International Council for
the Exploration of the Sea

C.M.1984/H:37
Pelagic fish Committee

NORWEGIAN SPRAT INVESTIGATION IN THE NORTH SEA IN LATER YEARS

by

Svein A. Iversen and Rikard Ljøen
Institute of Marine Research, Bergen, Norway

1. ABSTRACT

The variation in abundance and distribution of sprat during November 1979, January 1980, 1981 and 1982 is studied in relation to environmental factors. The main abundance of sprat was observed in waters with salinity ranging from 34.3‰ to 34.8‰ with a maximum near 34.5‰.

2. INTRODUCTION

During the years 1979-1982 Norwegian sprat surveys were carried out in the North Sea as part of an ICES programme to estimate the stock size acoustically (Aglen and Iversen, 1980, Iversen, Aglen and Bakken, 1981, Johnson, Iversen, Edwards and Baily, 1982). The sprat distribution and hydrographical data from these surveys are further analyzed here.

3. MATERIAL AND METHODS

The data were collected during the Norwegian surveys in November 1979, January 1980, 1981 and 1982. A 38 kHz echo sounder connected to a two channel echo integrator was applied for echointegration. Sampling of recordings was mainly done by pelagic trawling. Nansen bottles and CTD sonde were used to collect the hydrographical data.

The investigation of the physical environment has been based on observations done on the plateau between 58°N and the English Channel. The grid of hydrographical and trawl stations in November 1979 and January 1980 are shown in Aglen and Iversen (1980). In Iversen, Aglen and Bakken (1981), Johnson, Iversen and Edwards (1982) are shown the positions of trawl hauls and survey tracks along which hydrographical stations were taken in January 1981 and 1982.

Average integrated echo intensities were computed each fifth nautical mile steamed, and given as mm integrator deflection per nautical mile referred to 40dB integrator gain. The echo fraction of sprat was calculated from the species and size composition of the trawl catches as described by Aglen and Iversen (1980).

4. HYDROGRAPHY

The physical investigation describes the conditions of the primary water types in the North Atlantic and Channel inflow, both with high salinity as well as the secondary types Northern and Central North Sea water with medium salinity (Laevastu, 1963). A few observations have also been done in Continental and English coastal waters. The different zones referred to are indicated in Fig. 1 and 2. Based on occurrence of zooplankton species indicative of North Atlantic water, Fraser (1965) transferred the main part of the North Atlantic to Northern North Sea water in this area.

During the conserned season the water masses are vertically well mixed and the average temperature and salinity is shown in Figs. 1-4. The main feature of the distribution of the different water masses indicated by salinity lasted the period of observations. The border between Continental Coastal and North Sea waters appears as a sharp lateral gradient. The influence of Channel inflow (high salinity) is significant. Only a minor part of the North Atlantic inflow as defined by Laevastu had water with salinity above 35‰. The temperature in January 1982 was 2-3^0 C lower than in the previous years.

5. SPRAT DISTRIBUTION IN RELATION TO HYDROGRAPHY

The distribution of sprat as mm integrator defleaction per nautiacal mile is shown in Figs. 5-8. In January 1980 (Fig. 6) most of the sprat were observed in Central North Sea water (Fig. 2). The sprat distribution was limited to the east by the Continental Coastal water and to the northwest and south by the North Atlantic and Channel waters respectively. In November 1979 a significant abundance occurred in parts of the North Atlantic inflow (Figs. 1 and 5).

As the abundance of sprat seems to be attached to certain water qualities the sprat echo intensity at each hydrographic station was plotted versus the simultaneously observed salinity (Figs. 9-10).

In January 1980 the main abundance of sprat was observed in the salinity interval 34.3‰.-34.8‰. with a maximum near 34.5‰. (Fig.9). Geographically this maximum coincides with the main axis of the Central North Sea water in the temperature interval 5-6^0 C (Fig. 2).

In November 1979 the sprat was distributed in waters with wider salinity range and with higher average salinity (Fig. 9). The best sprat concentrations occurred on the east and west side of a core with a temperture minimum and a salinity maximum (Figs. 1 and 5).

While in January 1980 the observations covered the shallow area south to the Channel, the November 1979 survey was limited to the south by the 55^{0}N (see Aglen and Iversen, 1980, Figs. 1 and 2). In the last instance therefore observations from only a minor part of the low salinity Central North Sea water is included. In spite of the difference in coverage Figs. 5 and 6 clearly demonstrate that the sprat has moved from North Atlantic and Northern North Sea waters to Central North Sea waters during the winter 1979/80. This is also the main reason for the axis in the deflection versus salinity relation being transferred to a slightly lower salinity during the same period of time (Figs. 9 and 10).

During the November survey the sprat in some areas was distributed rather close to the surface or close to the seabed. This sprat was outside the range of the integrator and thereby the sprat abundance was underestimated in such areas. In January this was evident only in the shallowest areas, less than 25 m bottom depth. In November the sprat was often recorded mixed with plankton. Such mixtures were difficult to separate in a sprat and plankton fraction based on the trawl haul data because both plankton and sprat are not sampled representatively by the trawl. However, this problem was of minor importance in the January surveys. Therefore the integrator readings classified as sprat in January are probably more precise than in November.

