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# COD SPAWNING IN GREENLAND WATERS

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This paper deals with results on studying, distribution and drift of cod eggs and larvae in waters of Greenland, as well as with some data on occurrence of mature cod during the spawning period. When preparing this information, samples of ichthyoplankton taken by Soviet research vessels in 1962 and the materials obtained during the NORWESTLAND surveys, given in the contributions of member countries presented to the ICNAF Annual Meeting, June 1964, were used. (A. Lee and others, 1964; J. Magnusson and others, 1964; Report on Norwegian participation ..... 1964; Rossov and others, 1964; E. Smidt, 1964; R. Wells and others, 1964).

When analysing the mentioned material, the principle of the division of the ICNAF Area was adopted. In the waters of East Greenland, Divisions I C', I D', I E', I F' taken arbitrary are limited by the following co-ordinates: I C' - north from 66°00N, I D' - 66°00 N, I E- 63°00 - 61°00 N, I F - 61°00 - 58°00 N (Fig. 1).

Distribution of cod eggs and larvae in the waters of East Greenland was not known until the present. However, based on the analysis of adult fish gonads, the ichtyologists pointed out the possibility of cod spawning near the coasts of the East Greenland (Arno Meyer, 1957, Jon Jonsson, 1957; AFZ, 1961).

The probability of spawning near the East Greenland can be also confirmed by our data on distribution of cod at different maturity stages during the spring time (Table 1).

Table 1. Maturity of cod gonads in Divisions of East Greenland during 1958-1963 (Mature part of stock is given).

| Area | Month | Maturity stage in % | | | | | Number of Cod |
|---|---|---|---|---|---|---|---|
| | | III: | IV: | V: | VI: | VI - II | |
| I C' | Apr | 10 | 7 | - | 80 | 3 | 29 |
| I C' | May | - | 11 | 36 | 39 | 14 | 129 |
| | Jun | - | - | - | 3 | 97 | 227 |
| I D' | Jun | - | 21 | 78 | 1 | - | 139 |
| | May | - | 11 | 45 | 2 | 42 | 123 |
| I E' | Mar | - | - | - | - | - | 25 |
| | Apr | - | 12 | 66 | 22 | - | 211 |
| | May | - | - | - | 100 | - | 40 |
| | Jun | - | - | 3 | - | 97 | 234 |

Eggs and spawning cod are distributed everywhere near the East Greenland in April - May (Fig. 2, 3). Maximum number of eggs may be found in the surface layer at the temperature from 1.50° to 4.16°C. Sometimes, the eggs were found at negative temperatures being -0.64°, -0.01°C. The temperature of bottom layers in the areas of eggs' distribution was not lower than 2.21°C. The relation between the stages of eggs' development differs for the areas of the East Greenland.

Eggs at the development stage I predominate (95%) in the area of Angmagssalik (1 $D^{I}$). A relative number of eggs at this stage of development was decreasing to the south, but at the same time the number of eggs at later stages of development was increasing (Table 2).

Table 2. Stages of egg's development in East and West Greenland waters.

| Area | Data | Development stages in % | | | | Number of Cod |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | |
| 1D' | 1-10 May 1962 | 95 | 5 | - | - | 772 |
| 1E' | 24-30 Apr 1962 | 70 | 17 | 12 | 1 | 2133 |
| | 9-30 Apr 1963 | 44 | 30 | 24 | 2 | 3395 |
| 1F' | 24-30 Apr 1962 | 36 | 10 | 37 | 17 | 1534 |
| | 9-30 Apr 1963 | 35 | 40 | 23 | 2 | 2377 |
| 1F | 9-30 Apr 1963 | 58 | 25 | 12 | 5 | 9332 x/ |
| 1E | 24-30 Apr 1962 | 29 | 14 | 51 | 6 | 281 |
| 1D | 24-30 Apr 1962 | 25 | 6 | 59 | 10 | 115 |

(x/ Collections made by means of 2 m Stramin net)

Knowing the temperature of the surface layer, the direction and the velocity of the current where the greatest number of eggs at the development stage I is distributed, as well as the duration of development of this stage at the temperature, it is possible to calculate the distance between the area of eggs location and the area of their possible extrusion. (Table 3).

TABLE 3. AREAS OF DISCOVERING THE GREATEST NUMBER OF EGGS AND THE DISTANCE BETWEEN THESE AREAS AND THE AREAS OF THEIR PROBABLE EXTRUSION.

| | DATE | POSITION N | POSITION E | DEPTH (M) | EGGS AT STAGE I No. | EGGS AT STAGE I % | TEMPERATURE °C SURFACE | TEMPERATURE °C BOTTOM | PERIOD OF EGGS DEVELOPMENT AT STAGE I (DAYS) | CURRENT VELOCITY (KM/DAY) | CALCULATED DISTANCE BETWEEN THE AREA OF EGG'S LOCATION AND THE AREA OF LARVAE EXTRUSION (KM) | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10.5.62 | 64°33' | 37°21' | 320-390 | 470 | 88 | 3.0 | 3.78 | 6 | 21 | 126 | CURRENT VELOCITIES ARE TAKEN FROM THE PAPER OF CHAPLIGIN (1960) AND THEY ARE CONVERTED FROM CM/SEC. TO KM/DAYS. |
| | 20.4.63 | 62°40' | 40°40' | 761 | 930 | 77 | 4.16 | 4.1 | 5 | 25 | 125 | |
| | 29.4.63 | 62°34' | 40°36' | 210 | 170 | 81 | 3.0 | 4.0 | 6 | 25 | 150 | |
| | 19.4.63 | 62°20' | 40°40' | 534 | 144 | 28 | 3.0 | 4.0 | 6 | 25 | 150 | |
| | 24.4.63 | 62°14' | 41°14' | 500 | 430 | - | 4.16 | 4.1 | 5 | 25 | 125 | |
| | 13.4.63 | 62°30' | 40°40' | 197 | 190 | 54 | 3.0 | 4.5 | 6 | 25 | 150 | |
| x/ | 13.4.63 | 60°20' | 42°33' | 459 | 118 | 75 | 1.5 | 4.0 | 7 | 35 | 245 | |
| | 12.4.63 | 60°00' | 42°20' | 320 | 180 | 37 | 4.2 | 4.0 | 5 | 35 | 185 | |
| | 27.4.62 | 59°55' | 41°58' | 1000 | 120 | 35 | 2.0 | ... | 7 | 35 | 245 | |
| x/ | 13.4.63 | 60°20' | 42°20' | 459 | 176 | 76 | 1.5 | 4.0 | 7 | 35 | 245 | |

x/ SAMPLES TAKEN WITH TWO METRE STRAMIN NET

The eggs at the development stage I only can be carried away by the East Greenland current at the distance of 125-245 km from their spawning grounds

Taking into consideration correction for drift, it is possible to draw a sketch - map of distribution of cod spawning grounds near the East Greenland (Fig. 4)

Spawning areas plotted on this map coincide with the areas of spawning cod concentrations, which were described by A. Meyer (1957) and J. Jonsson (1957, 1959).

Spawning areas near the West Greenland are also given in Fig. 4. In March, April, May, June cod at spawning stages of maturity occur near the West Greenland (Table 4).

