

COOPERATIVE RESEARCH REPORT

No. 74

THE BIOLOGY, DISTRIBUTION AND STATE OF EXPLOITATION
OF SHARED STOCKS IN THE NORTH SEA AREA

At its November 1976 Meeting NEAFC decided to request ICES to submit as soon as possible information on stocks shared between zones of extended fisheries jurisdiction, their biology and the fisheries based on them. This request was referred to the various Assessment Working Groups of the Council, and they in turn incorporated the tasks in their working schedule during the first part of 1977. The relevant data and information provided by the Working Groups were included as Appendices to their Assessment Reports which as such formed part of the documentation for ICES Statutory Meeting in September/October 1977.

In conformity with the responsibility for submitting the advice of ICES to NEAFC, the Liaison Committee, after careful evaluation of the data and information provided on this subject, found it necessary in the time available to limit the scope and coverage of the present report to major stocks in the North Sea. Shared stocks in other parts of the Convention Area will be dealt with in another report to be submitted later.

The North-East Atlantic is renowned as an area with long-standing and intensive fisheries investigations. In spite of this, the Liaison Committee noted that for many stocks much basic biological information is still needed. The Parties concerned may find it opportune to make further use of the services of ICES to provide the necessary biological information to assist them in their efforts to solve the management and the allocation problems.

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Introduction

1. The world fisheries are at present in a difficult transitional stage. The principle of fishery resources as a common property in the international sense has largely been abandoned and a regime is emerging based on the concepts of the proposed new Law of the Sea. The major part of the problems of the transition to the new regime has been the subject of elaborate negotiations in the various sessions of the UN Conference on the Law of the Sea. There appears, however, to be one set of problems which has not been dealt with extensively in these negotiations, and this relates to the fact that in many areas of the world and perhaps particularly in the North-East Atlantic, the distribution of major fish stocks covers more than one zone of extended fisheries jurisdiction. These resources shared between several zones of extended fisheries jurisdiction or between such zones and international waters represent an entirely new problem in international fisheries work: to allocate between various national parties the "ownership-rights" and management responsibilities for various parts of a fish stock or unit resource.
2. It is of course up to the parties concerned to solve these complex problems. It is hoped that the information contained in this and subsequent reports will facilitate these tasks. In addition to conveying this information to the Commission and its member countries, the Liaison Committee of ICES would also like to present some comments on the problem complex itself because of the underlying implications for the conservation and management of the resources.
3. The first priority in dealing with fully exploited stocks of the shared resources category should be to establish a system of joint overall management of the resource in its entire area of distribution in accordance with the generally accepted criteria for rational usage and conservation of fishery resources. Ordinarily, such systems will include the setting of a TAC, total allowable catch, for the stock on an annual basis. The allocation of this TAC to the coastal states in whose zones the stock occurs could then conceivably take the form of establishing sub-quotas for each zone. This direct approach will, however, probably meet with a number of difficulties. The apparently simplest solution would seem to be to base the allocation on historical fishing and split the total TAC in proportion to the current yields in the various zones or the means of a recent period. But for many stocks the fishery has for various reasons been concentrated to particular parts of the distributional area of the fish. Furthermore,

considerable fluctuations will often occur in the distribution of many fish stocks, both seasonally, or over a shorter or longer period of years and this will evidently complicate a simple "historical" allocation.

4. There may also be more fundamental objections against basing these very important and definite decisions concerning allocation of the resources merely on the exploitation pattern of some recent years. When allocating the access to a resource, it would seem reasonable to consider also its non-fishable components. The harvestable part of a fishery resource represents only one component of a resource complex which in addition consists of a reproductive phase and a recruiting- and growth phase. And the whole resource complex is of course dependent on the system of productivity at lower trophic levels in the sea. The geographical distribution of these various phases and of the system of primary production in the sea does not necessarily coincide with that of the fishable part of the population. For example, the main areas of the juvenile pre-recruit fish may not be located in the zone in which the main fishery occurs.
5. Other problems that may arise when splitting a total TAC into zonal sub-quotas relate to the state of exploitation of the stock in question. Exploitation pressure may cause changes in the distribution and migrations of the population and will thus affect the allocation problems.
6. A further problem of systems of zonal quotas for shared stocks is that the geographical distribution of the fishing operations may have consequences for the management and conservation of the stocks. An intensive fishery in a zone dominated by young fish may reduce the total yield and endanger the stock. Obviously the exploitation pattern can be optimized by regulation of fishing gear or minimum landing size of fish, but if such regulations discriminate against the fishery in one particular coastal zone they would tend to be unacceptable.
7. One may thus conclude that the complexity and often fluctuating nature of fisheries and fish resources seriously complicate the adaption to a rigid system of zones of extended fisheries jurisdiction, particularly in areas where resources are shared. It seems likely that the allocations will have to be based on a number of criteria, of which the following may be the most important:-

The occurrence and migrations of the fishable part of the stock.

The occurrence of juvenile and pre-recruit fish.

The spawning areas and the distribution of egg and larvae.

The history of the fishery including the distribution of catch, rate of exploitation and fishery regulations.

The state of exploitation of the stock.

Information of this type may then form the basis of negotiations for a long-term proportional allocation of the TAC. It would not be practicable to adjust this allocation to short-term changes and fluctuations which may occur in the distribution and migrations of the stocks, but revisions may have to be made from time to time for stocks with major long-term fluctuations.

