Preliminary Report of the 0-group fish survey in the Barents Sea and adjacent waters in August-September 1968

1. Introduction

This survey was the fourth of a series of surveys in the Barents Sea and adjacent waters to study the distribution and abundance of 0-group fish of the main commercial species: herring, capelin, cod, haddock, redfish, saithe, long rough dab and polar cod.

The vessels taking part and the scientists in charge of each vessel were as follows:

USSR	R/V "Akademik Knipovich,"	Yu. K. Benko
	R/V "Fridtjof Nansen"	A.S. Seliverstov
Norway	R/V "Johan Hjort"	O. Dragesund, T. Monstad
	R/V "G.O. Sars"	L. Midttun, P. Hognestad
England	R/V "Ernest Holt"	B. W. Jones

A preliminary planning meeting was held in Bergen on 27-28 June, then all the vessels met in Murmansk on 23-24 August for a final discussion of the program in the light of the results of a preliminary survey that had been made by "Akademik Knipovich" 6-15 August. The survey proper commenced on 25 August and ended on 9 September.

2. Methods

As in previous years the distribution and density of the pelagic scattering layer ware estimated from the echo-sounder paper record, and were identified by direct sampling by midwater trawl. As in 1967 some of the ships used integration techniques to obtain a more quantitative estimate of the scattering layer. High frequency echo-sounders (100-120 KHz) were also used to obtain better discrimination.

The area covered by the survey was much the same as in previous years. The ships' tracks and the distribution of hydrographic and trawl stations are shown in Fig. 1.

3. Results

3.1. Hydrography

The full hydrographic data are not yet analyzed but the charts have been prepared of the temperature distributions in depths of 4, 50, 100 and 200 meters (Figs. 2, 3, 4 and 5).

3.2. The distribution and abundance of 0-group fish

Fig. 6 shows the variation in total density of the scattering layer, which is composed of a variety of plankton organisms as well as 0-group fish. Echo density was determined by examination of the paper echo-sounder record and expressed in terms of the paper scale 0-4. In some areas scattering layers or shoals of fish older than 0-group were recorded. Results from the integrating equipment are not yet analysed.

The general distribution of 0-group fish. was closely related to the water temperature. The majority of species were distributed in the warmer water in the central part of the Barents

Sea and extending up along the west coast of Spitsbergen. Polar cod was recorded in the colder water in the eastern part of the survey area, but also west of Spitsbergen.

3.2.1. Herring

0-group herring were again very scarce this year being almost entirely absent over the whole area. They were even less abundant than last year. This is the fourth successive year in which very low abundance of herring has been recorded in the joint surveys.

3.2.2. Cod

0-group cod were distributed over an area in the southern central part of the Barents Sea with a small isolated patch west of Spitsbergen (Fig. 7). The length composition is shown. in Fig. 13 Once again the abundance of cod recorded was low which suggests that the 1968 year-class will be another weak one. As was the case last year there was again a virtual absence of cod on the Svalbard shelf.

3.2.3. Haddock and saithe

Both these species were found to be of very low abundance. The general distribution of haddock was similar to previous years (Fig. 8), but again the indications are that the 1968 year-class is a poor one.

Saithe also were found only rarely and no shoals which could be identified as saithe were located. The low abundance of saithe this year can be constructed with the widespread distribution and high of abundance of the previous year when a considerable number of dense shoals were identified.

3.2.4. Redfish

This year redfish were distributed over a more restricted area than in 1967, being limited to an area off the northern coast of Norway (Fig.9) with isolated patches to the west of Bear Island and West of Spitsbergen. This species was also lower in abundance than in previous years. The average size of redfish was also lower than in previous years (length range 15-45 mm).

3.2.5. Capelin

In contrast to most other fish species 0-group capelin were abundant and widely distributed over the Barents Sea (Fig.10) with a tongue extending almost to Novaya Zemlya coinciding with the eastward extension of the warmer water. Capelin were also found in an area over the west Spitsbergen shelf. The indications are that the 1968 year-class is a good one.

3.2.6. Long rough dab.

Long rough dab were distributed in small numbers over the most of the area (Fig. 11). This year their distribution extended up to the west coast of Spitsbergen. The general impression is that this species was much less abundant than in previous years.

3.2.7. Polar cod

This species was again found in the colder water at the eastern end of fhe Barents Sea (Fig.12) with a second area of distribution to the west of Spitsbergen. The general abundance of this species appeared to be similar to last year.

3.2.8. Greenland halibut

0-group Greenland halibut were recorded this year sometimes in quite large numbers on the west coast of Spitsbergen. This is the first year that Greenland halibut has been recorded in the joint surveys. The lenth distribution is shown in Fig. 13.

3.2.9. Other species

0-group of several other species ware recorded during the survey. Cottidae, Agonus and Liparis occurred frequently and other species included Anarhichas, Triglops, Myctophum.

3.2.10. Adult and juvenile pelagic fish

Adult blue whiting were, as last year, recorded over a wide area along the eastern boundary of the Norwegian Sea, from Spitsbergen to the Norwegian coast outside the shelf. The conclusion last year, that the stock size must be quite considerable, was confirmed this year.

Adult polar cod was observed with approximately the same abundance is the same area as last year, namely from east of Bear Island and Hope Island, over the northern part of the Central Bank to Novaya Zemlya.

Fat herring was not observed during the surveys this year. Mature herring were at the time of the surveys concentrated within the area from 72° N-75 °N and 6° E- 10° E.

Adult capelin were found to have a wider distribution than in previous years. The greatest concentrations were found in the area around Bear Island and Hope Island and up to the south western part of West-Spitsbergen. The concentrations consisted mainly of I-group fish, but older age-groups (mainly II-group) were also recorded. I-group capelin was also distributed in the central and south-eastern parts of the Barents Sea.

