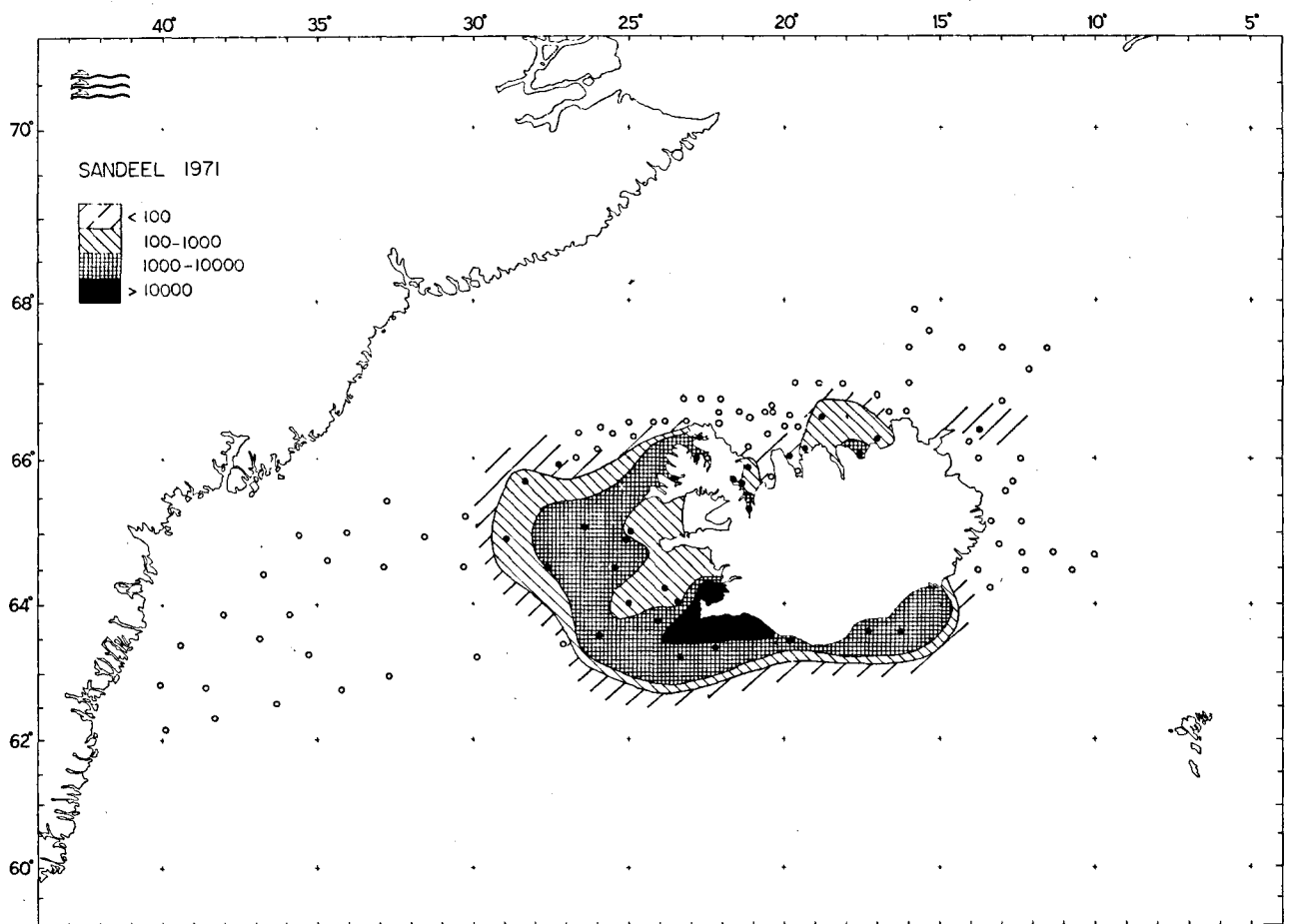


Figure 3. Quantitative distribution of 0-group sandeel 1971.