Table 4. Maturity of cod gonads caught in the areas of West Greenland in 1958-1963

| Area | Month | Maturity stage in % | | | | | Number of Cod |
|---|---|---|---|---|---|---|---|
| | | III | IV | V | VI | VI-II | |
| I E | Mar | | 2 | 72 | 8 | 18 | 268 |
| | Apr | 1 | 2 | - | 4 | 93 | 385 |
| | Jun | 1 | 2 | 1 | 10 | 86 | 479 |
| I D | Mar | 34 | 40 | 10 | 16 | - | 74 |
| | Apr | 4 | 4 | 18 | 21 | 53 | 1161 |
| | May | 1 | 1 | 7 | 13 | 78 | 1636 |
| | Jun | 1 | 1 | 41 | 2 | 55 | 693 |
| I C | Mar | 36 | 26 | 1 | 10 | 31 | 155 |
| | Apr | 8 | 9 | 41 | 17 | 25 | 606 |
| | May | 2 | 4 | 20 | 15 | 59 | 1404 |
| | Jun | - | - | 2 | 46 | 52 | 163 |
| I B | May | - | 1.5 | 0.5 | 14 | 84 | 262 |

As is seen from Table 4, fish with running sex products (stage V) evidently predominate only in the area I E (72%), and in the areas I C and I D ripe fish do not exceed 41%.

This may be caused either by long duration of spawning period or by the fact that the bulk of cod must be spawning not in the areas of fishing (on banks) but somewhere in the neighbouring areas, apparently in the fjords and immediately off coastal areas, from where they return to the banks just after the termination of spawning.

A considerably less number of cod larvae was found in waters of the West Greenland in comparison with that near the East Greenland (Figs. 2 and 3, Table 2). Basing on data on distribution of cod eggs at the development Stage I, one can assume that cod spawns in April - May in the areas of Bezimjannaja,

Frederickshaab, Danas, Fiskenaes, Fyllas, Banan, Lille Hellefiske Banks. As the eggs in these areas were very scarce, these spawning grounds cannot be of great importance for the West Greenland stock of cod. Dr. Hansen suggests that the main spawning grounds of cod are located in fjords, as the eggs and larvae are in greater numbers than those near the shore (Hansen, 1949).

We also think that spawning determining the reproduction of the West Greenland cod should take place in the ashore skerries and fjords of the West Greenland.

Spawning grounds on the banks of the area are of less importance in comparison with these ones in fjords and offshore. First of all, this suggestion can be proved by a great number of eggs in fjords and ashore areas and by a small number of eggs in the offshore shelf areas (Hansen 1949, 1951-1957), as well as by the fact that the eggs at the later stages of development are prevailing in the offshore areas (Table 2).

In addition, this fact is also confirmed by the relationship between maturity stages on the banks areas, where the spawning stages during the spawning period were not clearly observed (Table 4). In the Greenland waters where cod eggs can be observed at the temperature from -0.3° to 5° the period of development calculated according to the table of Apstein, (Apstein, 1909), ranges from 50 to 17 days. The relation of stages of eggs development in different Greenland areas was not the same (Table 2). The reduction in the number of the initial stages of development in certain areas and the increase of the relative number of later stages in other neighbouring areas serve as an indicator of drift direction. Near the East Greenland eggs and larvae are drifted from the north to the south, near the West Greenland - from the south to the northwest. Knowing the speed of current and period of development one can determine the extension of the drift and speed of its movement. An average ariphmetical speed of the East Greenland Current at latitudes between 65°00 N and 61°00 N is about 21 km/day (Chapligin, 1960).

Praelarvae developed of eggs deposited on the spawning grounds in the Angmagssalik area at the temperature 5° may appear in the plankton not nearer than 430 km to the south, i.e. in the Division 1 E'. It was just here, in the area of Tordenskjeld Bank, that we discovered praelarvae 4 mm long at the temperature 3.5°, depth being 207 m. Moreover, in April praelarvae are observed in the area to the south and southeast of Cape Farewell as well as in the area of Julianehaab (Figs. 5, 6) at the temperatures 3.4° and 5°C. According to temperatures, praelarvae can be carried away from the spawning grounds near Angmagssalik, Mösting and Bille Banks situated up to 550, 480 and 430 km upstream to the north. Praelarvae developed of eggs, extruded in the area to the south of Bille Bank are carried away more further, in the West Greenland areas.

In May-June, cod larvae 3.5 - 9.0$^{mm}$ in length occurred near Frederickshaab, Fiskenes, Fyllas Banks and in the central part of the Davis Strait (Figs. 7, 8). At an average ariphmetical speed of the West-Greenland Current (26 km/day) x/ and the temperature 2-4° these larvae could be carried out from the spawning grounds located 730-520 km upstream, i.e. from south-eastern, south and south-western Greenland shelfs.

In July, cod larvae distributed xx/ in Danmark Strait on Cheimland Bank, in the Frederickshaab area, in central part of the Davis Strait, in the areas of Fyllas, Banan, Lille and Store Hellfiske Banks (Fig. 9).

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x/ An average speed of the West Greenland Current in the area from Cape Farewell to Godthaab was calculated by us from current speeds given by Killerich (Killerich, 1943) and Bogdanov, 1959.

xx/ In July hauls were made by the 2 m stramin net.

Larvae discovered in the Danmark Strait were up to 5.0 - 65.9 mm in length. The greatest number of larvae (81%) were 15.0 - 34.0 mm long, that corresponds to pterygiolarva stage (Rass, 1949) or to larvae at the age of 2 or 3 months (Bigelow and Schroeder, 1953).

Most probably, these larvae were carried out by the western branch of the Itminger Strait in the Danmark Strait from its spawning grounds near the West and South-West Greenland (Bigelow & Schroeder, 1953). With little speed of this branch (5.0 - 6.7 km/day) / Dietrich, 1957, p.298, Fig 31/, approximately 50 - 90 days will be necessary for larvae to be drifted from the Iceland cod spawning grounds in the Danmark Strait (the distance is 320 - 480 km), i.e. this period corresponds to the age of our larvae. At rather high water temperatures in the upper layers of water, the rate of eggs and larvae development in these waters is much higher, than that near the East and West Greenland waters.

These larvae reach pterygiolarva stage for two-month period of development. With the length of above 35 mm, cod development is characterized by praejuveni stage, which terminates when fish reach 70 - 80 - 90 mm long (Rass, 1949). At the end of the prejuvenile stage, the transition to the near bottom mode of life is observed. The pelagic period of cod life in the moderate British and South Norway waters terminates approximately in two months after the extrusion (McIntosh & Masterman, 1897, Dannevig, 1894), and in the northern waters not earlier than in three months. In this case larvae discovered in the Danmark Strait (in positions 65°00N, 28°00W) reach the stage, which is the transition to the bottom mode of life, not earlier than in two months, i.e. to the end of September - the beginning of October. During this period at an average speed those larvae are driven away by the East Greenland Current with the average speed of 20-21 km/day at the distance of 1200-1300 km downstream along the shores of the East Greenland and come to the area of Southwestern Greenland late in September - early in October. Apparently, in this area cod fries of the Icelandic origin settle on the bottom. It can be also confirmed by the fact that south-western areas are those areas, where young cod stock inhabit and grow (Hansen, 1949, AFZ, 1961).

The possibilities of the drift of cod larvae from the Icelandic spawning grounds into the areas of the Southwest Greenland was described by as far as in 1937 (Täning, 1937).

However, in 1958 the author noted that the problem of larvae drift from the Icelandic spawning grounds became complex owing to the availability of cod spawning grounds observing near the shores of the Southeast Greenland (Täning, 1958) during some years.

In our opinion, the East Greenland spawning grounds are not related with a rich stock of the cod youngs in the southwestern areas of Greenland. It can be confirmed by the character of the larvae drift of the East Greenland origin. In April - May, in the waters of South Greenland only prelarvae of 3.0 - 5.0 mm cod, and in July proptery-giolarvae of 11.0 - 34.0 mm cod, were found (Täning, 1950). In both cases, stages of development of larvae are characterized by the pelagic mode of life (Rass, 1949); those larvae cannot settle to the bottom. Those larvae also cannot be kept in palagic layers in these areas, as the velocity of the West Greenland Current in this area is too high (up to 51 km/day). It is clear that larvae are carried out by the current in the waters of the West Greenland.