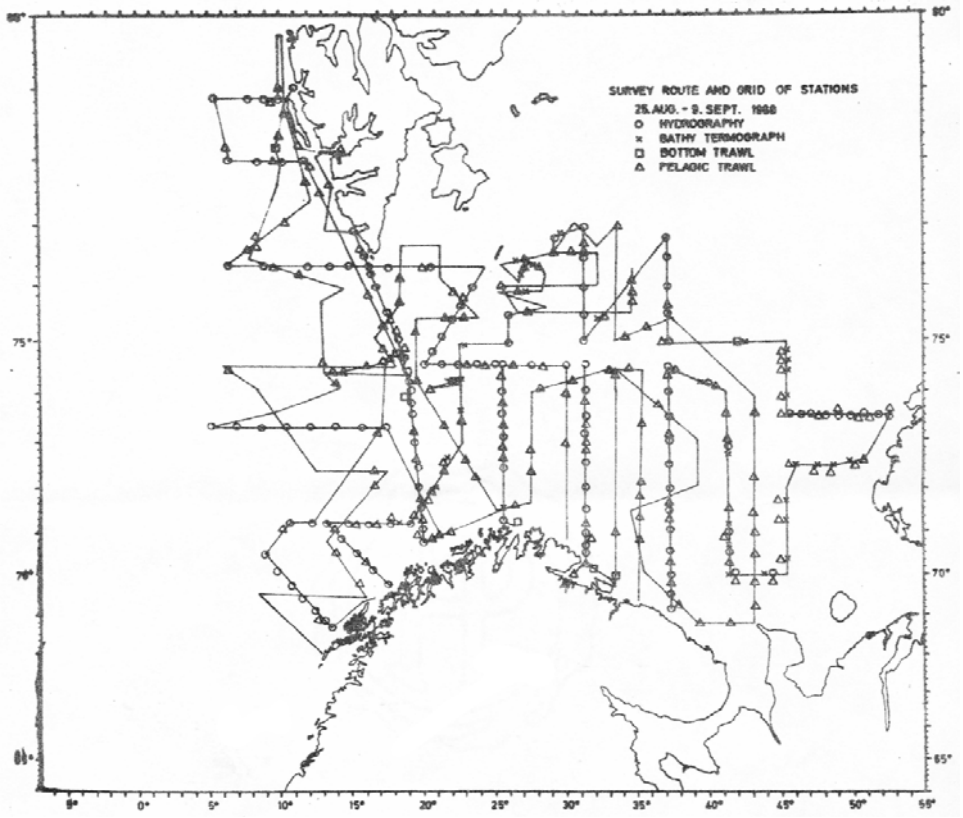

Fig. 1. Survey routes and grid of stations

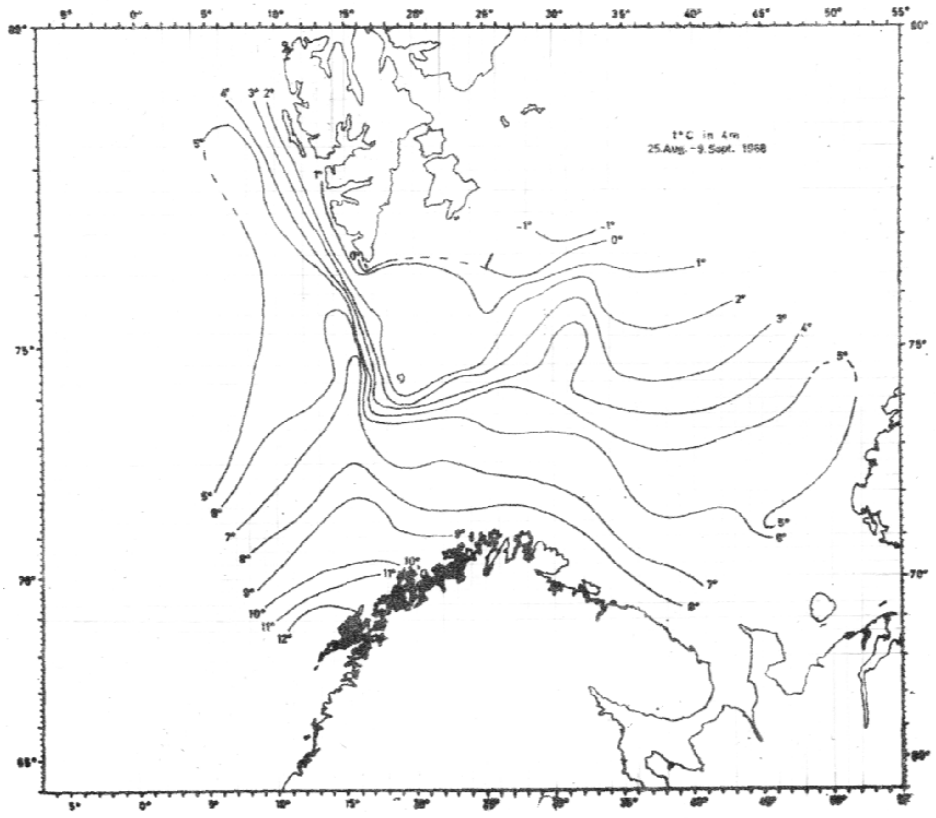

Fig. 2. Isotherms at 4 m

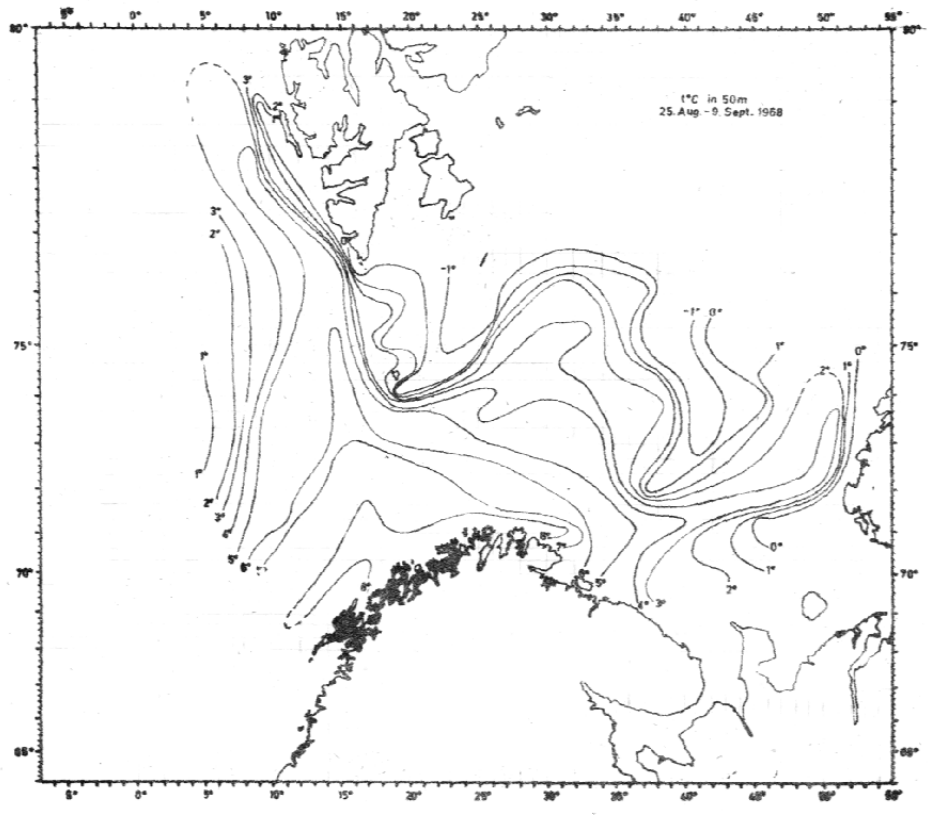

Fig. 3. Isotherms at 50 m

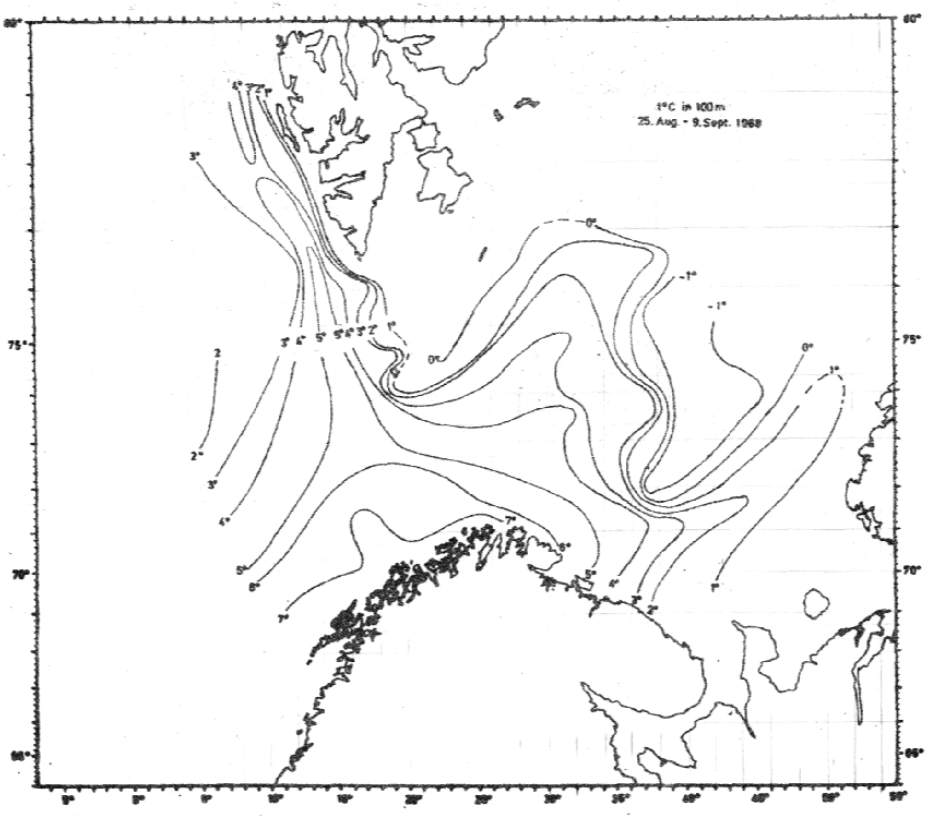

Fig. 4. Isotherms at 100 m

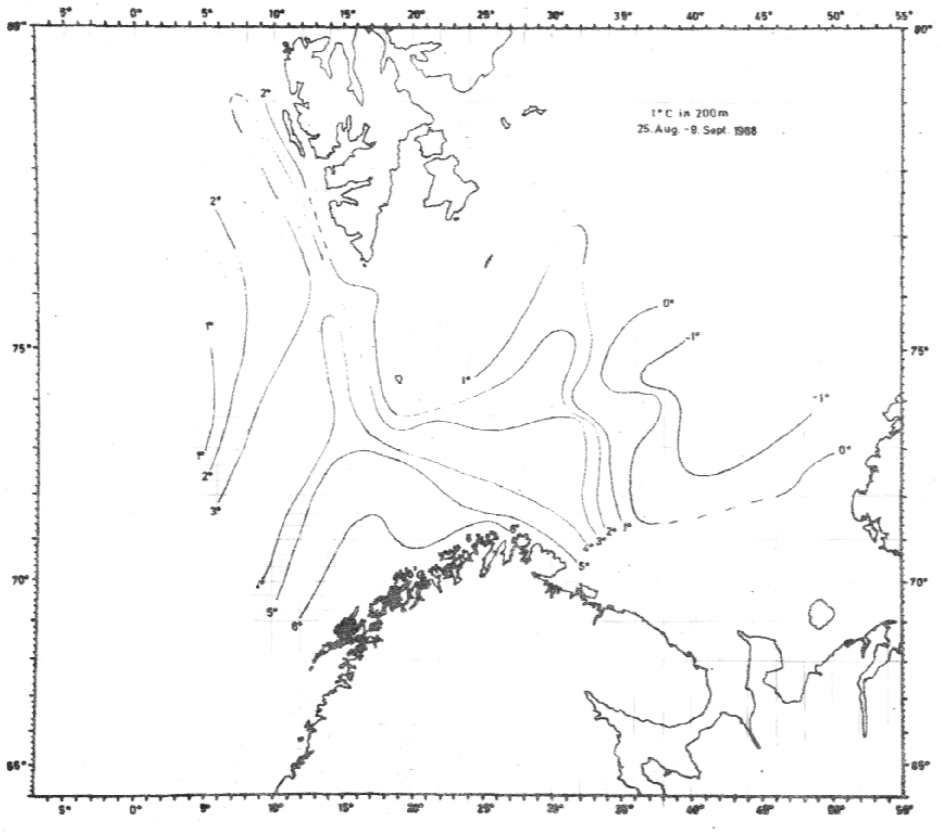

Fig. 5. Isotherms at 200 m

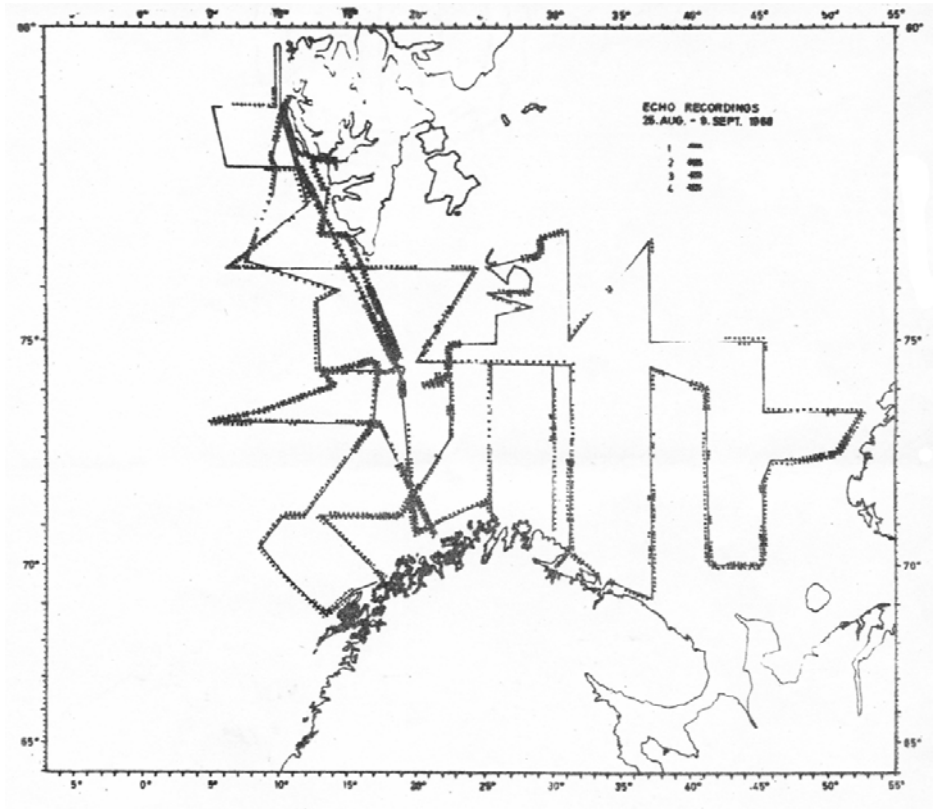

Fig. 6. Courses and echo recordings

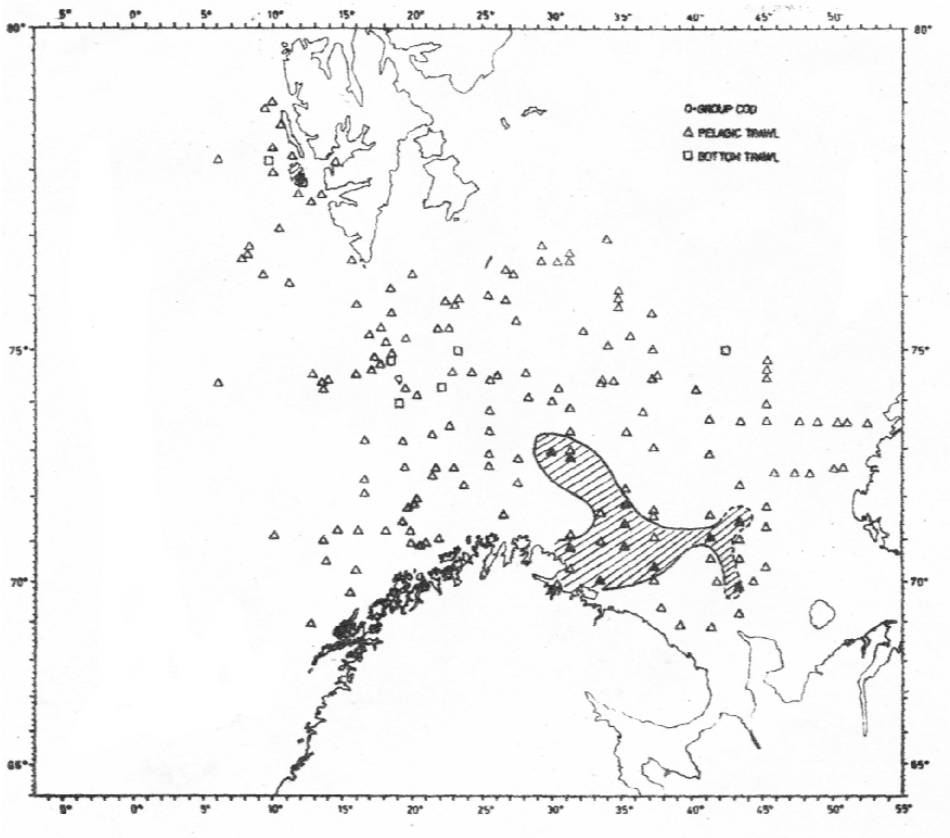

Fig. 7. Distribution of 0-group cod

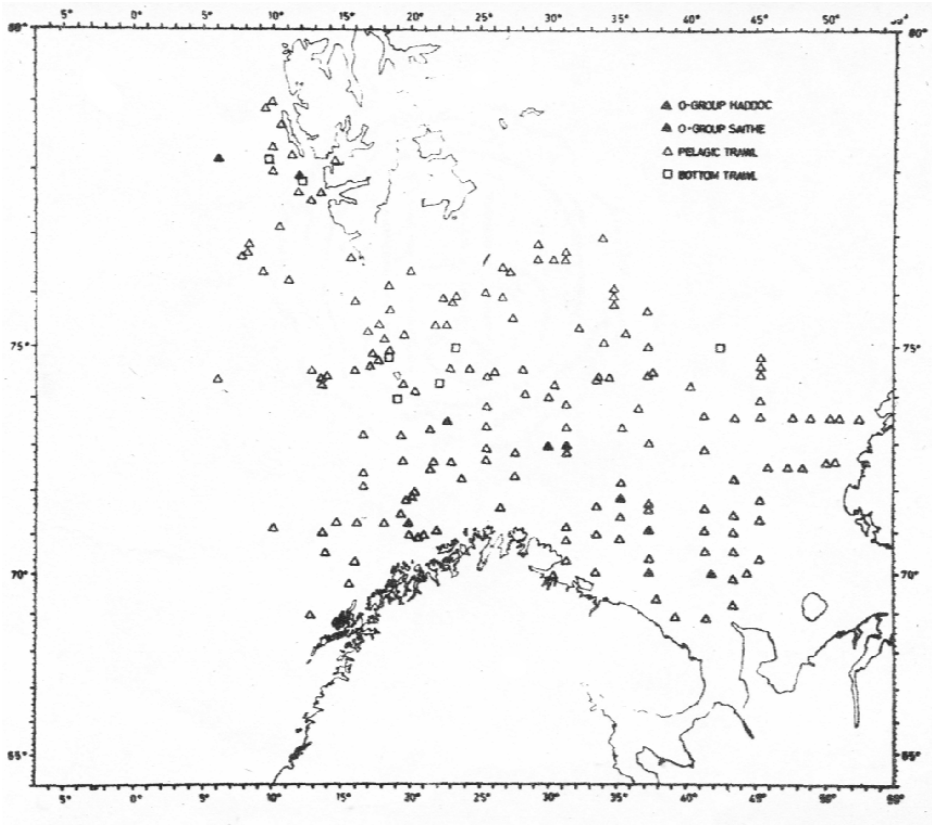

Fig. 8. Distribution of 0-group haddock and saithe

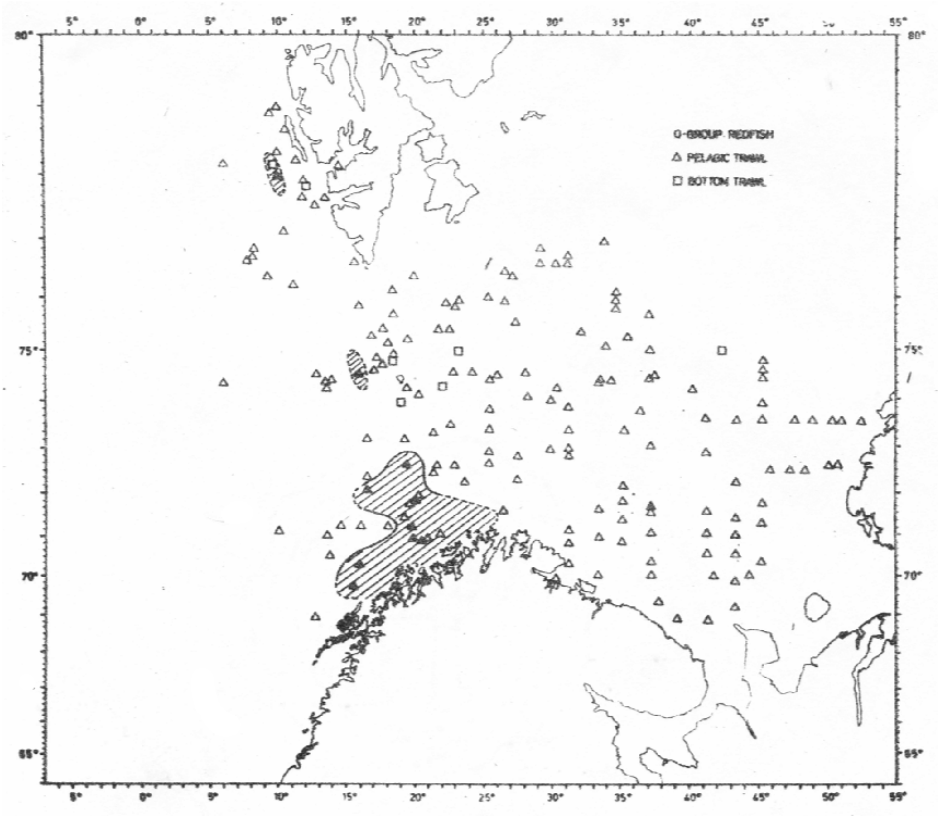

Fig. 9. Distribution of 0-group redfish

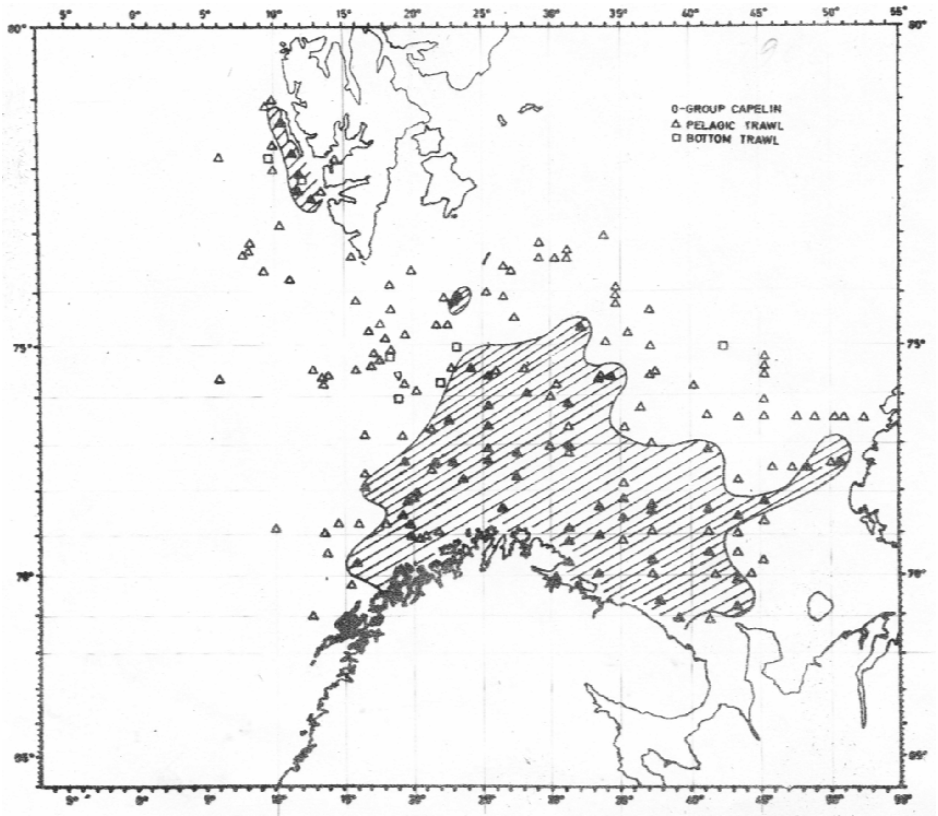

Fig. 10. Distribution of 0-group capelin

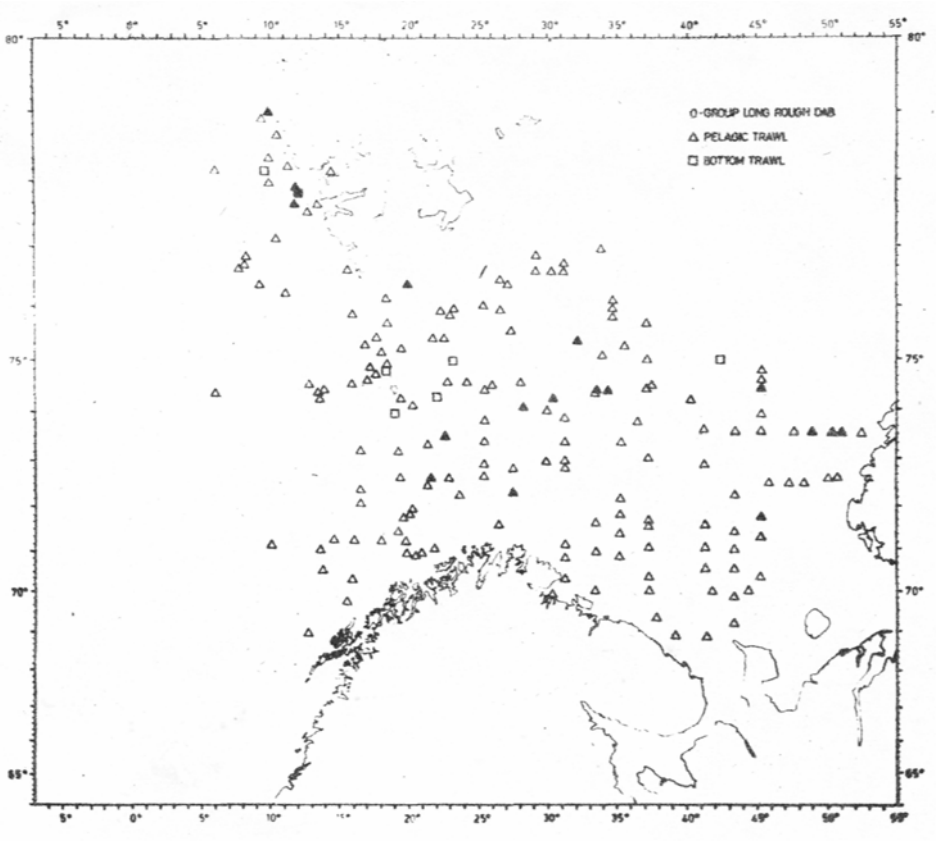

Fig. 11. Distribution of 0-group long rough dab

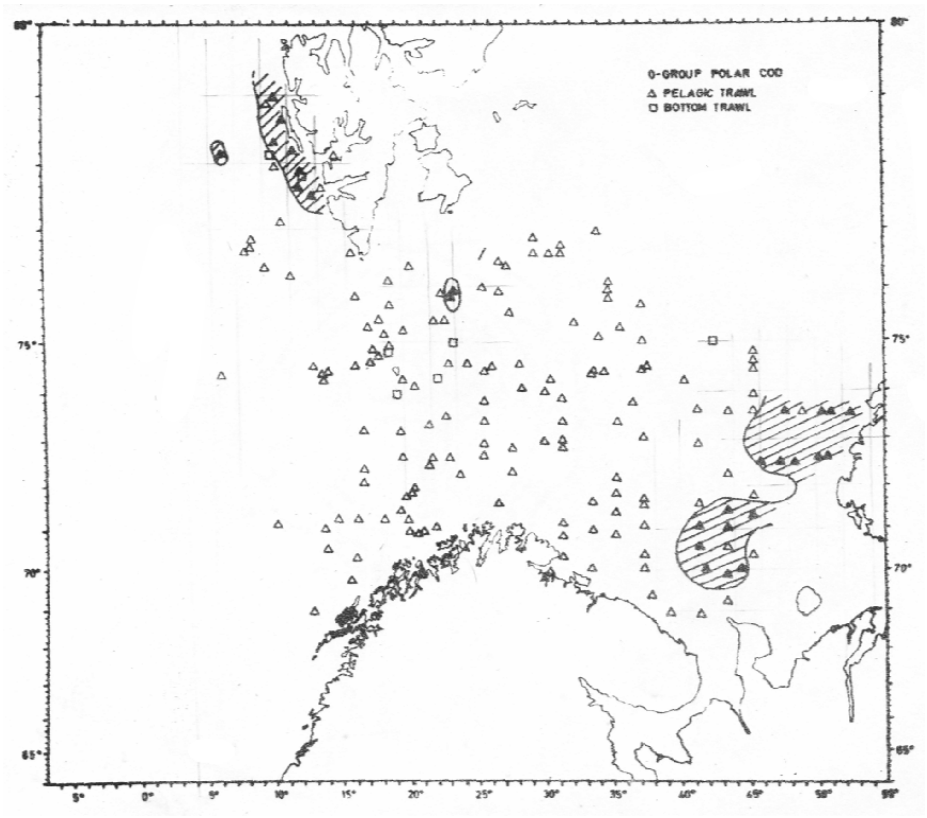

Fig. 12. Distribution of 0-group polar cod

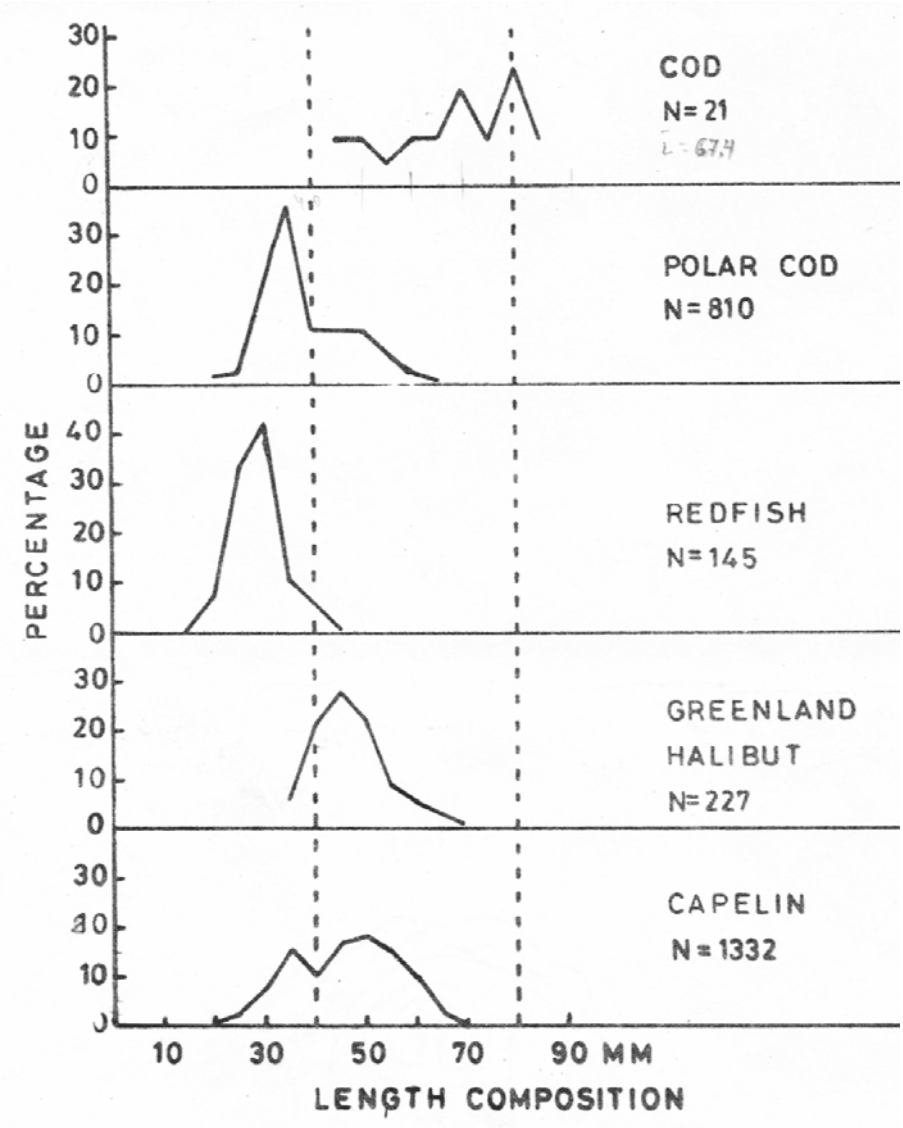

Fig. 13. Length composition

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Pelagic Fish (Northern) Commette

Report of the 0-group fish survey in the Barents Sea and adjacent waters in August-September 1969

1.Introduction

This was the fifth of a series of surveys in the Barents Sea and adjacent waters to study the abundance and geographical distribution of the 0-group fish of the main species of commercial importance: cod, haddock, herring, capelin, redfish, coalfish, polar cod and some others.

The five vessels taking part and the scientists in charge of each ship were as follows:

U.S.S.R.	R/V "Akademik Knipovich"	Yu.K. Benko
	R/V "Fridtjof Nansen"	A.S. Seliverstov
Norway	R/V "Johan Hjort"	L. Midttun, B. Myrseth
	R/V "G.O. Sars"	P.T. Hognestad, T. Monstad
England	R/V "Ernest Holt"	B.W. Jones

Preliminary plans for the survey were made at a meeting in Bergen in May 1969, and final arrangements for the coordination of the survey were made in Murmansk 22-24 August before the survey commenced. The survey took place between 24 August and 7 September, and was followed by a meeting in Tromsø 8-12 September where exchange of data and analysis of the results took place.

2. Methods

The survey method was much the same as in previous years. The distribution and density of the pelagic scattering layer were estimated from the echo-sounder paper record, and the organisms forming the scattering layer were identified from samples taken with small meshed pelagic trawls. The area surveyed is shown in Figure 1, where the ships' tracks and trawl and hydrographic stations are also indicated.

3. Results

3.1. Hydrography

The first half of 1069 was characterized by low temperature in the Barents Sea. In May for example, the anomaly of average temperature of the 0-200 meter layer in the section North Cape - Bear Island was - 0.8° and in the section along the Kola meridian it was -0.9°.

In July and August 1969 the average temperature of the section along North Cape - Bear Island was 0.5° above normal in the 0-50 m layer and about normal in the 0-200 m layer, indicating an intensification of heat transport by the North Cape Current during; the period of

investigation. In early September 1969 the temperature in the 0-200 m layer of this section was higher than in 1965-1968 (Table 1):

Table 1. Mean temperature in the section North Cape-Bear Island in the beginning of September 1965-1969 in 0-200 m layer.

Year	1965	1966	1967	1968	1969
T °C	5.1	5.5	5.6	5.4	6.0

In the eastern Barents Sea great negative anomalies of water temperature were observed during the summer. In July, August and early September the anomaly along the Kola meridian in 0-200 m layer was close to -1°. Comparing all the years 1965-1969, only in 1966 was the temperature in 0-200 m layer lower than in 1969 (Table 2).

Table 2. Mean temperature in section along Kola Meridian in 0-200 m layer in end of August 1965-1969.

Year	1965	1966	1967	1968	1969
T °C	4.45	3.6	4.9	4.4	4.0

In the beginning of September 1969 the eastern branch of the Norwegian Current in the section along 74°30' N was characterized by higher temperatures in the 0—50 m layer than in the previous years (1965—1968). Thus, the temperature this year was 1.6° higher than in 1968. In the central branch the temperature was 1.3° higher in the 0-50 m layer compared to 1968.

The temperature in 0-200 m of both the eastern and central branches were higher than in 1965, 1966 and 1968, but very similar to the temperatures observed in 1967.

We may therefore conclude that along with a high heat content of the water masses in the western Barents Sea and the northeastern Norwegian Sea, water masses in the eastern Barents Sea in the period of our investigations were characterized with low temperatures (Figs. 2-5).

3.2. The distribution and abundance of 0-group fish

The variation in total density of the scattering layer is shown in Figure 6. As in previous years (Dragesund, 1970) the figure also includes traces from organisms other than 0-group fish, especially from certain invertebrate species of Medusae, Euphauciacea and Amphipoda which contribute to the uppermost scattering layers. However, since the target strengths of those scatterers are not sufficiently known, their contribution to the total echo-abundance is also difficult to estimate. The illustration also includes the contribution from fish of older age groups when occurring in the mid water above 100 metres.

As in previous years the variation in echo-abundance has been expressed on a subjective scale from 0-4. In order to improve the quantitative estimates of the total echo-abundance, an echo-integrator technique has been applied (Dragesund and Olsen, 1965).

The results show that the main concentration of the scattering layer was confined to the central and western part of the Barents Sea between the meridians 18° E and 28° E. Subsidary concentrations were found in eastern areas, i.e. off the east Finmarken-Murman coast and near the Novaya Zemlya.

On the Svalbard shelf several dense concentrations were observed within limited areas.

In the westernmost part of the area surveyed the recordings are from adult blue whiting.

In contrast to previous years 0-group fish this year were very abundant in Spitsbergen waters. In addition to the 0-group fish species discussed below, other less important species were also recorded, such as catfish, Leptagonus, Agonus, Cottidae etc.

3.2.1. Herring

0-group herring were almost entirely absent in the investigated area except for a few specimens distributed in a restricted area off the coast of North Norway between Lofoten and Sørøy. No 0-group herring were observed in the fjords of North Norway (Fig. 7). This is the fifth successive year in which very low abundance of herring has been recorded in the joint surveys.

3.2.2. Cod

0-group cod were distributed over a wide area in the central Barents Sea extending from the Norwegian coast north to 76° N and from Bear Island east to 40° E. The distribution also extended northwestwards from Bear Island along the western coast of Spitsbergen as far north as the northern limit of the survey at the polar ice edge (Fig. 8). The area of distribution was much more extensive than that recorded in 1968, particularly in the extension this year over the Svalbard shelf. The abundance of cod this year was also much greater than in 1968 or, in fact, than in any of the previous international 0-group fish surveys, and the indications are that the 1969 year-class is the most abundant in the North-East Arctic since the very strong year classes of 1963 and 1964. However, the abundance of the 1969 year-class may not be as great as those year classes.

3.2.3. Haddock

As with the cod the 0-group haddock were distributed over a wide area in the central Barents Sea, with extensions northwestwards from Bear Island along the coast of Spitsbergen as far north as the northern limit of the survey and also eastwards along the Murman coast (Fig. 9). The abundance of 0-group haddock was much greater than in 1968 and the 1969 year-class is easily the most abundant recorded during the five year period covered by the joint surveys. One notable feature of the 0-group haddock this year was the large length range recorded (27-145 mm). The length composition of the trawl catches is shown in Figure 15.

3.2.4. Redfish

Compared with 1968 the 0-group redfish this year had a wider distribution. The redfish were observed between the meridians 13° E and 32° E and from the Norwegian coast to 75° N with a narrow tongue eastwards along the Murman coast to 39 ° (Fig. 10). Further redfish were distributed northwards from Bear Island and along the coast of Spitsbergen and may be beyond the limit of the investigated area ended at approximately 80° N. The highest abundance was found between the Norwegian coast and 74°20' N and between 15° E and 26° E. The total abundance was much higher than in 1968 and the 1969 year-class may be

considered as a very good one. The average size of redfish was greater than in 1958 (length range 15-60 mm).

3.2.5. Capelin

The young capelin this year was distributed in much the same manner as the two previous years, but the distribution pattern had a few characteristic features. An area stretching from North Cape to 74°30' N and between 25° E and 31° E was completely free of 0-group capelin. As in 1967 and 1968 the young capelin this year was recorded close to the Murman coast, but near Novaya Zemlya there was only a local patch. Capelin were found around Bear Island as well as along the West Spitsbergen current occupying a more extensive area than in the previous years and reaching 80° N. This year the highest concentrations of capelin were recorded to the east of North Cape. On the whole concentrations of 0-group capelin were a little less dense than in 1968 but occupied a greater area, so we may conclude that the 1969 year-class of capelin is as rich as that of 1968 (Fig. 11).

3.2.6. Long rough dab

0-group long rough dab were mainly distributed from Bear Island northwards along West Spitsbergen as far north as the limit of the investigated area. The species this year was low in abundance (Fig. 12). The length range was 20-45 mm.

3.2.7. Polar cod

As previously this species was found in the northeastern part of the Barents Sea, and this year 0-group polar cod were also distributed in a second area stretching from Hope Island and along West Spitsbergen up to the northern limit of the investigated area (Fig. 13). The strength of the 1969 year-class seemed to be very good, and the distribution was very similar to that observed in 1966.

3.2.8. Mackerel

This year 0-group mackerel (length range 55-100 mm) were observed in the investigated area for the first time as far north as 72°30' N. The species was distributed in an area off North Norway (Fig. 14).

3.2.9. Other species

0-group fish of several other species were observed during the survey. Most frequently occurred Cottidae, Liparis, Leptagonits and Agonus. Further a few Anarhichas and Ammodytes were observed, besides a few Greenland Halibut off West Spitsbergen. Only one coalfish was taken during this year’s survey.

4. Concluding remarks

Again a numerous year-class of redfish and capelin has been produced. This is the fifth successive years of rich year classes of capelin and the third of redfish since 1965.

Concerning cod and haddock the 1969 year-class is by far the most numerous since the joint surveys started in 1965. But the cod seems to be less abundant than the 1963 year-class which was observed at the 0-group stage by Dragesund and Olsen (1965).

Polar cod is obviously one of the best year-classes observed since 1965. On the other hand this year-class of herring was very poor, being the fifth successive year class with very low abundance.

Coalfish was almost absent this year and the long rough dab was concentrated in a much smaller area than in previous years, indicating a poor year-class.

A striking feature this year was the location of mackerel in significant numbers off the coast of Norway as far north as 72°30' N.

The distribution pattern of the 0-group fishes was this year characterized by high abundance in the Spitsbergen branch of the current system. Length frequencies of the different species are shown in Fig. 15.

References

Dragesund, O. and Olsen, S. "On the possibility of estimating year class strength by measuring echo-abundance of 0-group fish". Fiskdir. Skr. Ser. Havunders. 13 (8): 48—75.

Dragesund, O. (Ed.). 1970. "International 0-group surveys in the Barents Sea 1965-1968". ICES Coop. Res. Rep. Ser. A. 18.