In January 1981 and 1982 a much lower abundance of sprat was observed than in January 1980. To compare the 1981 and 1982 echo intensities (Figs. 7,8 and 10) with the values for 1979/80 (Figs. 5,6 and 9), they have to be multiplied by respectively 1.15 and 1.50 due to changes in the acoustical equipment. Fig. 10 demonstrates for 1981 and 1982 a similar tendency as observed in 1979/80 for the sprat to congregate in waters with salinity ranging from 34.3‰ to 34.8‰. However, the effect was not as significant as in 1979/80, probably because hardly any dense consentrations of sprat were observed. According to the VPA given in Anon. (1984) the North Sea sprat stock was much lower in 1982 than in 1979/80. The total stock was reduced from 111×10^9 individuals in January 1980 to 34×10^9 individuals in January 1982.

The sprat distributions dealt with here consist of 0/I group and older sprat. The 0-group in November is classified as I-group in January two months later. The 0/I group has a wider distribution than the older sprat (Aglen and Iversen, 1980, Iversen, Aglen and Bakken, 1981). However, these yearclasses are distributed in the same water masses as older sprat.

6. LITERATURE

ANON. 1984. Industrial Fisheries Working Group. ICES, C.M.1984/Assess:9.

AGLEN, A. and IVERSEN. S.A. 1980. Distribution and abundance of sprat in the North Sea in winter 1979-1980 determined by acoustic methods. ICES, C.M.1981/H:41.

FRASER, J.H. 1965. Zooplankton indicator species in the North Sea. Serical Atlas of the Marine Environment, Folio 8.

IVERSEN, S.A., AGLEN, A. and BAKKEN, E. 1981. Stock size of sprat in the North Sea estimated from an echo integrator survey in January 1981. ICES, C.M.1981/H:42.

JOHNSON, P.O., IVERSEN, S.A. and EDWARDS, J.I. 1982. Report on echo-integrator surveys for sprat undertaken in the North Sea during the 1981-82 winter season. ICES, C.M. 1982/H:13.

LAEVASTU, T. 1963. Surface water types of the North Sea and their characteristics. Serial Atlas of the Marine Environment, Folio 4.