The drift of larvae in the waters of the West Greenland is more complicated. The area of larvae distribution near the West Greenland shift from south to north throughout May, June, July (Figs. 5, 6, 7, 8, 9). Besides that, larvae in samples collected also in areas from the south to the north become larger (Table 5). Larvae are carried away by the coastal current from the fjord, inshore and bank spawning grounds of the West Greenland to the north in the area of Disko-Holsteinborg, where the shoals of the cod young are observed (Hansen, 1949). This conclusion was confirmed by regular surveys made by Danish R/V DANA in these areas (Täning, 1950; Hansen, 1951, 1952, 1953, 1956, 1957).

It is still not clear what had happened with larvae drifted in the Davis Strait. According to Hansen (Hansen, 1957), these larvae are not need for the Greenland cod stock as they are lost, in case of settling to the bottom they have no time to reach the Labrador Shelf.

However, the drift of larvae in the areas of the Labrador Shelf is quite possible. Velocities of the current in the Davis Strait are 3,6; 4,5; 5,4; 7,7; 9,0 km/day (Kiilerich, 1943), the average velocity is 5.9 km/day. The distance from the extreme point in the Davis Strait where cod larvae were found (65°0N - 59°30W), to the Labrador Shelf amounts to 540 km. Therefore, larvae will reach this area in 80 - 100 days, i.e. to the middle of October or to November. At that time in other areas larvae reach the development stage, which is followed by the bottom mode of life (Maslov, 1944; Rass, 1949). In the Davis Strait and near the Labrador temperatures of water masses by which larvae are carried are low enough (2-4° C), therefore larvae development slows down and settling of the larvae to the bottom takes place later on, in December - March. But in this case also fries will be within the Labrador Shelf - apparently, in the areas of the North and Central Labrador. In some years, for example in 1957, larvae carried away in the Labrador Strait are in greater numbers than those distributed near the shores of the West Greenland to the north of 64°N (Hansen, 1957, Fig. 2). Thus, the stock of the cod youngs of the Greenland origin near the North and Central Labrador is great enough. Investigations of the cod youngs near the Labrador during the spring months, when cod fries settle to the bottom also in these areas evidently will help to discover the youngs of the Greenland origin. The problem of the possibility of larva drift from the Davis Strait can be finally settled by analyzing the number of vertabrals of these youngs.

Thus, the picture of cod spawning in the Greenland waters seems to be as follows. Cod spawning near the East Greenland takes place within the shelf area almost everywhere from Angmagssalik to the Cape Farewell in April - the first half of May, the near bottom water temperature being 2.0 - 5.0°, depths - 180-450 m. The main spawning grounds are distributed in the areas of Angmagssalik, Cheimland, on the slopes of Møsting, Bille, Fylkir, Tordbnsheld Banks. The spawning of cod in the areas of the West Greenland takes place late in March, April, May and early in June in fjords as well as near the shores, apparently, in the schera areas, and on the western slopes of banks, approximately from 60°40' N to 67°50' W depths being 50-500m, the near bottom temperatures - 1.5 - 3.5°.

Drift of larvae takes place from Icelandic spawning grounds through the Denmark Strait along the shelf near the East Greenland to the south-western areas of Greenland. Larvae are drifted by the western - and eastern Greenland Currents from the East Greenland spawning grounds to the areas of the West Greenland and the Davis Strait, and then by the Labrador Current - to the North and Central Labrador.

Larvae, developed of the eggs deposited in fjords and on the coastal spawning grounds are carried away by the West Greenland Current to the north, the areas of Lille and Store Hellefiske Banks, in the Disko-Holsteinborg, where the cod youngs inhabit. Larvae can be carried away from the spawning grounds lying on the western slopes of Frederickshaab, Danas, Fiskenaes, Fillas Banks to the Davis Strait and further to the Labrador.

Thus, three main routes of cod migration in the waters of Greenland are observed:

1/ from Iceland to Southwest Greenland;

2/ from the East Greenland to Davis Strait and further to Labrador;

3/ from the coastal and fjord West Greenland spawning grounds to the northern areas of West Greenland as far as Disko-Holsteinborg.

The location of the spawning grounds, distribution of eggs, larvae and the youngs x/, the paths of drift of eggs and larvae are given in Fig. 10.

x/ Distribution of the youngs is given according to Hansen (Hansen, 1949).

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TABLE 5. AREAS OF COD LARVAE DISTRIBUTION, THEIR SIZES AND NUMBER DISCOVERED IN THE WATERS OF GREENLAND, 1962 - 1963

| AREA | YEAR | DATE | N | E | LARVAE LENGTH IN M M | | | | | | | | | | | | | | | | | | | | | | | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-65 | N | |
| NORTH-WEST | 1963 | 30 JUN | 64°50 | 29°00 | | | | | 2 | | | | | 19 | | | 63 | 70 | 62 | 46 | 17 | 15 | 1 | 2 | 0 | 1 | 298 | 2M STRAMINE NET |
| ICELAND | 1963 | 24 OCT | 65°10 | 25°00 | | | | | | | | | | | | | | | | | | | | | | | | |
| I D' | 1962 | 27 MAY | 64°23 | 37°28 | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | |
| ? | 1963 | 21 MAY | 64°01 | 36°58 | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | |
| I E' | 1963 | 9-30 APR | 61°20 | 41°20 | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | |
| I F' | 1962 | 21 APR | 59°08 | 44°03 | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | |
| | 1962 | 23 APR | 59°36 | 41°51 | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | |
| | 1963 | 9-30 APR | 60°00 | 42°00 | | 2 | | | | | | | | | | | | | | | | | | | | | | LENGTH IS SHOWN ROUGHLY |
| | 1963 | 9-30 APR | 60°00 | 42°00 | | 1 | | | | | | | | | | | | | | | | | | | | | 6 | |
| | 1963 | 9-30 APR | 60°00 | 42°40 | | 3 | | | | | | | | | | | | | | | | | | | | | | |
| I F | 1962 | 26 APR | 60°59 | 49°30 | | 4 | 1 | | | | | | | | | | | | | | | | | | | | 5 | |
| | 1963 | 13 APR | 60°38 | 48°20 | | | | | | | | | | | | | | | | | | | | | | | | |
| I E | 1962 | 29 MAY | 61°03 | 49°33 | 15 | 6 | | | | | | | | | | | | | | | | | | | | | 21 | |
| | 1962 | 31 MAY | 62°12 | 50°50 | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | |
| | 1962 | 26 MAY | 62°58 | 52°15 | 1 | | | 1 | | | | | | | | | | | | | | | | | | | 2 | |
| | 1962 | 27 MAY | 63°04 | 52°28 | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | |
| | 1962 | 27 MAY | 63°07 | 52°28 | | | | | 2 | 2 | | | | | | | | | | | | | | | | | 4 | |
| | 1962 | 3 JUN | 61°15 | 50°38 | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | |
| I C, I B | 1962 | 21 JUN | 66°04 | 53°30 | | 1 | | | | | | | 1 | | | | | | | | | | | | | | 2 | |
| | 1962 | 22 JUN | 67°34 | 54°55 | | | | | | | | | | | | | | | | | | | | | | | | |
| WEST GREENLAND TO THE NORTH OF 62°50'-64°50'N | 1963 | 21 MAY 21 JUN | | | | | 16 | 24 | 16 | 4 | 1 | | | | | | | | | | | | | | | | 61 | |
| WEST GRL AND 62°45'-1, 05'N | 1963 | 2 JUL-15 JUL | | | | | | 5 | 4 | 11 | 26 | 21 | 23 | 18 | 7 | 4 | 1 | | | | | | | | | | 121 | 2 M STRA E NET |