8. According to the Revised Single Negotiating Text for the Law of the Sea, States will be obliged to set a TAC for all stocks within the economic zone including shared stocks. But for these latter the zonal quotas must of course be part of an agreed overall TAC for the stock in question. From the argumentation presented above it should be evident that the establishment of zone quotas will not per se and in general solve the problems of "ownership-rights" allocation. Zone quotas should thus not necessarily correspond to long-term resource allocation, but should be determined on the basis of a policy of good resource management and information on the predicted availability of the harvestable part of the resource. This implies that in many cases states which share a resource should, in the interest of general management, allow access to the stock on a mutual basis. Once agreement is reached over the long-term resource allocation, the establishment of zone quotas may be of secondary interest and may perhaps be dispensed with. From the point of view of conservation the decisive factors are the agreement on an overall TAC and an as far as possible optimum fishing pattern. Zone quotas for shared stocks will often represent additional and unnecessary regulations which may in fact form obstacles to an economic and rational conduct of the fishing operations.
9. The basis outlined above for introducing the new ocean regime in areas with shared resources may seem unnecessarily elaborate and the process will be both lengthy and require a great deal of information on the resources and the fisheries. It is difficult, however, to see any other procedure which will safeguard the resources.

A. HERRING

A.1 NORTH SEA HERRING

A.1.1 General Biology

Spawning areas and larval drift

The main spawning areas of North Sea herring are shown in Figure 1. All these spawning areas belong to autumn- or winter spawning herring. Small numbers of spring-spawning herring are found in the North Sea, but these fish do not make any significant contribution to the North Sea stock.

A distinction has been made between spawning grounds which are still in use at present, and areas where herring have not spawned in recent years. The most important spawning now occurs in the Orkney-Shetland area. Spawning along the northeast coast of England and in the eastern Channel has been very much reduced in recent years. On the Dogger Bank and Buchan grounds, spawning has ceased or has been at a very low level in recent years.

Larvae from the Orkney area are transported south and eastward. The exact drift route is not yet exactly known. A major part of these larvae are transported across the North Sea towards the Skagerrak and Danish coasts. Some of the larvae hatched on the northeastern coast of England will grow up along the English east coast, and some will be transported eastwards towards the German Bight. Larvae from the Channel spawning drift north along the Dutch coast and spend their earliest stages in the Wadden Sea.

A.1.2 Distribution and Migrations

Nursery areas

The nursery areas for the 0-group stages are widely distributed on the English east coast and on the Dutch, German and Danish North Sea coasts, and in the Skagerrak as shown in Figure 1. As these fish grow and attain the 1-group stage they move offshore into deeper water adjacent to the areas in which they spent their 0-group stage (Figure 2). Tagging experiments and studies of parasites have demonstrated an emigration of juvenile fish from the eastern central North Sea towards Division VIa. This also applies to juvenile herring of the Moray Firth.

Distribution and migration of adults

In their 3rd year of life, herring leave the nursery areas in the eastern North Sea and join the adult stock on its feeding grounds in the western North Sea. During the feeding season from May until August, adult herring are found from the Shetland Islands to the area off Shields. Spawning concentrations assemble in the Shetland/Orkney area in July/August. In September/October, spawning occurs in the Longstone area and off Whitby, and Flamborough Head. In December there is some very limited spawning in the eastern Channel. In the years prior to 1970, many overwintering herring were found in the Skagerrak and the NE North Sea. These herring belonged to the Dogger Bank and northwestern North Sea spawning populations. Since 1970, with the marked decline in these spawning populations, there have been very few overwintering herring in the northeastern North Sea.

A.1.3 Exploitation and Management

Exploitation methods

The methods of exploitation remained largely unchanged until the second half of the 20th century. The main fishing was done by drift nets, and this fishing method never exploited the resources beyond their capacity. The maximum catch level during this period of exploitation was around 700 000 tons a year.

Although the development of bottom trawling for herring started between the wars the use of echo sounders in conjunction with bottom trawls was introduced after the 2nd war and this proved to be much more efficient than the drift net, which was almost completely abandoned during the 1950s. Bottom trawls were used effectively on the feeding ground (Fladen), but even more on the spawning grounds (Dogger Bank, Sandettié, off Seine Bay). In addition to the trawl fishery for human consumption, an industrial fishery for juvenile herring developed in the eastern North Sea in the early 1950s. The change from drift net to trawl net also meant a re-distribution of the North Sea catch. The countries with major traditional drift net fisheries lost a large share of their catch to countries using the new trawling method.

A second change in exploitation occurred around 1965. At this time, the purse seine was introduced in the North Sea herring fishery. The countries utilising this gear took over the main share of the North Sea catch in a few years, and reduced the total stock considerably. The large catches of herring taken by purse seine were, originally, only used for industrial purposes.

Along with the introduction of the purse seine, the trawl net was perfected to a high degree. The development of mid-water trawls and large pair-trawls meant that a second highly directive fishing method was introduced for herring.

Changes in stock size

The development of these highly efficient fishing methods, and the absence of adequate conservation measures led to continuous decline of most North Sea stocks after 1950. In addition to the changes caused by fishing, there have also been some changes which may have been caused by natural factors.

The decline in stock size did not happen simultaneously for all populations in the North Sea. The first decline took place in the population of the Southern Bight and eastern Channel. About 1955 this population showed evidence of a marked reduction and by 1964 had become

almost extinct, as a result of excessive fishing. There was a small revival of the stock in the early 1970s but a high fishing effort was immediately attracted and it was again reduced to a very low level by 1976.