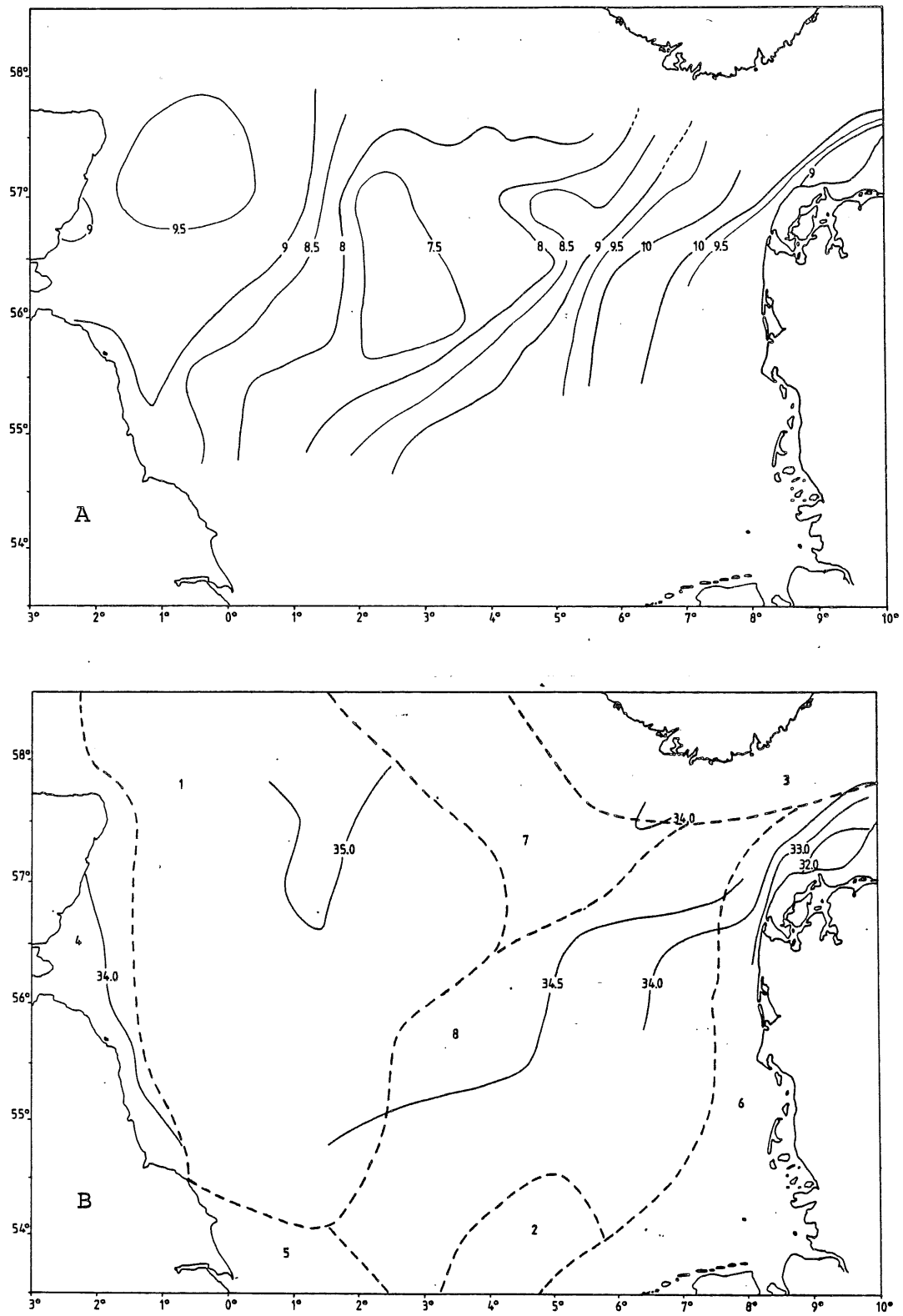

Fig. 1. The average temperature (A) and salinity (B) observed in November 1979. Dotted lines: Winter boundaries of water types. Primary types: 1 North Atlantic water, 2 Channel water, 3 Skaagerrak water. Secondary types 4 and 5 Scottish and English coastal water, 6 Continental coastal water, 7 Northern North Sea water and 8 Central North Sea water (Laevastu, 1963).

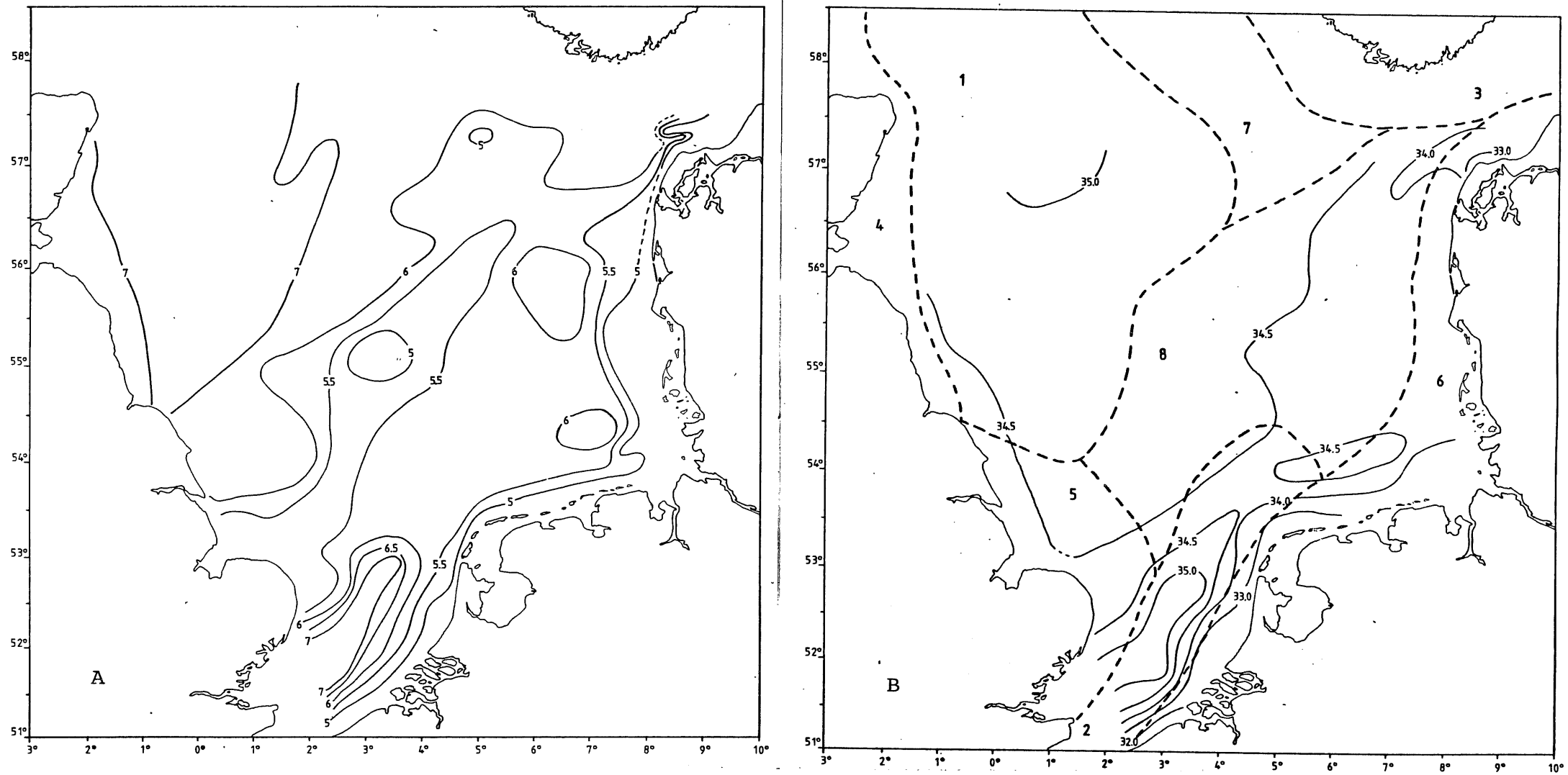

Fig. 2. The average temperature (A) and salinity (B) observed in January 1980. For further legend: see Fig. 1.