A 11

- 10 -

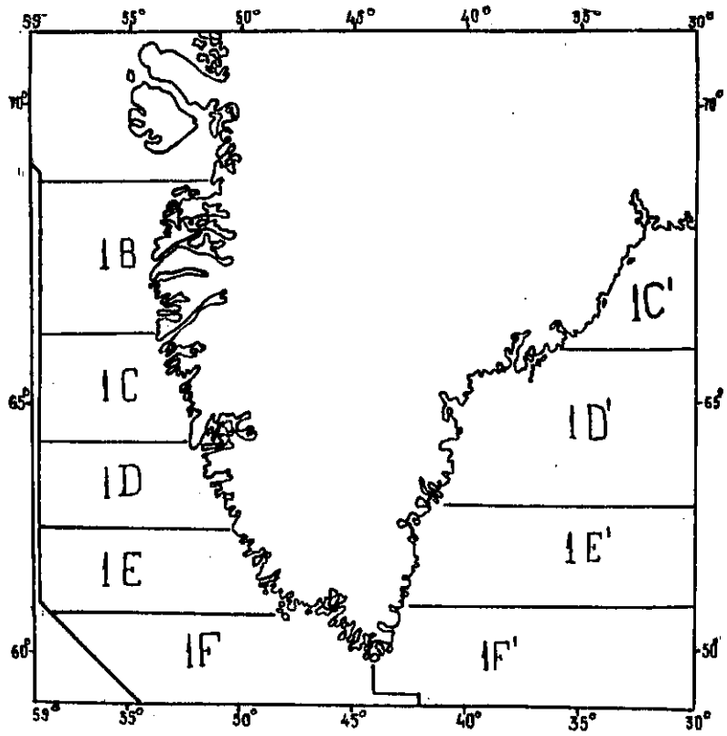


Fig. 1. Divisions of East and West Greenland waters

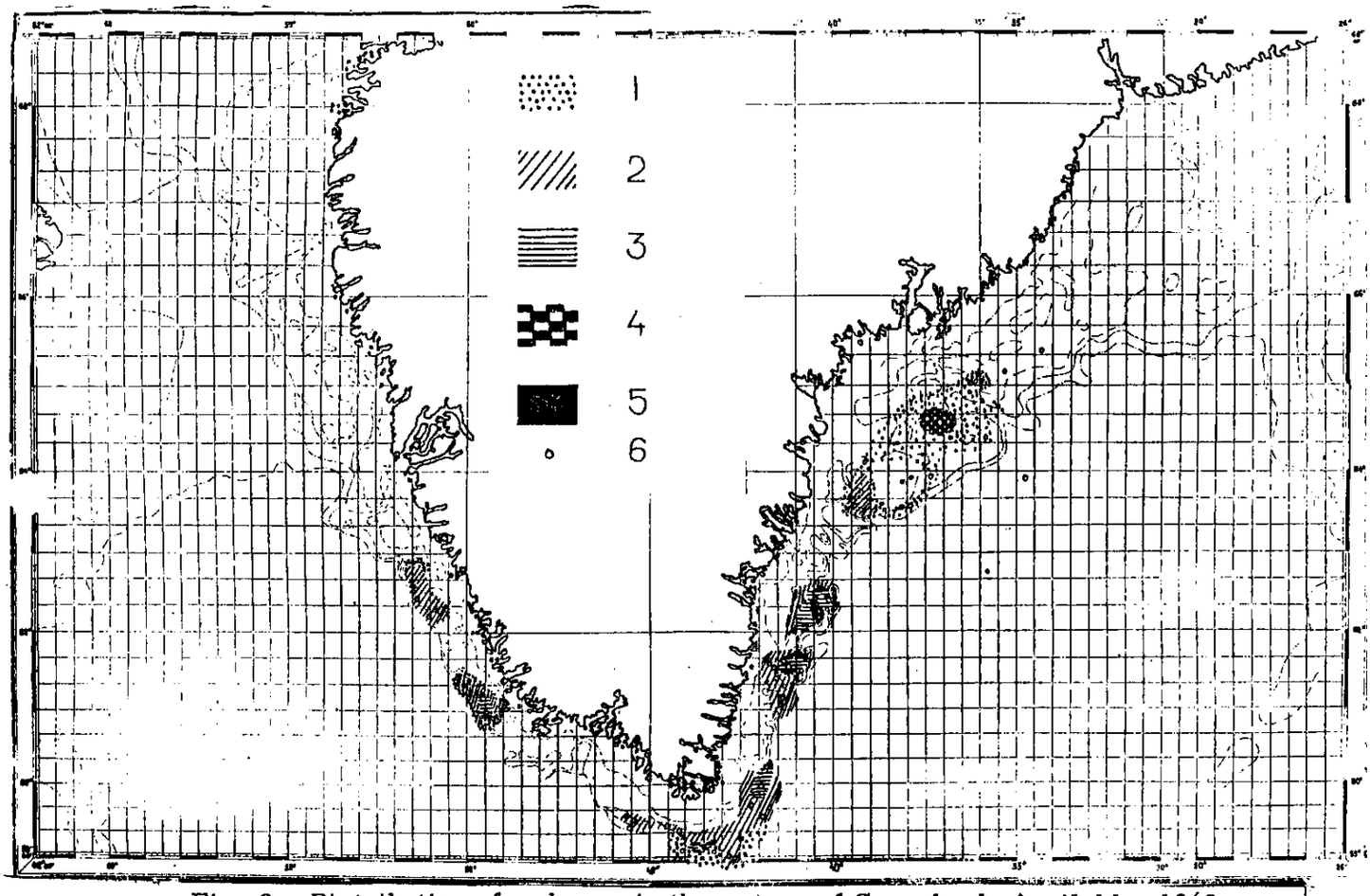


Fig. 2. Distribution of cod eggs in the waters of Greenland, April-May 1962.

Conventional symbols - number of cod eggs per one vertical haul with a conical eggs net: 1 - 1-10 specimens, 2 - 11-20 specimens, 3 - 101-500 specimens, 4 - 501-1000 specimens, 5 - above 1000 specimens, 6 - position of station.