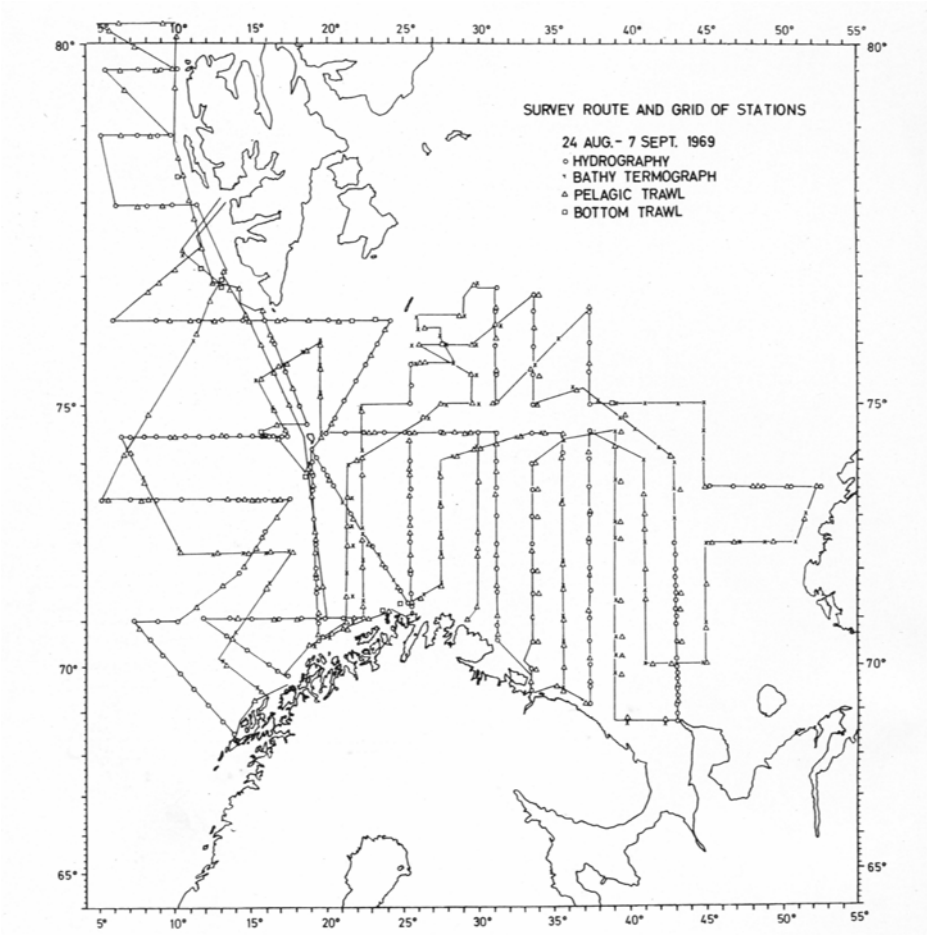

Fig. 1. Survey routes and grid of stations

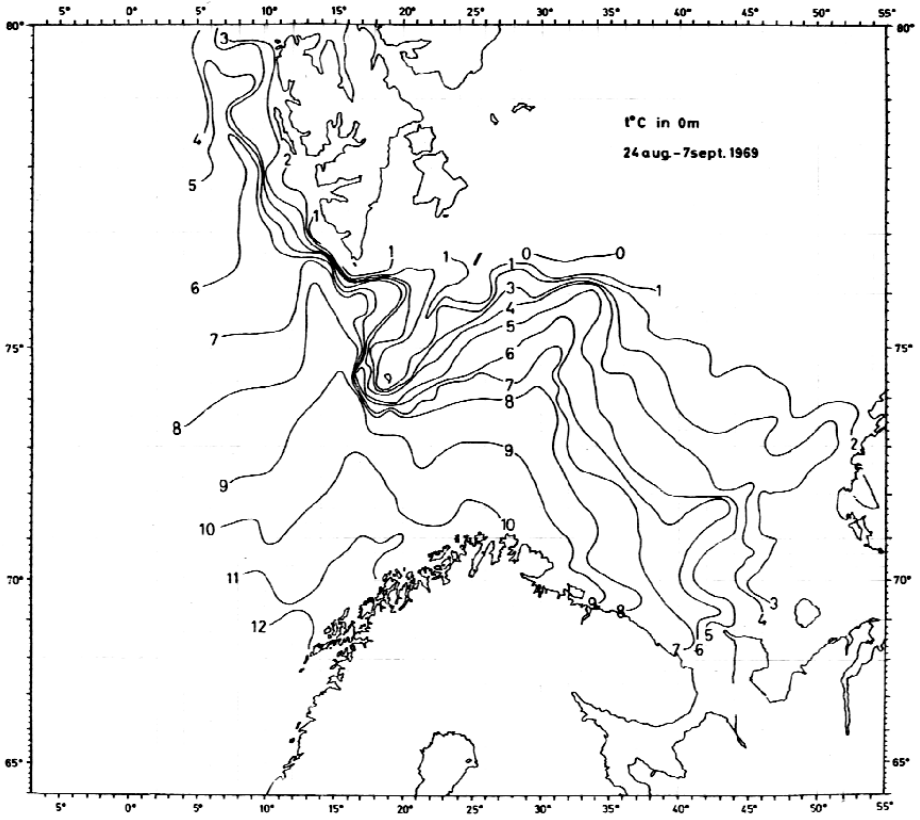

Fig. 2. Isotherms at 0 m

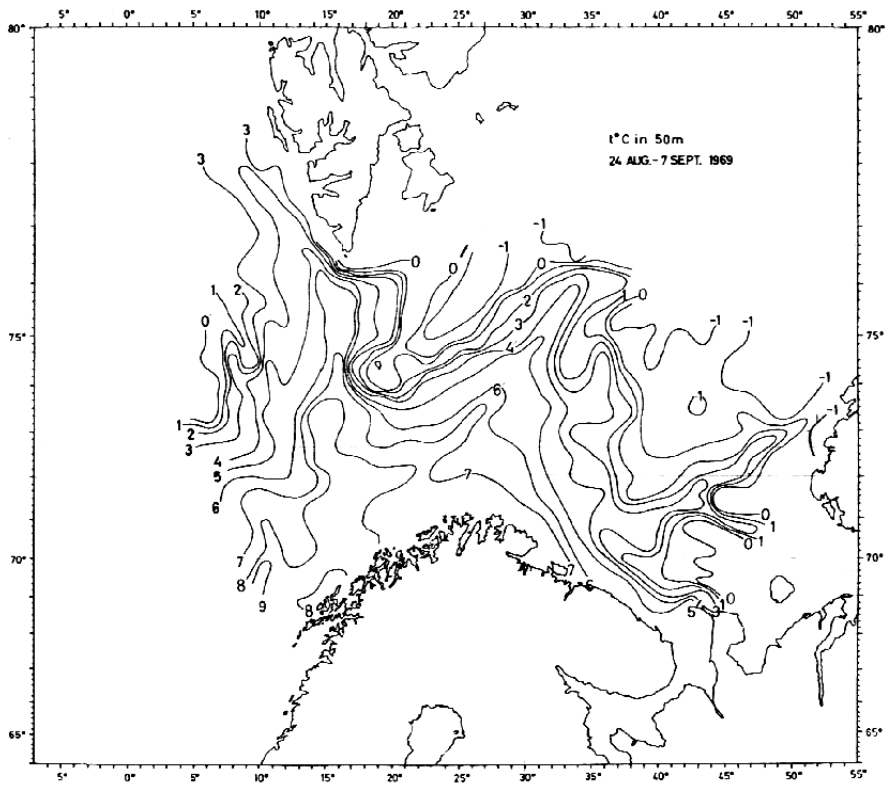

Fig. 3. Isotherms at 50 m

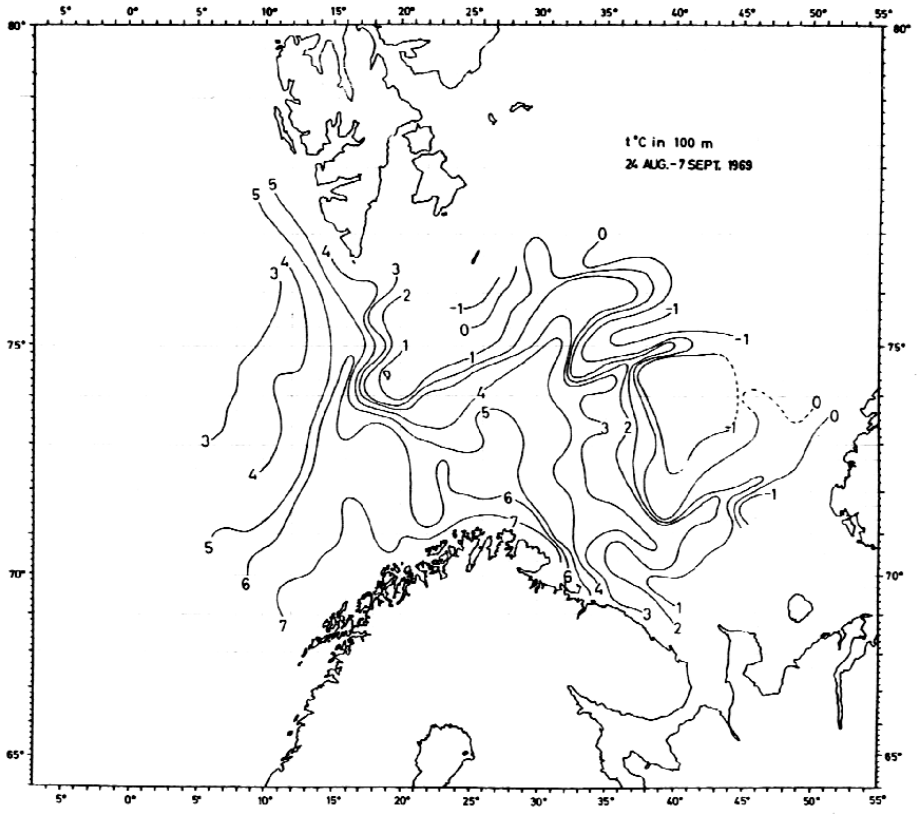

Fig. 4. Isotherms at 100 m

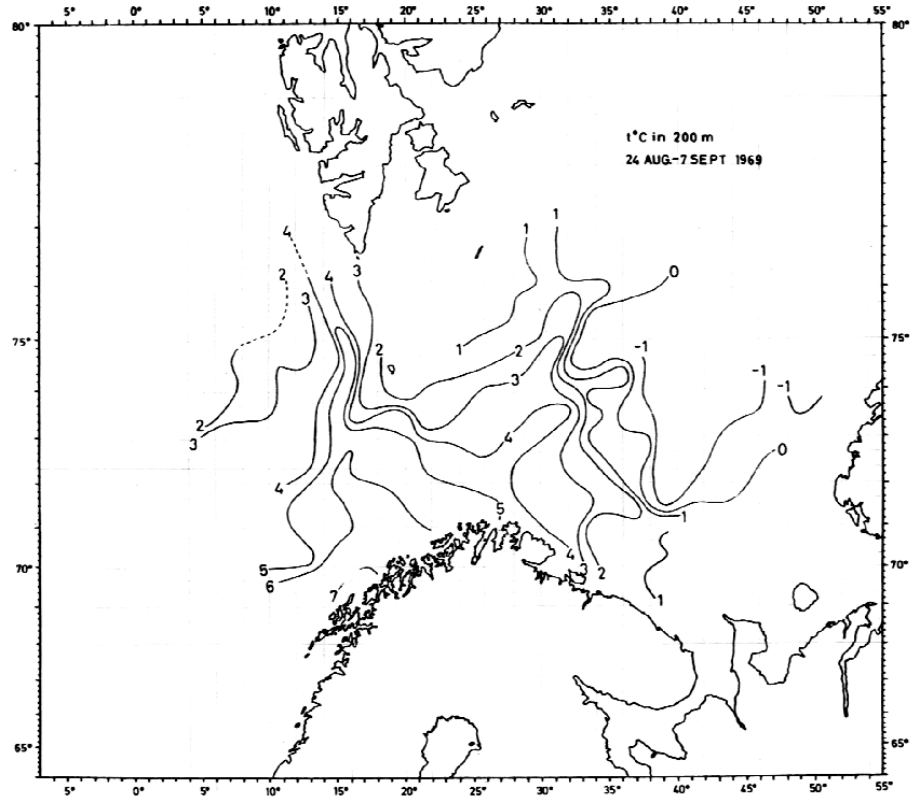

Fig. 5. Isotherms at 200 m

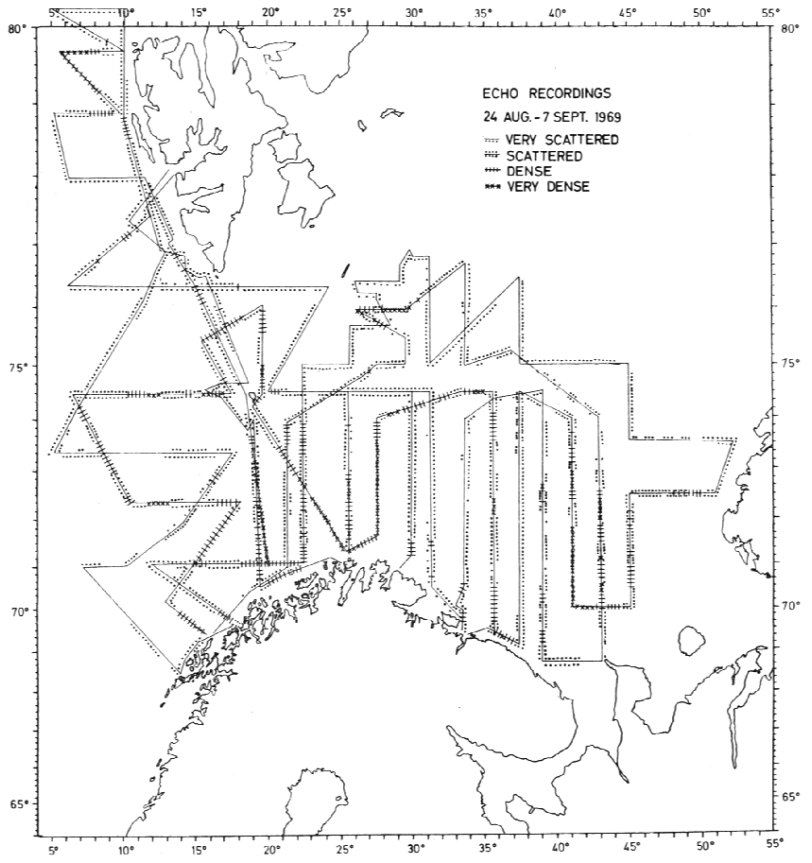

Fig. 6. Courses and echo recordings

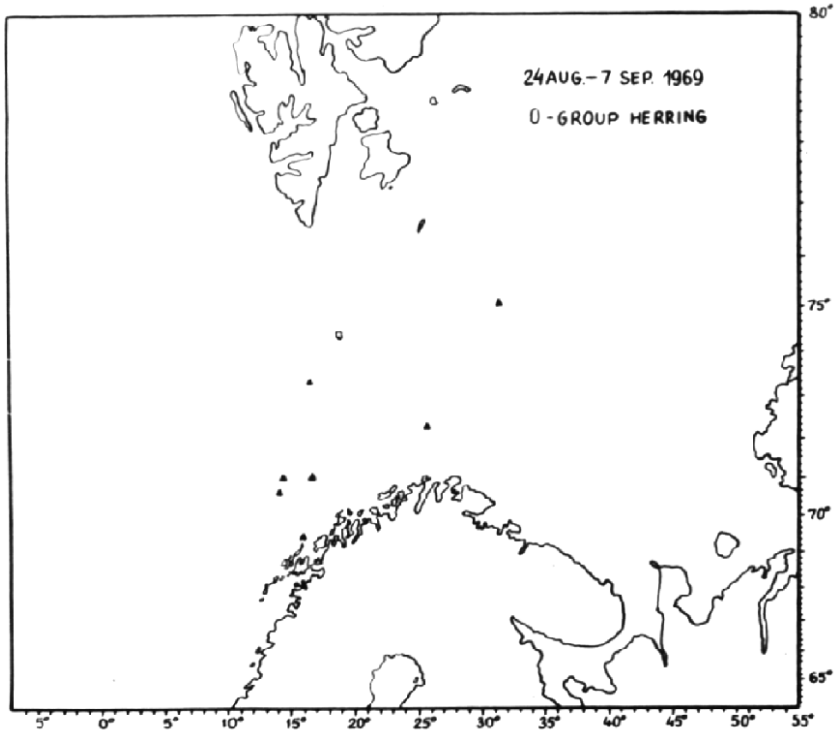

Fig. 7. Distribution of 0-group herring

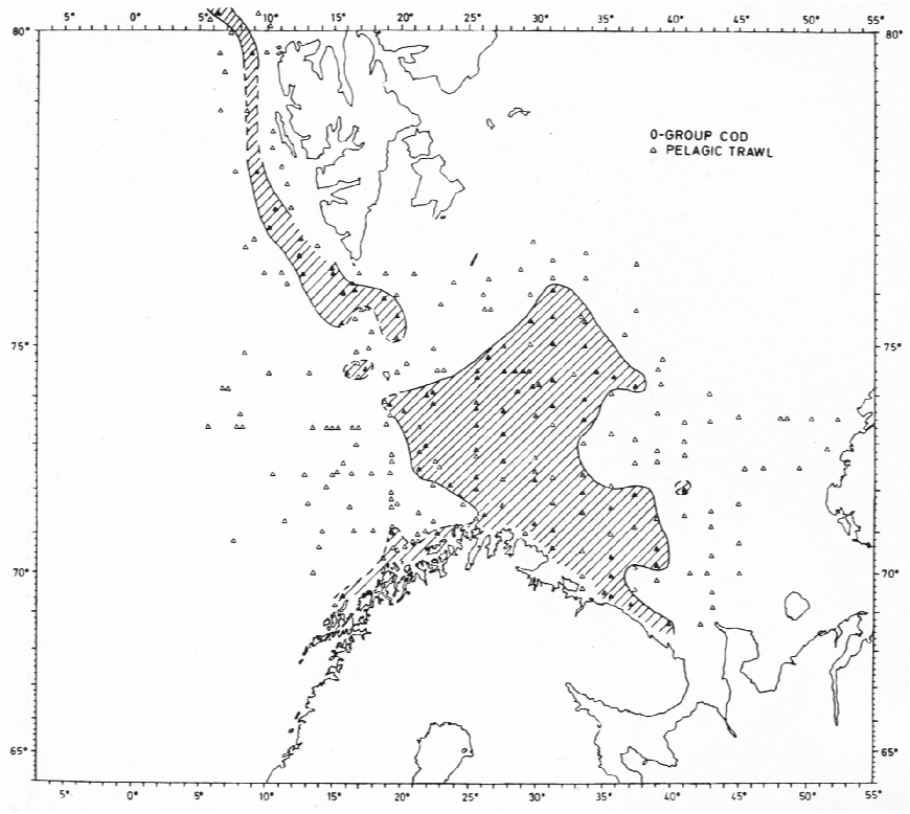

Fig. 8. Distribution of 0-group cod

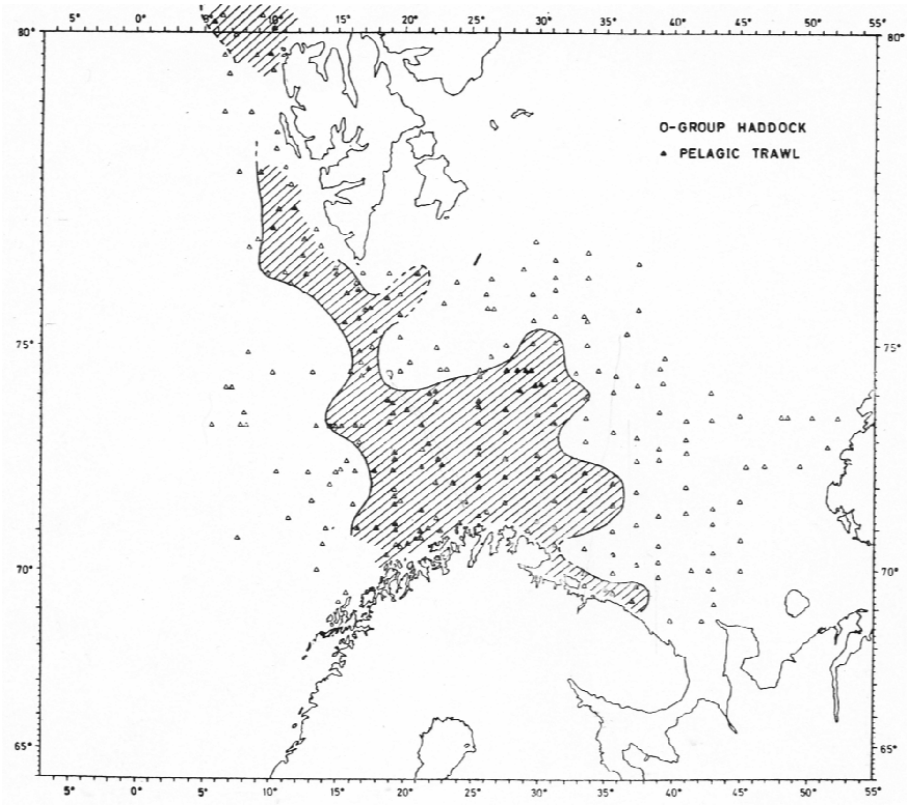

Fig. 9. Distribution of 0-group haddock

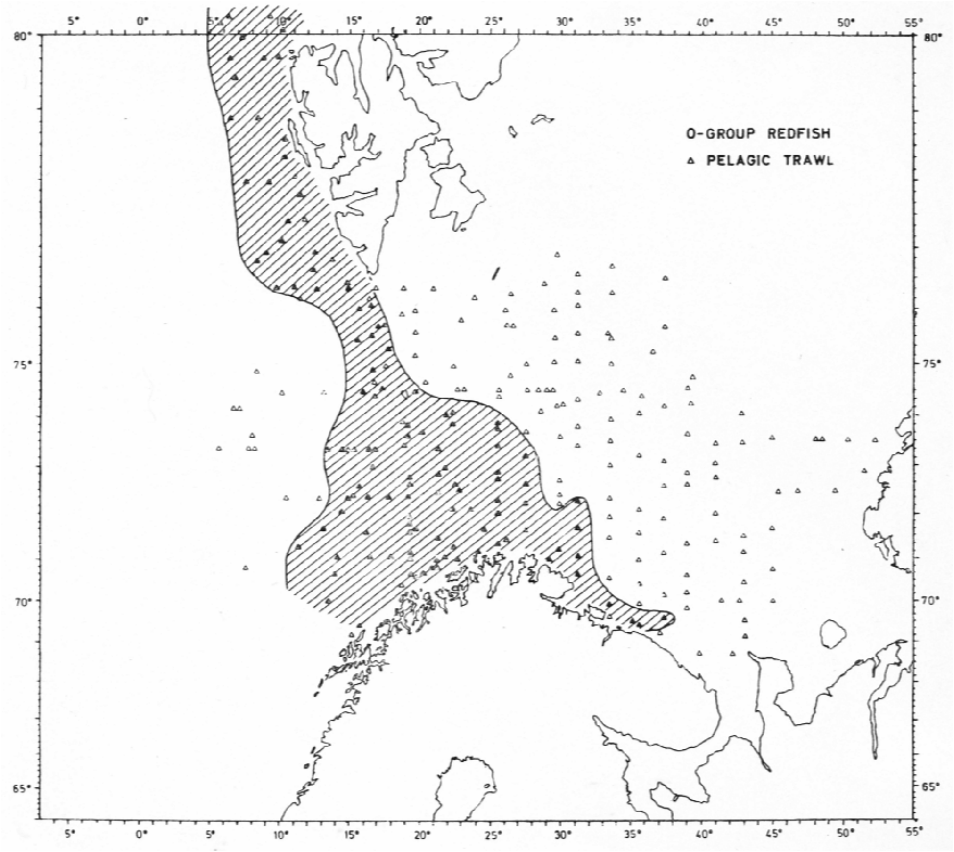

Fig. 10. Distribution of 0-group redfish

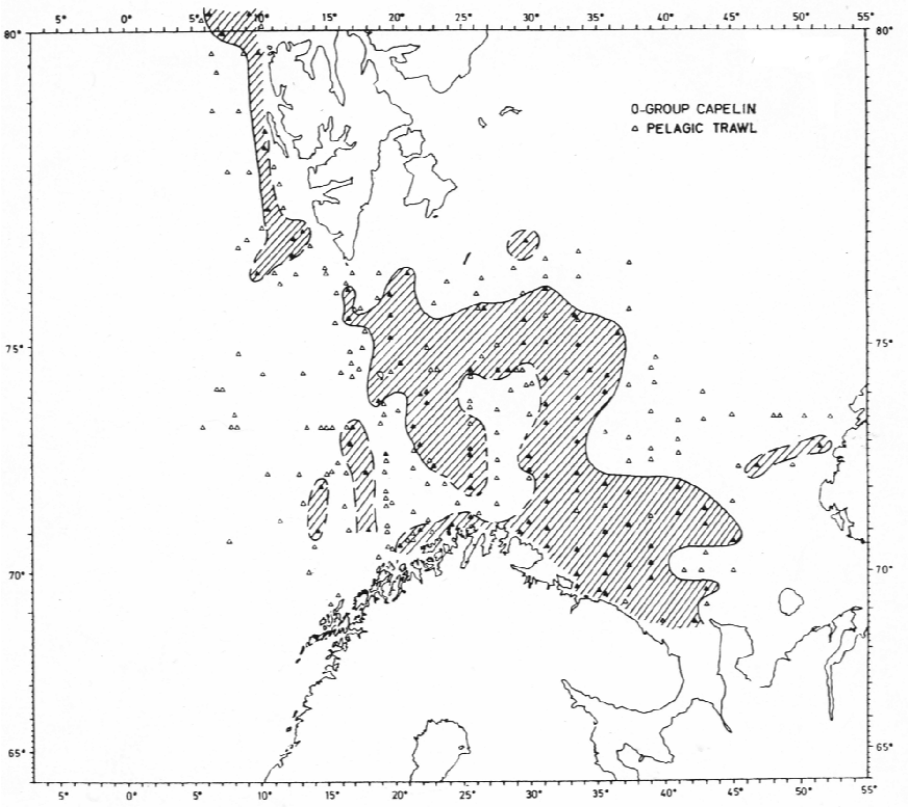

Fig. 11. Distribution of 0-group capelin

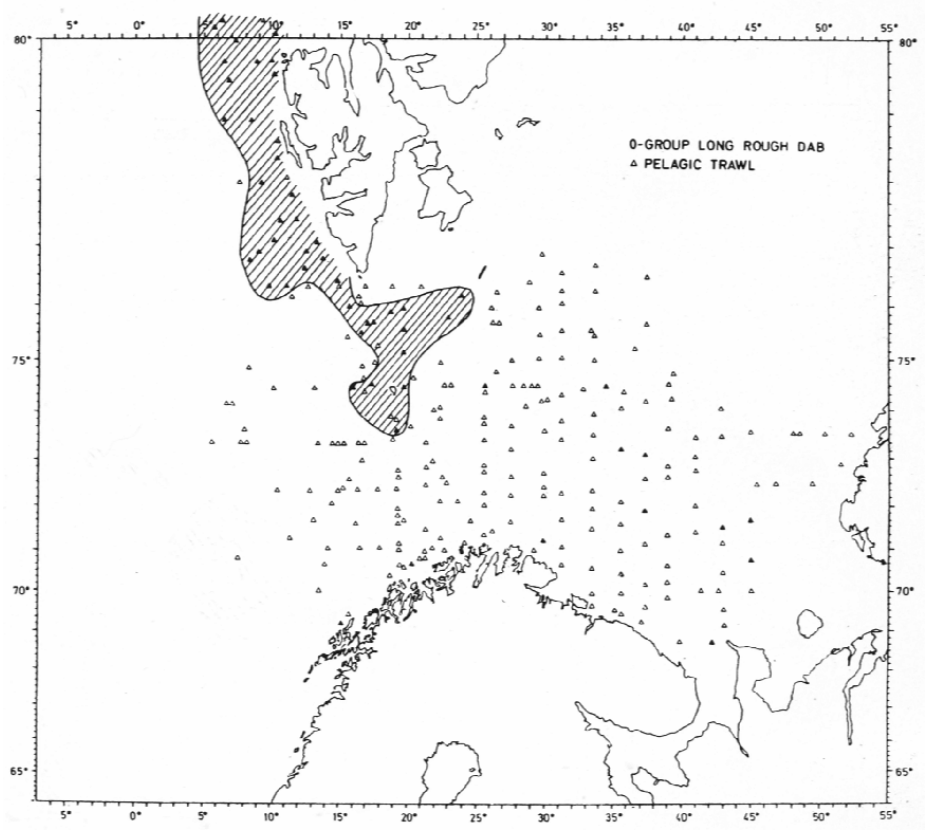

Fig. 12. Distribution of 0-group long rough dab

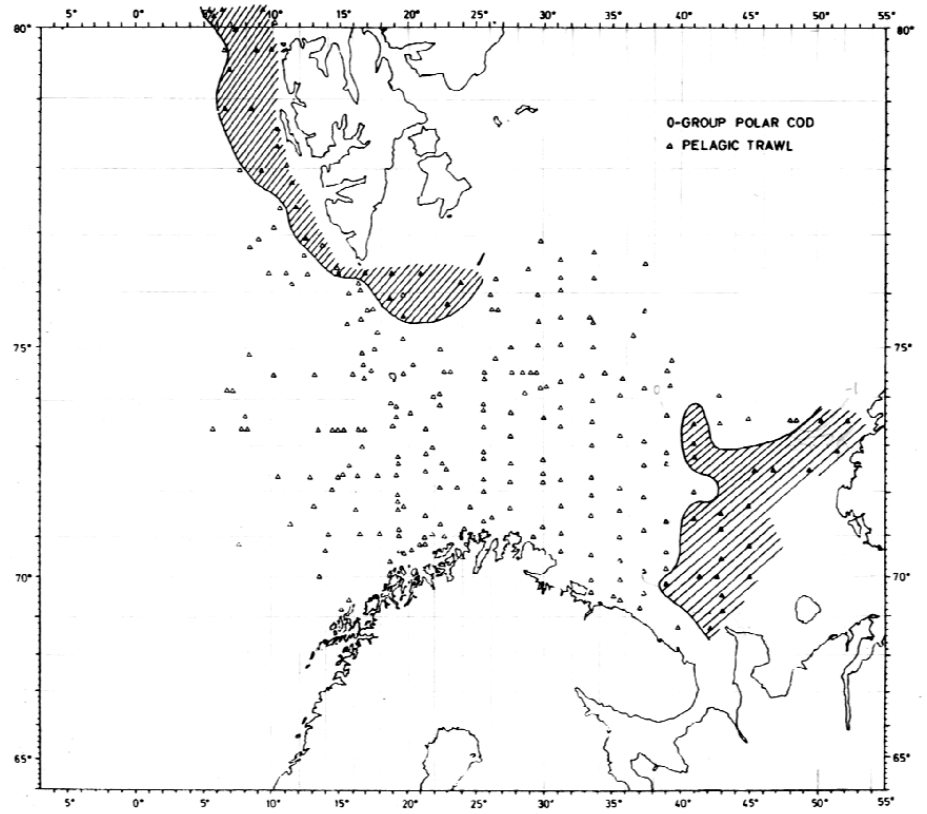

Fig. 13. Distribution of 0-group polar cod

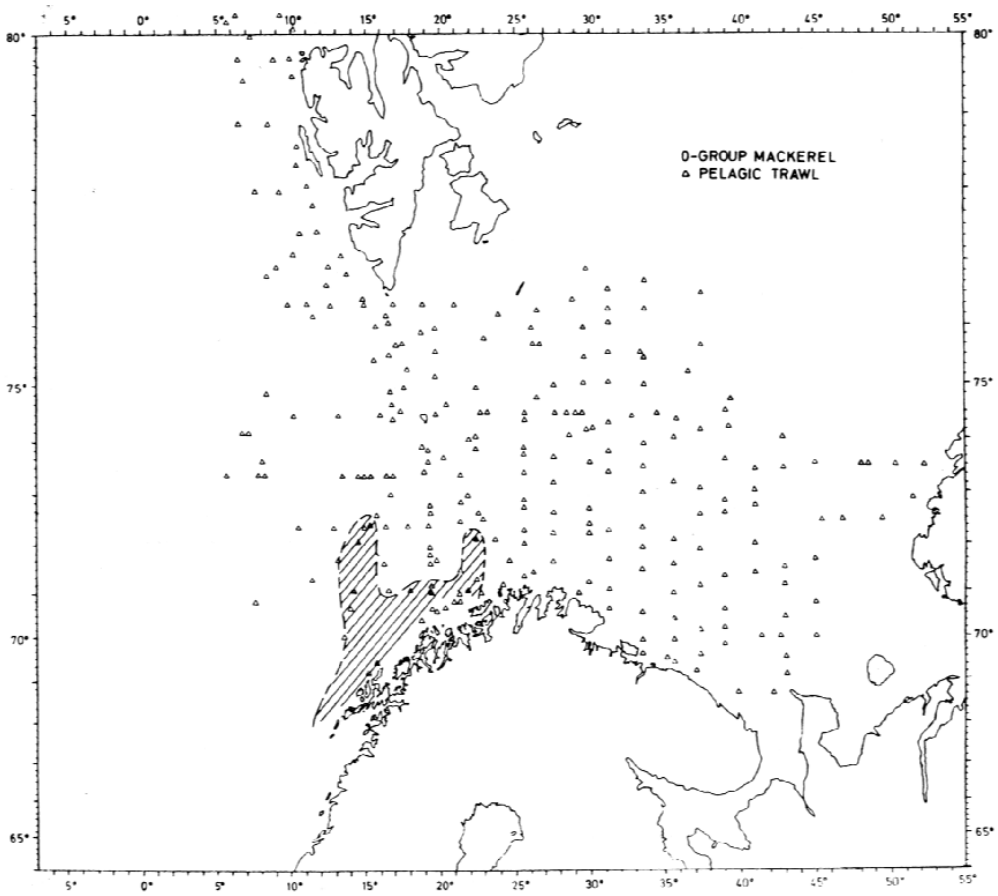

Fig. 14. Distribution of 0-group mackerel

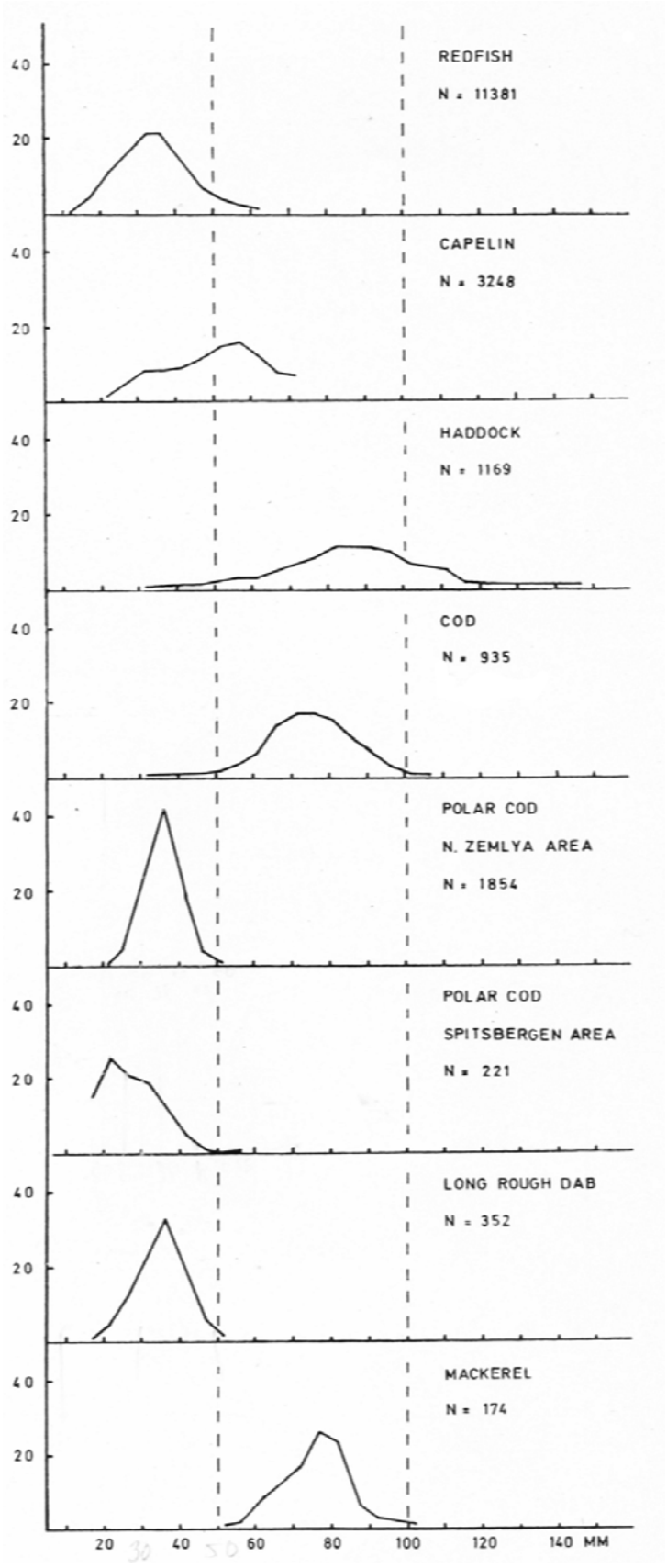

Fig. 15. Length composition

International Council for
the Exploration of the Sea

C.M. 1970/H: 34
Pelagic Fish (Northern) Committee
Ref:
Demersal Fish (Northern) Committee

Preliminary Report of joint Soviet-Norwegian 0-group fish survey in Barents Sea and adjacent waters in August-September 1970

Introduction

The present investigation was the sixth in the series of surveys in the Barents Sea and the Svalbard region to study the distribution and abundance of 0-group fishes.

The vessels and the scientists taking part were:

USSR	R/V "Akademik Knipovich"	V.V. Penin, M.L. Zaferman.
	R/V "Fridtjof Nansen"	A.S. Seliverstov, R.N. Sarynina, S.M. Kovalyov
Norway	R/V "Johan Hjort"	A. Hylen, O. Smestad, R. Sætre, B. Myrseth, G. Nilsen
	R/V "G.O. Sars"	L. Midttun, O. Dragesund, P.T. Hognestad, J. Blindheim, O. Nakken, N.Radhakrishnan, T. Benjaminsen

Preliminary plan for the survey was made at a meeting in Bergen in May 1970, and the final arrangements for the coordination was made in Murmansk 26-27 August before the survey commenced. The survey was carried out between 27 August and 11 September and was followed by a meeting in Tromsø 11-13 September where exchange of data and analysis of the material took place.

Material and methods

The distribution and density of the pelagic scattering layers were estimated from the echo sounder paper records and the organisms forming the scattering layers were identified from samples taken with small meshed pelagic trawls (Dragesund, Midttun and Olsen 1970).

R/V "G.O.Sars" had a Simrad Net Sonde and the other three research vessels had depth recorders attached to the trawls. On board the R/V "G.O.Sars" and "Johan Hjort" Simrad Echo Integrators (QM) worked in conjunction respectively with 38 and 50 kHz Simrad Scientific Sounder in order to estimate more quantitatively the total echo abundance. The results of these investigations will be presented later. The area surveyed is shown in Fig. 1, where also the ships' tracks, trawl and hydrographic stations are indicated.

Results

Hydrography

A preliminary analysis of data on water temperature in the Barents Sea observed during the survey (Figs. 2-7) made it possible to compare some hydrographica1 features to those of the previous years (Dickson, Midttun and Mukhin 1970).

The mean temperature of the 0-200 m layer observed in the Spitsbergen Current west of Bear Island (Fig. 6) was the highest since our surveys started in 1965.

The mean temperature of the 0-200 m layer in the North Cape Current observed in the section North Cape to Bear Island (Fig. 7) was also the highest since before 1965 (Table 1).

Table 1. Mean temperature in the 0-200 m layer in the North Cape Current

Year	1965	1966	1967	1968	1969	1970
T °C	5.0	5.5	5.6	5.4	6.0	6.5

The mean temperature of the 0-200 m layer in the Murmansk Current (along the 33°30' E meridian) was also characterized by high values. (4.70) (Table 2).

Table 2. Mean temperature of the 0-200 m layer in the Murmansk Current (along the 33°30' E meridian)

Year	1965	1966	1967	1968	1969	1970
T °C	4.4	3.6	4.9	4.4	4.0	4.7

The mean temperature recorded from surface to bottom in the section to the north of Cape Kanin (along 43°15' E) reached the long-term mean value (4.0°). Only the upper layers of water in the Kanin-Kolguev and Novaya Zemlya Currents were found to be warmer than the normal. For instance, the temperature of the surface layer in the Novaya Zemlya Current was 8,8°, whereas during the previous years it ranged from 5.7° to 6.8°.

Thus, it is obvious that during August-September 1970 the western part of the Barents Sea was relatively warmer than the eastern part, and that intensive heat advection had taken place in the Spitsbergen Current and in the northern branch of the North Cape Current.

The distribution and abundance of 0-group fish

The variation in total density of the scattering layers is shown in Fig. 8. As in previous years the recordings include the contribution from fish of older age groups occurring in the layer down to 100 meters. The density figures probably also to some extend include traces from organisms other than fishes, e.g. certain invertebrates species of Medusae, Euphausiacea and Amphipoda which contribute to the uppermost scattering layers. Although, attempts were made to distinguish such recordings from those of 0-group fishes by in situ target strength measurements their contribution to the total echo abundance is difficult to estimate since target strength of these scatters are yet to be determined.

As in previous years the variation in echo abundance has been expressed on a subjective scale from 0-4 (Dragesund, Midttun and Olsen 1970) The results showed that the concentration of scatters was mainly confined to the central and western part of the Barents

Sea between the meridians 18° and 28°E. Concentrations were also recorded near the Novaya Zemlya and off the Spitsbergen coast.

In addition to the 0-group fish species discussed below, a few other species were occasionally recorded such as Agonus, Cottidae, Leptagonus, Liparis, Lumpenus etc.

Herring

0-group herring were not recorded during the entire survey and this is the sixth successive year of very low abundance of 0-group herring.

Cod

The 0-group cod were distributed over a wide area in the central Barents Sea, extending from the Norwegian coast north to 77° N and from Bear Island along the western coast of Spitsbergen as far north as 79° N (Fig. 9). The area of distribution was more extensive and the concentrations were considerably denser than in any of the previous years since 1963. Therefore the indication is that the 1970 year-class of cod is very abundant.

Haddock

Similar to cod, the 0-group haddock were also distributed over a wide area in the central Barents Sea, with extensions northwards along the coast of Spitsbergen as far as the northern limit of the survey (Fig. 10). However, the abundance of 0-group haddock was probably lower than that of 1969 but second in strength for the years covered by the joint surveys (1965-1970).

Redfish

The 0-group redfish this year were distributed within a smaller area than in 1959. The redfish concentrations were observed in the western part of the Barents Sea with extension northwards along the Spitsbergen coast and may even be distributed beyond the limit of the investigated area, i.e. approximately 80° N. The density was found to be rather high (Fig. 11). The total echo abundance may indicate a fairly strong year-class, though probably less abundant than that of 1969.

Capelin

In contrast to the four previous years the distribution of 0-group capelin was found to be limited to smaller areas along the Finnmark and Murman coast and in the eastern part of the Barents Sea (Fig. 12). The concentrations were rather low indicating a weak 1970 year-class.

Long rough dab

The 0-group long rough dab were mainly distributed within an area from Bear Island northwards along the coast of Spitsbergen. Similar to 1969 this species again showed low values in abundance (Fig. 13).

Polar cod

The concentrations of this species were found in two separated areas, namely in the eastern part of the Barents Sea and in an area extending from Hope Island to the water west of Spitsbergen as far as the northern limit of the investigation (Fig. 14). The distribution was more or less similar to that of 1969 and the year-class seemed to be abundant.

Other species

0-group fishes of several other species were observed during the survey. The Greenland halibut (Fig. 15), Anarhichas and Ammodytes were frequently netted. Only a few saithe were taken during the survey (Fig.15).

Concluding remarks

Again a numerous year-class of redfish has been produced, being the fourth successive rich year-class since 1965. In contrast to the four previous years the abundance of capelin was low, indicating that a decrease in the adult capelin stock will occur during 1972-1973.

Concerning cod and haddock the 1970 year-class seems to be abundant. The 0-group cod may be of the same magnitude as that of 1963 and considerably more abundant than the 1969 year-class (Hylen and Dragesund 1970). The 0-group haddock seems to be somewhat less abundant than this year together with the rich year-classes of 1966 and 1969 (Anon. 1969, Benko et al.1970) indicate that the stock is on a relatively high level. Length frequencies of the different species are shown in Fig.16.

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Hylen, A. and Dragesund, O. 1970. Recruitment of young Arcto-Norwegian cod and haddock in relations to parent stock size. Stock and recruitment. Int. Coun. Explor. Sea. Symp., Aarhus. 1970 (19): 1-13, 21 figs. (Mimeo.).