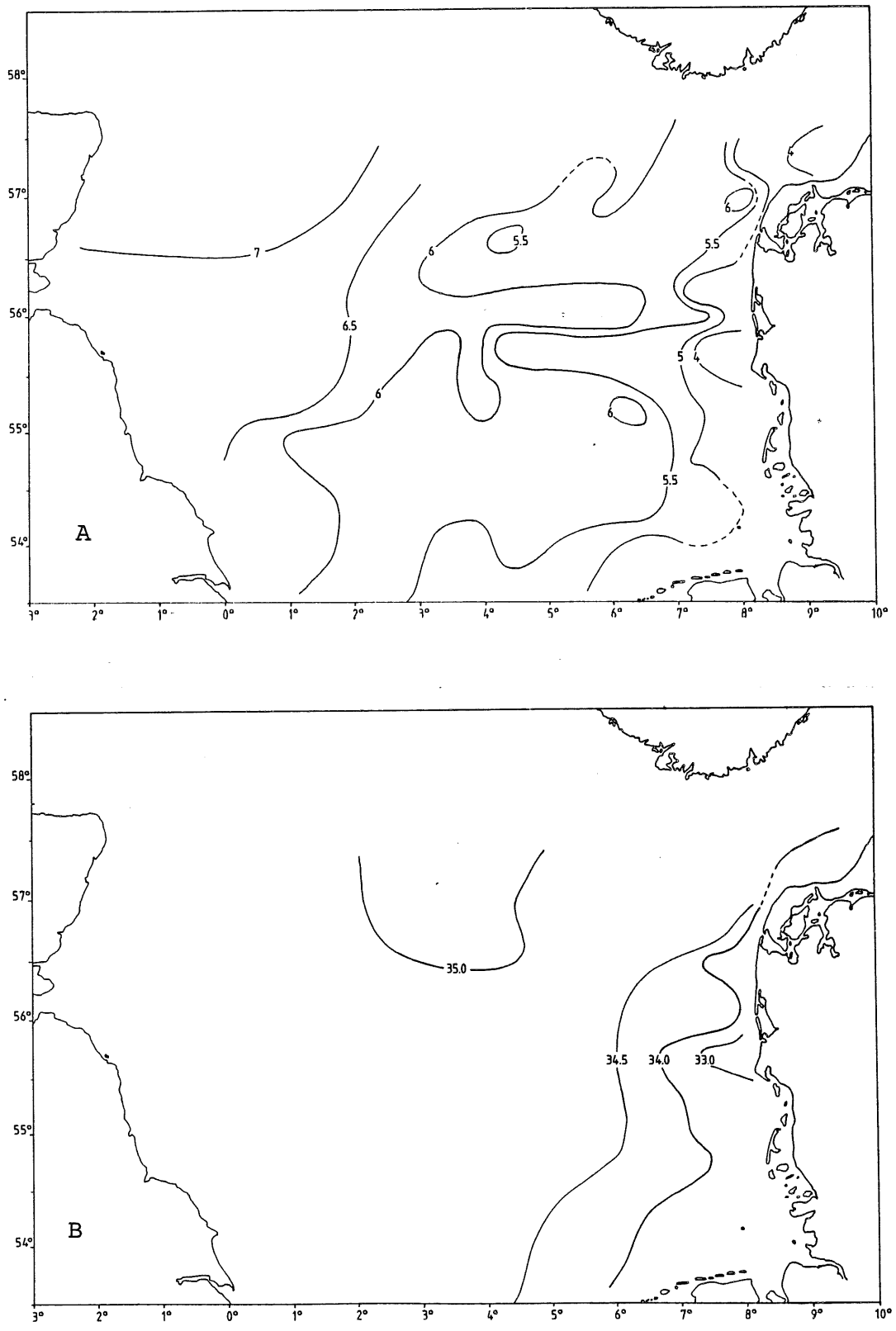

Fig. 3. The average temperature (A) and salinity (B) observed in January 1981.