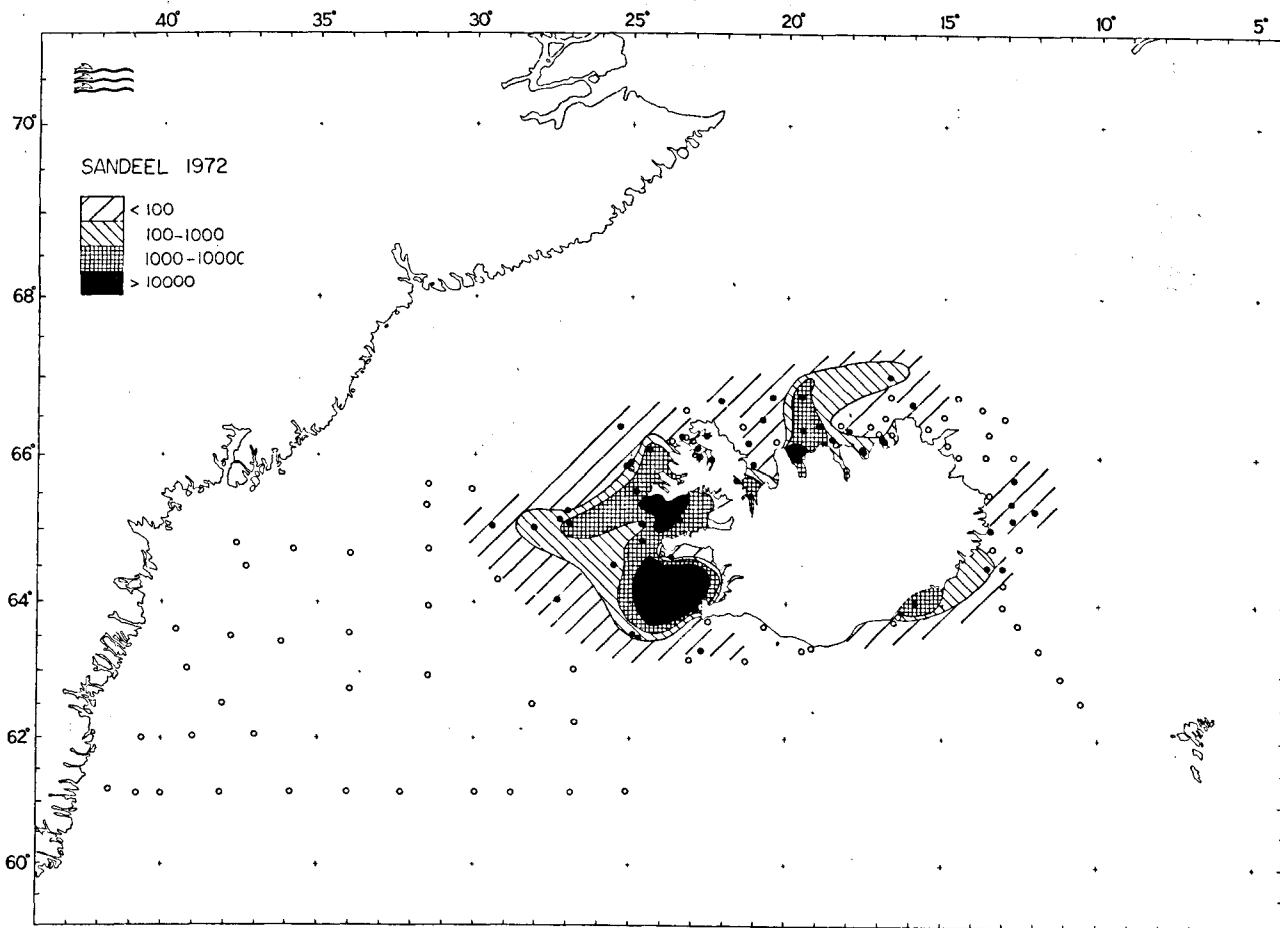


Figure 4. Quantitative distribution of 0-group sandeel 1972.