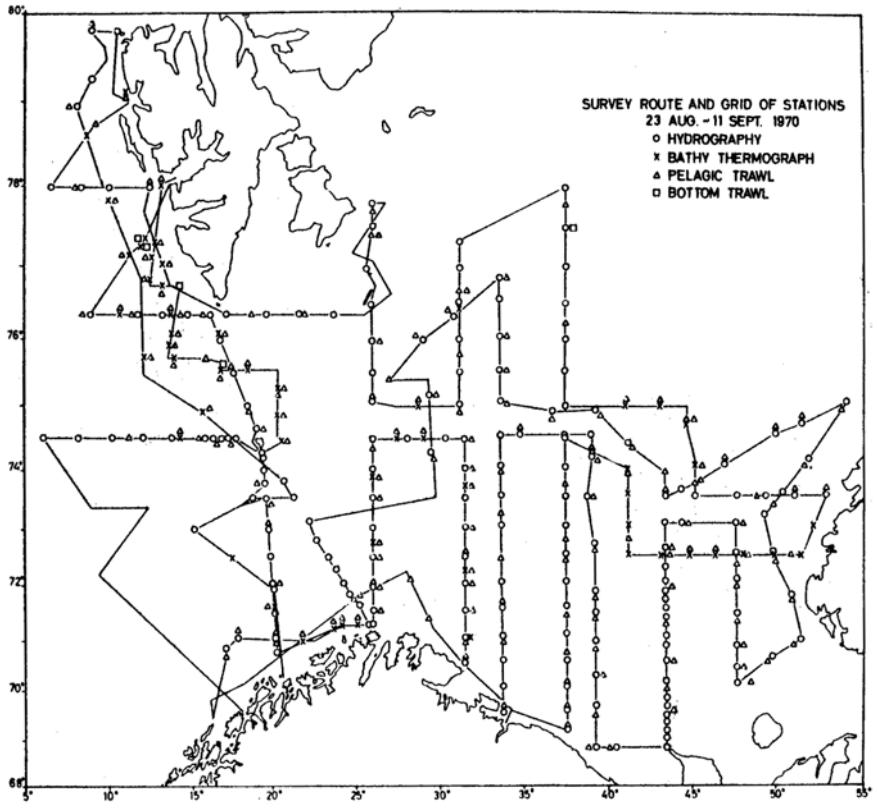

Fig. 1. Survey routes and grid of stations

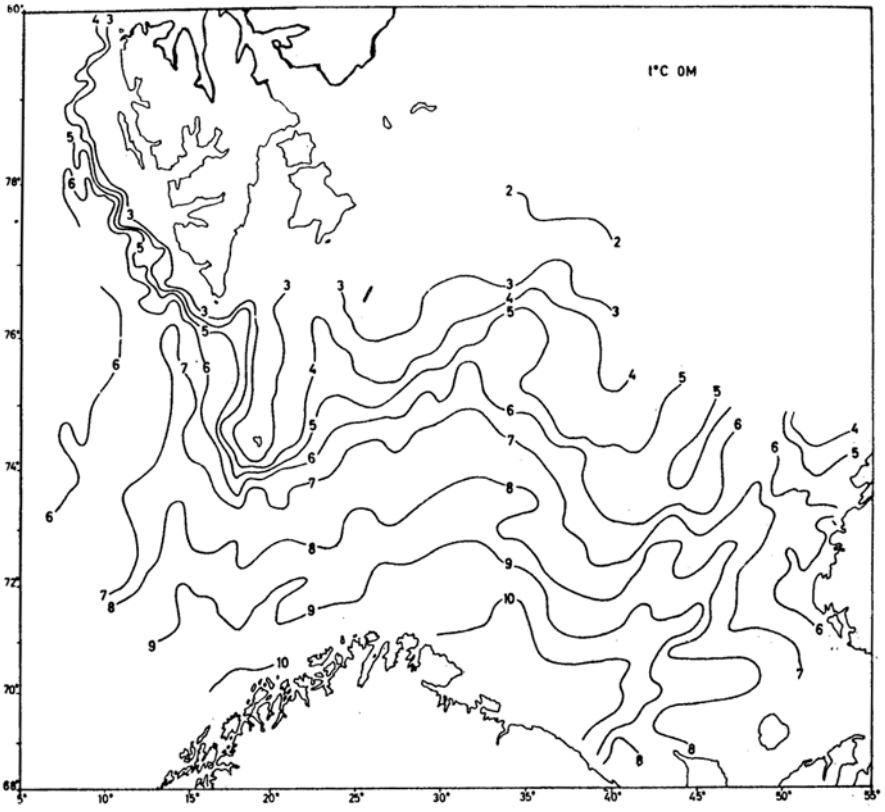

Fig. 2. Isotherms at 0 m

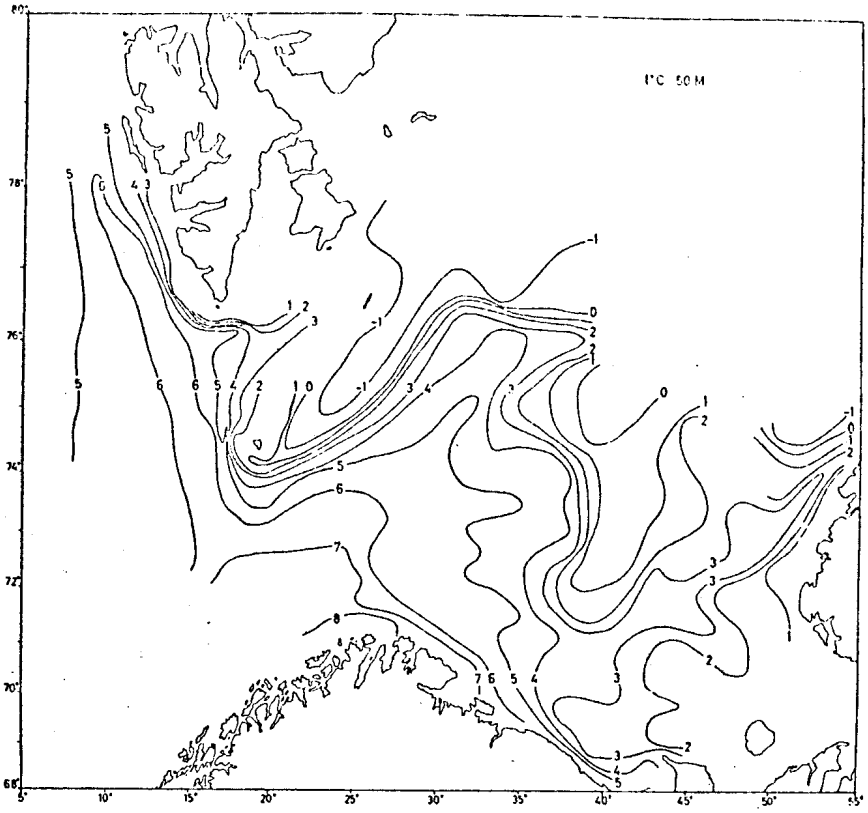

Fig. 3. Isotherms at 50 m

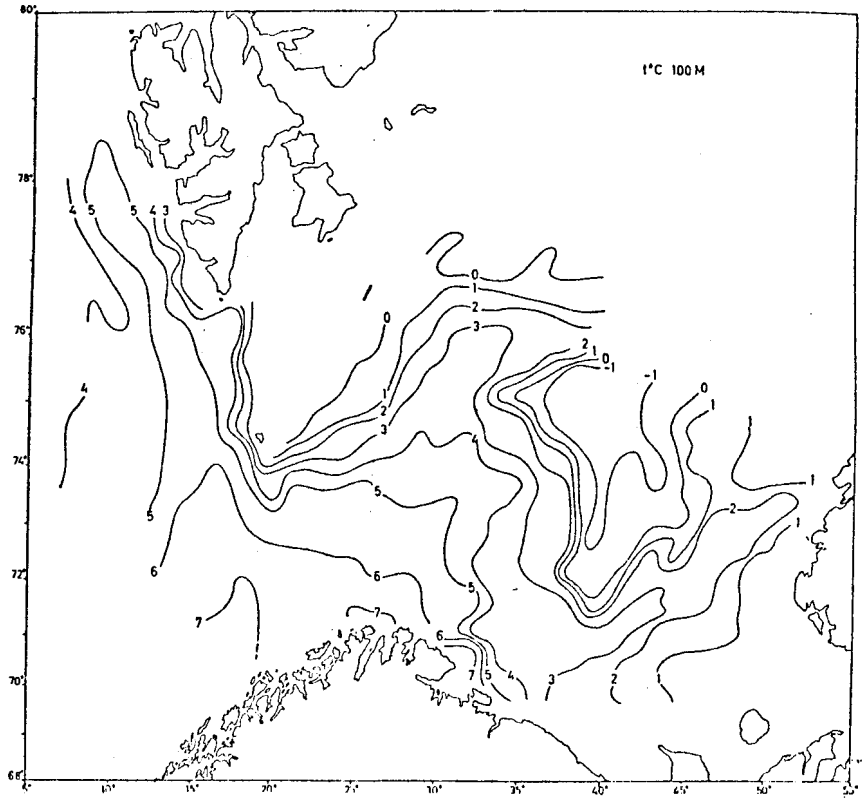

Fig. 4. Isotherms at 100 m

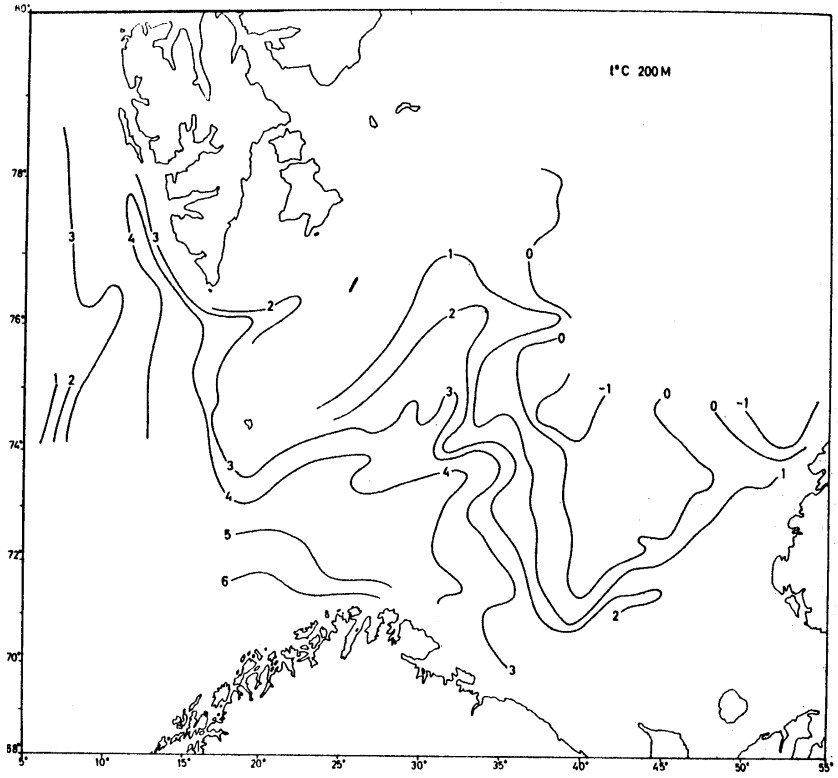

Fig. 5. Isotherms at 200 m

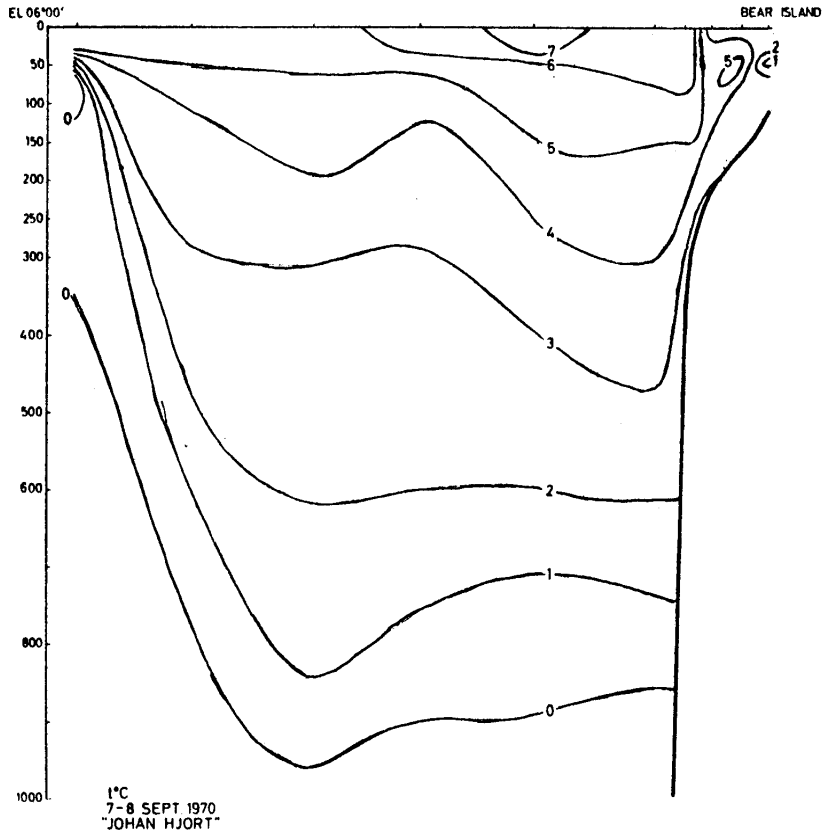

Fig. 6. Temperature section Bear Island-West

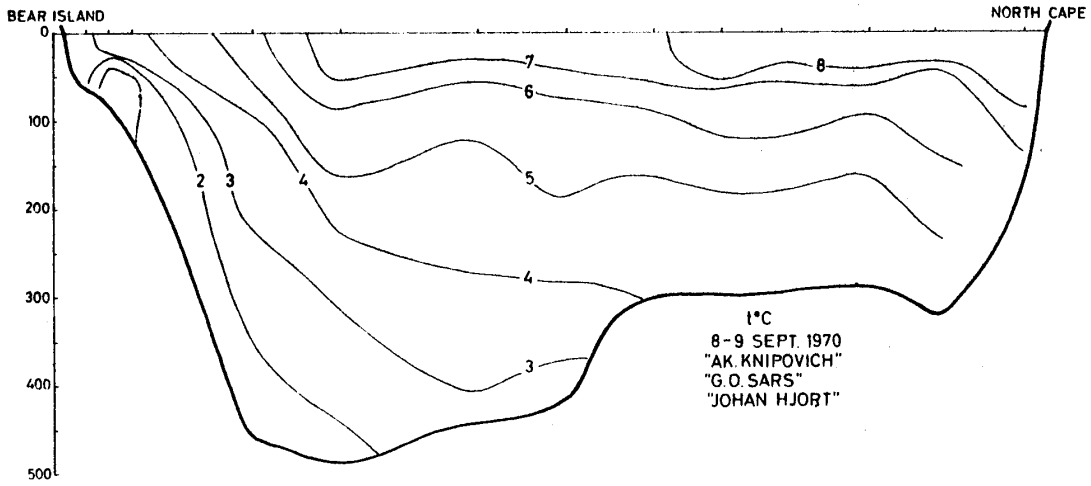

Fig. 7. Temperature section Bear Island-North Cape

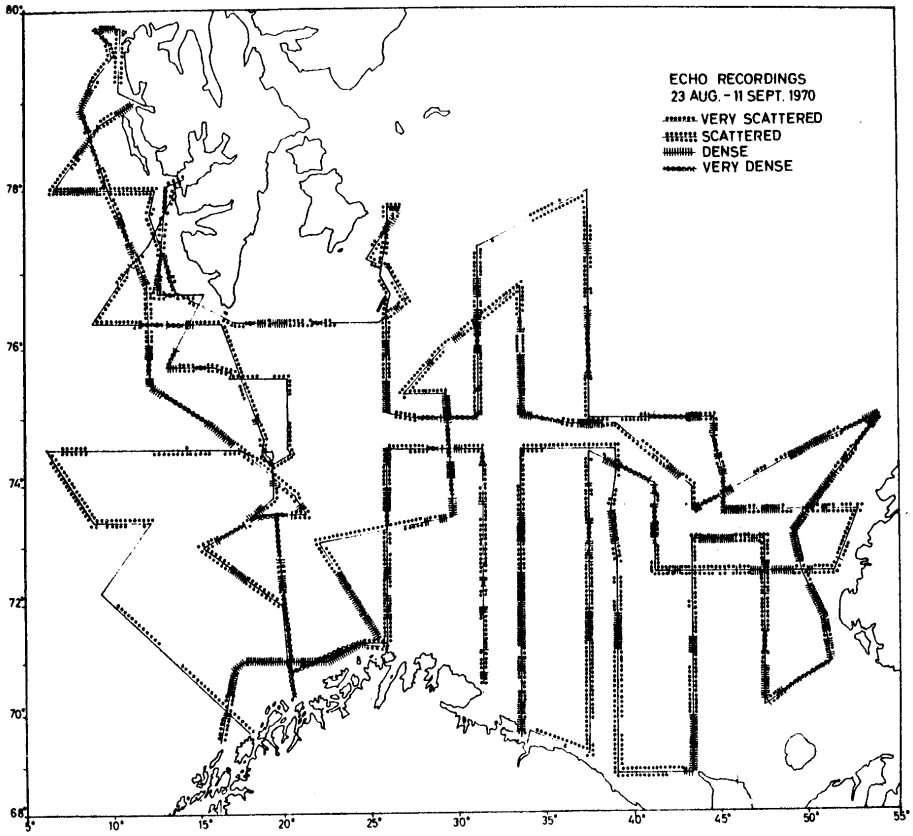

Fig. 8. Courses and echo recordings

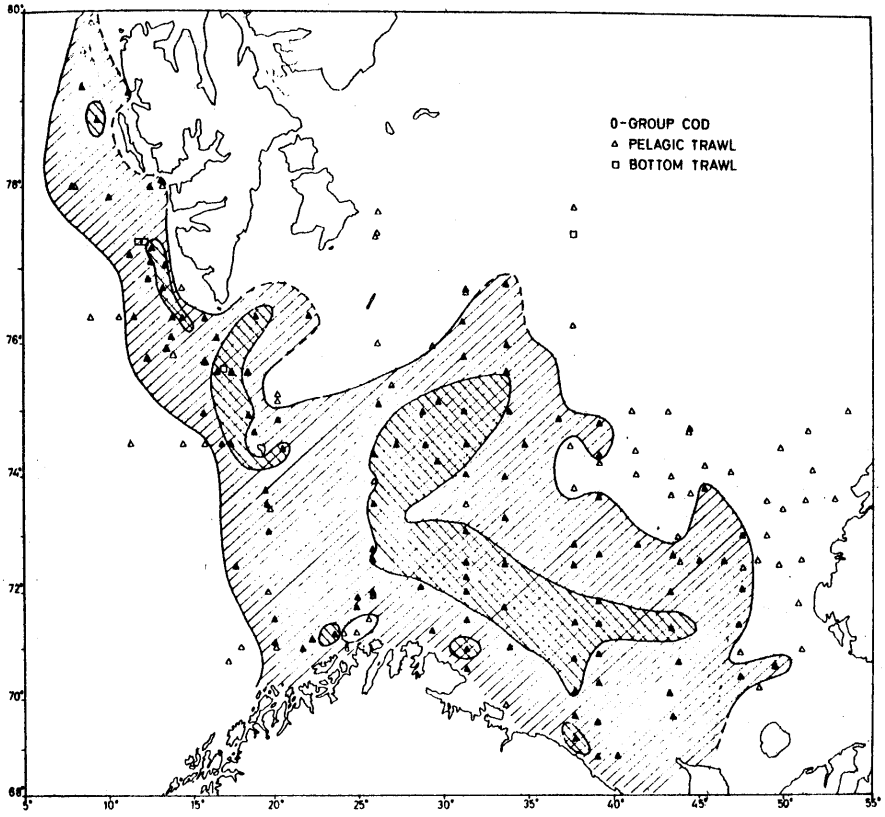

Fig. 9. Distribution of 0-group cod

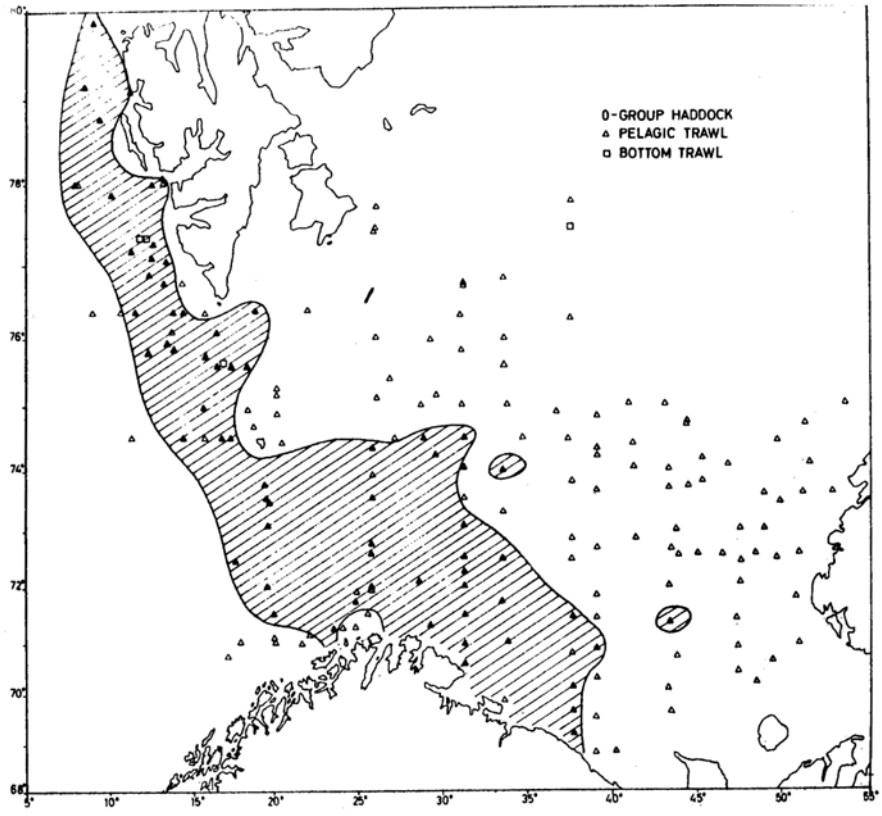

Fig. 10. Distribution of 0-group haddock

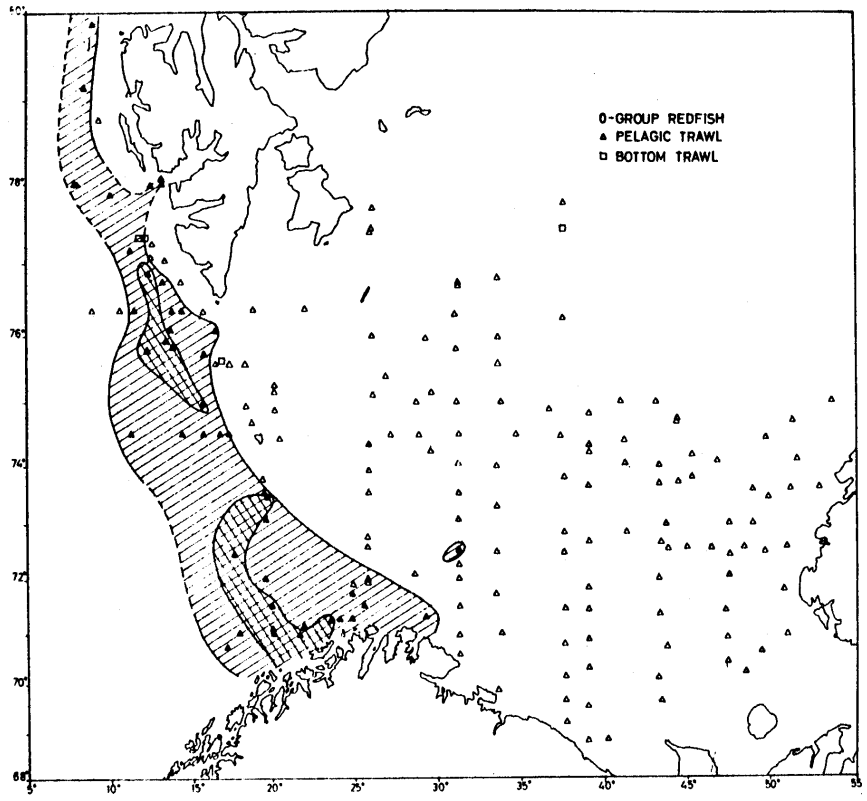

Fig. 11. Distribution of 0-group redfish

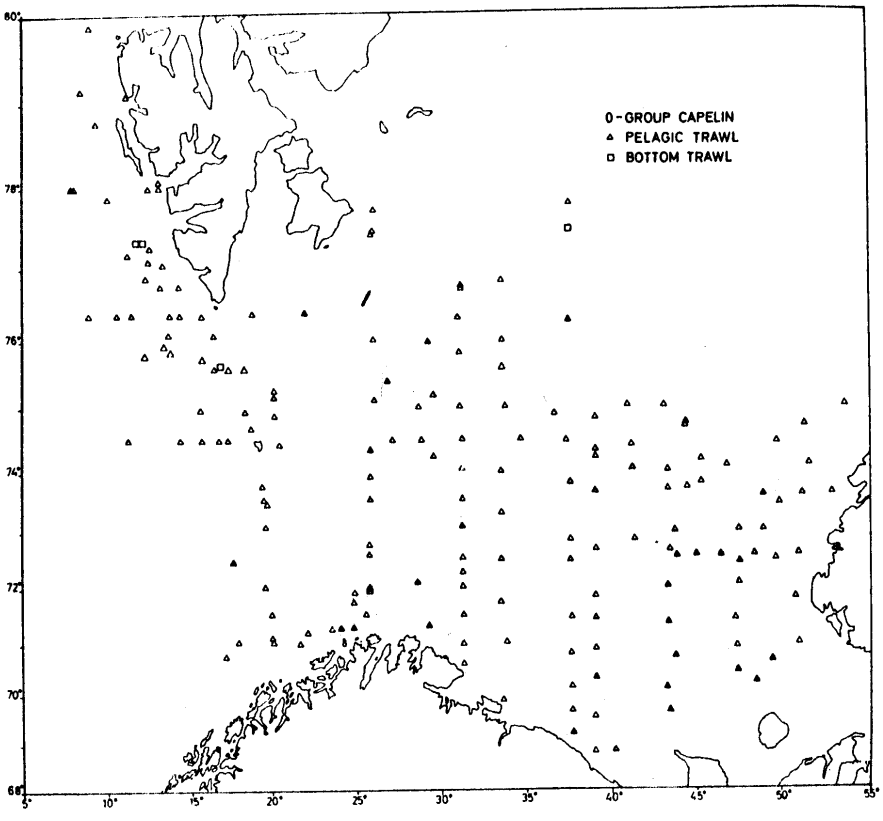

Fig. 12. Distribution of 0-group capelin

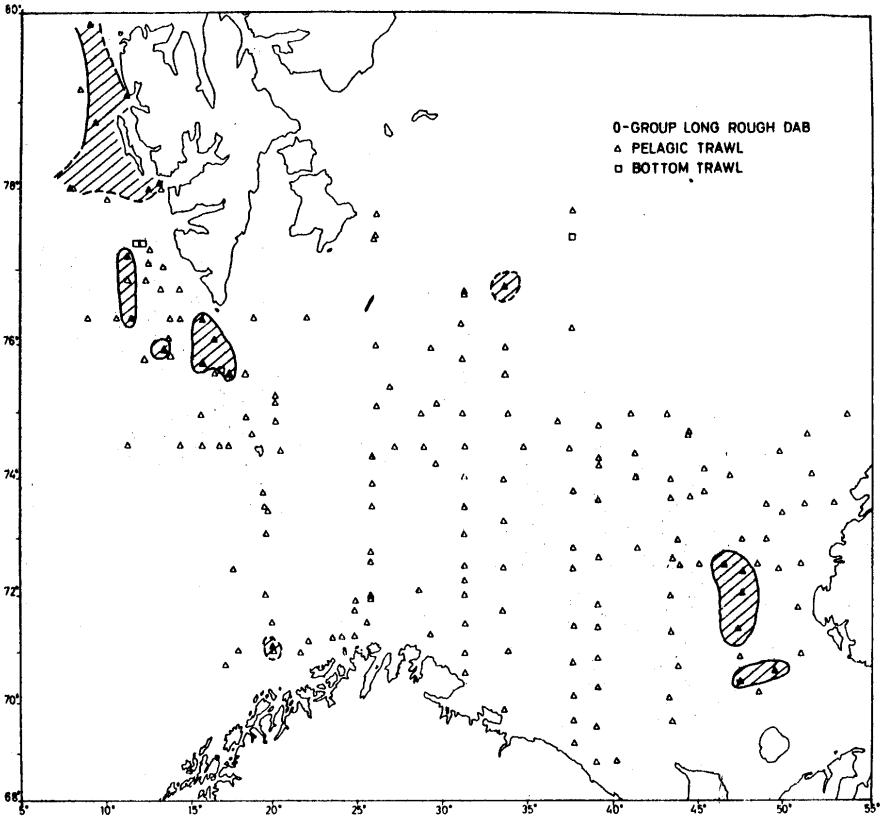

Fig. 13. Distribution of 0-group long rough dab

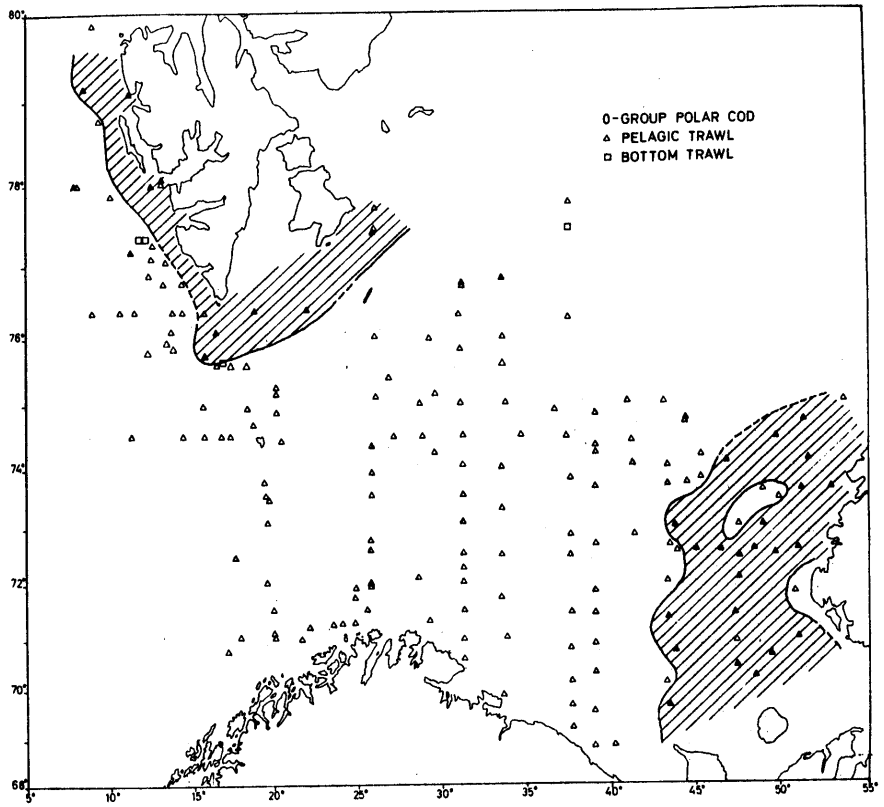

Fig. 14. Distribution of 0-group polar cod

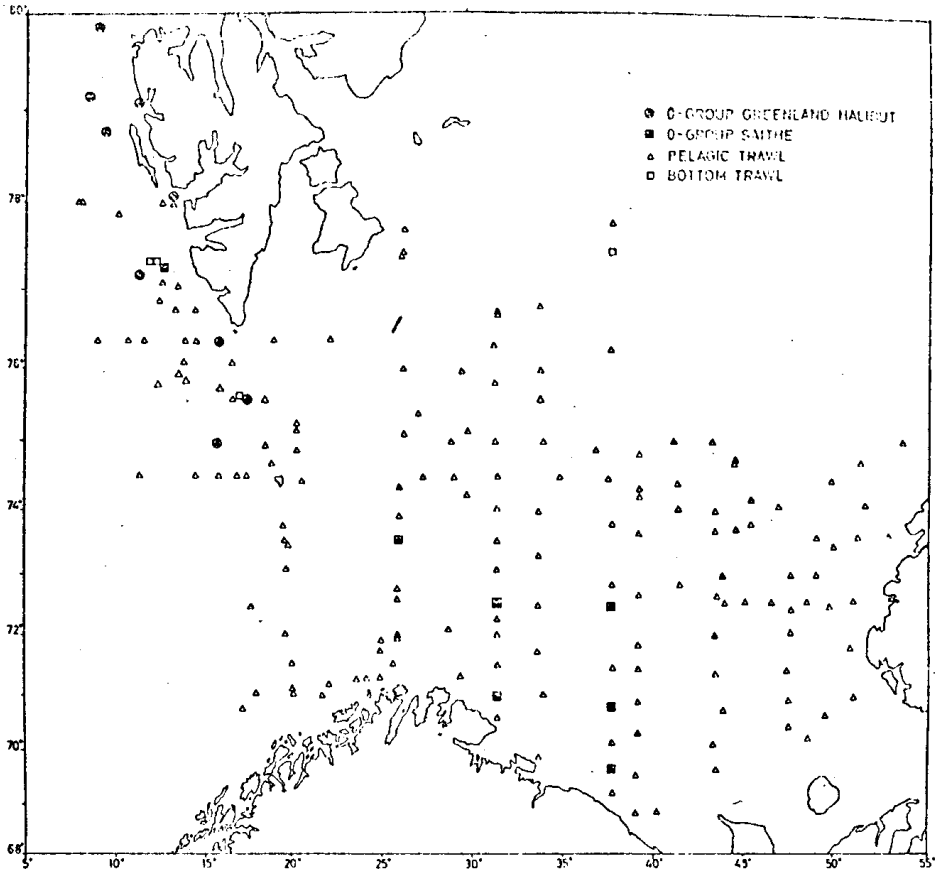

Fig. 15. Distribution of 0-group Greenland halibut and saithe

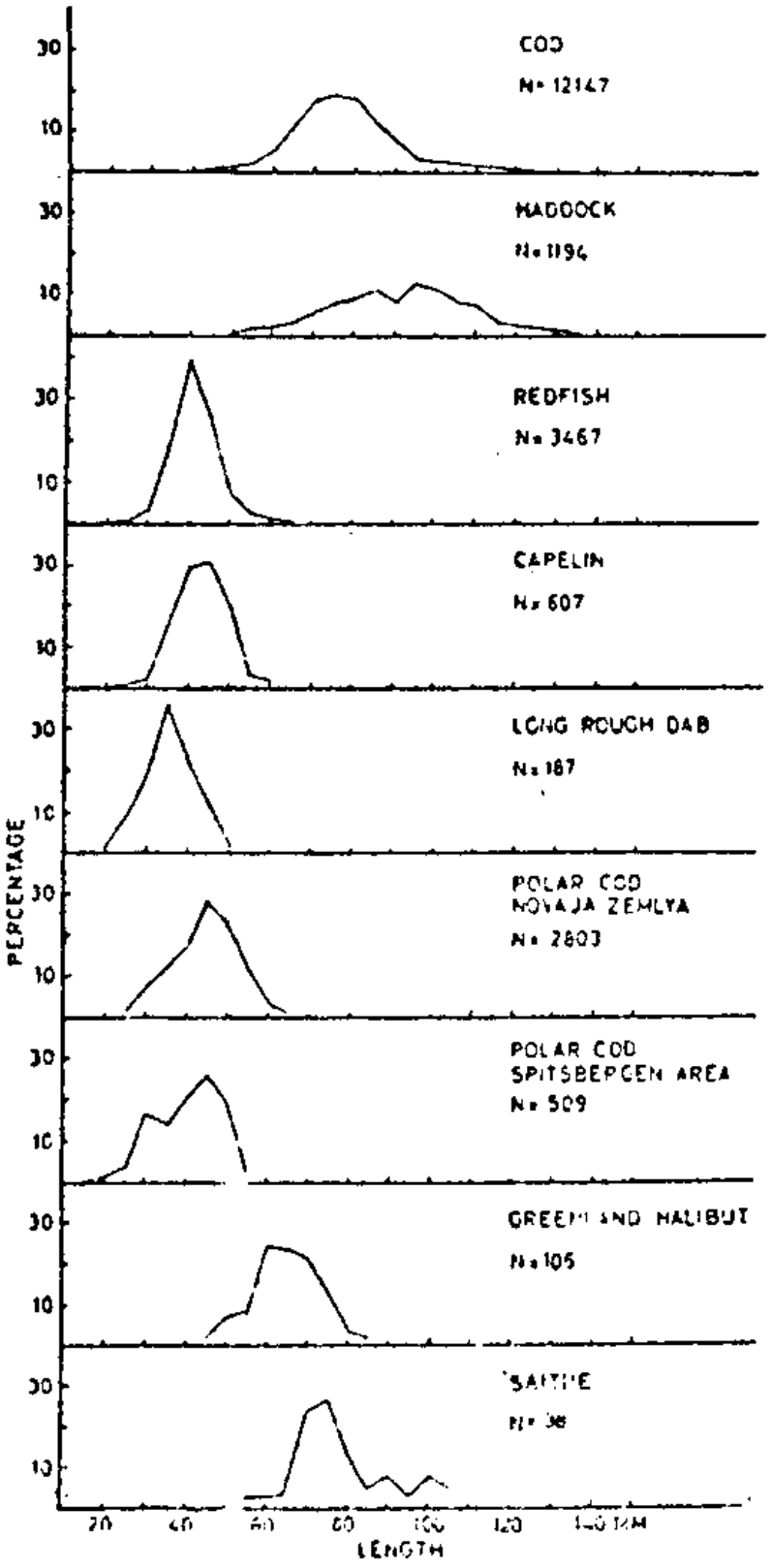

Fig. 16. Length frequencies

International Council for
the Exploration, of the Sea

C.M. 1971/H:32
Pelagic Fish (Northern) Committee
Ref:
Demersal Fish (Northem) Committee
Hydrography Committee

Preliminary report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1971

Introduction

This was the seventh in a series of international surveys to study the abundance and distribution of 0-group fish in the Barents Sea and the Svalbard region.

The following vessels and scientists took part in the survey:

USSR	R/V "Akademik Knipovich"	A.S. Seliverstov, V.V. Penin
	R/V "Fridtjof Nansen"	V.N. Schleinik, V.D. Tester, A.I. Lysota
Norway	R/V "G.O. Sars"	O. Dragesund, P.T. Hognestad, O.M. Nakken
	R/V "Johan Hjort"	A. Hylen, O.M. Gmedstad, R. Sætre
England	R/V "Cirolana"	B.W. Jones, J.H. Nichols, J.G. Pope, C. Doddington

Preliminary plans for the survey were made at a meeting in Bergen in May 1971, and final arrangements for coordination were made in Tromsø and Murmansk immediately before the commencement of the survey. The main part of the survey was carried out between 25 August and 9 September, but "Akademik Knipovich" commenced on 20 August. The survey was followed by a meeting in Tromsø during 10-13 September arranged for the exchange and analysis of data.

Material and methods

As in previous years the distribution and density of the pelagic scattering layers were estimated from the echo sounder paper records, and the organisms forming the scattering layers were identified by sampling with small meshed pelagic trawls. Various depth metering devices on the trawls were used for the accurate control of the depth of trawling. Echo integrators were used in conjunction with the echo sounders on board R/V "G.O. Sars", R/V "Johan Hjort", R/V "Cirolana" and R/V "Fridtjof Nansen".

It was thought that the different trawls used on the various ships probably had different fishing characteristics and it was recommended that for the future surveys a standard net should be selected and used by all ships in order to make quantitative comparisons of the catches more reliable.

Fig.1 shows the area surveyed and the ships' tracks together with the trawl and hydrographic stations worked.

Results

Hydrography

Hydrographic observations were conducted on the standard sections: along the Kola meridian (33°30' E), along the 43°15' E (north of the Cape Kanin), between Kolguyev Island and south-west part of Novaya Zemlya, between North Cape and Bear Island and west of Bear Island (74°30' N) and also on other hydrographic sections and at trawl stations, as shown in Fig. 1.

A preliminary analysis of data made it possible to conclude the following (Figs. 2-8). In early September the temperature of the 0-200 in layer in the eastern branch of the Spitsbergen Current in the section west of Bear Island was only 0.1° higher than the normal. Compared to the temperature in 1970, it was 0.4° lower. The temperature of the 0-200 m layer in the middle branch of the Spitsbergen Current in this section was found to be close to the normal, but it was 0.7° lower than that of 1970 observed at the same period. The degree of the surface warming in these waters was similar to the long-term mean, but a little lower than in 1970.

In early September 1971 the temperature of the 0-200 m layer in the North Cape Current in the section North Cape-Bear Island was found to be the highest during all the 0—group fish surveys; it was 0,6° higher than the normal and 0,2° higher than that of 1970.

At the end of August 1971 the temperature of the 0-200 m layer in the northern branch of the North Cape Current in the section eastward of Bear Island was found to be close to the normal, but was 0.4° less than in 1970. At 33°30' E and north of 76°00' N the water temperature of this current was 0.3° below the normal and 0.7° below that of early September 1970.