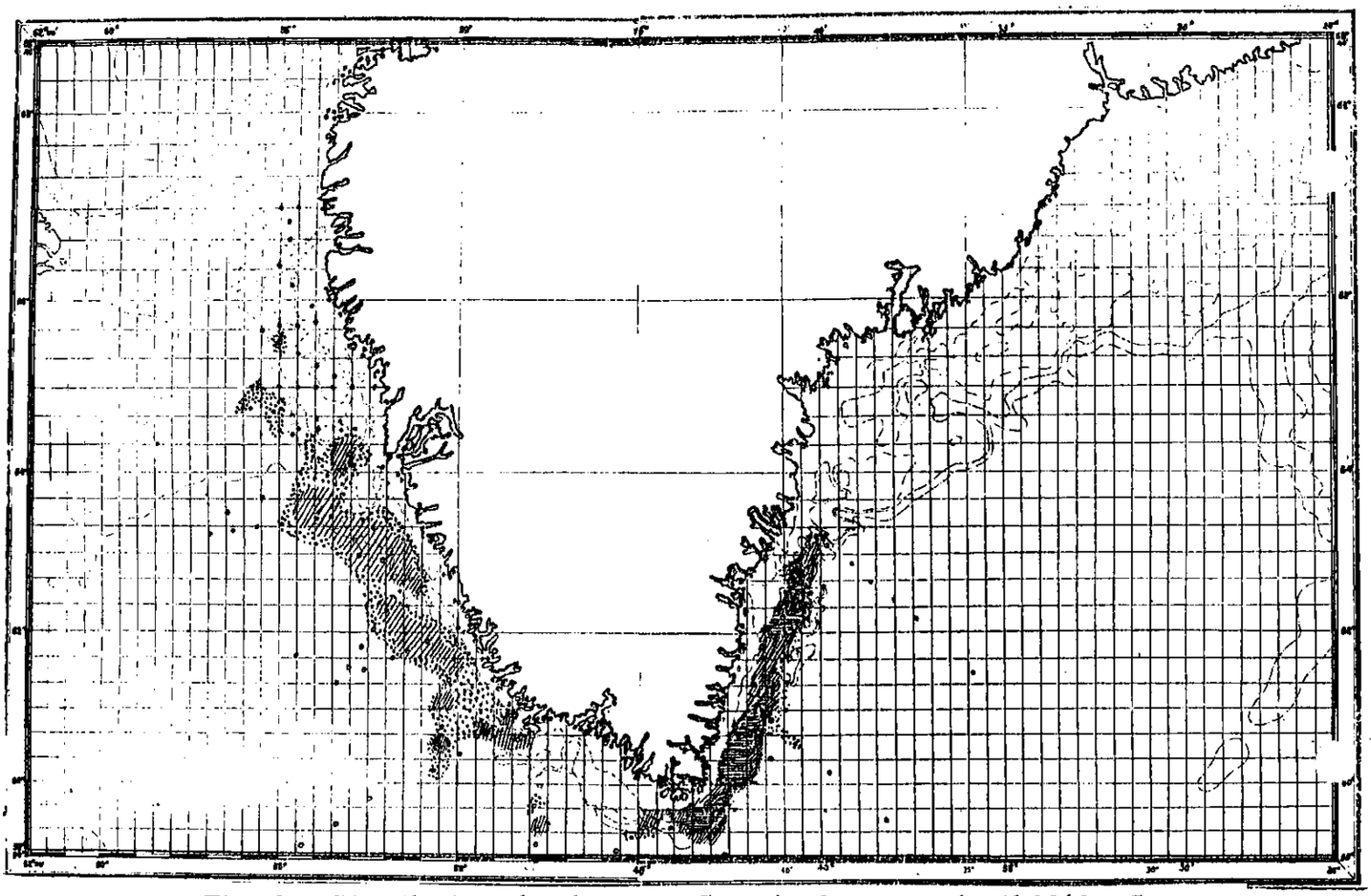

Fig. 3. Distribution of cod eggs in Greenland waters, April 1963. Conventional symbols are the same as in Fig. 2.

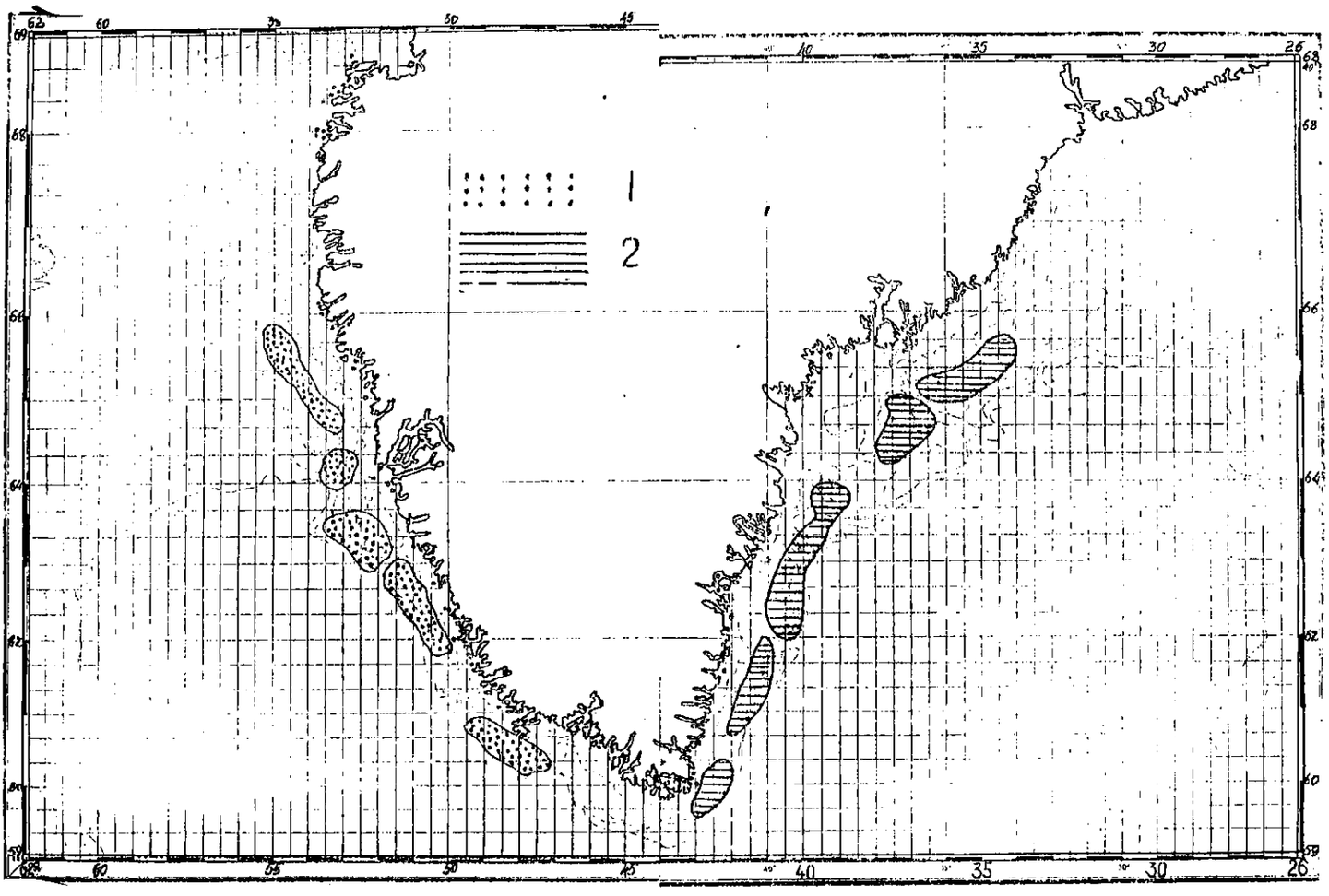


Fig. 4. Distribution of cod spawning grounds in areas of Greenland: (Conventional symbols) 1 - areas of spawning of high intensity, 2 - areas of spawning of low intensity.