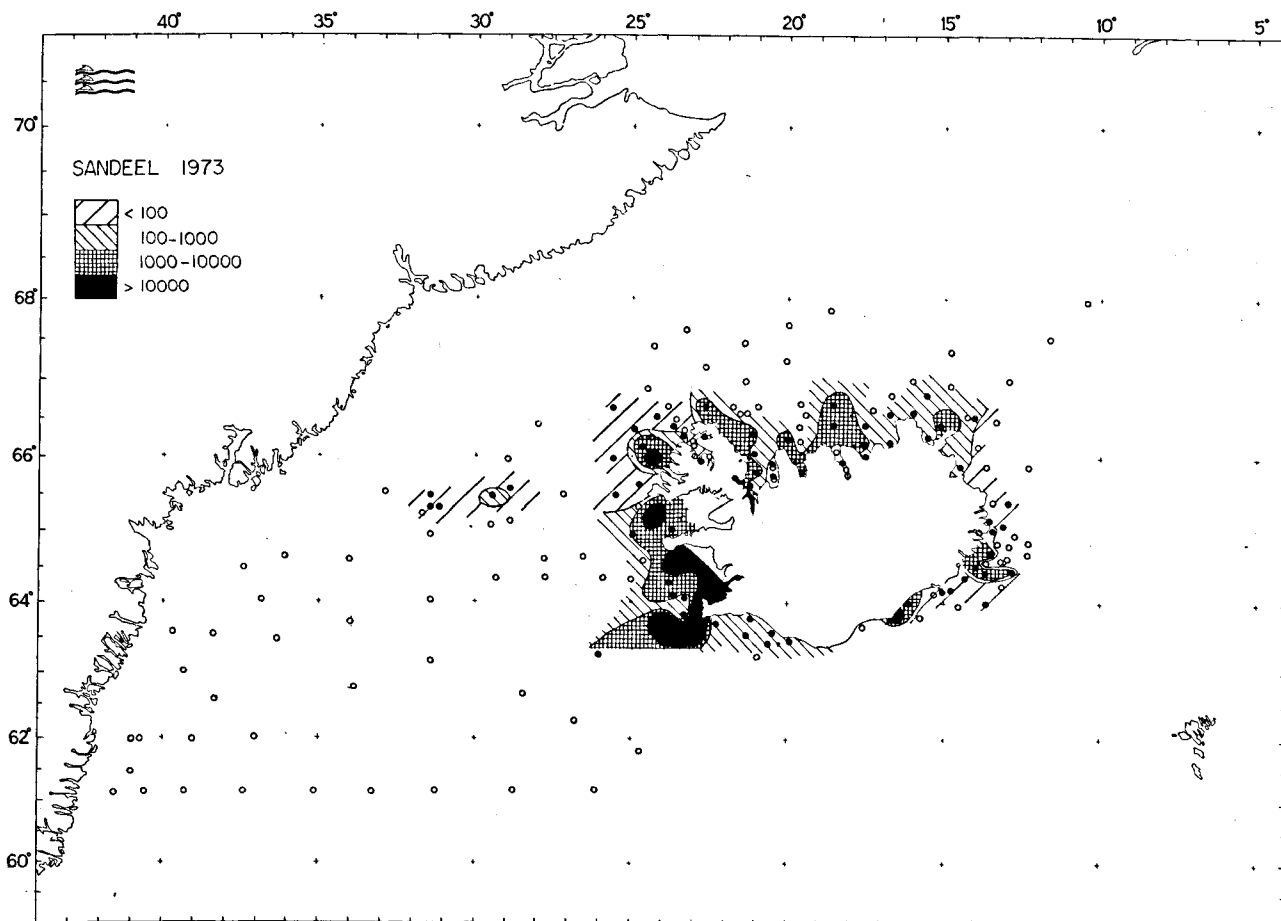


Figure 5. Quantitative distribution of 0-group sandeel 1973.

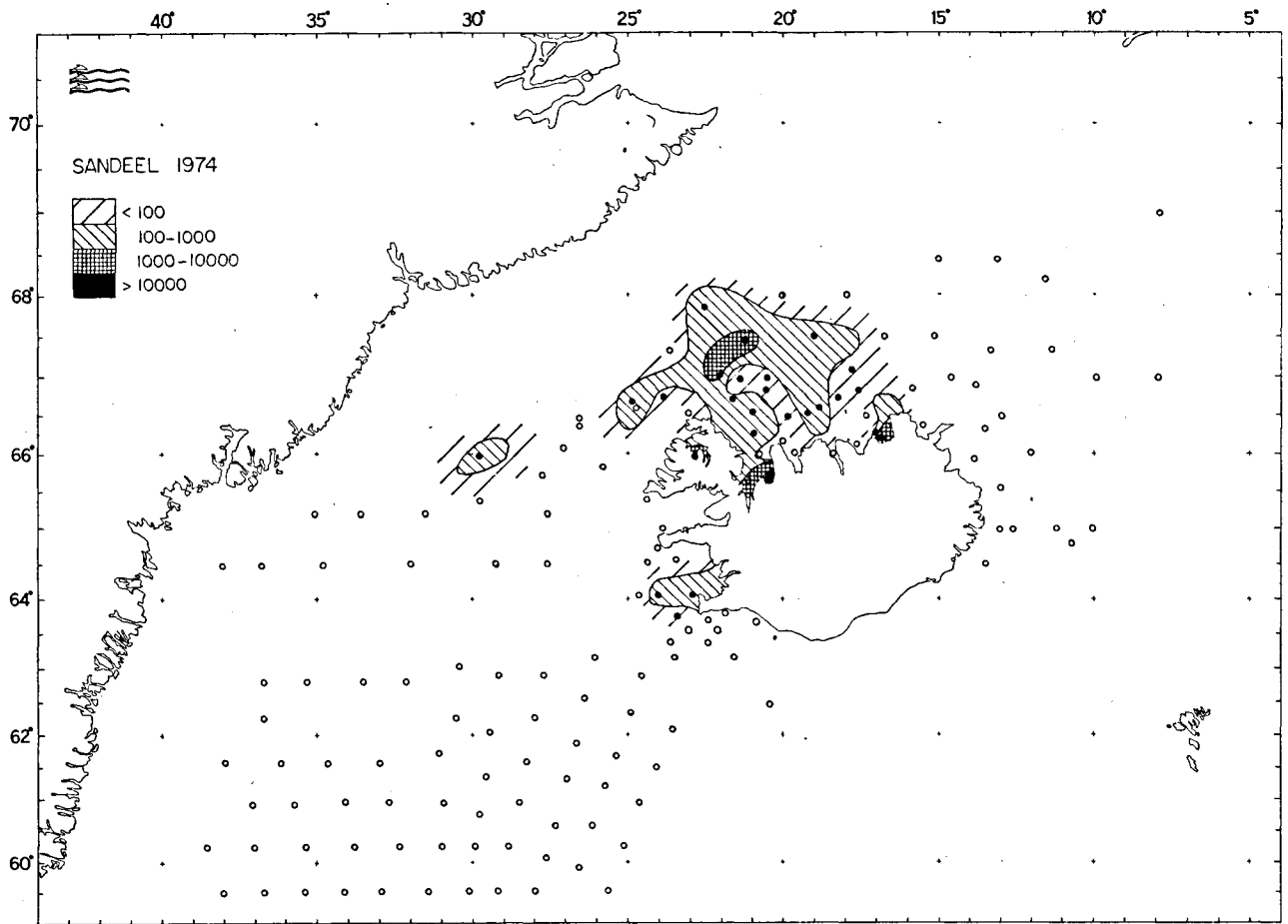


Figure 6. Quantitative distribution of 0-group sandeel 1974.