In late August 1971 the temperature of the 0-200 m layer in the Murmansk Current in the section along the 33°30' E was 0.1° below the normal, but 0.5° below that of 1970 observed in the same period. Surface temperature in this current was found to be 1.9° below that of 1970, which was characterized by considerable warming up.

At the end of August 1971 in the section north of Cape Kanin the temperature of the whole water column in the Murmansk Current was found to be close to the normal and its value in previous years, whereas the surface temperature was 0.7° below the normal and 2.6° below that of 1970.

The temperature from the surface to the bottom in the warm Kanin-Kolguyev Current was also close to the normal and its value observed in 1970; but in the surface layers it was found to be 1° below the normal and 2° below that of 1970.

Distribution and abundance of 0-group fish

The variation in the total density of the scattering layers is shown in Fig. 9. The echo recordings include, as well as 0-group fish, contributions from fish of older age-groups, notably capelin, polar cod and blue whiting, and also include any echos which may come from invertebrate organisms. The total echo abundance has been expressed on a subjective scale from 0-4.

In addition to the species listed below a few other species were also recorded in the catches as catfish, lumpsucker, Agonus, Leptagonus, Cottidae, Liparis, lumpenus and Triglops. No saithe were recorded this year.

Percentage length compositions of the main species caught are given in Fig. 10.

Herring

No 0-group herring were recorded this year and this is the seventh year in succession of very low abundance of the species.

Cod

0-group cod were distributed over a wide area in the central Barents Sea from Norwegian coast to 77° N, with an extension from Bear Island along the western coast of Spitsbergen to 80° N (Fig. 11). The area of distribution was somewhat less extensive than in 1970. Although the abundance was lower than was recorded in 1970 when cod were very abundant the 1971 year class can be described as being of above average abundance and more numerous than were recorded for the year classes 1965-1969.

Haddock

The distribution of 0-group haddock was similar to that of cod being distributed over a wide area in the central Barents Sea with an extension northwards along the west coast of Spitsbergen (Fig. 12). The abundance of haddock was about average for the years covered by the International surveys, the 1971 year class being less abundant than the 1969 and 1970 year classes, but more abundant than the poor year classes of 1965-1968.

Redfish

The 0-group redfish had a more westerly distribution than cod and haddock and the area covered was very similar to that observed in 1970, covering the western part of the Barents Sea and extending northwards along the west coast of Spitsbergen to 81° N (Fig. 13). The 1971 year-class appeared to be less abundant than the year classes of 1970 and 1969.

Capelin

The abundance of 0-group capelin this year was not so great as was observed in the years 1966-1969, but was more abundant than in 1970 which was relatively poor year. It should be noted however, that the 1970 year-class seems to be somewhat stronger than indicated by the last years 0-group fish survey, probably due to a contribution from summer spawned capelin. The area of distribution (Fig. 14) was more widespread than in 1970 and more similar to that observed in earlier year.

Long rough dab

0-group long rough dab were distributed in an area around Bear Island and west of Spitsbergen and also in the eastern Barents Sea (Fig. 15). The abundance was greater than in the previous two years, but possibly not as abundant as in 1965-1967.

Polar cod

There were two areas of distribution of 0-group Polar cod, one in the eastern Barents Sea and the other in an area extending from Hope Island to Bear Island and west of Spitsbergen (Fig. 16). The 1971 year-class appears to be of average abundance.

Greenland halibut

0-group Greenland halibut were recorded from eight trawl hauls. The numbers caught were small, but the average size or the fish vas larger than in previous years.

Distribution of adult fish

During the survey fairly abundant concentrations of adult Polar cod and capelin were observed in the northeast Barents Sea. Adult blue waiting were widely distributed over the western part of the survey area and extended eastward to the region between South Cape Bear Island- Fugløy.

Additional observations

During the course of the survey there were indications that the small trawl used by "Cirolana" was not catching representative catches of the larger 0-group fish, particulary cod and haddock. Earlier this year this net had proved to be very satisfactory for gadoid fish, but during this survey it was suspected that the gadoids, having reached a larger size, were able to escape capture to some degree. This suspicion was confirmed with comparative hauls with an Engels trawl.

During a period of 24 hours fishing by R/V "Cirolana" and R/V "Johan Hjort" in the same position considerable haul to haul variation was observed in species composition and the quantities of fish caught. Some evidence was obtained that for redfish the larger fish have a deeper distribution than the smaller ones.

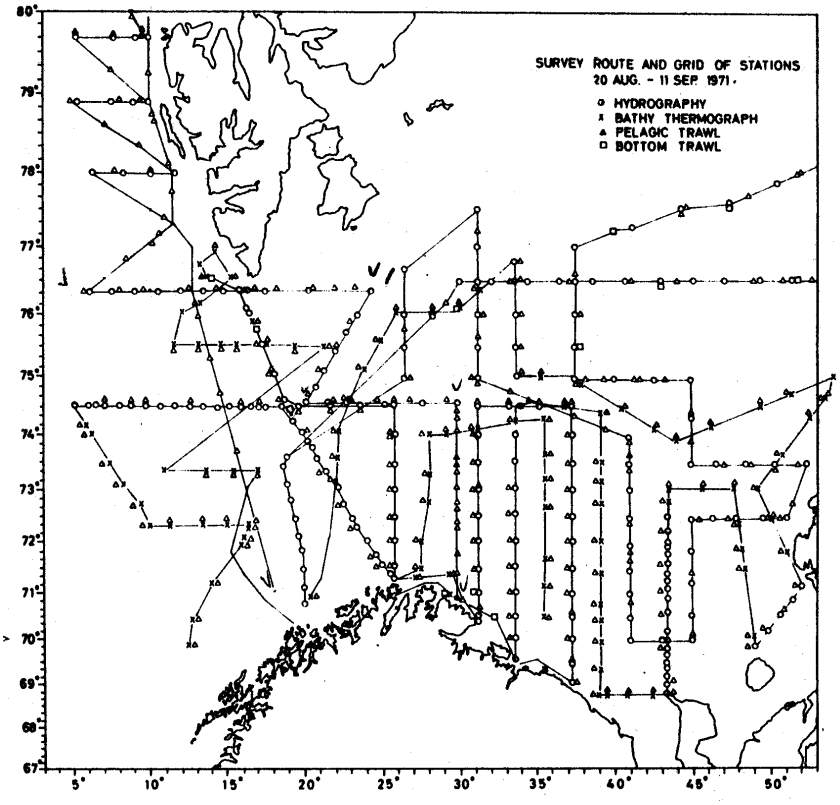

Fig. 1. Survey routes and grid of stations

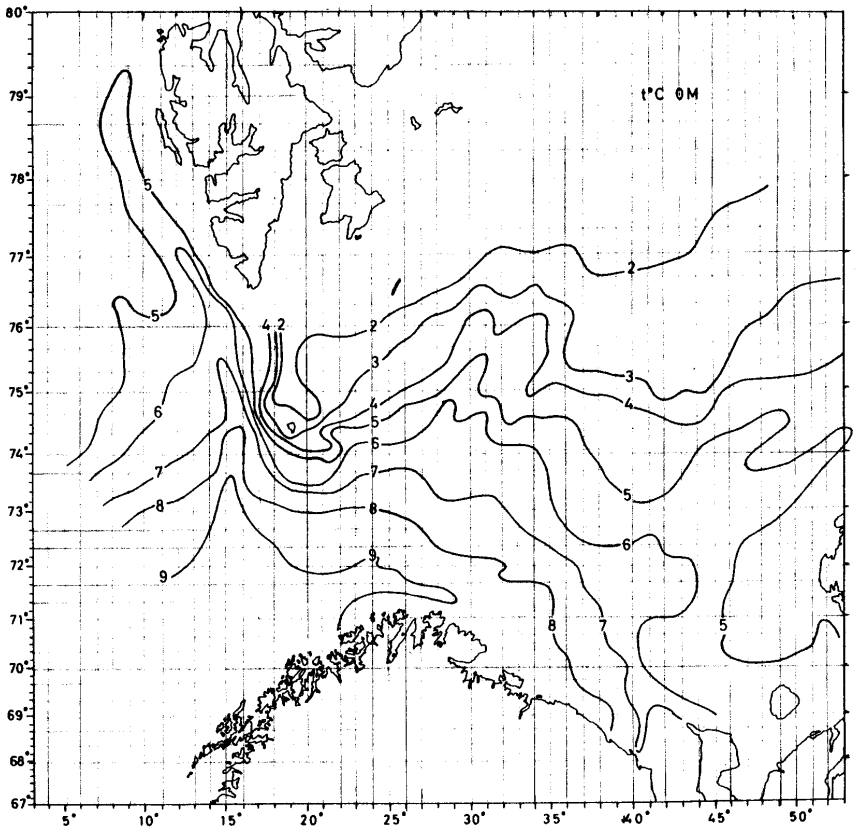

Fig. 2. Isotherms at 0 m

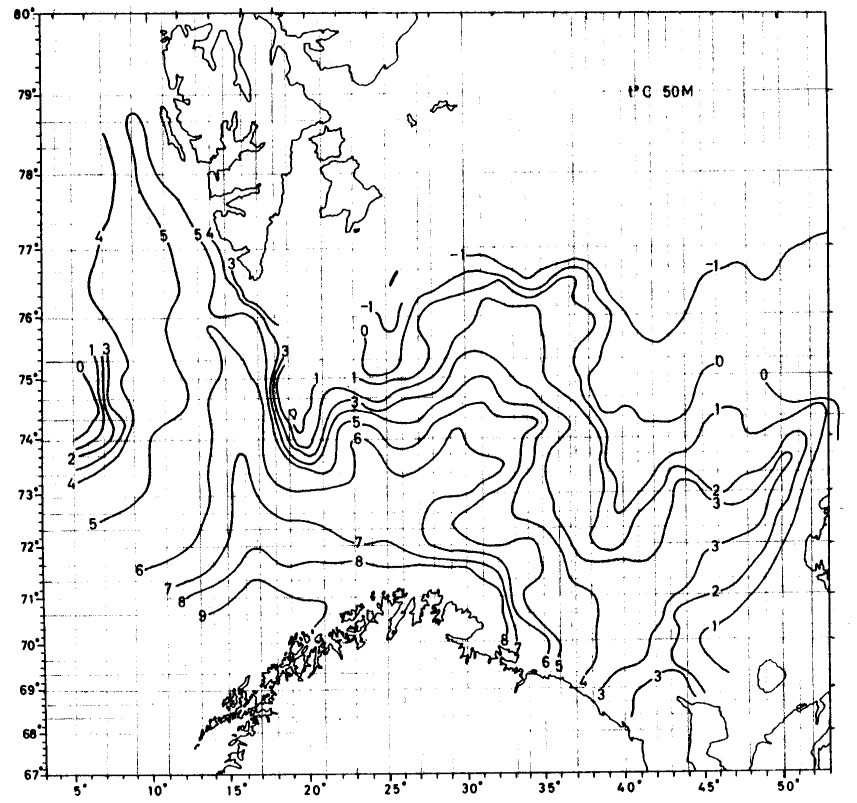

Fig. 3. Isotherms at 50 m

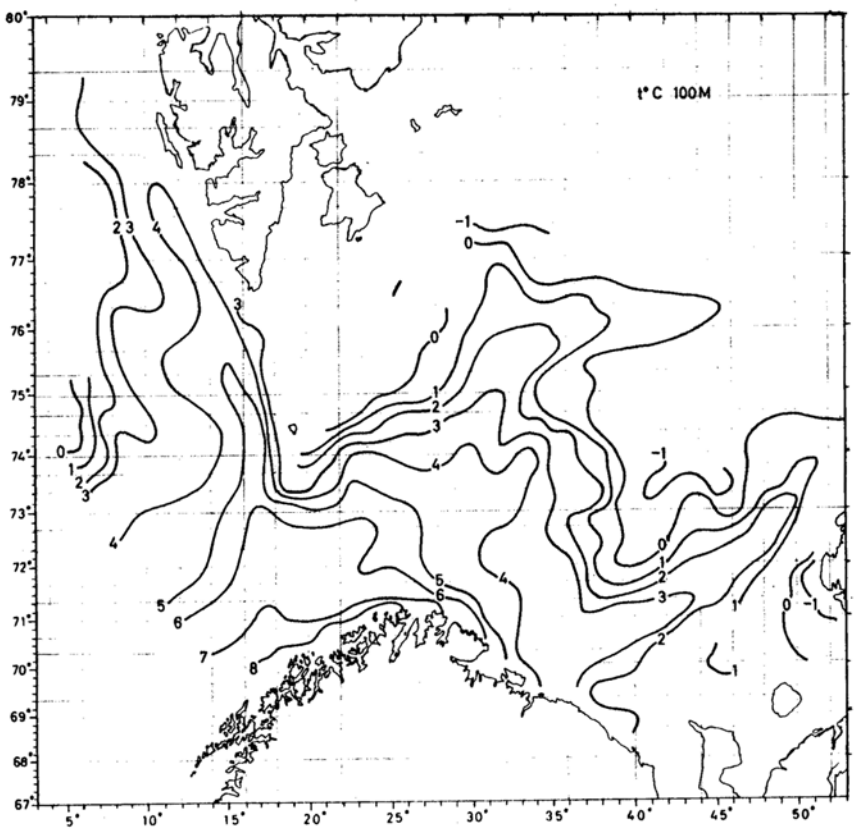

Fig. 4. Isotherms at 100 m

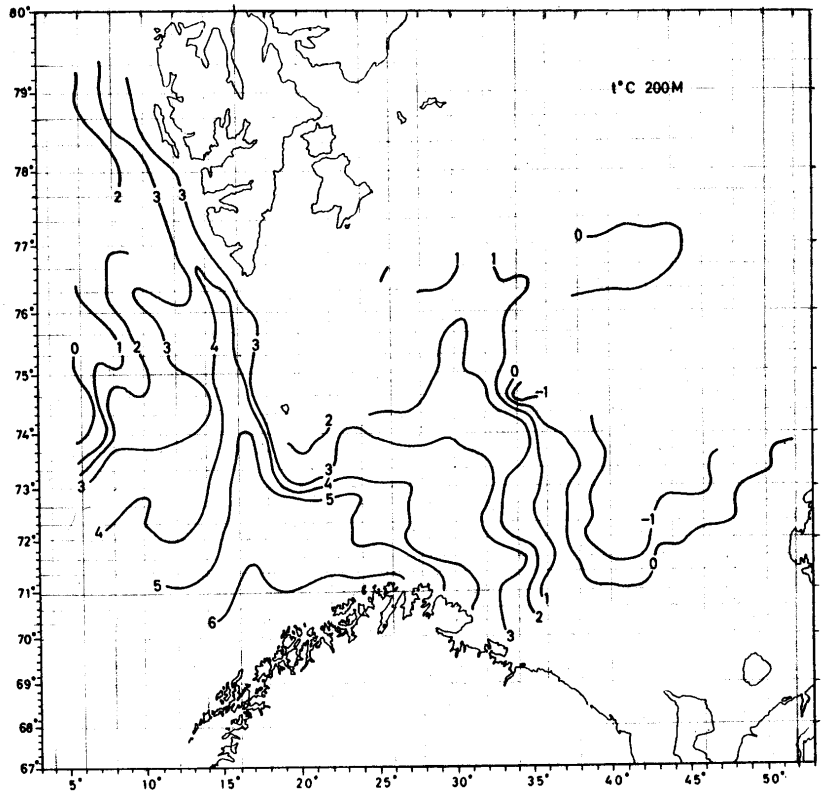

Fig. 5. Isotherms at 200 m

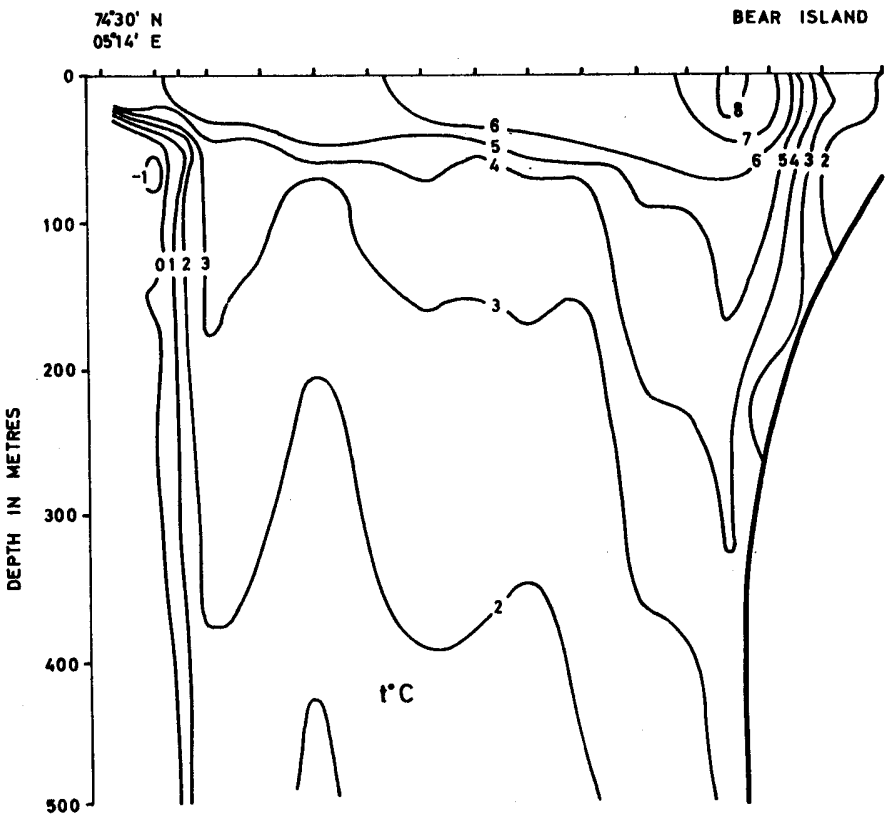

Fig. 6. Temperature section Bear Island – West. 3-9 September 1971

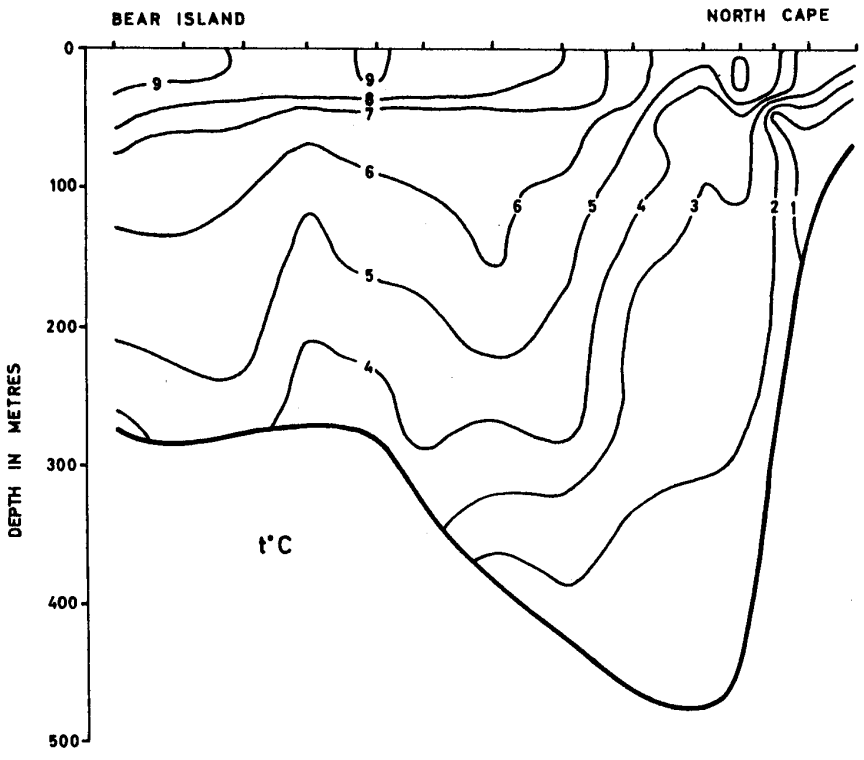

Fig. 7. Temperature section Bear Island – North Cape. 1-9 September 1971

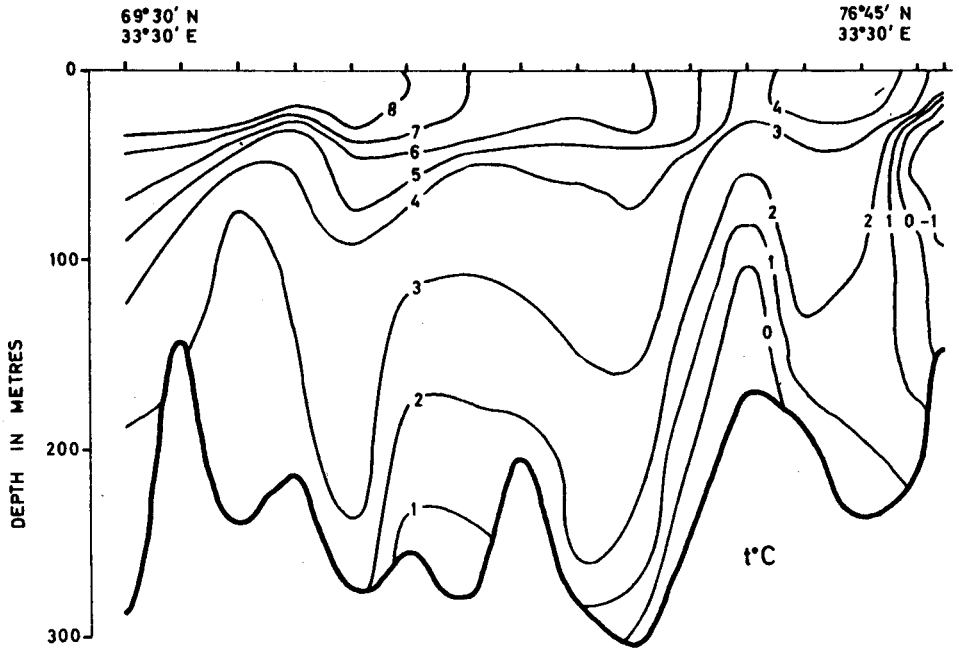

Fig. 8. Temperature in the section along the Kola meridian, 33°30'. 20 August-6 September 1971