The population on the Dogger Bank ceased to exist after 1965, also as a result of overfishing. In addition to the heavy fishing intensity on the spawning grounds this stock experienced a concentrated fishing effort on its overwintering area in the northeastern North Sea and Skagerrak.

The Buchan stock declined about the same time and by 1965 had completely disappeared from its traditional spawning grounds off the coast of Aberdeenshire. This decline may not have been entirely due to fishing; possibly there was a relation between the reduction of the Buchan stock and the increase in the stock of autumn spawners around Orkney and Shetland in the mid-1960s.

In addition to these fisheries on the adult stocks from the mid-1950s there was a major increase in exploitation of juvenile herring in the eastern Central North Sea.

By 1975 the total North Sea herring stock had been reduced to approximately 10% of its immediate post-war level.

After 1970, the overall recruitment to the North Sea population started to decline. Year classes 1972, 1974 and 1975 were very poor, while 1970, 1971 and 1973 were only of about average strength.

Management

The deterioration of the stocks led to the introduction of protection measures after 1970. From 1971 to 1974, closed seasons were in force and subsequent data suggest that these had little effect in reducing the exploitation rate on, or halting the decline of, the stock. After 1 July 1974 catch quotas were agreed between the various countries. However, the principle of TACs was probably accepted too late for realistic values to be readily accepted and as a result the final agreed figures have been too high to achieve the objective of rebuilding the stock. The TACs recommended by ICES, those agreed by NEAFC and the actual catches taken are given in Table 1.

Since October 1975, the Liaison Committee has been advising a total ban on directed herring fisheries, and maximum restriction of the herring by-catch in industrial fisheries.

Long-term sustainable yield

If the various sub-populations of the North Sea were given a chance to

rebuild (for some sub-populations it may be too late), the annual sustainable yield could theoretically be 700 - 800 thousand tons. This is also the level of total annual catches that was obtained until the drastic changes in the stock occurred after 1960. The long-term yield, however, is very dependent on the pattern of exploitation. The figure of 700 - 800 thousand tons per year is based on a fishing mortality on 1-group of not more than 1/10th of that on adults. This would entail no directed fishery on juvenile herring and more restrictions on the by-catch in other industrial fisheries.

A.1.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

There have been considerable changes in the distribution of catches within the North Sea in recent years. In order to evaluate these changes in catch distribution, three years have been selected (1965, 1970 and 1975) to represent the catch distribution at different levels of population size.

The catch distribution by ICES fishing areas for these years is given in Tables 2-4. As there is no more detailed information on catch distribution available from most countries, the split by zones has to be made according to the division by ICES fishing areas.

In practice Division IVa east is almost coincidental with the Norwegian zone, and Division IVa west almost entirely within the EEC zone. Division IVb contains several squares belonging to the Norwegian zone. In some years considerable catches have been taken in these squares but at present these cannot be quantified.

A.2 HERRING IN SKAGERRAK (part of Division IIIa)

A.2.1 The Various Stocks in the Skagerrak

Skagerrak is frequented by a number of herring stocks. Three stocks are known to spawn in the area, two of which are of only minor importance. For some stocks the Skagerrak is an important nursery area. The Skagerrak is also part of the seasonal migration route of adult herring from the North Sea, the Kattegat and the Baltic. The adult herring fisheries in the Skagerrak are mainly based on these seasonal visitors. In earlier years the young herring fisheries in the Skagerrak were to a large extent based on recruits to the North Sea herring. In more recent years the other stocks have constituted a major part of these catches of juveniles. The occurrence of the various stocks in the Skagerrak and their contribution to the fisheries in the area are discussed in the paragraphs below.

North Sea herring

In the 1950s and 1960s overwintering herring of North Sea autumn spawners (Bank- and Buchan Shetland spawners) played a major role in the Skagerrak fishery for adult herring. These herring concentrated in the area of Egersund Bank from about October to March and penetrated into the westernmost Skagerrak. In periods of high abundance the overwintering shoals of North Sea herring even reached inside the Swedish skerries. The famous "Swedish Herring Periods" are explained in this way. At the present low level of abundance of the North Sea adult herring they are of negligible importance to the Skagerrak fishery.

Larvae from the northern North Sea, and perhaps even from the areas northwest of Scotland, drift into Skagerrak. Progeny of these stocks, in their first year of life, are found after metamorphosis in inshore waters in summer. Subsequently they migrate into deeper water. These young herring seem to leave the Skagerrak in the following spring, i.e. at approximately $1\frac{1}{2}$ - $1\frac{3}{4}$ years of age. These juveniles derived from North Sea spawners are very often mixed, in this area, with progeny of spring spawners from both Skagerrak and Kattegat.

Kobberground autumn spawners

This herring stock is now almost extinct. The herring used to spawn from the end of September until November on banks in the western part of the Kattegat. It migrated from the North Sea, through Skagerrak, on its way to and back from the spawning area. In winter it probably joined the overwintering North Sea herring in the Egersund area. The Kobberground stock decline in the late 1960s was probably related to the heavy exploitation of overwintering North Sea herring in the eastern North Sea and Skagerrak.

Skagerrak spring spawners

Spring spawners are found along the Norwegian southeast coast, in the Oslo fjord, and off the Swedish west coast. They spawn in February-March. In addition there is another group spawning along the Swedish coast in April-May, probably of the same origin as spring spawners from the Kattegat and the Belt Sea. A third spawning group in the Skagerrak is the so-called Jammer Bay spring spawners. There is insufficient knowledge about these three local spring spawning groups in relation to their life cycle and their importance to the juvenile and adult herring fisheries in the Skagerrak.