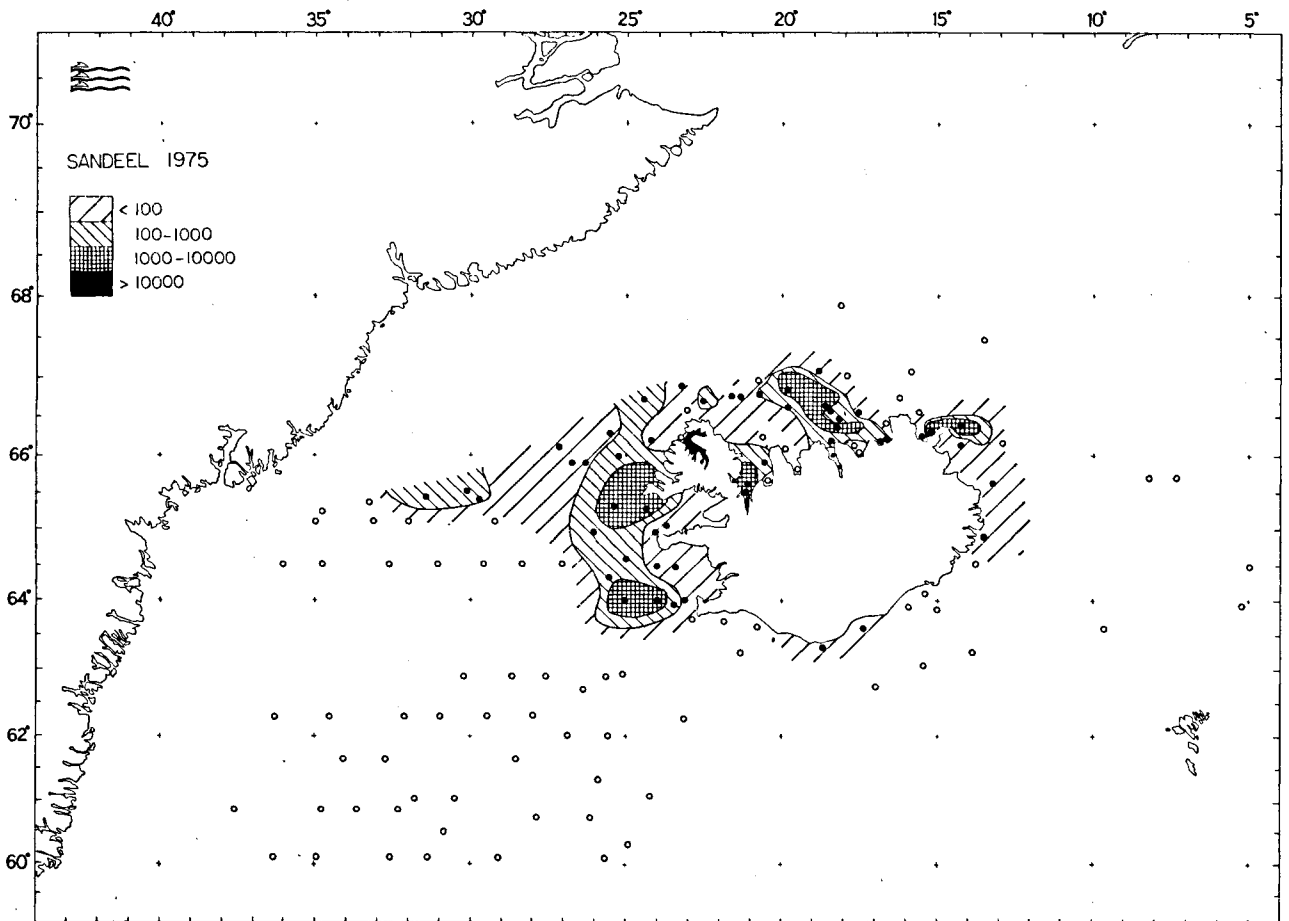


Figure 7. Quantitative distribution of 0-group sandeel 1975.