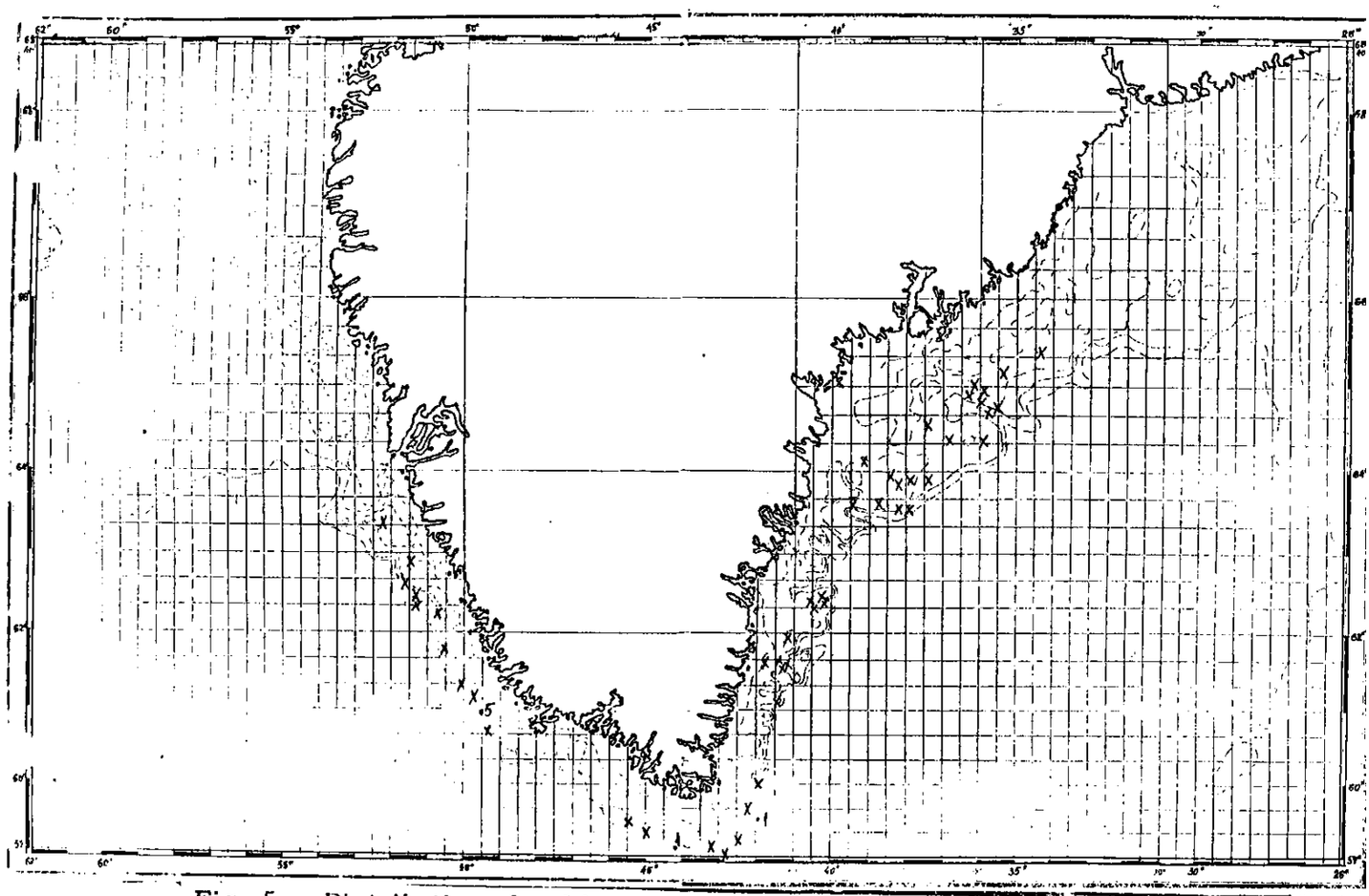

Fig. 5. Distribution of cod larvae in the waters of Greenland, April-May 1962. Conventional symbols as in Fig. 6.

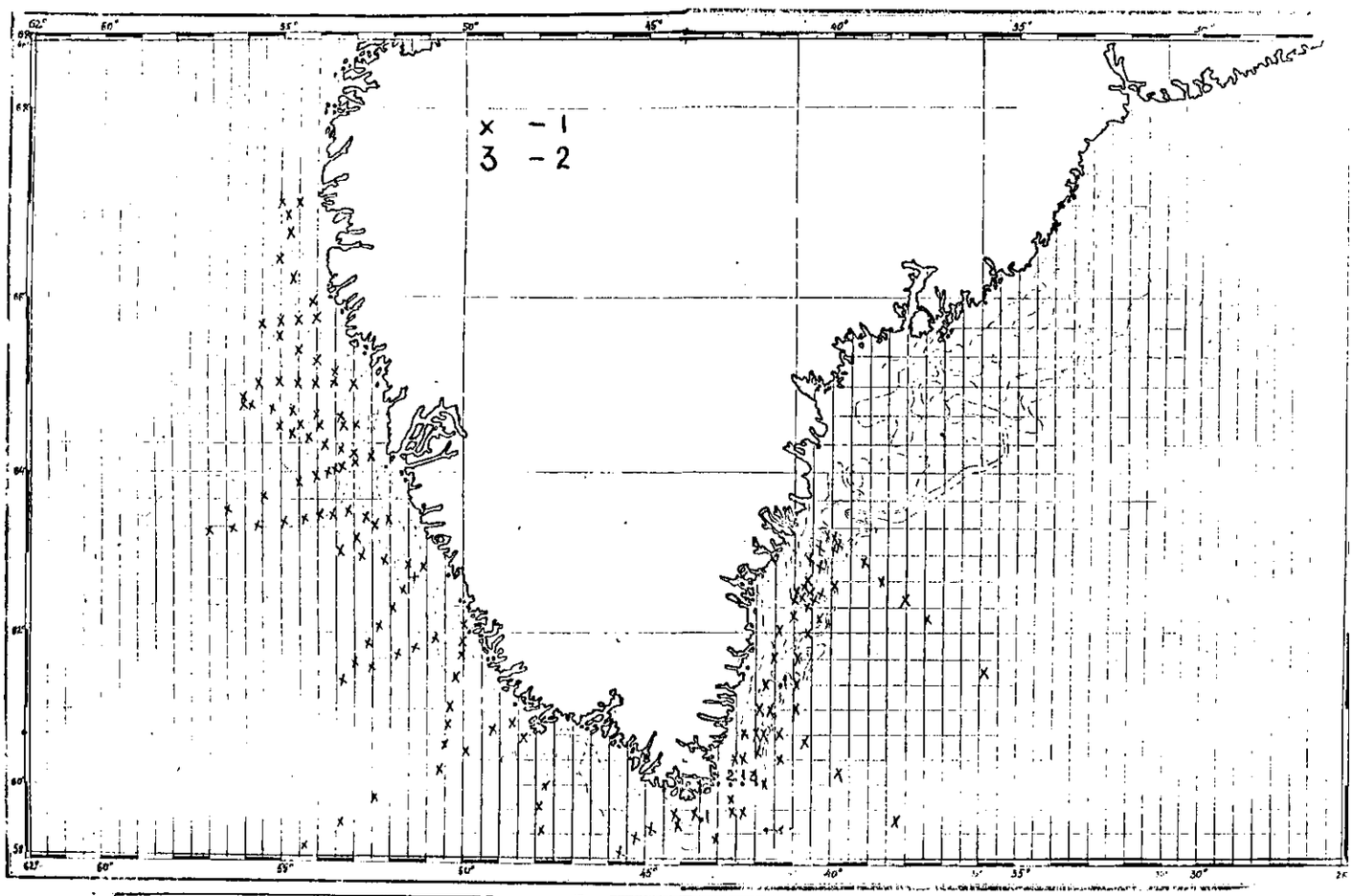


Fig. 6. Distribution of cod larvae in the waters of Greenland, in April 1963. Conventional symbols: 1 - no larvae, 2 - number of larvae per one vertical haul at a given station.