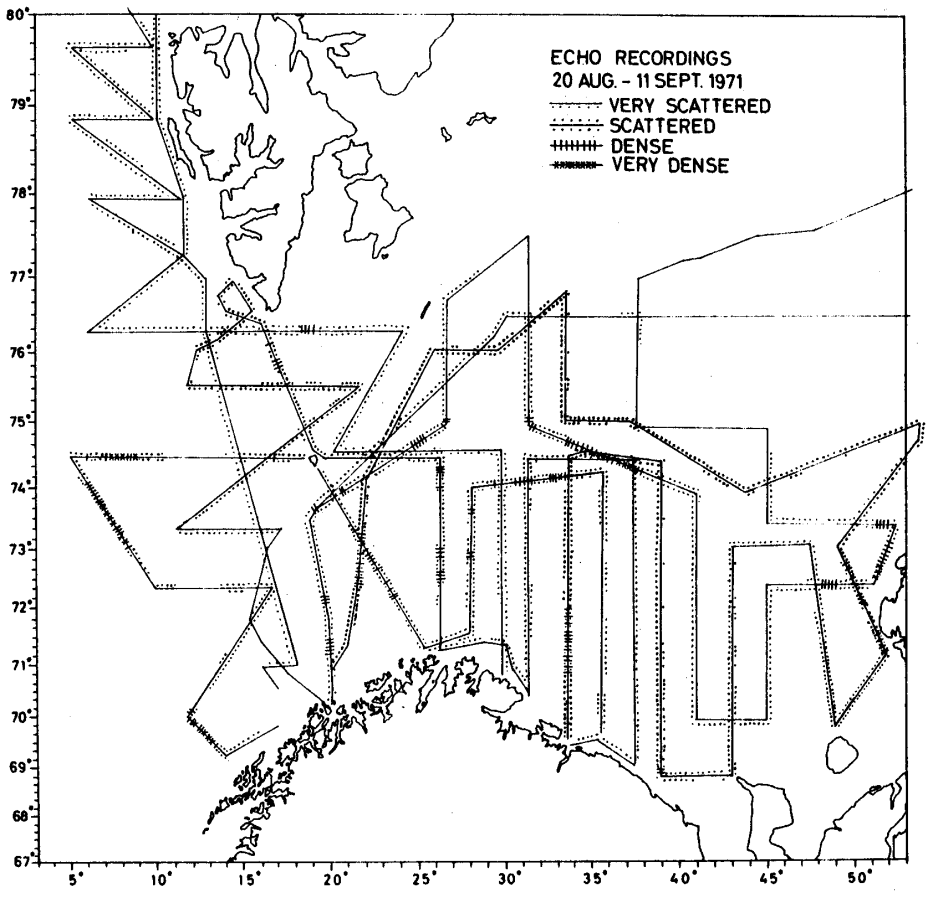

Fig. 9. Courses and echo recordings

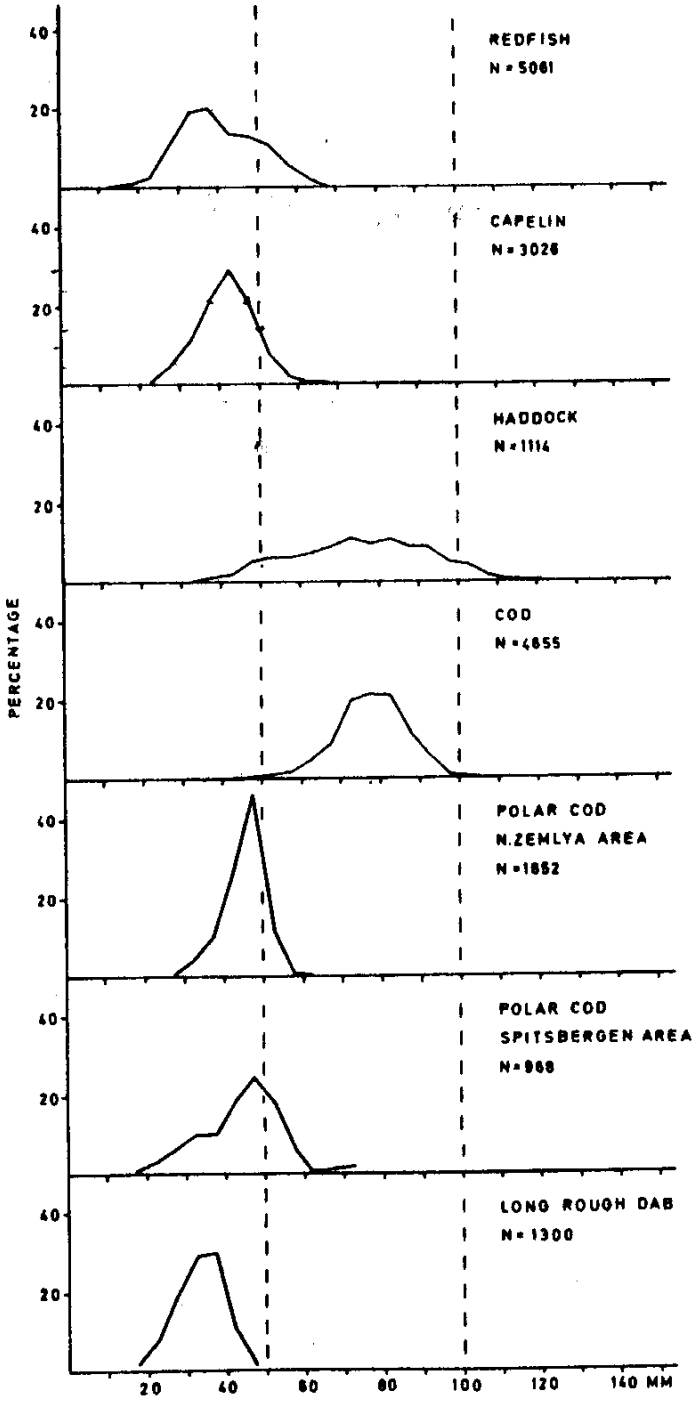

Fig. 10. Length distribution of 0-group fish

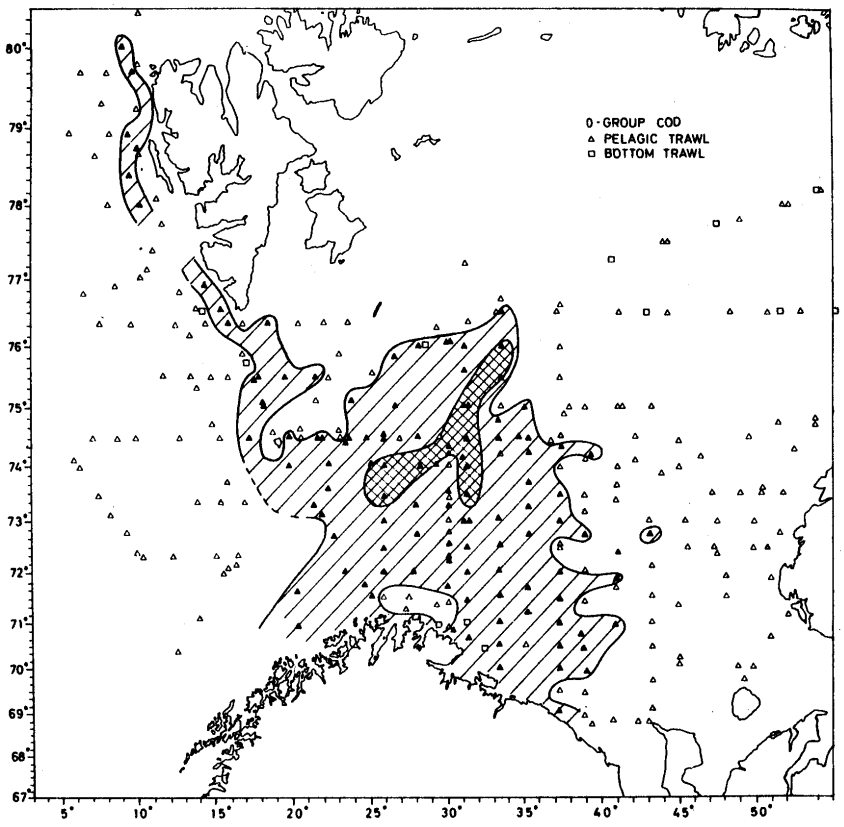

Fig. 11. Distribution of 0-group cod

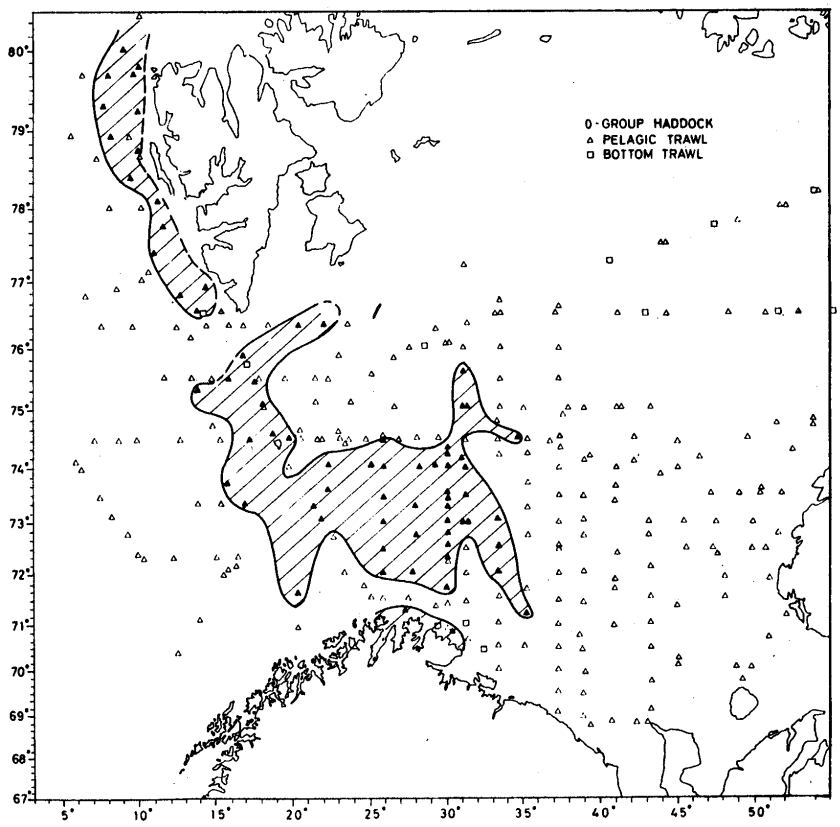

Fig. 12. Distribution of 0-group haddock

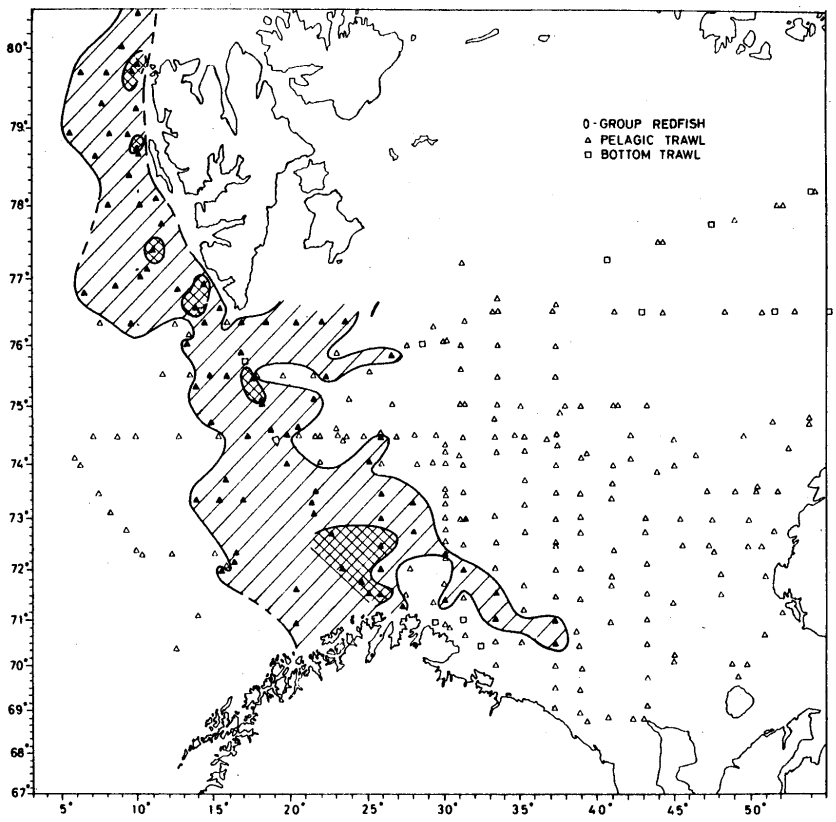

Fig. 13. Distribution of 0-group redfish

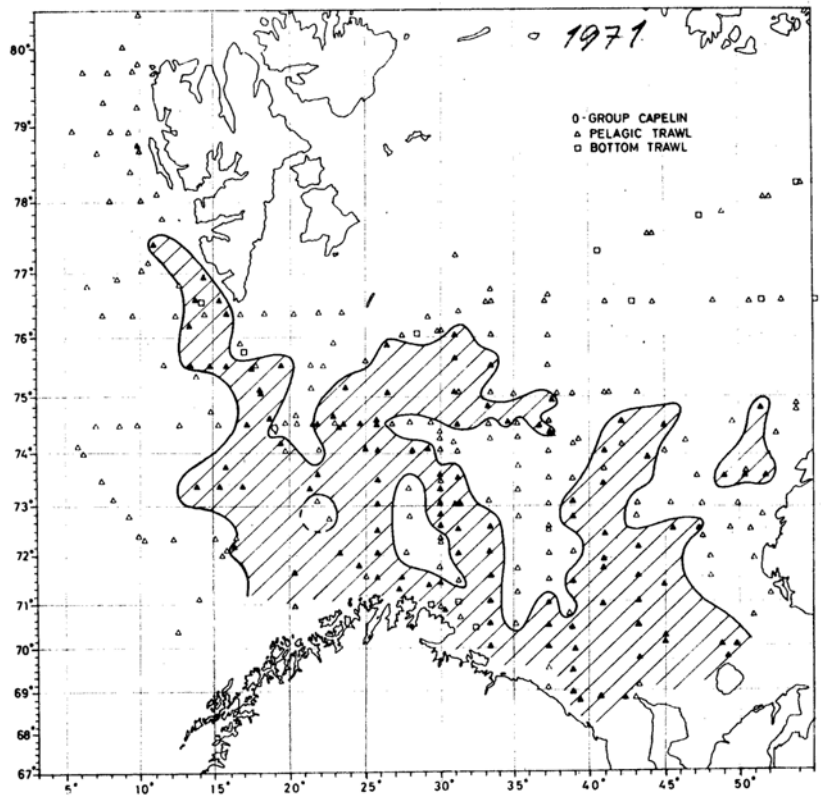

Fig. 14. Distribution of 0-group capelin

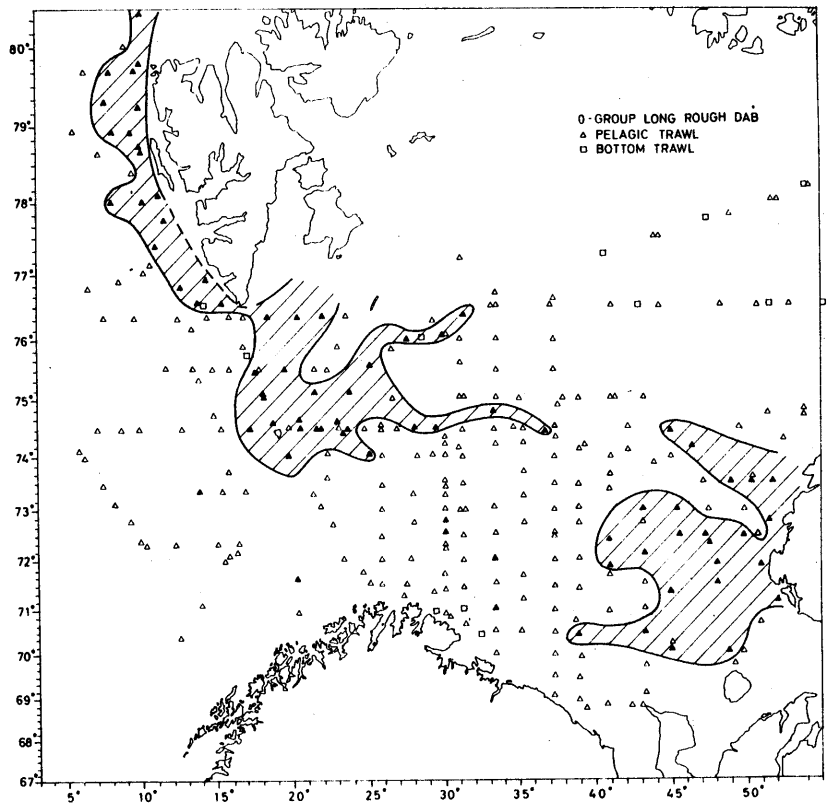

Fig. 15. Distribution of 0-group long rough dab

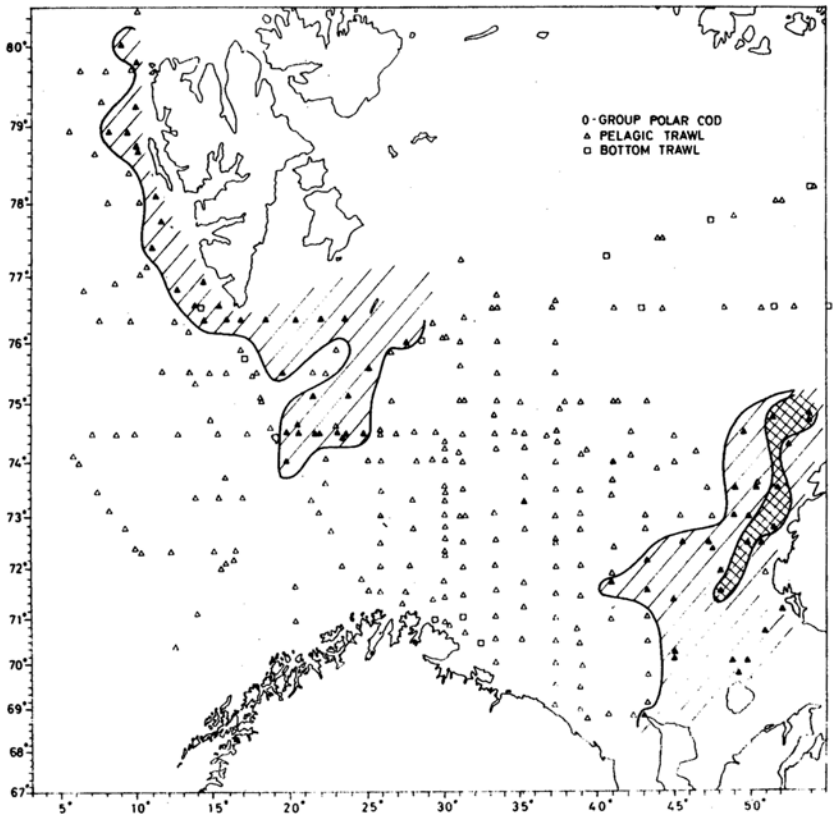

Fig. 16. Distribution of 0-group polar cod

Preliminary Report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1972

Introduction

This was the eighth in a series of international surveys to study the abundance of 0-group fish in the Barents Sea and the Svalbard Region.

The following vessels and scientists took part in the survey:

USSR	R/V "Akademik Knipovich"	V.N. Schleinik
	R/V "Fridtjof Nansen"	V.N. Kusnetsov
	R/V "Poisk"	A.S. Seliverstov, V.K. Nethaev
Norway	"Johan Hjort"	T. Monstad, R. Sætre, O. Smestad
	"G.O.Sars"	L. Midttun, P. Hognestad, O. Nakken

Dragesund and Sarynina took part in preparation of the report.

Preliminary plans for the survey were made at a meeting in Bergen in May 1972, and final arrangements for coordination were made in Kirkenes and Murmansk immediately before the commencement of the survey. The main part of the survey was carried out between 27 August and 11 September but "Akademik Knipovich" commenced somewhat earlier. The survey was followed by a meeting in open sea on the 13 September. Materials were exchanged and a brief report worked out based on a rather superficial analysis of data. The final version of this report was agreed upon in a meeting in Moscow in November 1972.

Material and methods

The distribution and density of the pelagic scattering layers were estimated from echo sounder paper records but also to some extent from echo integrator measurements. The organisms forming the scattering layers were identified by sampling with small meshed pelagic trawls. Various depth metering devices on the trawl were used for the accurate control of the depth of the trawling. Since different trawl types were used by the different vessels, a direct quantitative comparison between catches could not be made.

Fig. 1 shows the area surveyed and the ship's tracks together with trawl and hydrographic stations worked.

Results

Hydrography

Hydrographic observations were carried out along the same standard sections as in previous years.

A preliminary analysis of the data made it possible to conclude as follows (Fig. 2-6, 6a) (horizontal temperature distribution is shown for 0,50,100 and 200 m depth in Bear Island-North Cape, Bear Iceland-West and Kola sections).

Section's data are based on the material of Russian investigations. Maps and pictures made by Norwegian scientists.

Distribution and abundance of 0-group fish

The distribution and density of the scattering layers are shown in Figs. 7 and 8. The echo records do not include other age group fish but there might be some contribution from invertebrate organisms. The echo abundance is as usual expressed on a subjective scale from 0-4 (Fig. 7). However, this year is also prepared a distribution chart based on echo integrator deflections (Fig. 8). Integrator deflection is proportional to fish density.

In the following we shall give short comments on the abundance of the different species observed. Length distribution based on all catches of the most important species are shown in Fig. 9.

Herring

No 0-group herring were recorded this year.

Cod

0-group cod were distributed over a rather wide area both in central and eastern parts of the Barents Sea and also along the western and north-western Spitsbergen shelf (Fig. 10). The total area of distribution was hardly covered this year, since the cod had an unusual far easterly and northerly location within the circulation system. The abundance is considered to be of the same magnitude as in 1971, this means somewhat above average.

Haddock

The haddock were found in the western Barents Sea and along the west coast of Spitsbergen (Fig. 11). This year the abundance was estimated to be low compared with the years 1969-1971.

Redfish

The distribution of redfish was found to be similar to that in 1965 and 1971, located in the western Barents Sea and northwards along the western Svalbard shelf (Fig. 12). The 1972 year-class was considered to be somewhat stronger than those of 1965 and 1971 but weaker than the rich 1969 year-class.

Capelin

The 0-group capelin were distributed over the total Barents Sea south of latitude 77° N and within a smaller area west of Spitsbergen (Fig. 13). The exact northern limit of distribution was not fully described by this years field coverage. The density varied much and the highest concentrations were found west of Novaya Zemlya and near the Bear and Hope Islands. The abundance of young capelin (0 and 1 groups) can be considered as being high. Part of the recorded capelin originated from the spawning of 1971. This is indicated by the length distribution of Fig. 9. The 1971 year-class can be stated to be rich probably comparable with those of 1967 and 1969.

Long rough dab

The 0-group long rough dab were found within three separated areas as seen from Fig. 14. The abundance this year was appearently low.

Polar cod

According to observations from R/V "Akademik Knipovich" the polar cod was found to be abundant in the Novaya Zemlya area, but in the other parts of the area covered, the abundance was low (Fig. 15). However as a conclusion the 1972 year-class is considered to be strong, probably at the same order as that of 1969. It should also be noted that the distribution in the southern area of sea was somewhat more south-easterly than in previous years.

Other species

Fig.16 indicate observations of three other species viz. Greenland halibut, Mackerel and Saithe. These species were found in only small quantities. Smaller quantities of Cottides, Squids and Lumpenus were also observed, the abundance of Cottides is probably somewhat higher this year compared to 1971.

Adult fish

The observations of adult fish during the 0-group survey were not been reported in this paper, but will be dealt with in national reports.

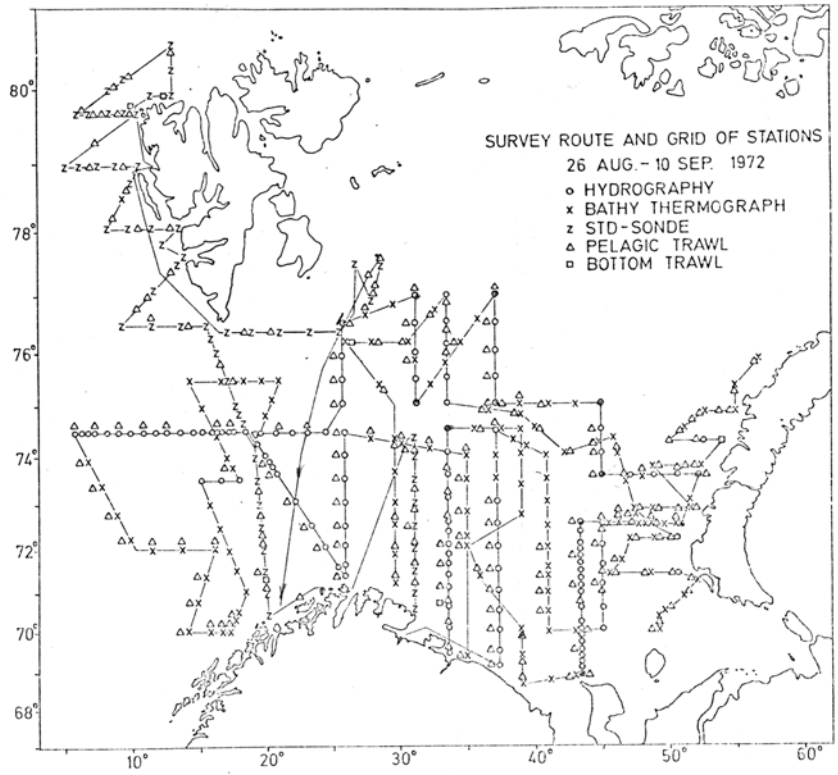

Fig. 1. Survey routes and grid of stations

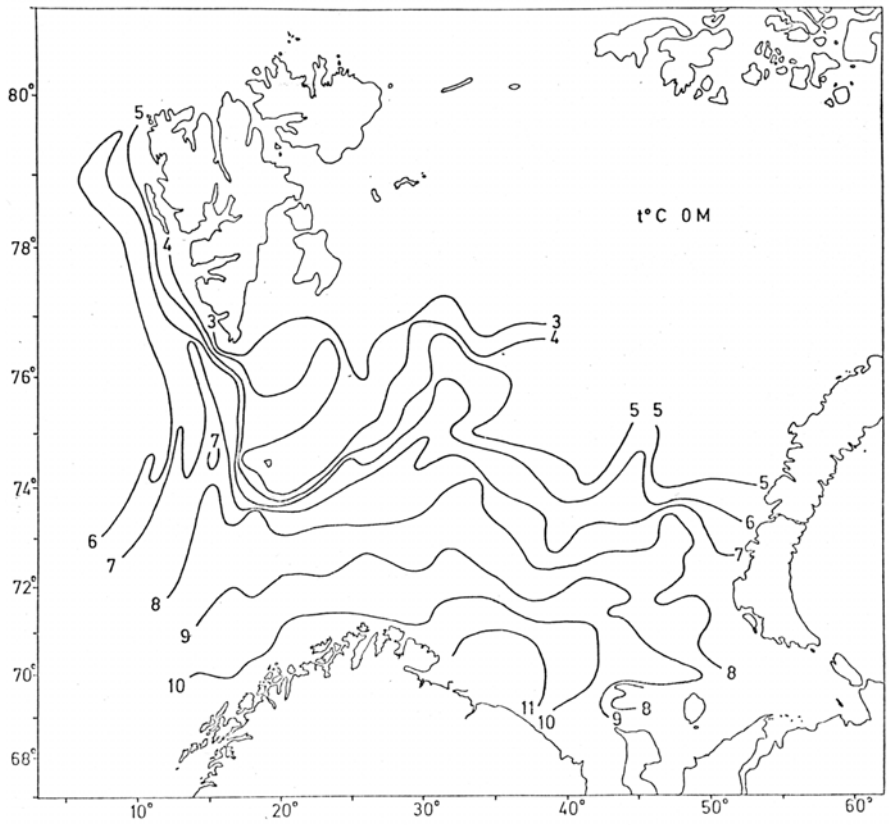

Fig. 2. Isotherms at 0 m

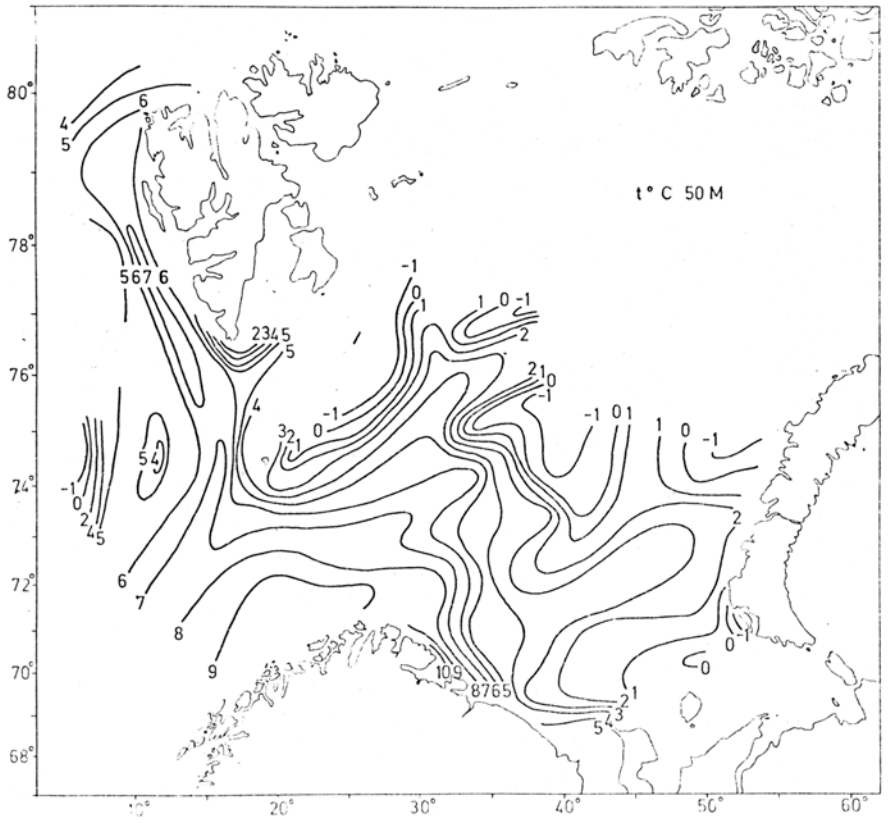

Fig. 3. Isotherms at 50 m

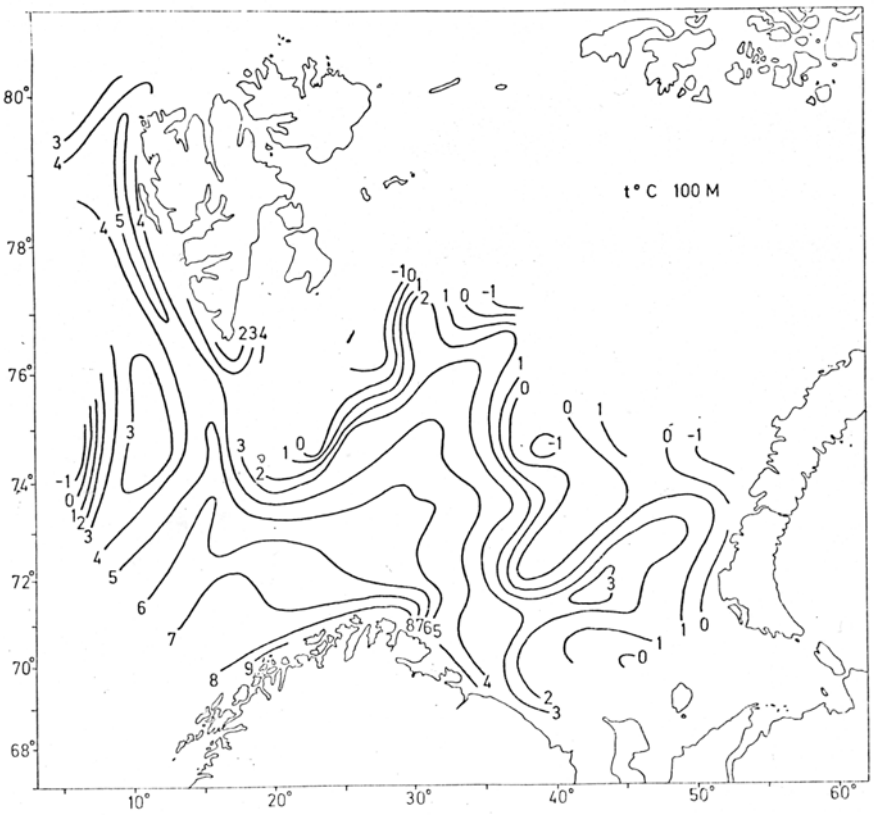

Fig. 4. Isotherms at 100 m

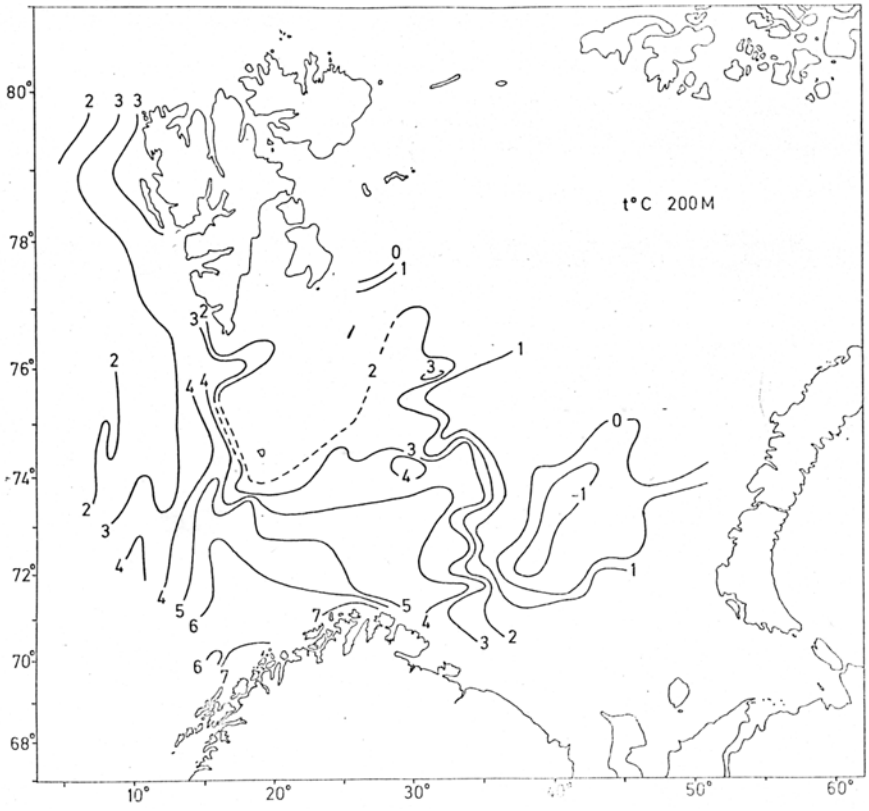

Fig. 5. Isotherms at 200 m

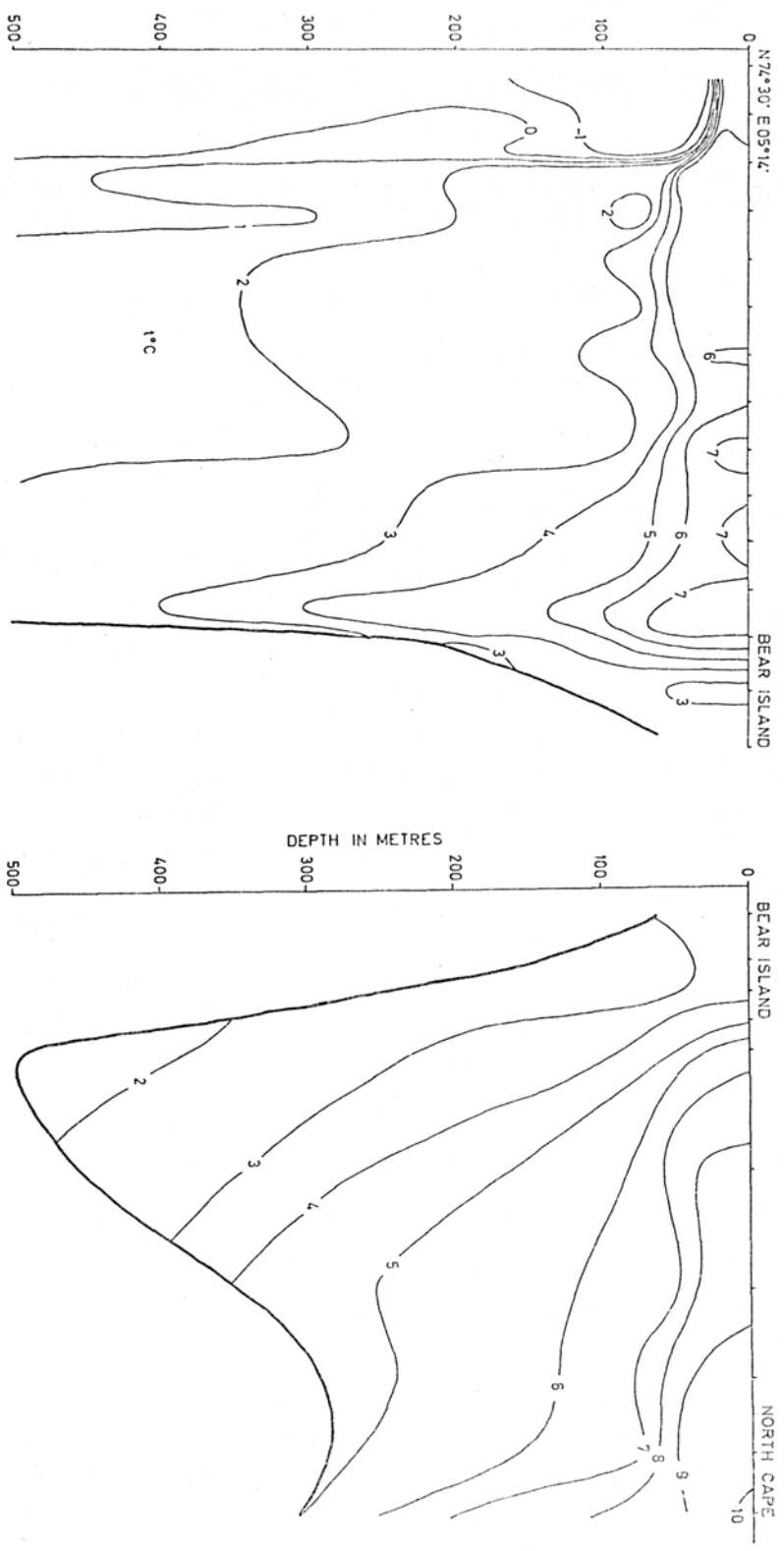

Figure 6. Temperature section Bear Island-west and Bear Island-North Cape.