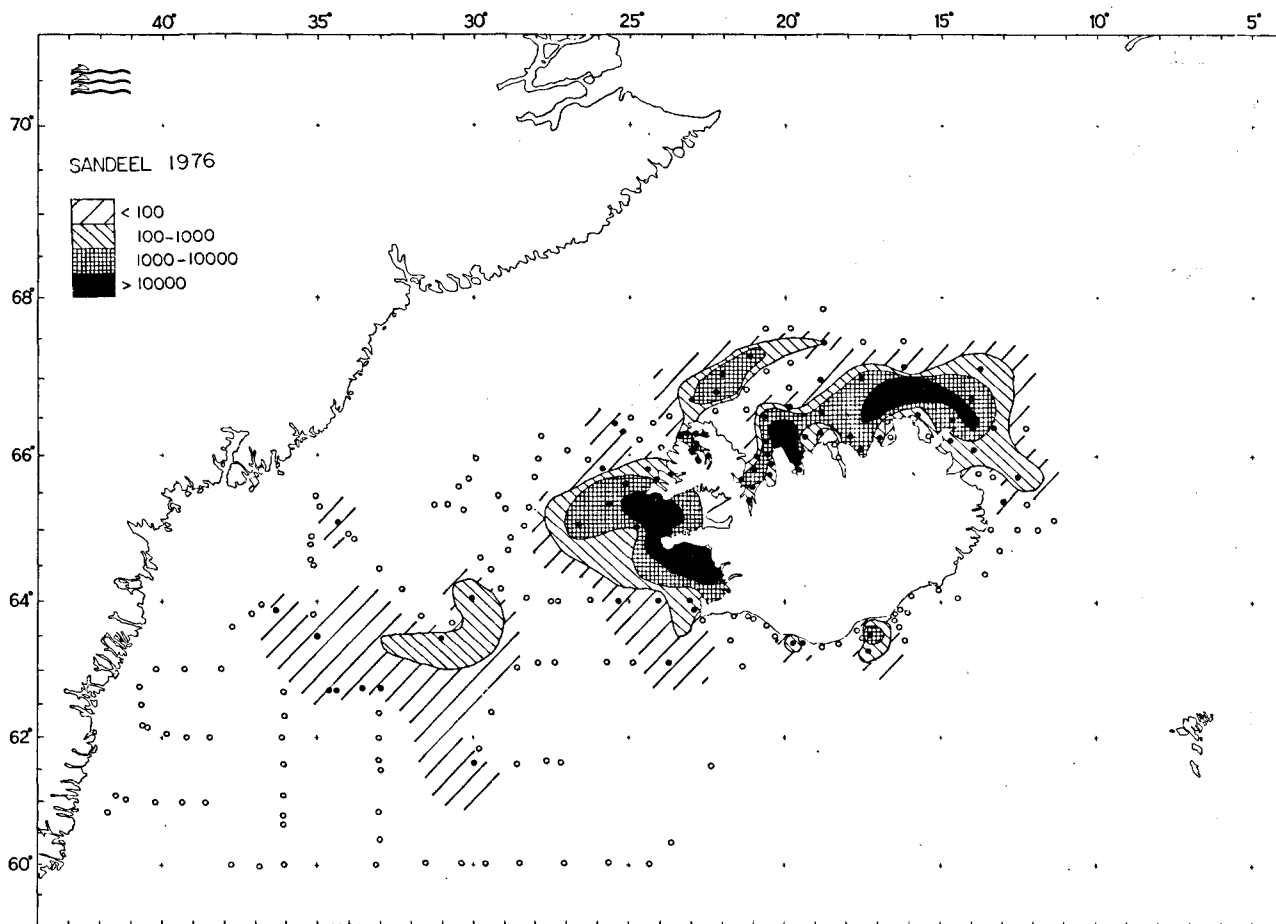


Figure 8. Quantitative distribution of 0-group sandeel 1976.

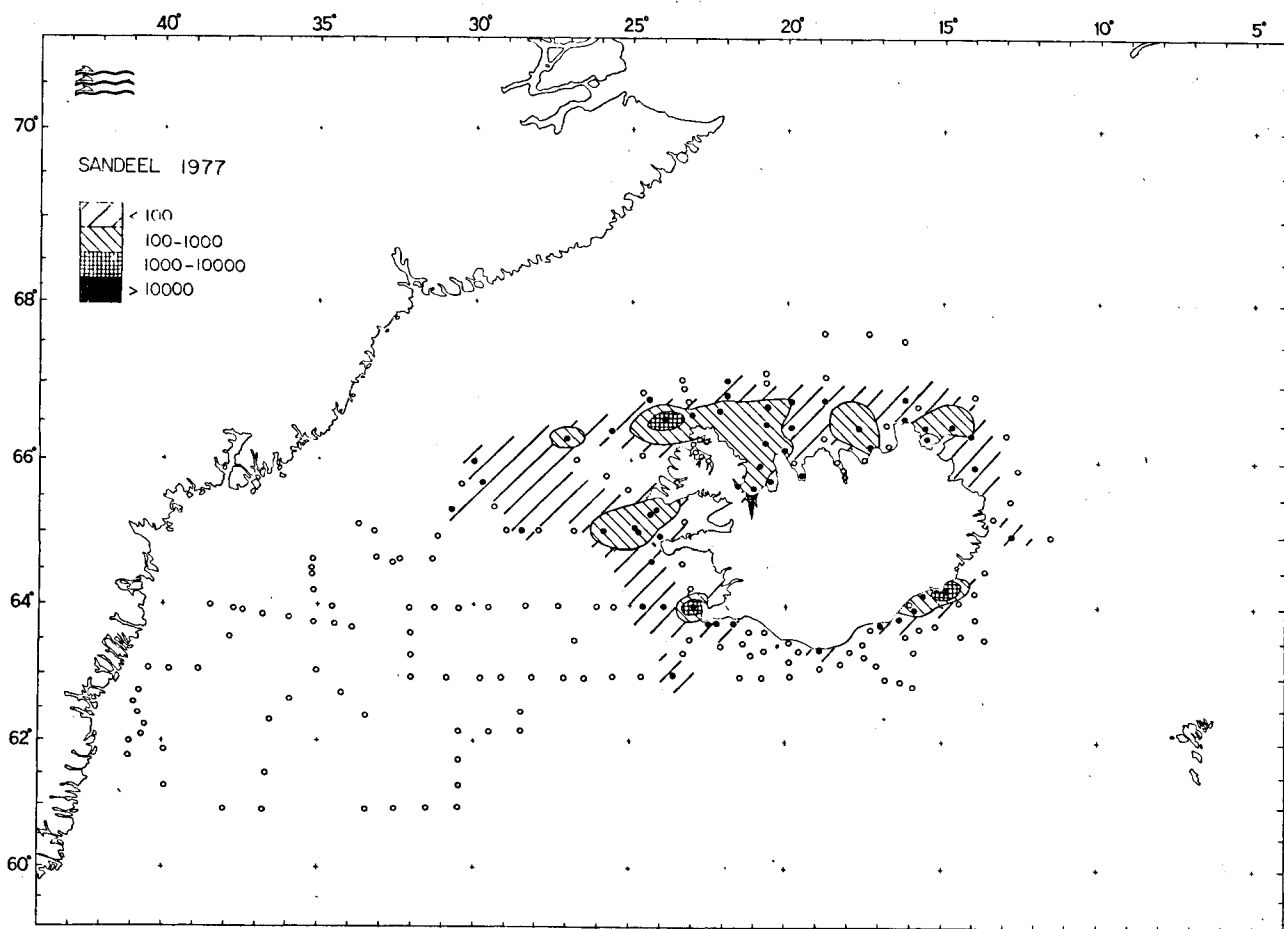


Figure 9. Quantitative distribution of 0-group sandeel 1977.