Other herring stocks

Several other stocks spawning outside the Skagerrak spend part of their feeding or overwintering periods in the Skagerrak. The more important of these stocks are:

1. Kattegat spring spawners.
2. Spring spawners of the western Baltic.
3. Longshore herring of the Danish west coast (Limfjord, Nissum fjord, Ringkøbing fjord, Ho Bugt and even the river Elbe).
4. Local autumn spawners from Kattegat.

These stocks form the main constituents of the catches of adult herring from the Skagerrak at present.

A.2.2 Exploitation and Management

Exploitation

Total nominal catches of herring in 1966-76 are given in Table 5. The catches reached a maximum of 280 000 tons in 1967-68. A steep decline followed to about 68 - 80 000 tons in 1969-71 with a further decrease to 50 - 55 000 tons in the early 1970s. The preliminary catch figure of 17 000 tons for 1976 shows a very sharp decline in the catches, mainly due to the prohibition of the industrial fisheries (Recommendation 8C).

Monthly catches of the fisheries for adult herring (human consumption) are shown in Table 6. Comparing the two periods shown, it is obvious that the winter peak disappeared in recent years, and this again is primarily due to the decline of the overwintering autumn spawning stock from the North Sea.

Management

For management purposes the North Sea and Skagerrak have hitherto been regarded as one management area. As concerns restrictions on the herring fisheries in the Skagerrak under an international regime, reference should therefore be made to Section A.1 of this report. The essential outcome of the assessment made there for the North Sea and Skagerrak stock is that, in the current depleted state of this herring population, overwintering adult fish of the North Sea stock are too scarce in this area to provide the basis of a fishery. The catches of North Sea herring which have been taken in the Skagerrak in recent years have been very predominantly juvenile fish. The exploitation of these in the Skagerrak is likely to be reduced to a rather low level by NEAFC Recommendation 8C which prohibits a directed fishery on herring for industrial purposes.

B. SPRAT

B.1 NORTH SEA SPRAT

B.1.1 General Biology

Spawning areas and times, larval drift

The most important areas of sprat egg and larval distribution so far established, south of 62°N, are shown in Figure 3, together with an approximate boundary for the limits of spawning. Within this area as a whole, eggs and larvae have been recorded in most months of the year, although peak spawning times do vary in different parts of it. These are earliest in the southern and central North Sea (April/June), and later in Scottish waters (May/July). Little is known about larval drift. Localised concentrations of post-larvae are found in coastal waters and estuaries of Scotland, England and the continental coast, but sprats at this stage of the life cycle can also be found over large areas of the open sea.

B.1.2 Distribution and Migrations

Nursery areas

There are no clearly defined nursery areas for North Sea sprat. Although 0-group fish may be found in coastal waters in considerable abundance, they also show a widespread distribution in the open sea. Their abundance and pattern of distribution varies considerably from year to year.

Distribution and migration of adults

The area shown in Figure 3 can also be used to illustrate the distribution of adult fish during the spawning season. The migrations of these fish are not known in any detail, except that during the winter months shoals aggregate into localised concentrations in coastal waters and further offshore, particularly in the western half of the North Sea. These are not spawning or feeding aggregations. These concentrations disperse in March as the mature fish move offshore for spawning and feeding. In summer, inshore surveys in United Kingdom coastal waters have shown that most of the population remaining there are immature fish.

B.1.3 Exploitation and Management

The North Sea sprat has been exploited, on a small scale, in localised coastal fisheries for several hundred years. In the period 1903-60 total annual catches, recorded in "Bulletin Statistique", only twice (1929 and 1959) exceeded 30 000 tons. In the 1960s catches increased

substantially, exceeding 100 000 tons in 1966. From 1971 there has been a marked, continuous increase in catch, culminating in a figure of 641 000 tons in 1975. Provisional statistics for 1976 show a slight reduction to 617 000 tons.

The first attempt to assess North Sea sprat was made by an ICES Assessment Working Group in February 1975. It was then recommended that, in view of the large increase in catches that had taken place over the previous 3 years, a precautionary TAC of 300 000 tons should be set for the North Sea (excluding the Norwegian fjord fisheries) in 1976. This approximated to the level of catch taken in 1974. This recommendation was not implemented, and the total catch of North Sea sprat increased to 641 000 tons in 1975. A TAC of 650 000 tons was then recommended by the Liaison Committee, and implemented by NEAFC for 1976. Provisional figures suggest that 617 000 tons was in fact taken in that year.

The Liaison Committee in 1976 recommended a TAC for 1977 of 400 000 tons, based on the predicted long-term equilibrium catch. No agreement has yet been reached on the implementation of this recommendation.

Geographical distribution of the fisheries

The distribution of the main fishing areas in the years 1974-76 are shown in Figure 4. Most of the fishing effort has been concentrated in the central North Sea between 53° and 57°N; mainly in the months July-November to the east of 3°E, and December-March to the west of this line. A more recent development has been a fishery on the Fladen Ground (57°-59°N), where most effort has been applied in the months October-December.

Very little sprat fishing has taken place in recent years in the southern North Sea, south of 53°N.

The main fishing gears used are mid-water trawls and purse seines.