Fig. 6. Temperature section Bear Island-West and Bear Island-North Cape

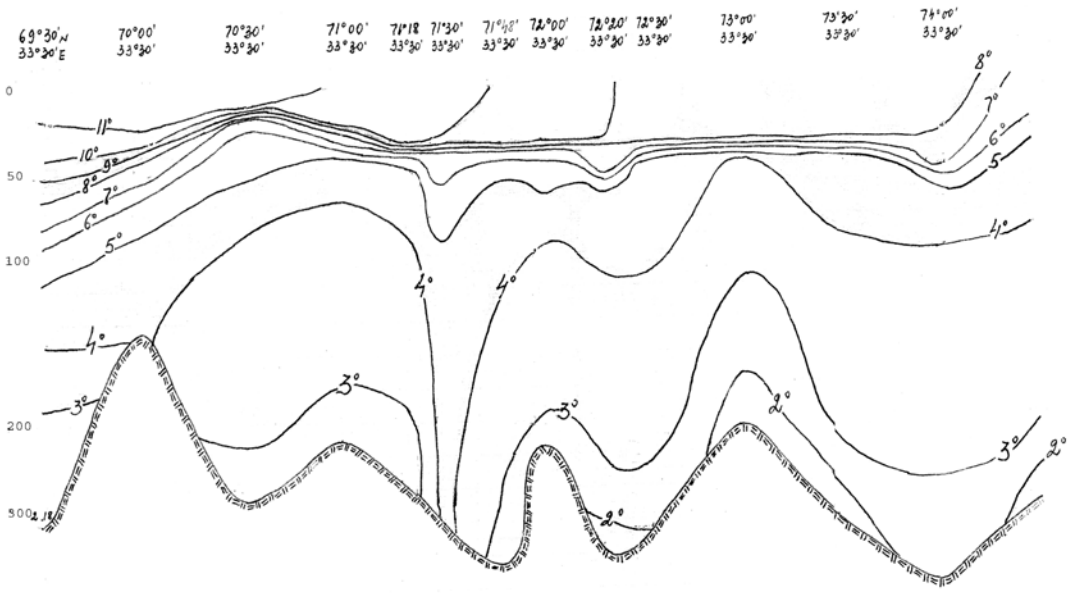

Fig. 6a. Temperature section along the Kola meridian

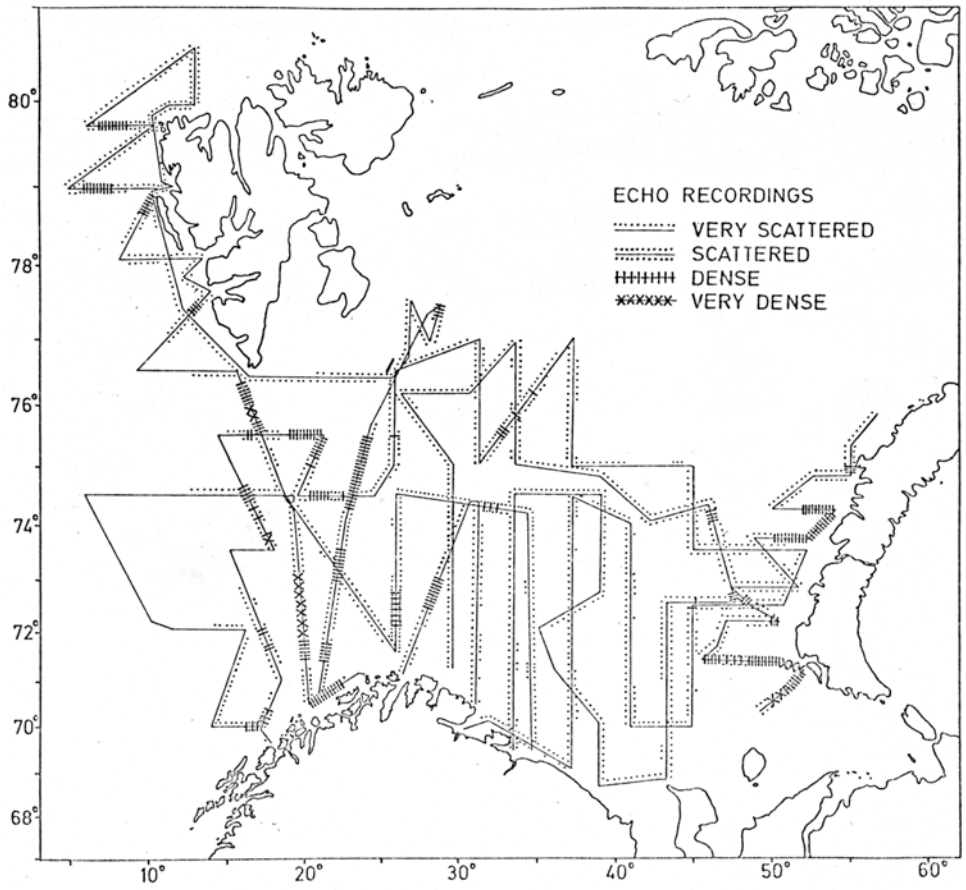

Fig. 7. Courses and echo recordings

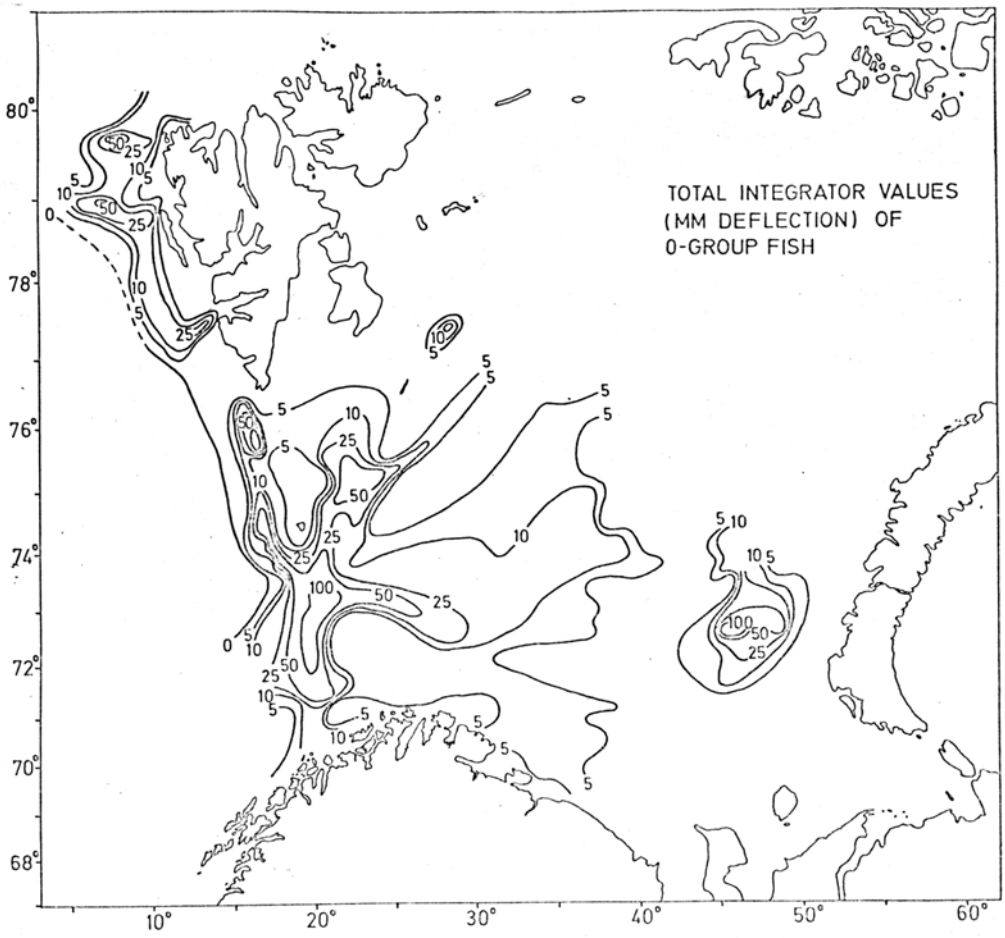

Fig. 8. Total integrator values (mm deflection) of 0-group fish

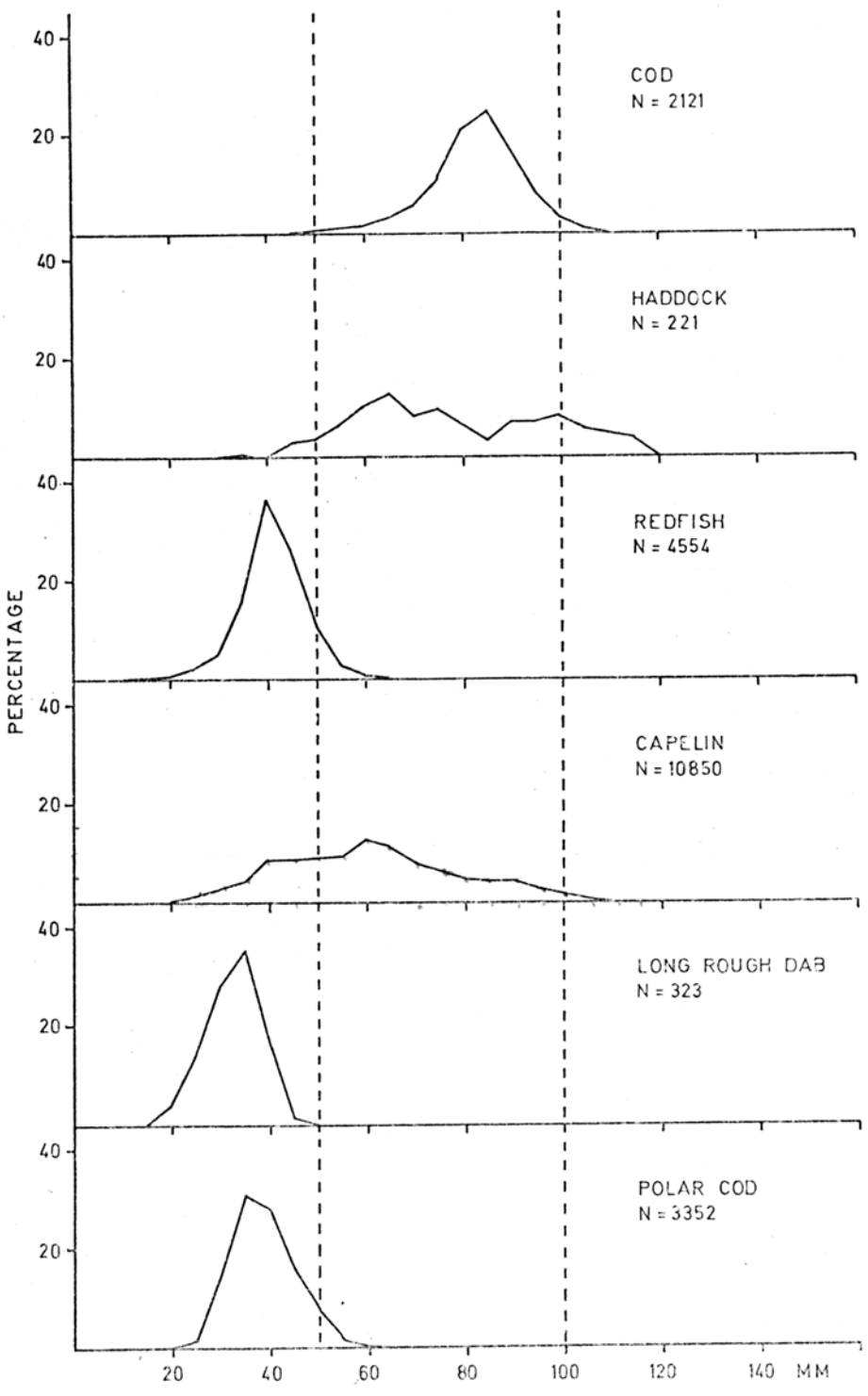

Fig. 9. Length distribution of 0-group fish

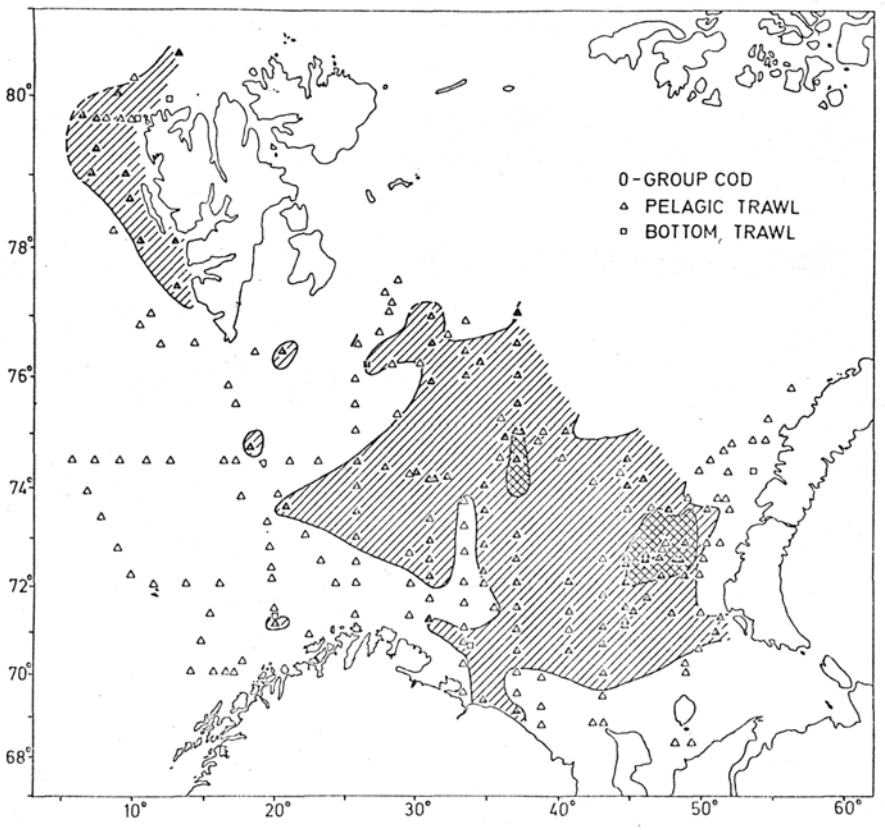

Fig. 10. Distribution of 0-group cod

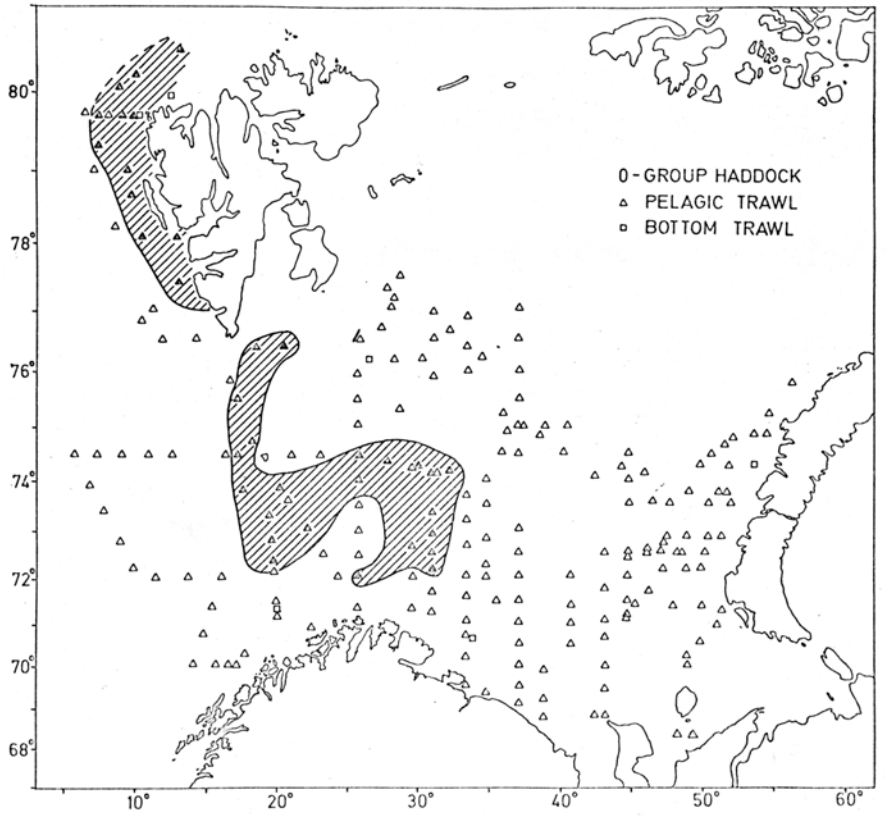

Fig. 11. Distribution of 0-group haddock

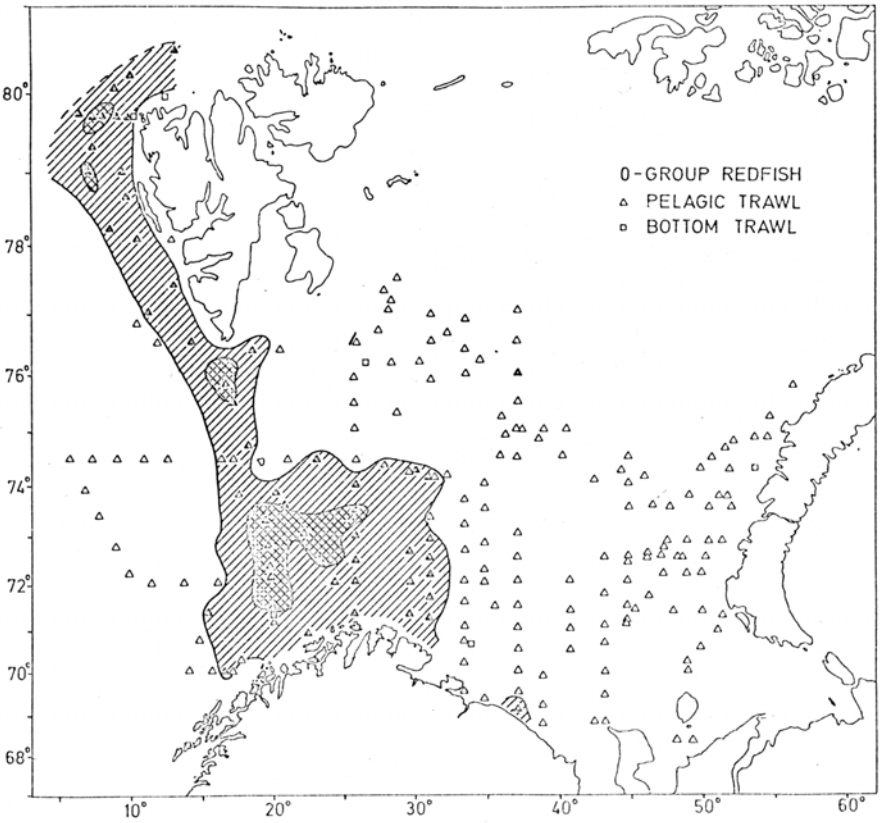

Fig. 12. Distribution of 0-group redfish

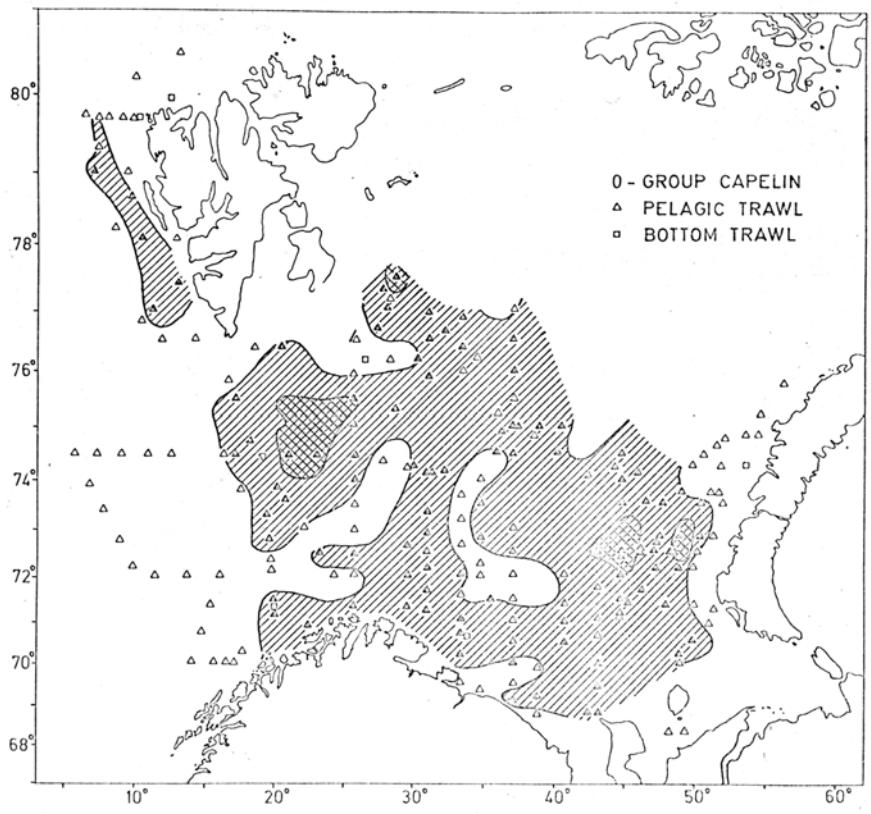

Fig. 13. Distribution of 0-group capelin

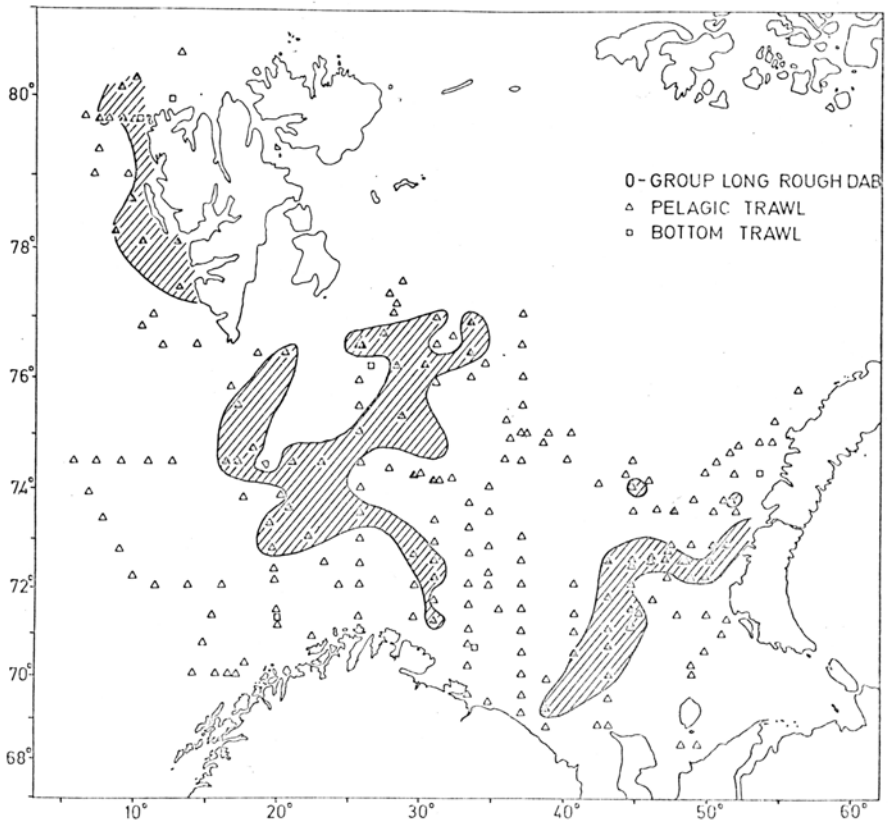

Fig. 14. Distribution of 0-group long rough dab

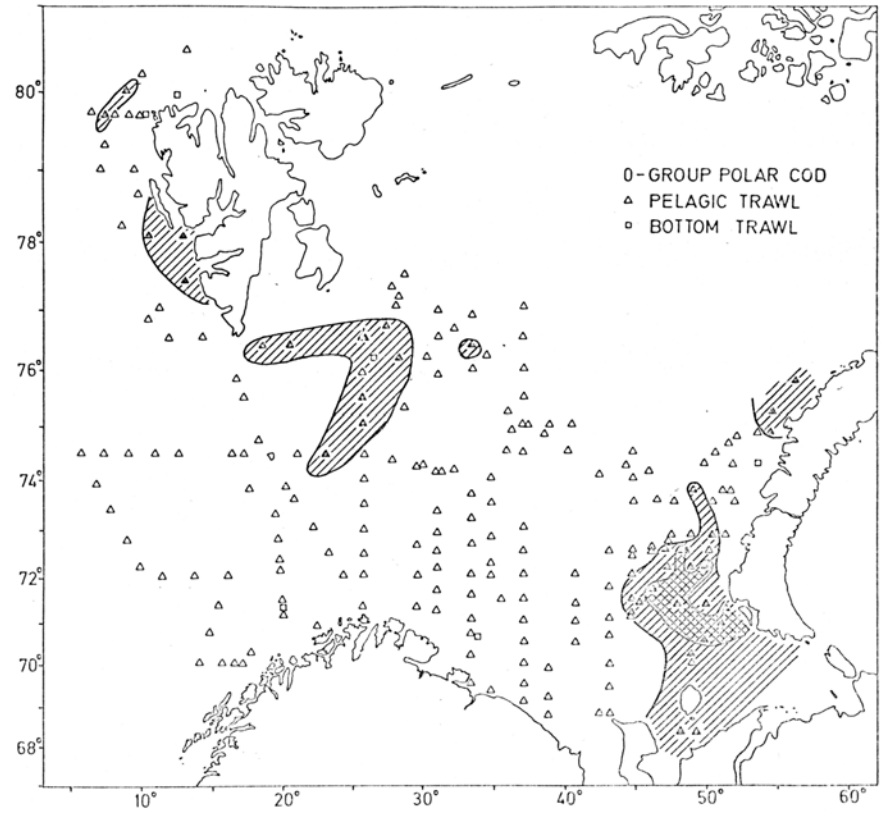

Fig. 15. Distribution of 0-group polar cod

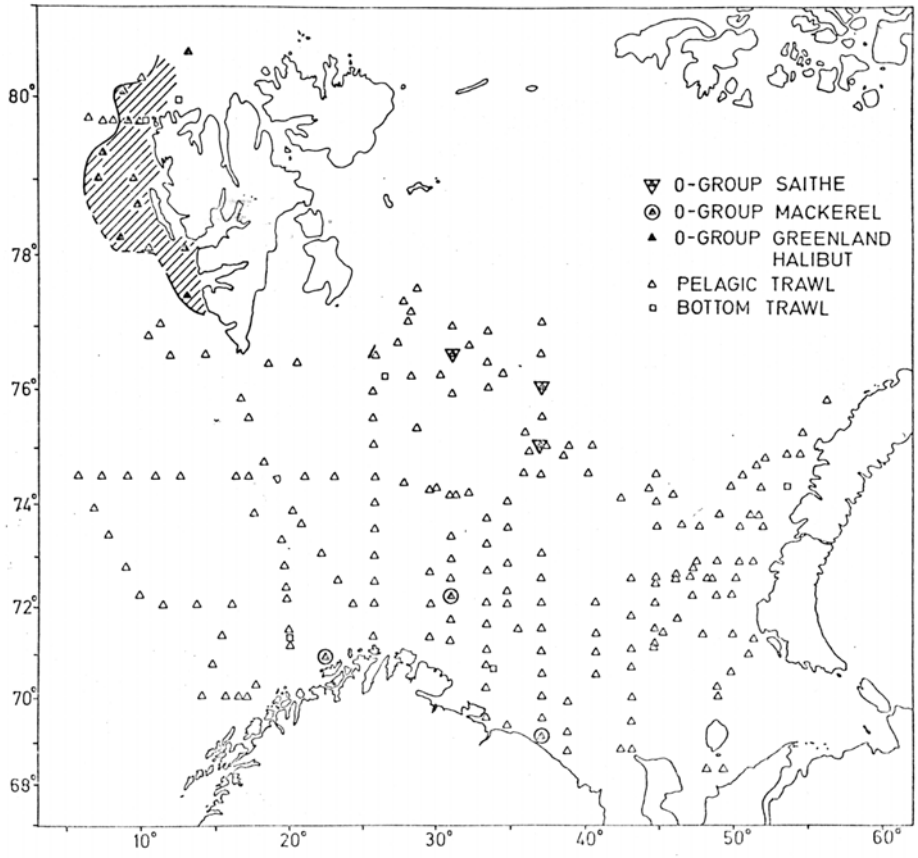

Fig. 16. Distribution of 0-group saithe, mackerel and Greenland halibut

Internal Council for
the Exploration of the Sea

C.M. 1973/H25
Pelagic Fish (Northern) Committee
Ref: Hydrography and Demersal
Fish (N) Committees. 27 pp.

Preliminary Report of the International 0-group fish survey in Barents Sea and adjacent waters in August-September 1973

Introduction

This was the ninth in a series of international surveys to study the abundance of 0-group fish in the Barents Sea and the Svalbard region.

The following vessels and scientists took part in the survey:

USSR	R/V "Fridtjof Nansen"	V.N. Kusnetsov, V.V. Rossov, N.G. Ushakov.
	R/V "Poisk"	V.N. Shleinik, Z.M. Berdichevski
Norway	"Johan Hjort"	O. Nakken, O. Smedstad, I. Hoff
	"G.O. Sars"	L. Midttun, O. Dragesund, G. Vestnes
U.K.	"Cirulana"	R.W. Blacker, K. Brander, W. Huggins M. Vine

Preliminary plans for the survey were made at a meeting in Bergen in May 1973, and final arrangements for coordination were made in Kirkenes and Murmansk immediately before the commencement of the survey. The main part of the survey was carried out between 28 August and 11 September but "Cirolana" commenced and finished a little earlier. The survey was followed by a meeting in Hammerfest 12-14 September. Material was exchanged and a report worked out.

Materials and methods

The distribution and density of the pelagic scattering layers was estimated from echo sounder paper records but also to some extent from echo integrator measurements. The organisms forming the scattering layers were identified by sampling with small meshed pelagic trawls. Various depth metering devices on the trawl were used for the accurate control of the trawling depth.

An attempt was made to compare the fishing power of the trawls used by "Poisk", "Fridtjof Nansen", "Johan Hjort" and "G.O. Sars". Two parallel tows were made on the same recording of 0-group redfish. The results are too few to give a reliable comparison, but they indicate that comparability increases with increasing size of the trawl gape.

No comparison could be made with the "Cirolana's" gear, but most of the houls were made with a Norwegian trawl similar to that used on the "Johan Hjort" and "G.O. Sars".

Fig. 1 show the area surveyed and the ship's tracks together with trawl and hydrographic stations worked.

Results

Hydrography

Hydrographic observations were made along the same standard sections as in previous years. Preliminary analyses of the data are given in Figs. 3-9.
Comparison of the hydrographic conditions in the Barents Sea in 1973 with those of previous years shows that temperatures were similar to the very warm conditions of 1972 (Tables 1 and 2).

Table 1. Mean water temperature in the Murman Current, the Kola section at the end of August in the years 1965-1973

Year/ Layer	1965	1966	1967	1960	1969	1970	1971	1972	1973
0-50 m	6.7	6.7	7.5	6.4	6.7	7.8	7.1	8.7	7.7
50-200 m	3.8	2.6	4.1	3.7	3.1	3.6	3.2	4.0	4.5
0-200 m	4.6	3.6	4.9	4.4	4.0	4.7	4.2	5.2	5.2

Table 2. Mean water temperature in the North Cape Current, the North Cape-Bear Island section at the beginning of September in the years 1965-1973

Year/Layer	1965	1966	1967	1968	1969	1970	1971	1972	1973
0-200 m	5.1	5.5	5.6	5.4	6.0	6.1	5.7	6.3	6.2

The surface temperature in the southern part of the Barents Sea was about 1 °C colder than in 1972, but at 50 m depth conditions were much warmer and the limit of water colder than 0 °C was nearly 100 n. miles further north along longitude 40°00' E than in 1972.

The temperature of the 50-200 m layer of the Murman Current was the highest recorded in the period 1965-1975. This shows very intensive advection of warm water in the Murman Current in 1973, in contrast to the situation in 1972 when the warm conditions were attributable to high solar radiation.

In the Bear Island-Hope Island area the influence of the Cold Bear Island current was weak, and the sub-zero temperatures typical of the 50-100 m layer were not found in 1973.

The West Spitsbergen current was also very warm in 1973 compared with conditions in 1971 and 1972 (Table 3).

Table 3. Mean water temperature in the Spitsbergen Current west of Bear Island at the beginning of September in the years 1971-1973

Year/Layer	1971	1972	1973
0-200 m	4.5	4.6	5.4

Distribution and abundance of 0-group fish

In previous years a map has been given showing: the total echo density based on a subjective evaluation of the echo sounder paper records. Improvement in echo-sounding techniques has now introduced more accurate assessments by the use of echo integrators

which can measure relative fish density parameters and even absolute density, provided some calibration constants are known.

Last year total echo abundance from echo integrator deflection values was given.

This year's data based on data from the "G.O. Sars" and "Johan Hjort" with additional information from "Poisk". Both "Poisk" and "Cirolana" have integrators, but in order to compare the results with those from "G.O. Sars" and "Johan Hjort" calibration trials must be made between the ships. This was not possible with "Cirolana", but some comparable values were obtained from "G.O. Sars", "Johan Hjort" and "Poisk". More information is needed before all the data can be combined.

It is recommended that next year's survey program should allow time for these essential calibration runs.

The "G.O. Sars" carried out some initial trials to relate integrator values to absolute abundance for some species. These values need confirmation from additional experiments.

The distribution of the 0-group fish of various species is shown by the shaded areas in Figs. 11-19.

The estimates of the relative abundance in the following comments have been based mainly on the trawl catches, but the echo abundance indices as used by Haug and Nakken (1973) have also been taken into account.

Herring (Fig. 11)

For the first time since 1966 0-group herring were recorded in more than a few scattered hauls. The main area of distribution was similar to that found in 1966, but none found west of 19°00' E.

Cod (Fig. 12)

As in 1972 0-group cod were distributed over a wide area of the Barents Sea from 17°00'-18°00' E to Novaya Zemlja and south of 76°50' N latitude. The highest concentrations were found in the east and south-east Barents Sea. 0-group cod were virtually absent west of Spitsbergen and only small numbers were caught in Storfjordrenna. The indications are that the 1973 year-class is a strong one.

Haddock (Fig. 13)

The distribution of haddock extended further south and east in the southern Barents Sea than in 1972, but off West Spitsbergen its range was less extensive. The abundance was estimated to be similar to that of the 1972 year-class which was below the average of the 1969-1971 year-classes.

Redfish (Fig. 14)

Like the cod and haddock the distribution of 0-group redfish extended further south and east into the Barents Sea than in 1972. Redfish were much less abundant than usual west of Spitsbergen. The 1973 year-class was considered to be strong.

Capelin (Fig.15 and 16)

0-group capelin was sparsely distributed except in the eastern Barents Sea. None were caught off West Spitsbergen. 1-group capelin was widely distributed over the north and east Barents Sea, but few were caught west of Spitsbergen. Catches of 1-group capelin seem to confirm last year's estimate that the 1972 year-class was a strong one. The abundance of the 1973 year-class appears to be low compared with the 1971 and 1972 year-classes.

Long rough dab (Fig. 17)

The distribution of 0-group long rough dab is broadly similar to that found in 1972, except that few were caught in the Hope Island area, and its abundance is about the same as the 1972 year-class.

Polar cod (Fig. 18)

Polar cod were found in areas west, south and east of Spitsbergen and also off Novaya Zemlya as in 1972. Assessment of the abundance of 0-group polar cod must await data from the "Akademik Knipovich".

Creenland halibut (Fig. 19)

0-group Greenland halibut were found in small numbers north west of Spitsbergen.

Other species (Fig 19)

Small numbers of mackerel, saithe, catfish and 0-group blue whiting were caught during the survey, and 0-group Leptagonus, Lumpenus and Liparis were widely distributed. 0-group sandeel were abundant and widely distributed in the south-east Barents Sea.

Adult fish

Adult blue whiting were caught over deep water of the Norwegian Sea, everywhere from 79°29' N southwards. Small numbers of Lumpsucker (Cyc1opterus lumpus) were also caught. Off north-west Spitsbergen cod of the 1970 year-class occurred pelagically along the edge of the shelf.