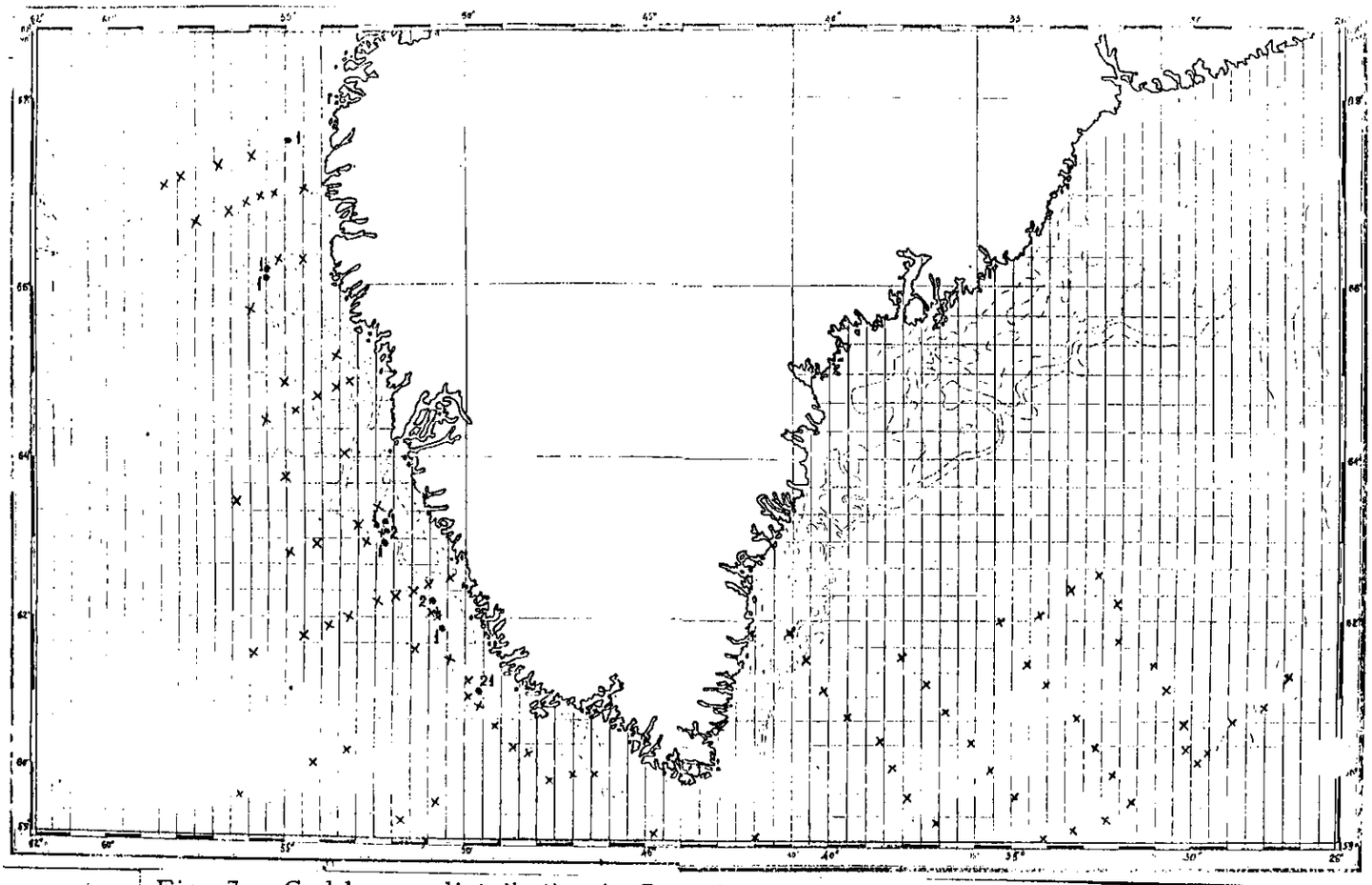

Fig. 7. Cod larvae distribution in Greenland waters, May 1962. Conventional symbols are the same as in Fig. 6.

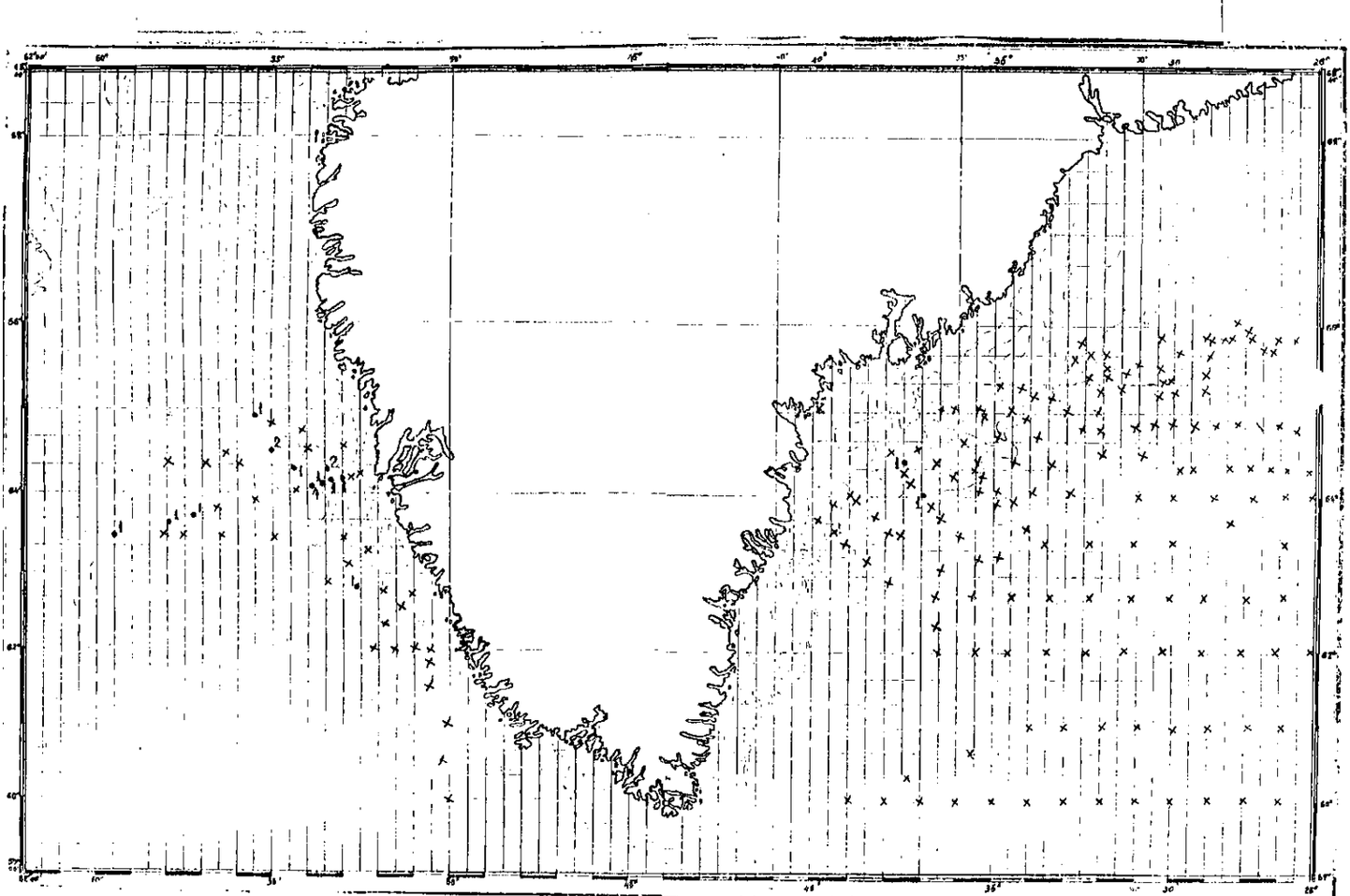

Fig. 8. Distribution of cod larvae in Greenland waters, May 1962. Conventional symbols are the same as in Fig. 6