B.1.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

Over the 11-year period 1965-75 the only significant catches of sprats reported for the North Sea from outside the EEC zone are those taken in the Norwegian western coast fjords. These averaged 7 160 tons per year over this period, but are considered to be taken from the Skagerrak stock which is treated as a separate management unit. However, in 1976 approximately 4 500 tons were taken from the North Sea stock from within the Norwegian zone.

B.2 SKAGERRAK, KATTEGAT AND NORWEGIAN FJORD SPRAT

B.2.1 General Biology

Spawning areas and times, larval drift

The main spawning area in the region is located between the northern point of Jutland and the Swedish coast (Figure 5). It typically has a sharp northern boundary. Spawning also occurs on Jutland Bank in some years, but Kattegat seems to be of little importance for spawning. There are other spawning areas of minor importance in the fjords along the Norwegian east and west coasts, in the Oslofjord, and in the Swedish archipelagoes and the Danish Limfjord and Isefjord.

Spawning starts about the end of April and lasts to the end of July with a peak in May and June. The eggs and larvae drift with the Baltic current eventually entering the archipelagoes and fjords along the coast of Sweden, and both east and west coasts of Norway. Current vortices in the Skagerrak carry many larvae back to their point of origin. Most of the sprat population in the Norwegian west coast fjords probably originate from larvae drifted from the Skagerrak and very few from local spawning within the fjords.

B.2.2 Distribution and Migrations

Nursery areas

0-group sprat are found in the fjords and archipelagoes of Norway and Sweden, but they have a wide distribution also in the open sea.

The 1-group and older sprat remain within the Norwegian fjords, probably for their whole lives, whereas in the Swedish archipelago there is a seasonal migration to and from the coast.

Distribution and migration of adults

Figure 6 shows the distribution of adult sprat. In the Skagerrak and Kattegat there is a migration in spring to the main spawning area shown in Figure 5, and thereafter dispersal over the whole region. During autumn, concentrations are formed in the coastal areas and archipelagoes along the Swedish and east Norwegian coasts. Along the Norwegian west coast the adult fish appear to stay within the fjord system spawning where conditions are suitable.

B.2.3 Exploitation and Management

For stock assessment purposes the sprat in the Kattegat, Skagerrak and the Norwegian west coast fjords are considered as a single unit. Although the origin of the sprat in the Norwegian fjords north of 62°N and their relationship to the Skagerrak spawning stock is

uncertain, it seems rational to consider them together for management purposes. Within the total area of distribution, there are local populations inside the skerries with different growth rates and age of spawning. They are, however, small and of negligible importance in relation to the main population.

The mean age of sprats in the catches in the Skagerrak and Kattegat remained very stable until pelagic trawls were introduced in the 1950s.

Although no detailed numerical assessments of this sprat stock have yet been possible, the Herring Assessment Working Group considered in 1976 that any further increase in fishing effort might reduce recruitment and recommended a TAC of 100 000 tonnes for 1977 for Division IIIa and the Norwegian fjords in Division IVa combined. At its 1977 Meeting, this recommendation was revised to 80 000 tonnes for both 1977 and 1978.

Geographical distribution of the fisheries

Fisheries for sprat in this area are carried out by three countries. The landings from 1966-76 are given in Table 7.

- a) A Danish trawl fishery throughout the year for industrial purposes mostly in the Kattegat;
- b) A Swedish trawl fishery in the Kattegat from October-March for canning purposes, continuing with purse seines in the archipelagoes of the Skagerrak;
- c) A Norwegian purse-seine fishery in the west coast fjords from June-October for canning purposes. A northward shift in this fishery has taken place in the last 6-8 years. This fishery is almost entirely dependent on 1-group sprats.

B.2.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

Only Norway has hitherto declared an economic zone in the Skagerrak. The fishery for sprat during the last decade has been located in the following way:

- Norway: almost totally within its economic zone close to the coast or within the fjords.
- Denmark: trawl fishery in the eastern Skagerrak and in the Kattegat.
- Sweden: purse-seine fishery in the eastern Skagerrak, mainly close to the Swedish coast, and trawl fisheries in the Kattegat area.

C. MACKEREL

C.1 NORTH SEA MACKEREL

C.1.1 General Biology

Stock identification

There are generally considered to be two stocks of mackerel, the North Sea stock (Anon., 1974) and the Western stock, which spawn and overwinter in the North Sea and the Celtic Sea area, respectively. North Sea mackerel are mainly found in ICES Sub-areas III and IV. Tagging has shown that a considerable amount of mackerel from the Western stock migrate into these areas during summer (Hamre, 1975; Anon., 1976 and 1977); there is also some emigration of North Sea mackerel into Sub-area VI.

Spawning

The main spawning area for North Sea mackerel is in the central North Sea (54°-58°N, 0°-7°E) during June and July (Iversen, 1973; Johnson and Dawson, 1975), but there is also some spawning in the Skagerrak (Lindquist and Hannerz, 1974). The main spawning area is indicated in Figure 7.

C.1.2 Distribution and Migrations

Distribution of larvae and juveniles

There is little information about the younger stages of mackerel. Larvae are mainly found in the central North Sea, particularly in July (Bainbridge, Cooper and Hart, 1974). The 0-group occurs in the same area, while I- and II-group have a wider and more scattered distribution (Walsh, 1974). The coasts of the northern North Sea and the Skagerrak can be considered to be important nursery areas.

Distribution and migration of adults

North Sea mackerel overwinter in deep waters in the Norwegian Trench, from about 62°N southwards into the Skagerrak (Hamre and Nakken, 1970; Postuma, 1972). In early summer the mackerel appear in the upper water layer and after spawning are mainly found in the northern North Sea. The distribution of adults by season is shown in Figure 8.