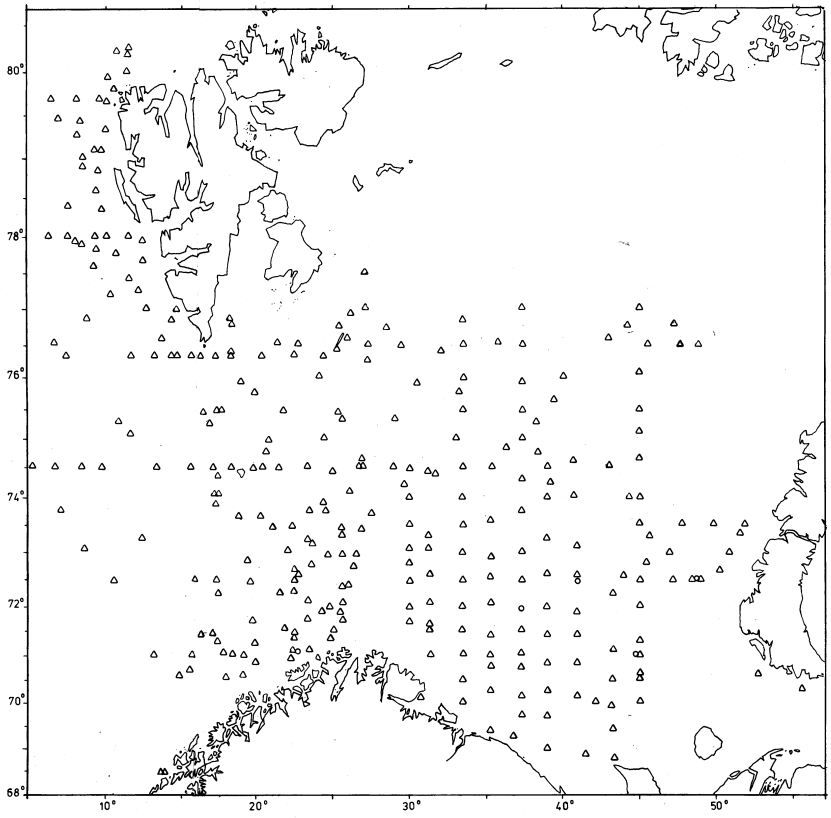

Fig. 1. Survey routes and grid of stations

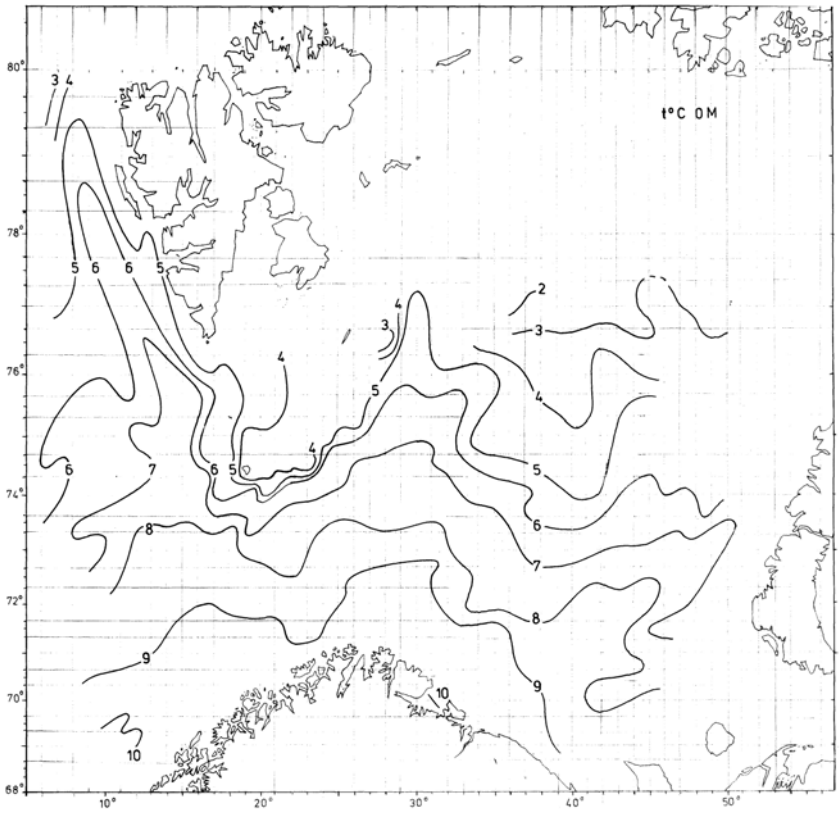

Fig. 3. Isotherms at 0 m

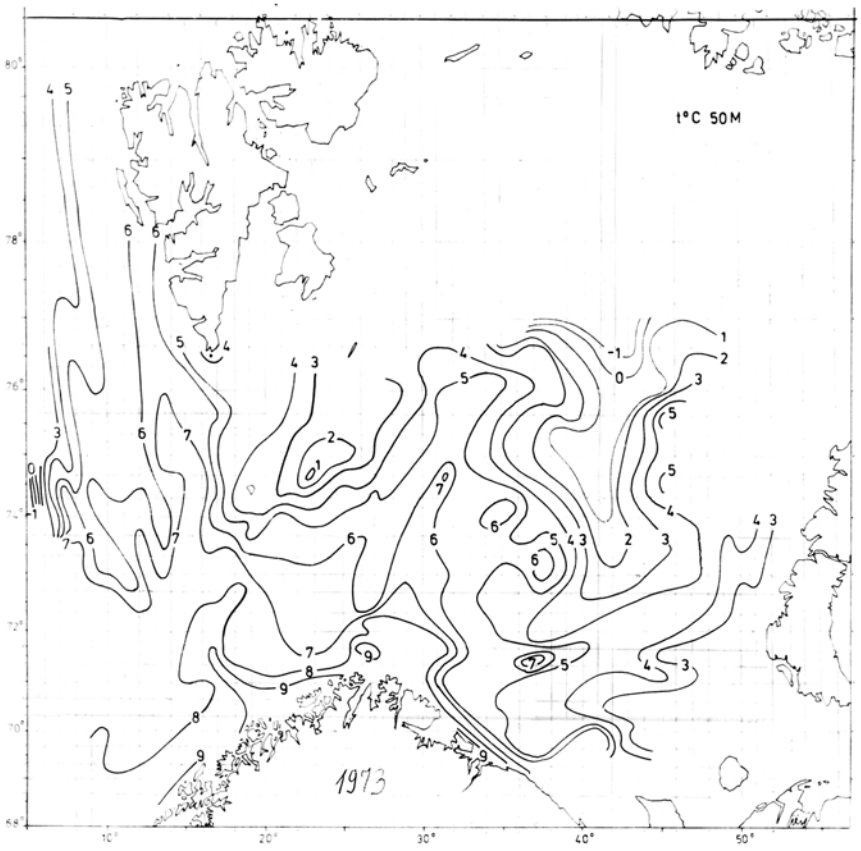

Fig. 4. Isotherms at 50 m

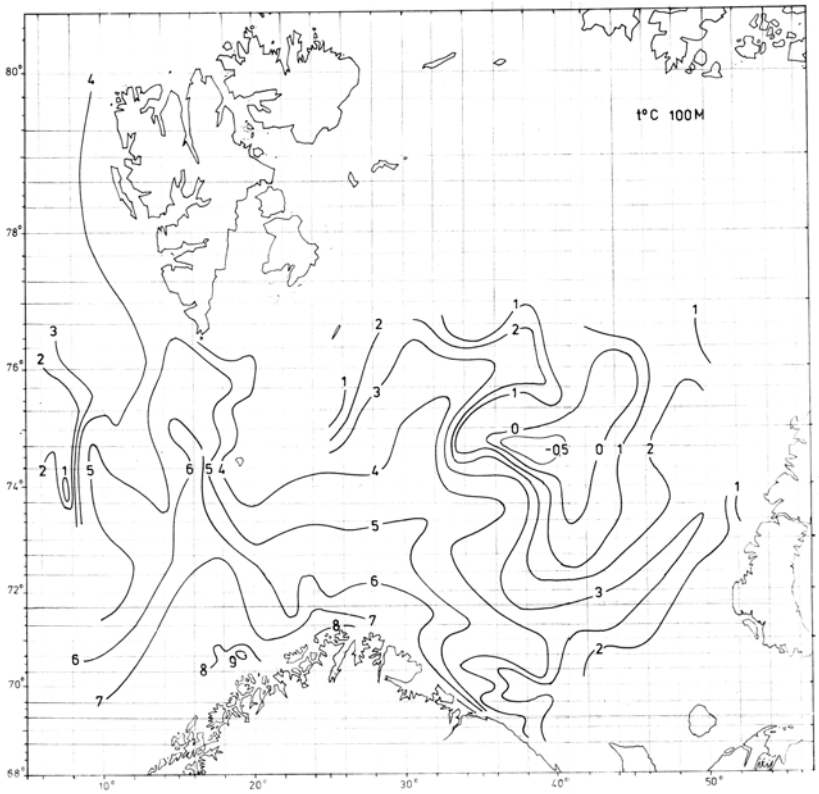

Fig. 5. Isotherms at 100 m

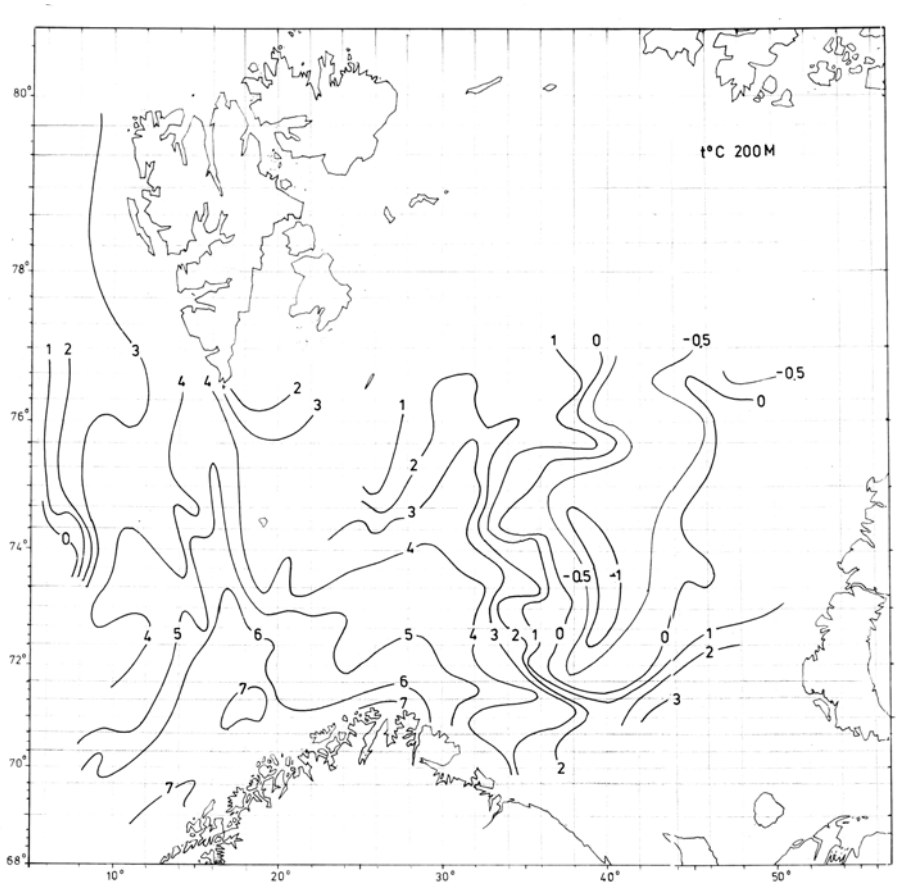

Fig. 6. Isotherms at 200 m

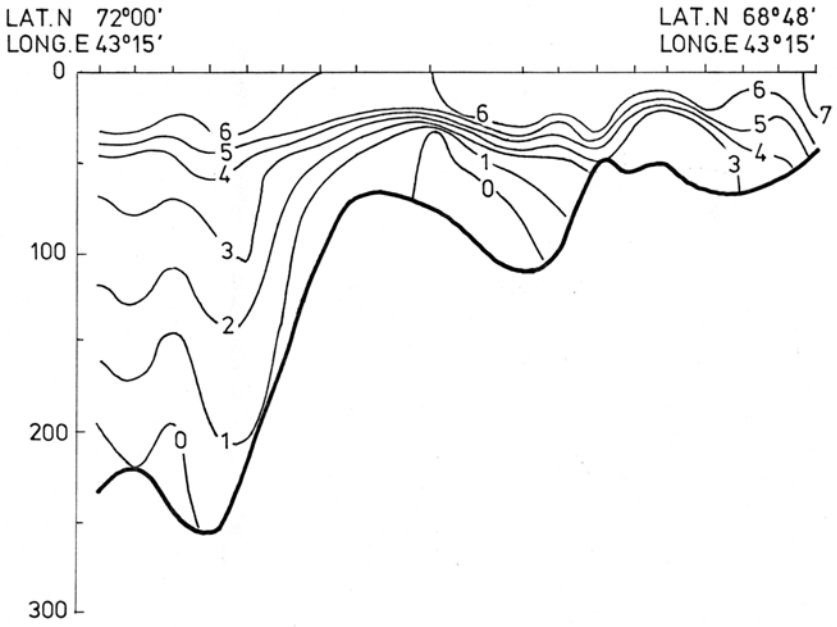

Fig. 7. Temperature section along the Cape Kanin meridian

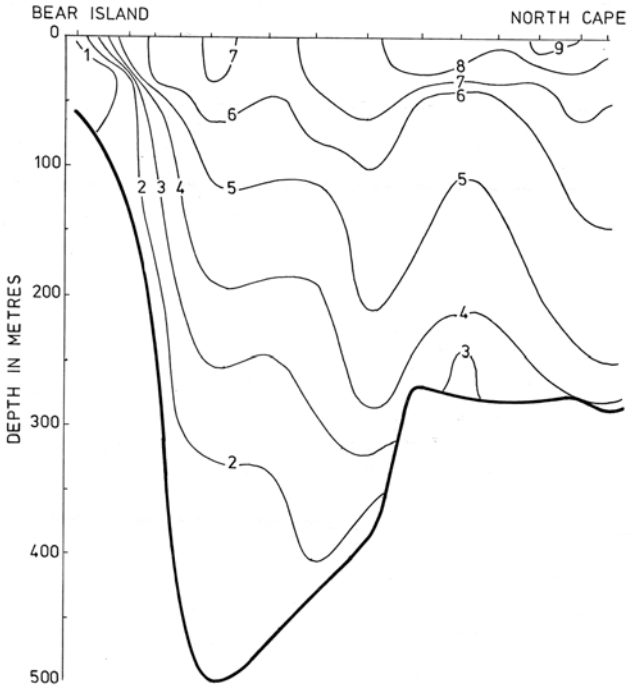

Fig. 8. Temperature section Bear Island-North Cape

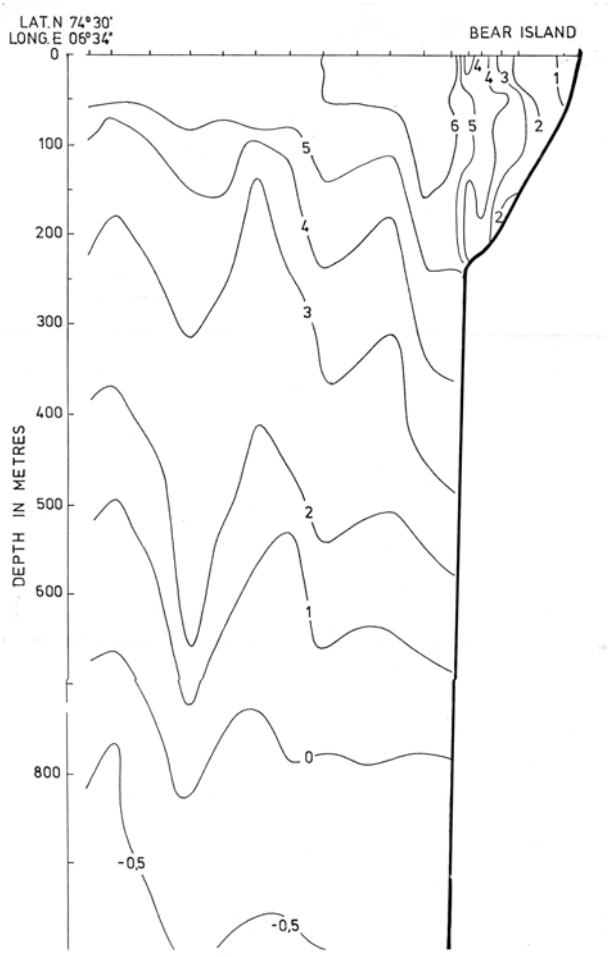

Fig. 9. Temperature section Bear Island-West

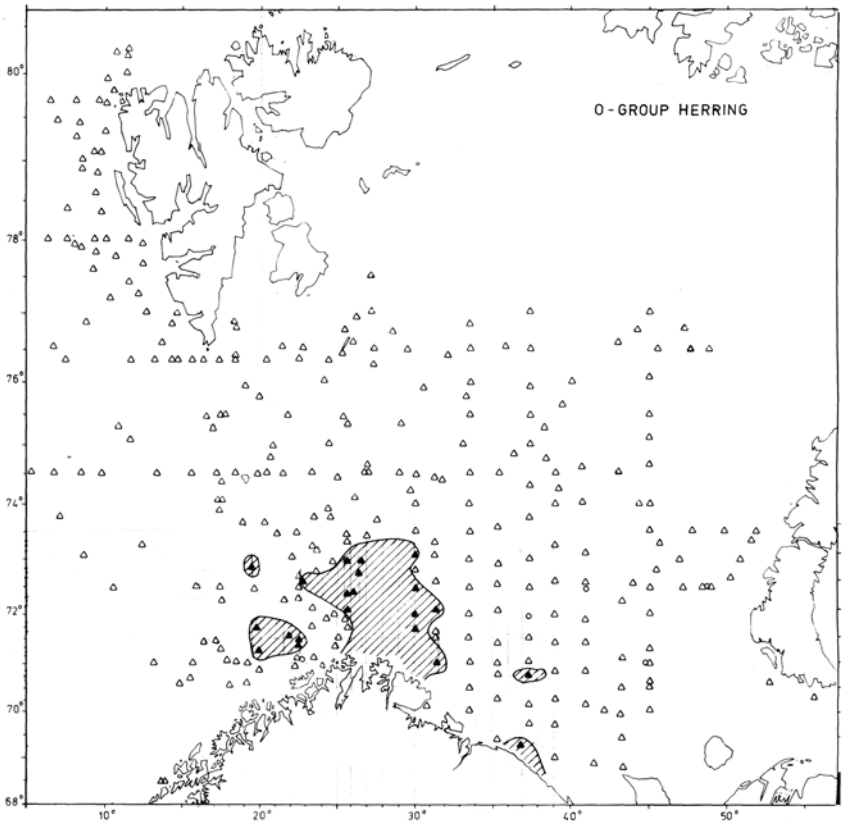

Fig. 11. Distribution of 0-group herring

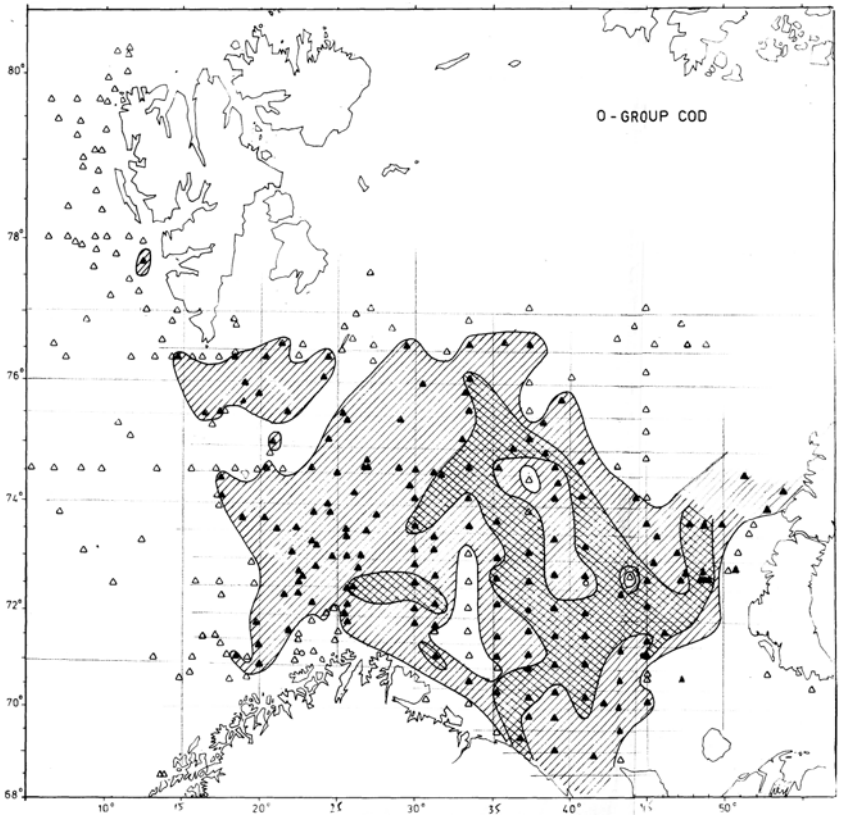

Fig. 12. Distribution of 0-group cod

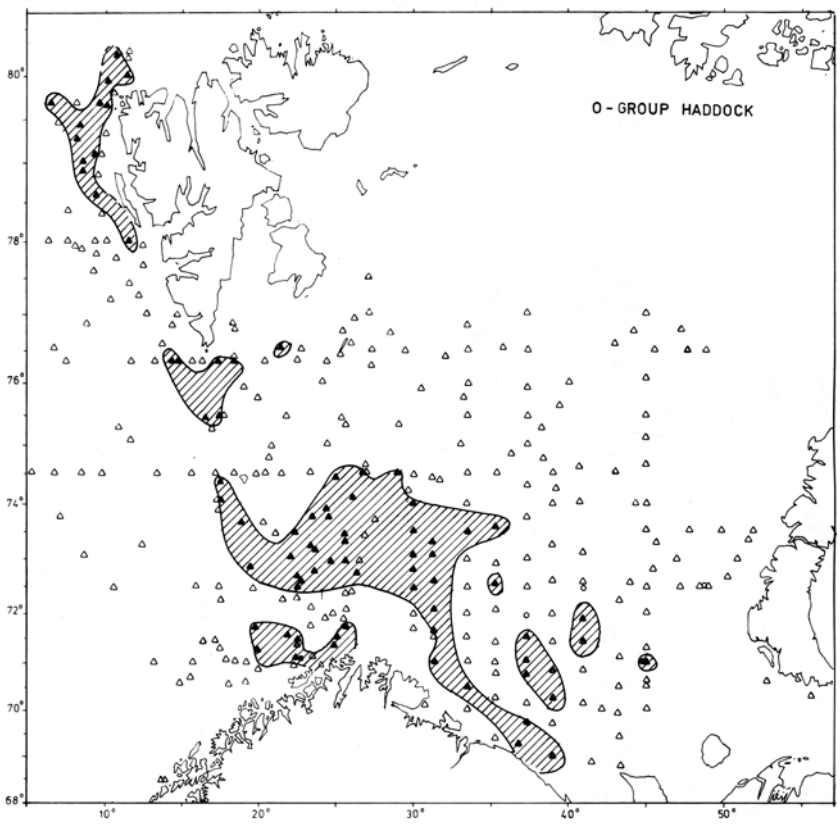

Fig. 13. Distribution of 0-group haddock

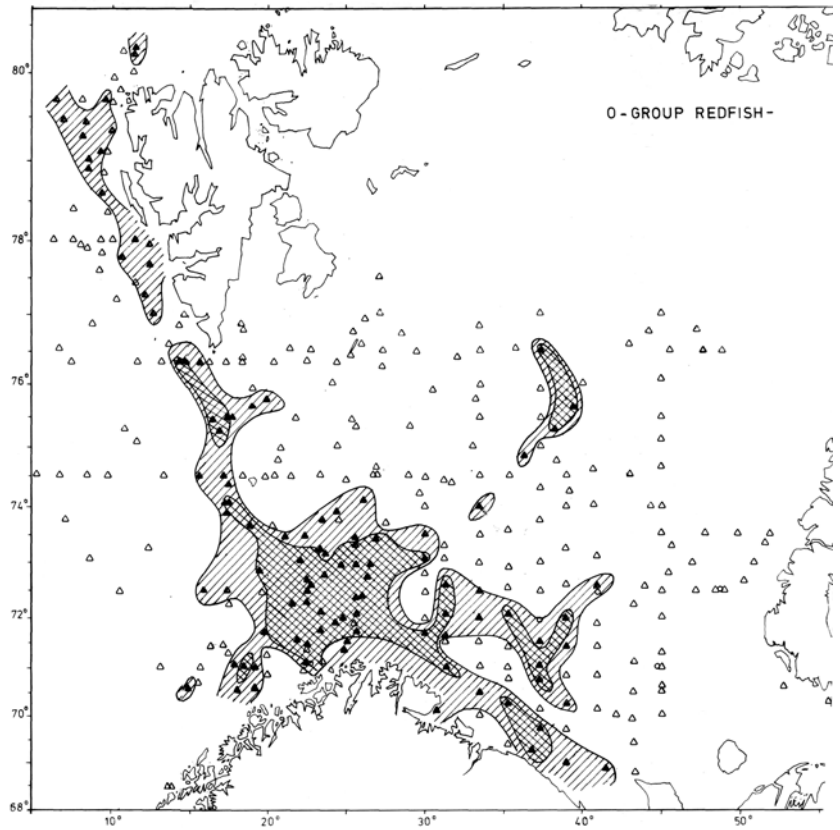

Fig. 14. Distribution of 0-group redfish

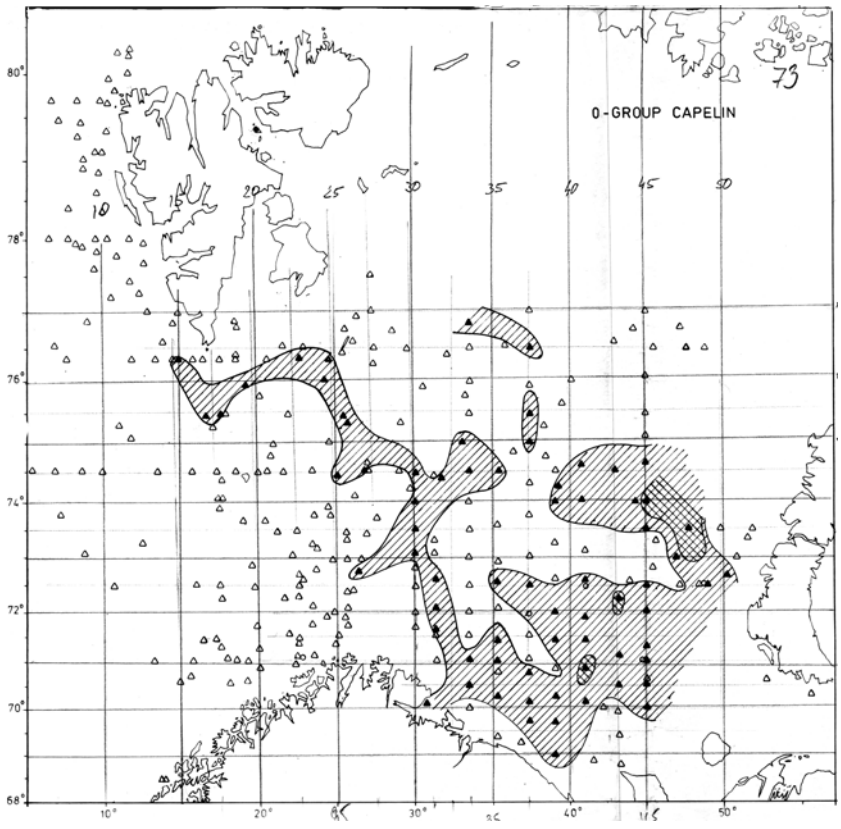

Fig. 15. Distribution of 0-group capelin

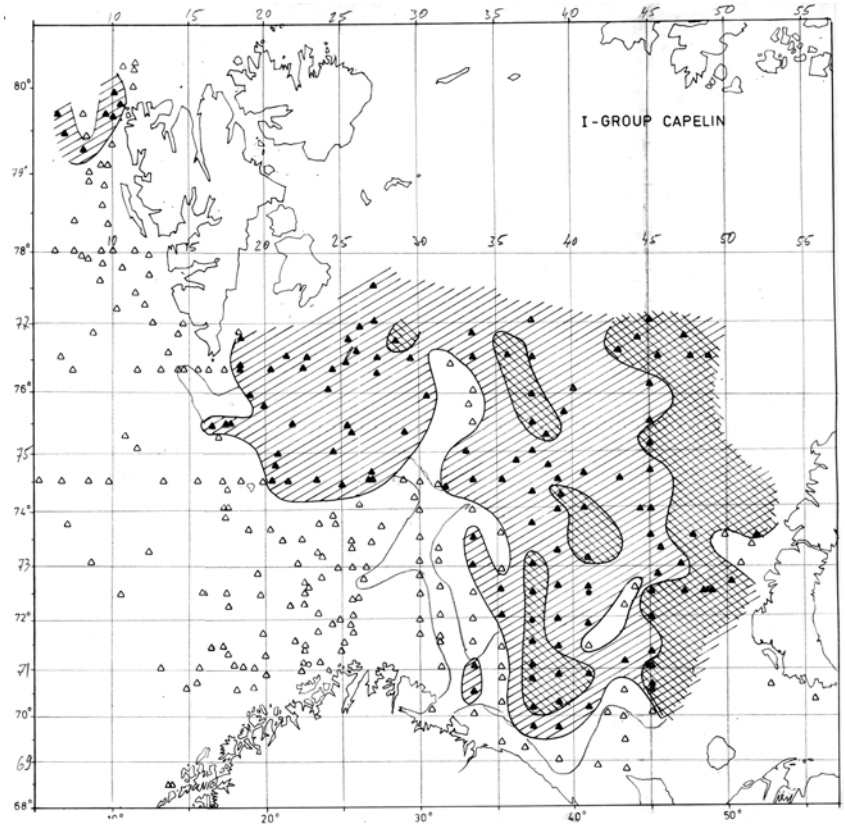

Fig. 16. Distribution of 1-group capelin

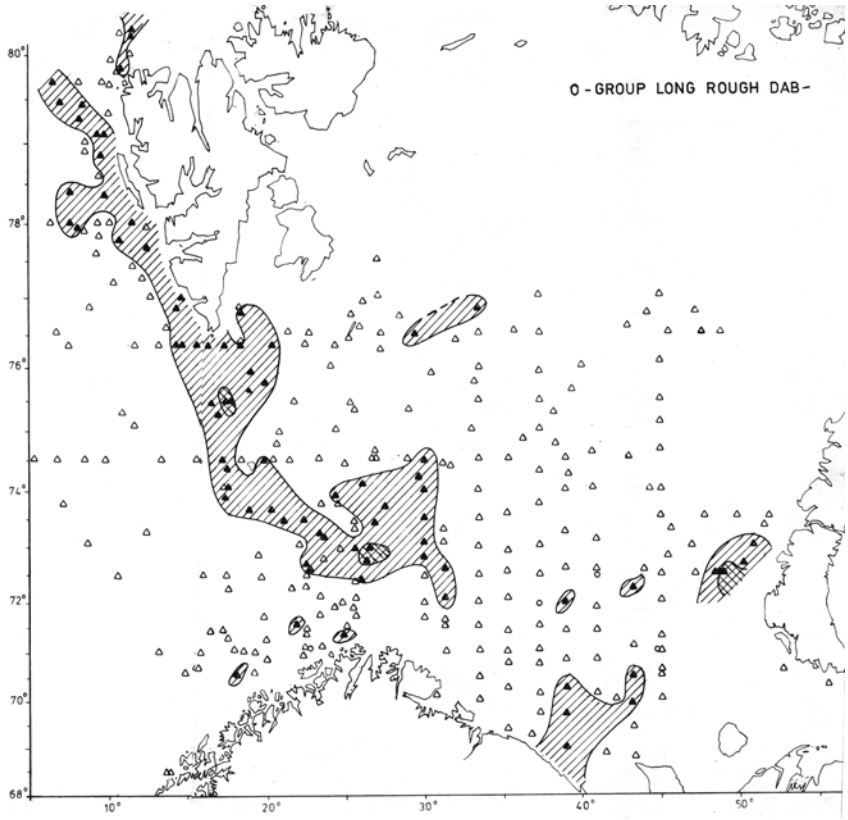

Fig. 17. Distribution of 0-group long rough dab

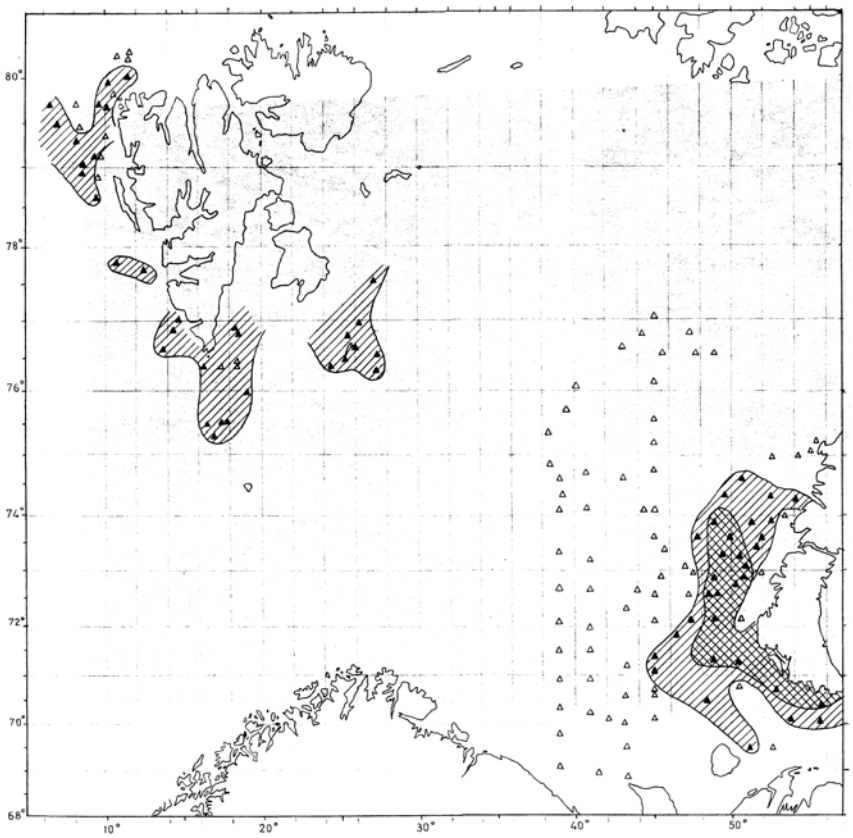

Fig. 18. Distribution of 0-group polar cod

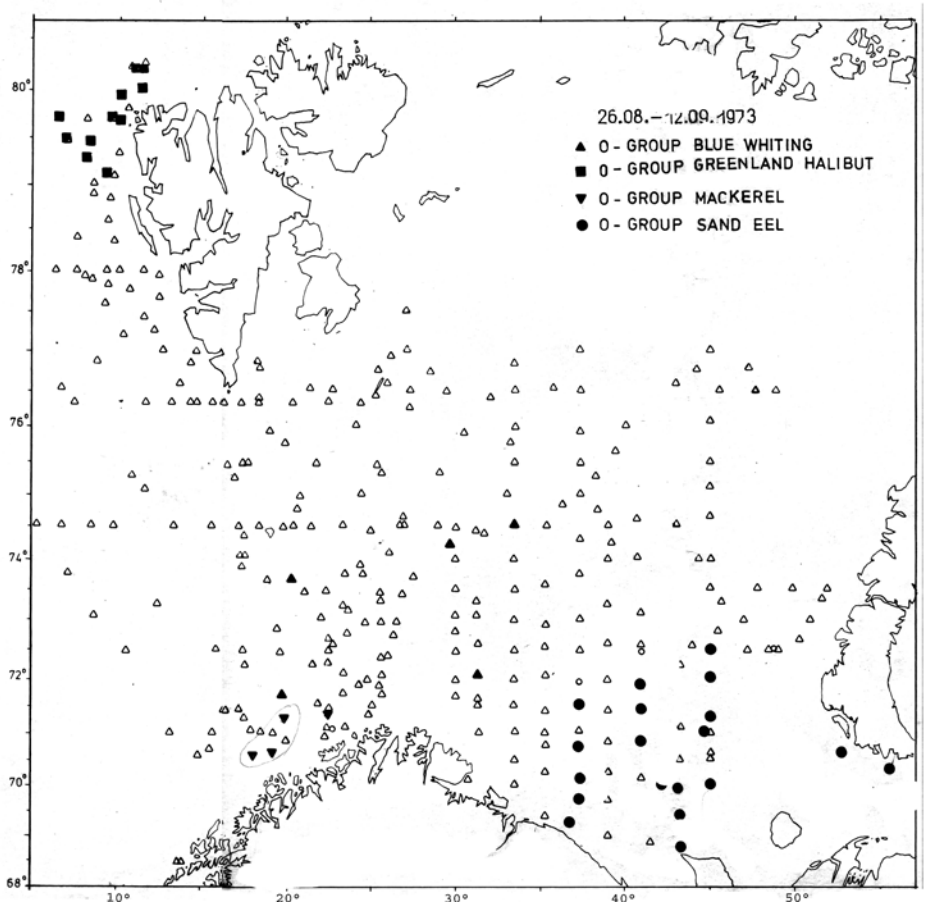

Fig. 19. Distribution of 0-group blue whiting, Greenland halibut, mackerel and sandeel