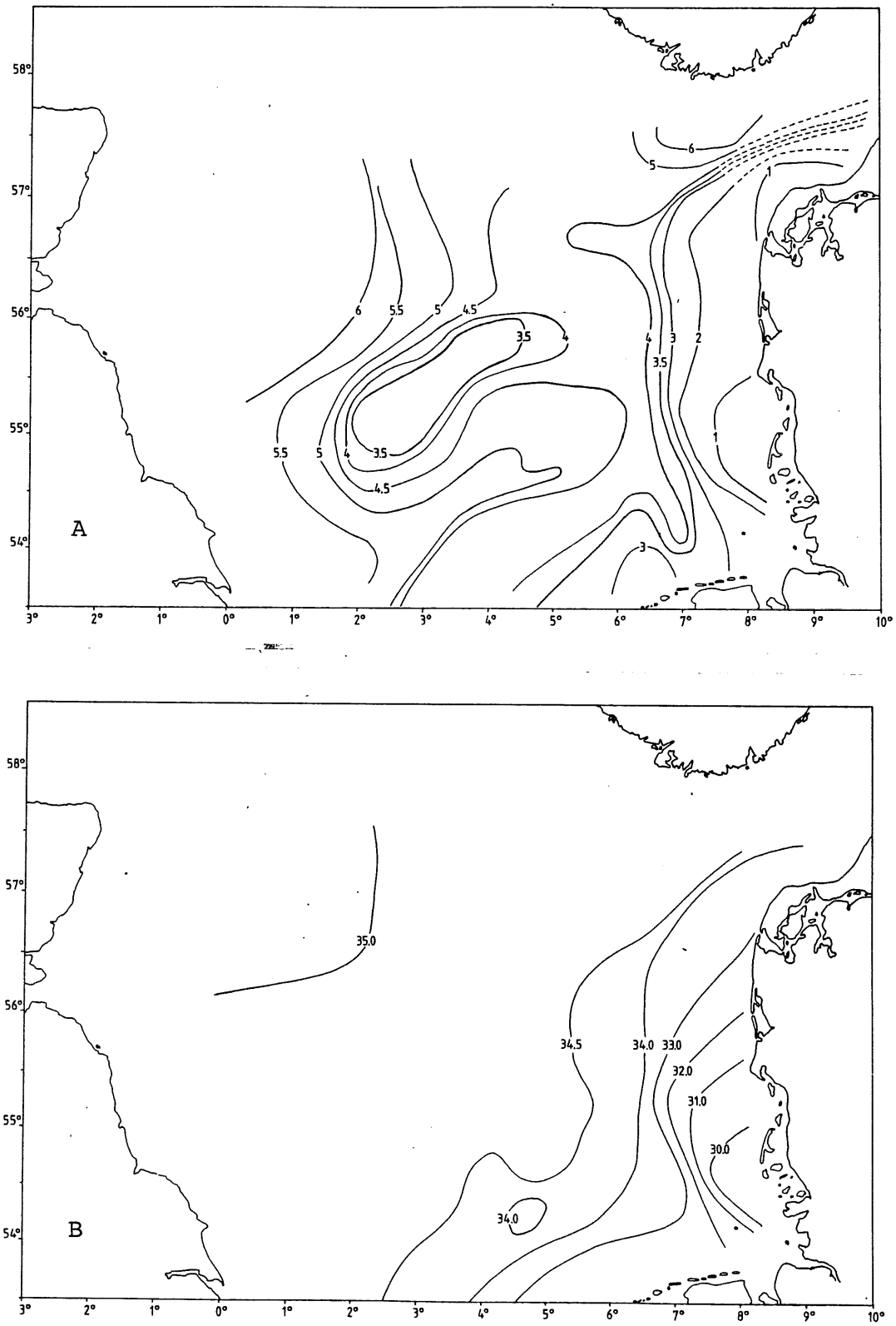

Fig. 4. The average temperature (A) and salinity (B) observed in January 1982.

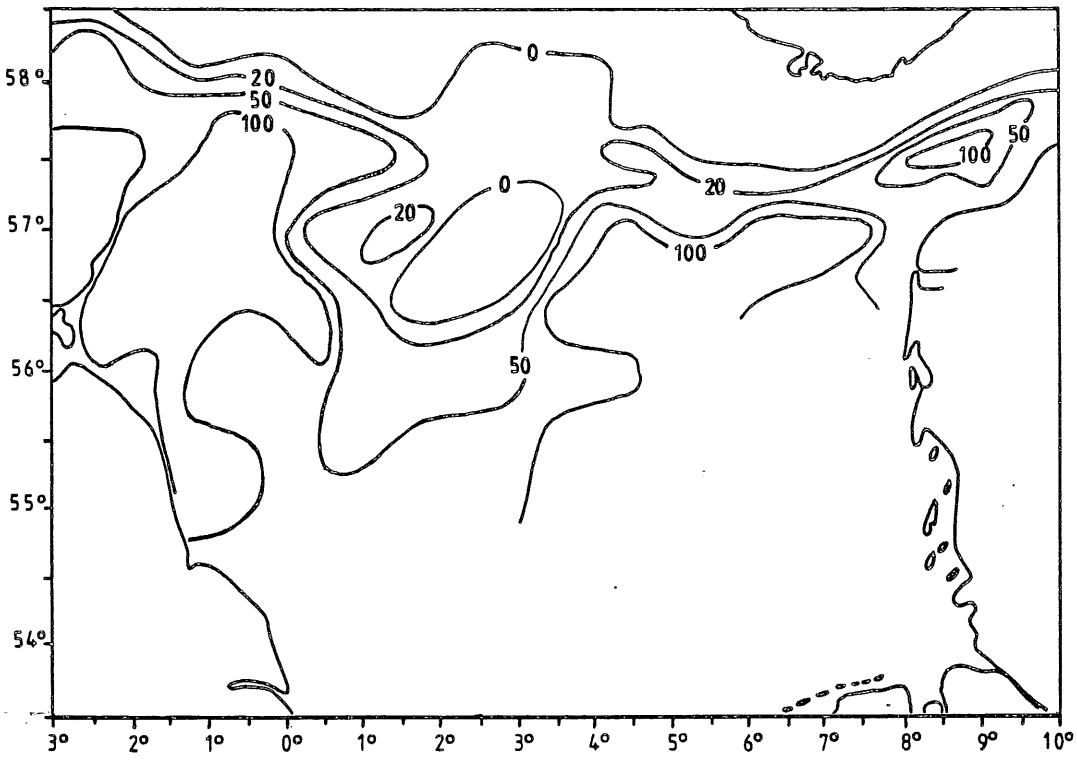

Fig. 5. Distribution of sprat as mm integrator deflection in November 1979.