C.1.3 Exploitation and Management

The fishery

Until 1964 mackerel in the North Sea were caught mainly by trawl, gill net and hook and line. The total annual catch was less than 100 000 tons. After 1964 landings increased rapidly due to the

development of the Norwegian purse-seine fishery, and reached 934 000 tons in 1967. In the following years catches were reduced, partly due to regulation of the purse-seine fishery. The main fishing season is July-October. In Figure 9 the total catch of mackerel taken in the North Sea, Skagerrak and Kattegat in the last 11 years is shown. As indicated above, part of this catch is derived from the Western stock of mackerel. In 1972, 1973, 1975 and 1976 the contribution of the Western stock is estimated to have been about 25% of the total catch of mackerel from the North Sea shown in Figure 9. In 1974 it is estimated to have been about 40% because of the high proportion of the total North Sea catch taken during that year from the Shetland summer fishery.

Stock fluctuations

The changes in stock size of North Sea mackerel are indicated in Figure 10. The stock size at the beginning of each year has been estimated from tagging data. The decline in stock size up to 1970 is mainly a result of the fishery; after 1973 the decline has been due to the poor recruitment after the 1969 year class.

The average long-term annual yield is estimated to be about 300 000 tons at an exploited stock size of 1.2 - 1.5 million tons.

Fisheries regulations

The fishery for mackerel in the North Sea has not been subject to effective international management, although NEAFC Recommendation 11 prohibits fishing of mackerel smaller than 30 cm for industrial purposes and, with some exemptions, prohibits a fishery for this purpose in the first half of the year.

The Norwegian catch of mackerel in the North Sea has annually accounted for about 80% of the total catch. National regulation of the Norwegian fishery has therefore been of major importance. The regulations have been in force since 1970 and included: minimum legal size, prohibition of fishing for industrial purposes in November-July, total catch quota, and closed areas. As a result of these restrictions, the stock of mackerel increased from 1970 to 1973. Later it declined due to poor recruitment, although the rate of decline has been reduced by the quota limitations.

C.1.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

The last 10-year period

Catch statistics of mackerel have not been reported with reference to areas comparable to the new zones of extended fisheries jurisdiction

in the North Sea. Estimates of the catch proportions within each zone must therefore be based, to a large extent, on general information about the mackerel fishery of each country.

The very large catches of mackerel taken during the period 1966-69 were a result of the introduction of a purse-seine fishery by the Norwegians. A large part of the catch was taken in autumn along the southern and western slopes of the Norwegian Trench. The Swedish catch was taken in the same area. After this period, because of national regulations which reduced the fishing effort south of 59°-60°N, the Norwegian fishery took place further north and west. Consequently, a large part of the total international catch was then taken in the Shetland area, and a considerable proportion of this mackerel originated from the Western stock. In the most recent years the Norwegian and Faroe catches have accounted for most of the total, and these fisheries have resulted in larger proportions being taken on the eastern side of the northern North Sea.

In order to relate catches to zones of extended fisheries jurisdiction, it seems feasible to restrict considerations to the Norwegian and EEC zone within the North Sea, since in the Skagerrak the position of zones is obscure.

In the following table an attempt is made to estimate the proportion of the total catch taken within the zones of Norway and the EEC in the North Sea:

	<u>Norway</u>	<u>EEC</u>
1966-69	75	25
1970-74	40	60
1974-76	60	40

Present state

The catches of mackerel within each of the zones in the North Sea in 1975 are shown in Figure 11. The data are based on estimates made by Working Group members.

C.2 MACKEREL, WESTERN AREA

C.2.1 General Biology

Spawning (see Figure 12)

Two spawning areas have been identified for the Western stock:

- 1) In Biscay spawning starts along the continental shelf at the end of February with a maximum in March;

closer to the French coast spawning takes place in May and June.

- 2) On the Celtic Shelf the spawning season continues from March to July.

C.2.2 Distribution and Migrations

Juveniles

Not much is known about the distribution of young stages. 0-group fish (≈ 18 cm) appear to the south of Cornwall (Division VIIe) in October-December and overwinter in this zone. They do not seem to shoal with older fish.

Adults

The range of distribution of Western stock mackerel and its overwintering areas are shown in Figure 13. Fish spawning in Biscay migrate northwards to the Celtic Sea, the Shetland area and the northern North Sea. Some of them, however, remain in Biscay along the shore in summer.

As shown by English and Norwegian tagging experiments, after spawning in the Celtic Sea, adult mackerel tend to migrate northwards. Migration routes are known: one along the western coast of Ireland to Shetland, another through the Irish Sea and the third through the English Channel into the North Sea. In autumn a reverse movement occurs.

C.2.3 Exploitation and Management

The fishery

Between 1966 and 1969 the total catch from Sub-areas VI, VII, and VIII remained at a rather constant level of around 70 000 tons. Then an increase took place which brought the total reported catch to 103 000 tons in 1970 and around 500 000 tons in 1975. Although provisional, the figure for 1976 does not seem to be appreciably different from that of 1975 (see Figure 14).

At the end of the 1960s, both Sub-area VII and Sub-area VIII contributed about 40% of the catch, but in the 1970s the bulk of the catch has come from the Celtic Sea where a directed fishery has been operating on overwintering and spawning concentrations. The most recent assessment of this stock suggests that the exploitation rate in 1976 was appreciably above the optimum.