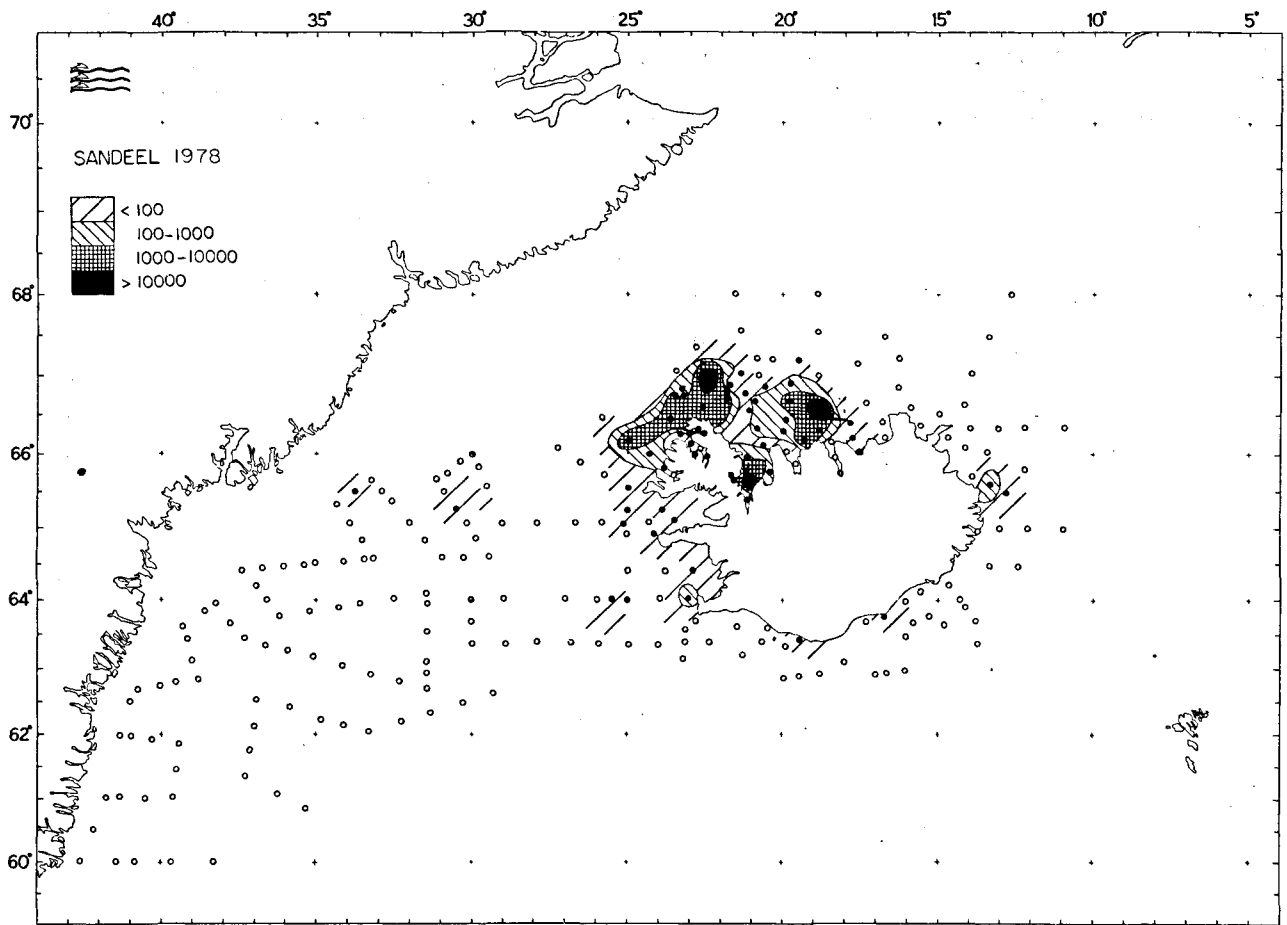


Figure 10. Quantitative distribution of 0-group sandeel 1978.