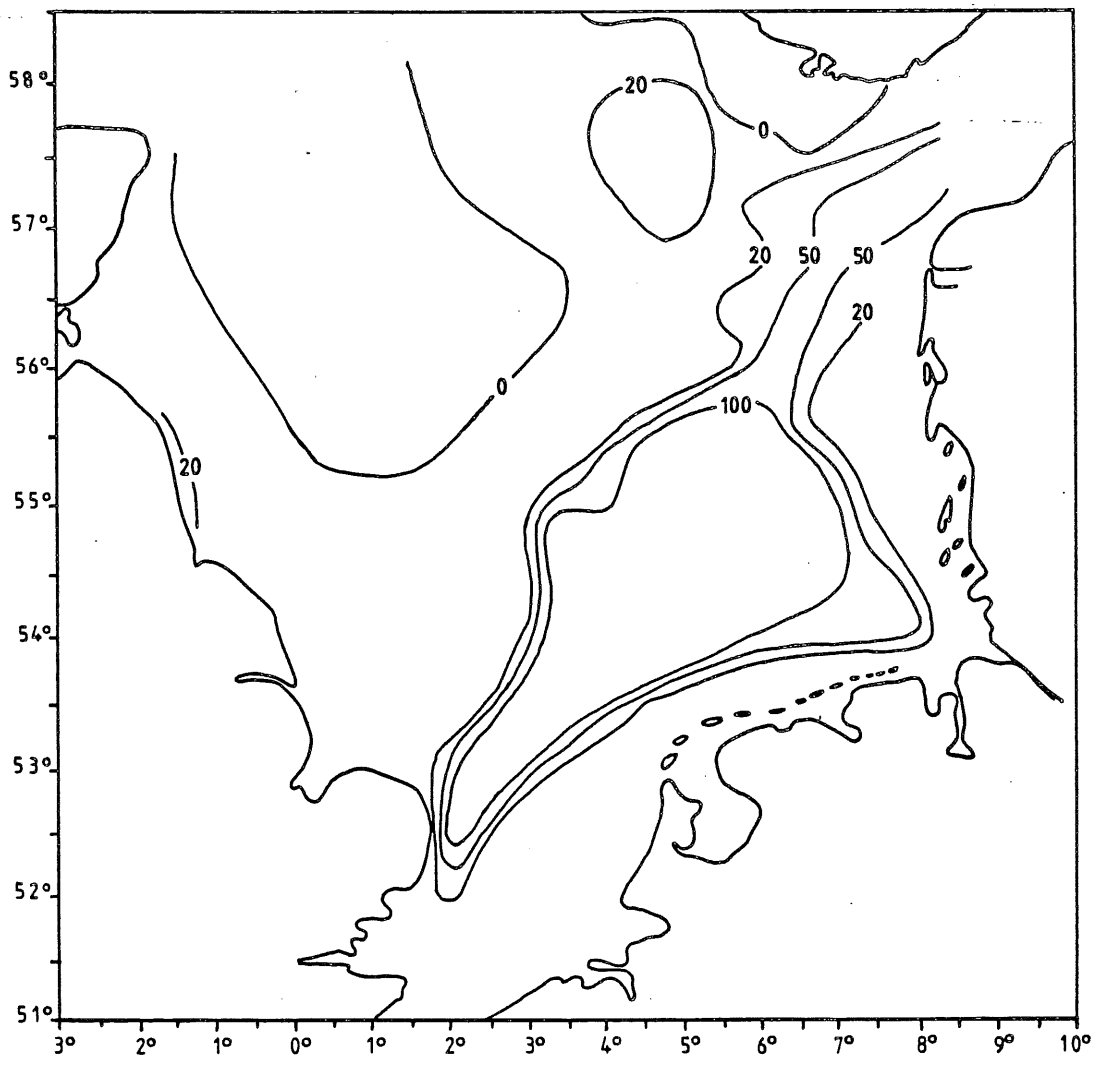

Fig. 6. Distribution of sprat as mm integrator deflection in January 1980.