Stock fluctuations

Up to recent years no stock estimate was available. In 1977 the ICES Mackerel Working Group estimated the stock size at 2 000 000 tons at the beginning of 1975 and noted a decline since 1973. Some echo sur-

veys and egg- and larval sampling are now being undertaken to provide estimates of stock size which are independent of commercial fisheries data.

As in the North Sea, large fluctuations in the abundance of year classes occur. Both 1968 and 1971 year classes were abundant and have made major contributions to the fishery.

Fisheries regulations

To date, no international regulations have been applied to the Western stock. Limited national commercial restrictions have been introduced on occasions in recent years by France.

C.2.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

During the last 5 years about 90% of the catch in Sub-areas VI, VII and VIII have been taken inside the EEC 200-mile fisheries jurisdiction, the remaining 10% being caught in Sub-area VIII adjacent to the Spanish coast.

In 1972, the U.S.S.R. catch accounted for 42% of the total. In 1975 this proportion increased to 63%. At the same time, the share of EEC member countries declined from 32 to 21%.

D. NORTH SEA SAITHE

D.1 NORTH SEA SAITHE (DIVISION IIIa and SUB-AREA IV)

D.1.1 General Biology

The North Sea saithe spawn in February-March at 150-200 m depth on the northern North Sea plateau north of about 61°N. The spawning is confined chiefly to areas near the slope of the shelf, and the spawning grounds are probably continuous, although spawning appears to be most intensive in the Tampen area and to the north and west of Shetland. In addition to North Sea fish the spawning population in this area is supplemented by migrants from northern Norway.

The distribution of eggs, larvae and juveniles is not known in detail. However, observations on the distribution of juvenile saithe pelagically and in the inshore regions added to what is known about the prevailing water current system of the North Sea in winter and spring, indicate the following basic pattern: eggs, larvae and juveniles from spawning in the Shetland area are transported chiefly southwards along the eastern coasts of the British Isles and the juveniles are finally distributed in the shore region of Shetland, Orkney and the east coast of Scotland and northern England. From the Tampen area

the transportation is basically southward along the western side of the Norwegian Deep which at some later stage is traversed. Most of the juveniles are finally distributed in the littoral region of the Norwegian west coast. Less regularly, and usually in relatively small numbers, 0-group saithe may occur on the Norwegian Skagerrak coast.

The saithe mainly stay in inshore waters until 2-3 years of age after which they migrate to areas of 100-200 m depth. Tagging experiments show that most of the young saithe from western Norway south of 62°N migrate to the eastern part of the North Sea plateau, especially to the area between 58°N and 61°N. There are indications that the saithe from the British coasts migrate basically to areas on the western side of the North Sea, although there is a considerable mixing at this stage with fish from the eastern side.

Recaptures of young saithe tagged in the North Sea area are occasionally made outside Sub-areas III and IV, but migration of immature saithe away from the North Sea is probably not very extensive. However, tagging experiments from the Norwegian coast north of 62°N, i.e. in Division IIa, indicate that in recent years young saithe from the area between 62°N and about 65°N also chiefly migrate to the North Sea, mostly the northern and eastern parts, whereas 20 years ago their migration pattern was more northerly directed. This change, which seems to be connected with a decreasing age of migration away from inshore waters, may be an expression of long-term variations in the life history of saithe on the Norwegian coast, in which case the present migration pattern could be expected to be reversed some time in the future.

In all probability, the young saithe in the North Sea are recruited mainly to the spawning stock on the northern part of the plateau. The migration pattern of the spawning stock is poorly known, but at least part of the stock remains on the plateau outside the spawning season. Apparently, most of the spawning stock return to the North Sea spawning grounds year after year. On the other hand, tagging experiments have shown that saithe from northern Norway also contribute to the spawning population in the northern North Sea, especially in the Tampen area.

The borderline between the Norwegian and EEC fisheries zones stretches across the Tampen spawning ground.

However, information on the detailed distribution of spawning grounds and of 0-group fish is at present very limited.

D.1.2 Exploitation and Management

The saithe in the North Sea is caught chiefly by trawl which normally accounts for 90-95% of the landings. The rest is taken mainly by Norwegian purse seine and gill netters. In the trawl fisheries, more than 10 countries participate. The fleets operate generally all the year round, but some tend to concentrate on the spawning season.

There has also been reported considerable landings of saithe in industrial trawl fisheries, in 1976 about 20% of the total, which are chiefly taken in the southeastern part of Division IVa and the northeastern part of Division IVb.

The saithe landings from the North Sea have increased from about 30 000 tons (not including industrial trawl) around 1960 to 340 000 tons in 1976. For years prior to 1974 it is not possible to separate catches from Sub-area IV and Division IIIa, but for 1974 and 1975 catches are given separately in Table 8.

From 1976 an international minimum landing size of 30 cm is applied to saithe in the North Sea region.

D.1.3 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

The geographical distribution of the greater proportion of catches is not known in any detail, and it was not possible to estimate the proportions taken in the Norwegian and EEC zones.

E. COD

E.1 NORTH SEA (SUB-AREA IV) COD

E.1.1 General Biology

There is a considerable amount of literature on North Sea cod and most of the relevant aspects of its biology and fishery have recently been summarised by Daan (1975).