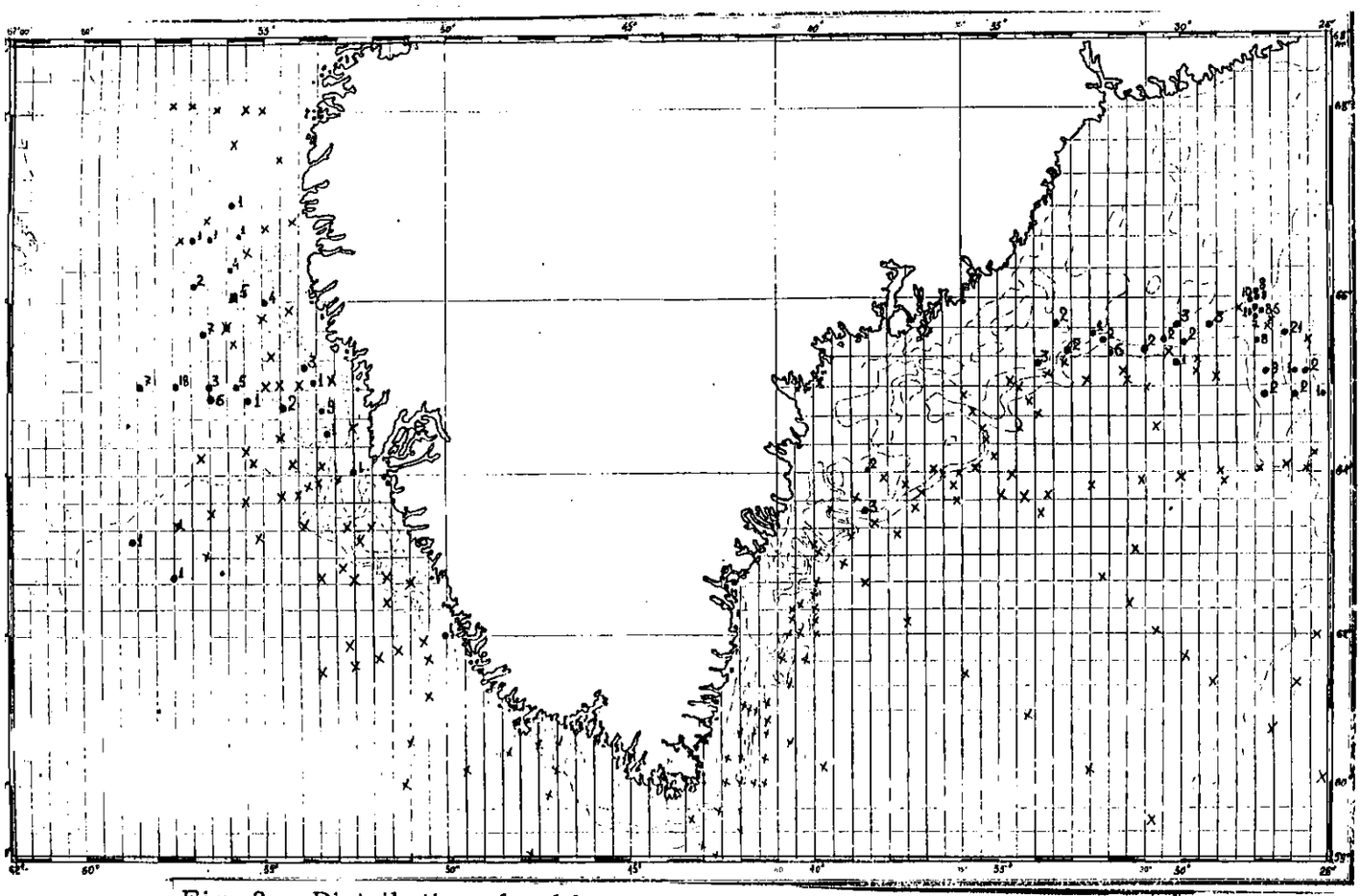

Fig. 9. Distribution of cod larvae in Greenland waters, July, 1963 (2m stramin net was used). Conventional symbols are the same as in Fig. 8.

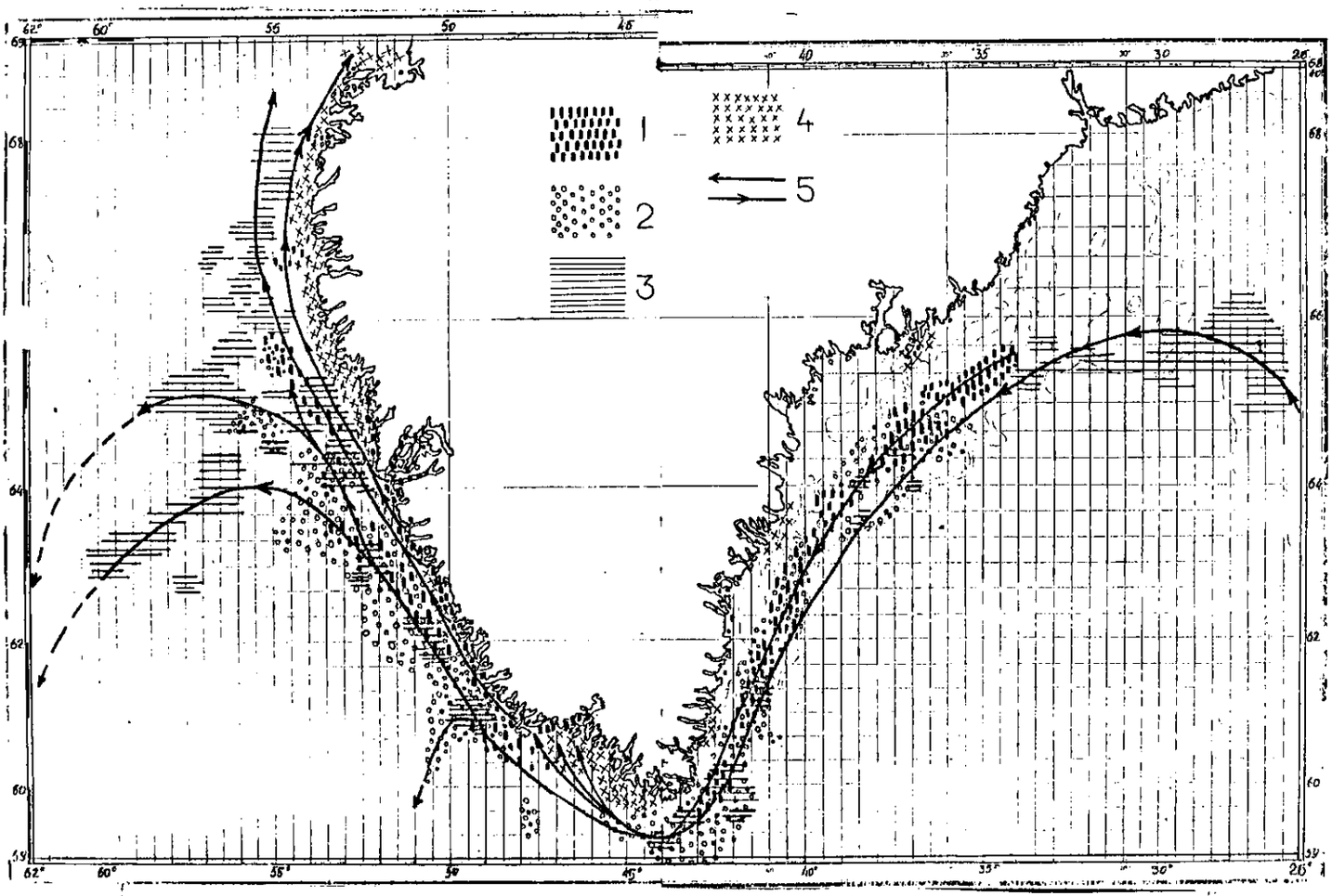


Fig. 10. Location of spawning grounds, distribution of eggs, larvae, youngs and paths of cod drift migration in the Greenland waters, Danish and Davis Straits. Conventional symbols: 1 - spawning grounds, 2 - eggs, 3 - larvae, 4 - young, 5 - paths of drift