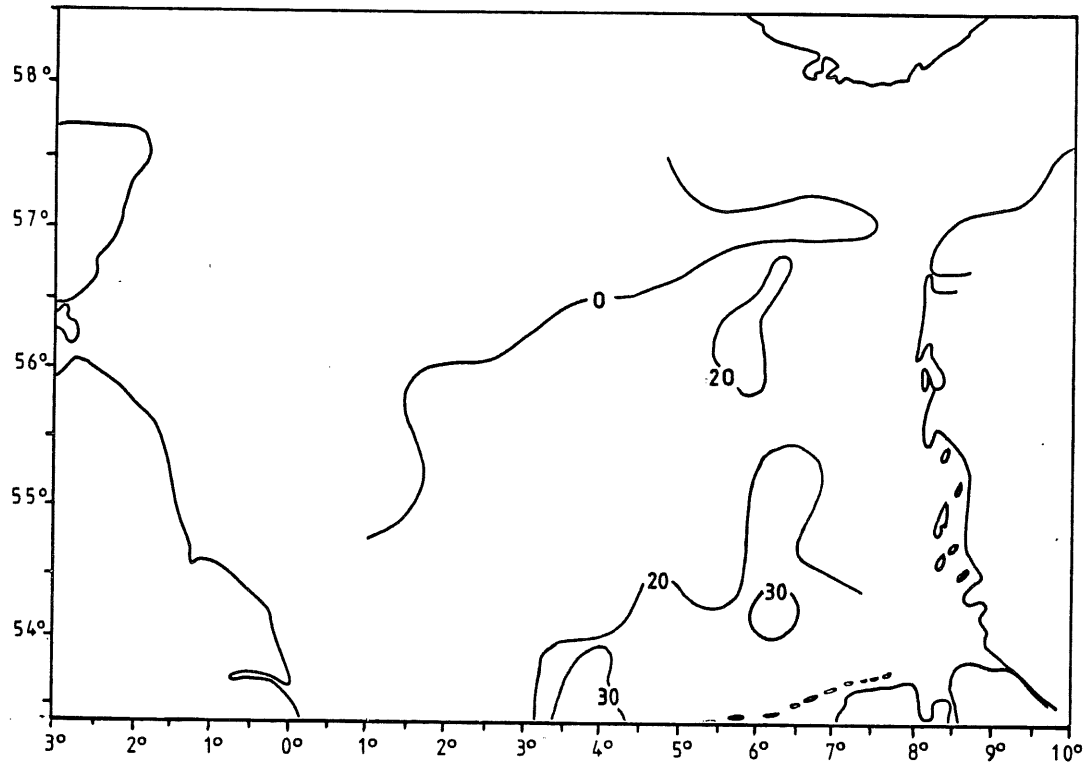

Fig. 7. Distribution of sprat as mm integrator deflection in January 1981.

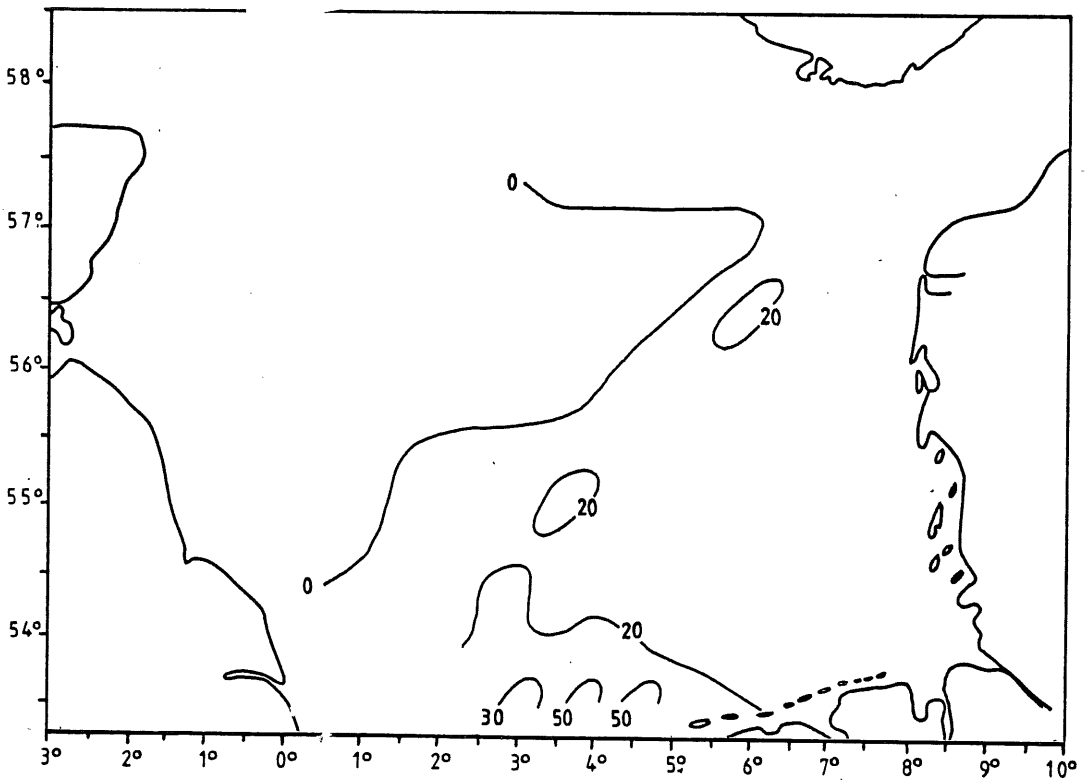

Fig. 8. Distribution of sprat as mm integrator deflection in January 1982.