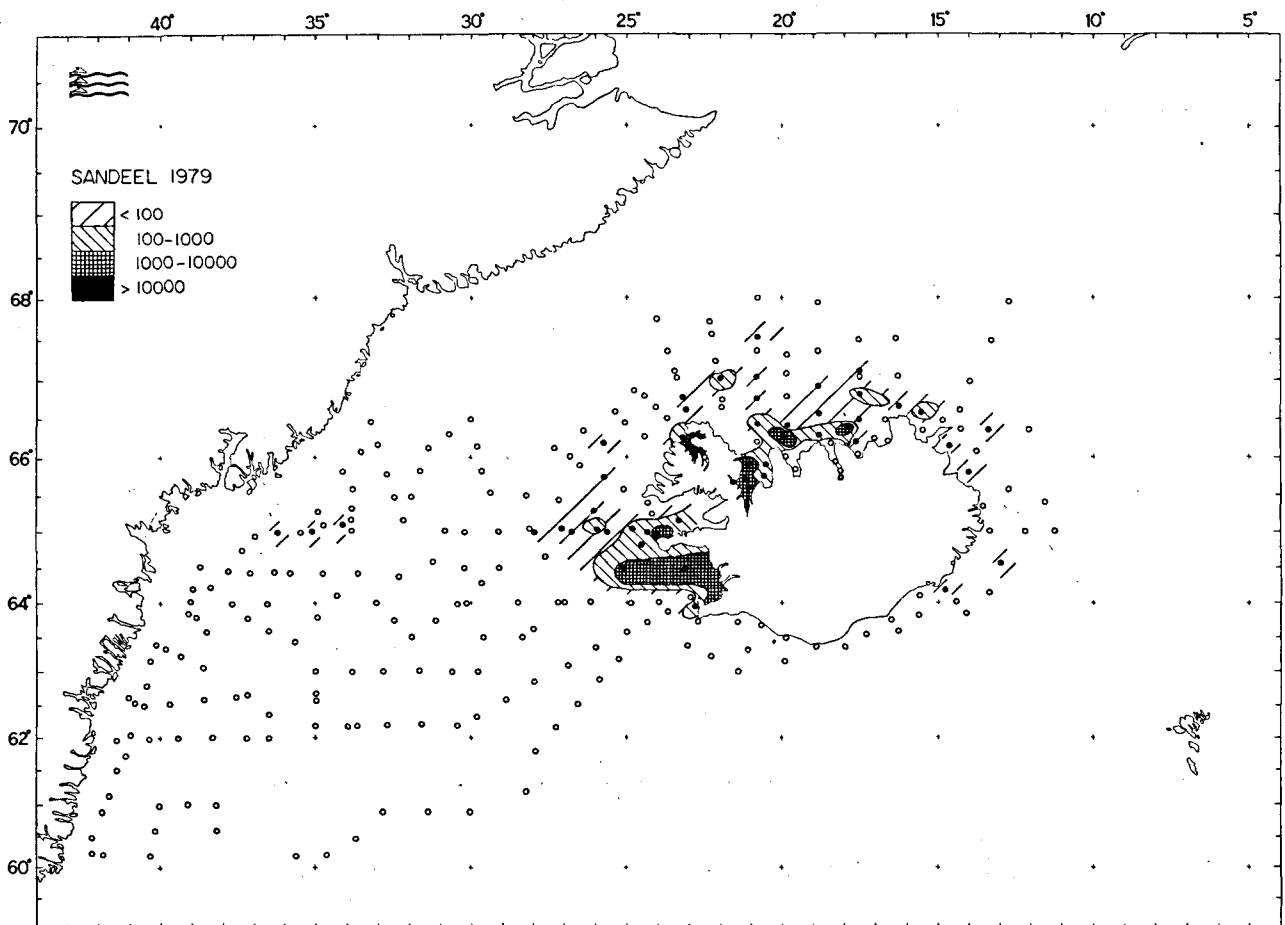


Figure 11. Quantitative distribution of 0-group sandeel 1979.