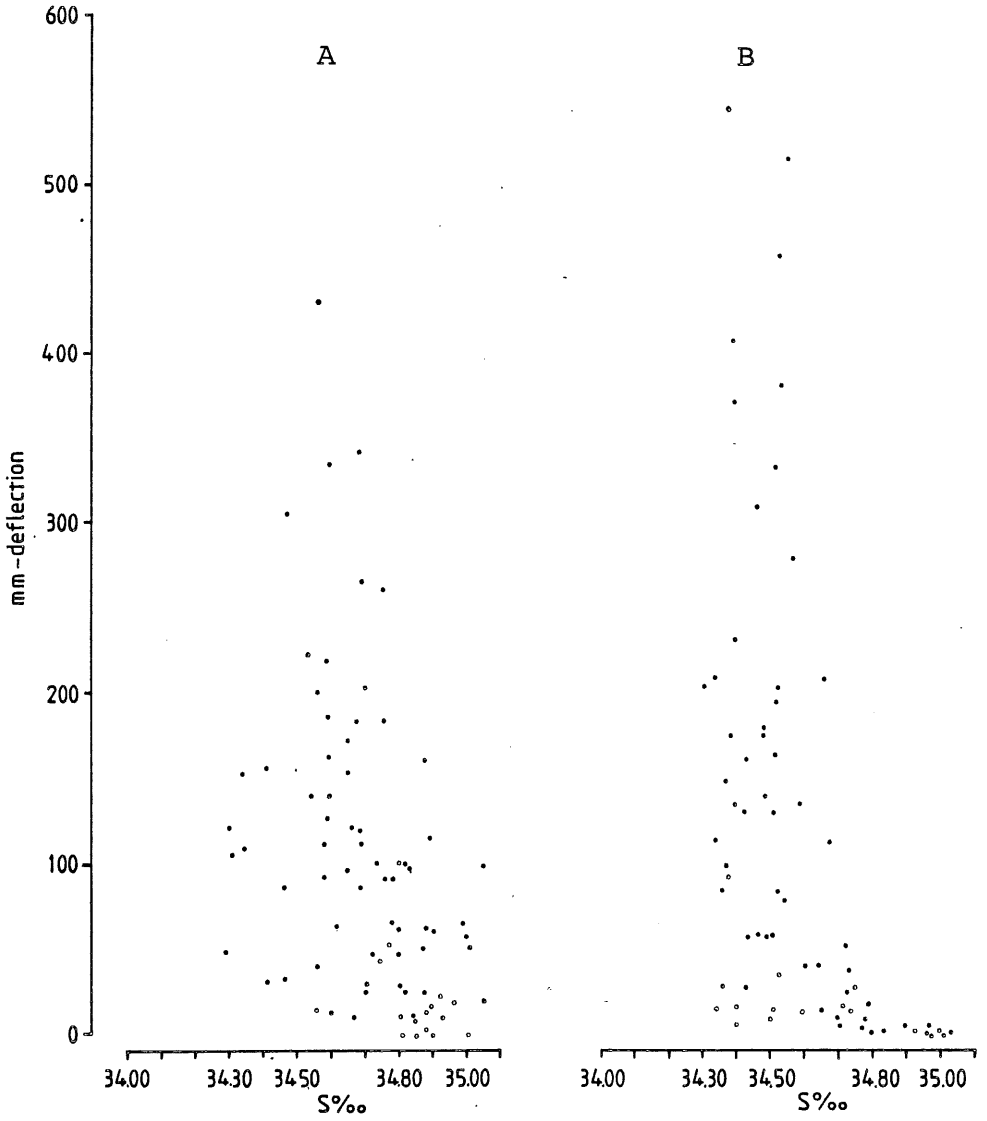

Fig. 9. The mm echo integrator deflection of sprat versus the salinity at each hydrographical station in November 1979 (A) and January 1980 (B).

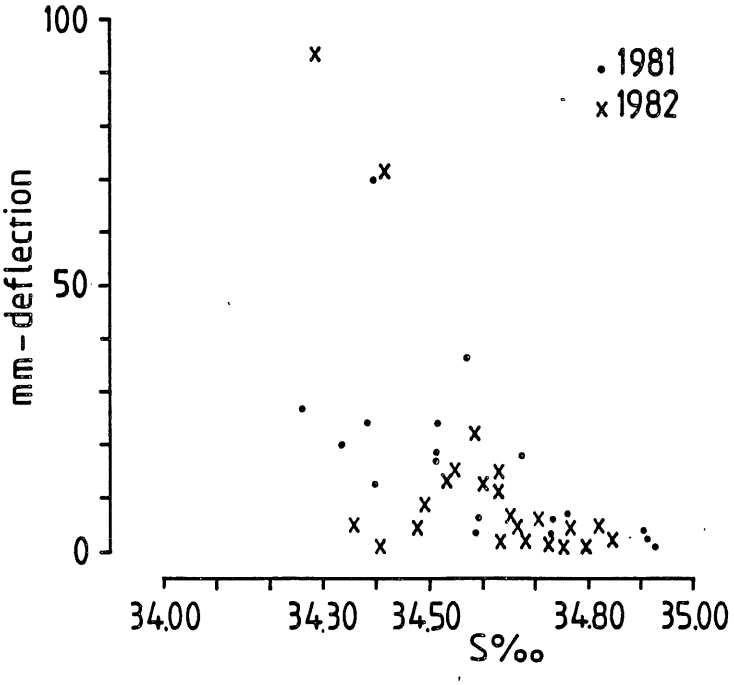

Fig. 10. The mm echo integrator deflection of sprat versus the salinity at each hydrographical station in January 1981 and 1982.