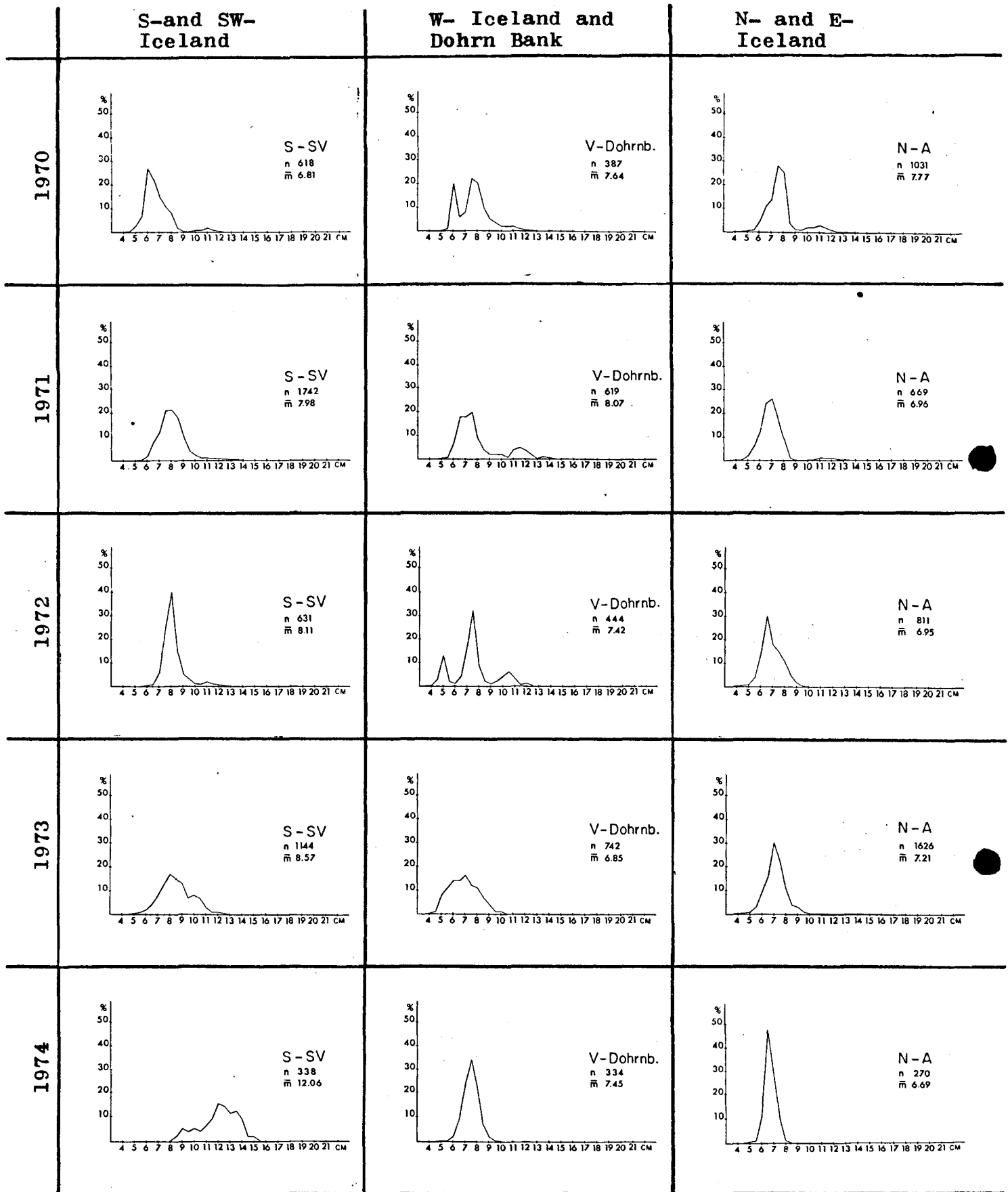


Figure 12. Length distribution by area of 0-group sandeel 1970-1974.

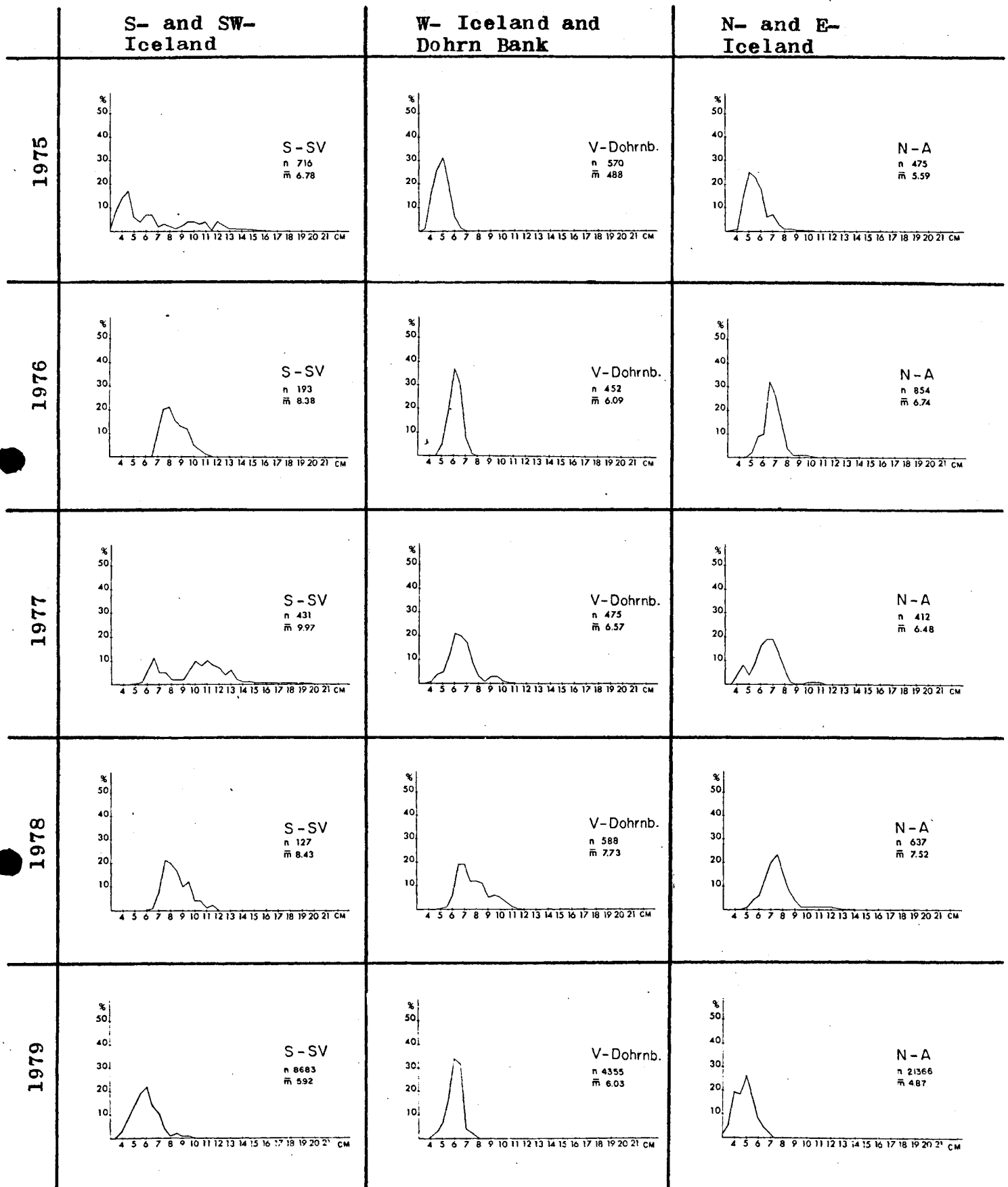


Figure 13. Length distribution by area of 0-group sandeel 1975-1979.