Spawning times and areas

Our current knowledge of spawning areas is summarised by Daan (1975). Cod eggs may be found over almost the entire area of the North Sea, with the exception of the continental coastal areas. Concentrations of eggs occur in several well-defined areas and additional evidence of spawning grounds is provided by data on catches of mature cod (Graham, 1934). In addition to the information given by Daan (1975), the (Flamborough) spawning area off the English NE coast has been confirmed and delimited by a series of English plankton surveys in 1976.

The peak of egg density is in February in the south and in March in the north, with range of occurrence from January to April.

E.1.2 Distribution and Migrations

Juvenile fish distribution

An international survey of 0-group gadoids has been in operation since 1974 and prior to this there was work by individual nations, notably by Scotland (Figure 15). The surveys have not covered the southeastern North Sea nor inshore areas but in the remainder, the areas of highest density are off the Danish coast, Tail End of Dogger, Ling Bank, Bressay Area and the east coast of England and Scotland. From shrimp trawl surveys and fisheries, 0-group cod are known to be abundant in inshore areas in the German Bight, along the Dutch coast, and in some English estuaries.

There is also an international survey for I-group gadoids and Figure 16 shows the average distribution (1965-75) of I-group and II-group cod. The highest concentrations occur along the coastal areas of Denmark, Federal Republic of Germany and the Netherlands. I-group cod are less widespread in the northern North Sea, although local concentrations do occur, e.g. in the Bressay Area.

Distribution and migration of adults

Numerous tagging experiments have been made and a summary of results was made in 1971 (ICES, 1971). In all experiments the centres of density of recaptures were located close to the areas of release, or they moved seasonally and returned close to the liberation area. In no case was there a tendency for the centre of density to move progressively away from the release area during successive years.

Fish tagged in the central North Sea and Southern Bight showed the most movement, and here 95% of the recaptures were within a radius of approximately 140 miles of the release area after 3 years.

With the possible exception of cod along the English NE coast, the Scottish coast (where movement is more restricted and parallel to the coast), and the Norwegian coast, the tagging results suggest that there is a continuous distribution in the North Sea, with intermixing over distances of up to about 140 miles.

E.1.3 State of Exploitation

From the beginning of the century up to 1965 the total catch fluctuated between 60 and 100 thousand tons. After 1965 landings rose sharply to a peak of 350 thousand tons in 1972; since then they have declined

to an estimated 209 thousand tons in 1976. The available evidence suggests that the main cause of the increased landings in the late 1960s/early 1970s was an increase in recruitment.

In recent years age groups 1-4 have contributed over 90% of the catch in number (2 year olds predominant), and 80% by weight (3 year olds predominant). The VPA indicates that 2 year olds are subject to maximum exploitation, while younger and older age groups have lower F values. The mean fishing mortality rate on two group fish and older has been between 0.6 and 0.9 in recent years. The maximum yield per recruit with the present exploitation pattern is obtained at an F value of between 0.3 and 0.4 at an M value of 0.2.

E.1.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

Tables 9 and 10 give estimates of the proportions and quantities of the Sub-area IV cod coming from the Norwegian zone.

E.2 COD IN DIVISION IIIa

The cod taken from Division IIIa come from Norwegian, Swedish, Danish and international waters. From 1966-75 annual landings have fluctuated between 13 000 and 32 000 tons. Since 1969 landings have increased, and the value for 1975 was 32 000 tons.

There are several stocks of cod within Division IIIa. The cod found in Norwegian coastal waters appear to be independent of all other cod stocks. Tagging experiments have shown an interchange of cod between the North Sea and the Danish side of the median line between Denmark and Norway in the Skagerrak.

There appears to be no migration of cod between the North Sea and Kattegat.

F. HADDOCK

F.1 NORTH SEA (SUB-AREA IV) HADDOCK

F.1.1 General Biology

Spawning times and areas

Spawning occurs in spring, the principal concentrations being in Divisions IVa and VIa. Eggs and larvae are pelagic and are mainly concentrated between 10 and 40 m depth. In the North Sea, the centres of larval concentrations are mainly in Division IVa (Figure 17). The larvae are found extending from the EEC zone into the Norwegian zone

as far east as longitude 3°E in the north and also over the Ling Bank area in the south.

F.1.2 Distribution and Migrations

Juvenile fish distribution

During their first summer, haddock are still pelagic. During this stage in the life history the principal concentrations within the North Sea occur north of latitude $58^{\circ}30'$. As in the case of the larvae, the pelagic juvenile stages are distributed partly in the EEC zone and partly in the Norwegian zone. 0-group individuals have also been taken pelagically to the west of Shetland and Orkney but at this latitude the distribution of pelagic stages has only been investigated as far west as longitude 5°W (Figure 18).

In near waters haddock, the demersal way of life is adopted some time between 6-18 months of age. By 12 months of age, juvenile haddock can be found over most of the North Sea, but tend to be concentrated primarily in the northwestern North Sea, north of a line drawn from latitude $54^{\circ}30'$ on the western side of the North Sea, to the mouth of the Skagerrak on the east (Figure 19).

Distribution and migration of adults

As for cod, tagging experiments suggest that haddock in the North Sea may be sub-divided into a number of groups. Lines of demarcation are not certain, but regions can be recognised, between which there appears to be relatively little interchange of tagged individuals.

F.1.3 State of Exploitation

The North Sea fishery is mainly carried out by seine and trawl. From 1923 to 1963 (excluding the war years) North Sea haddock landings averaged 97 000 tons annually. During the 1960s, good year classes caused landings to increase, and in 1969 and 1970 the landings exceeded 600 000 tons. It is not possible to predict whether, in the long term, landings will decline to a level nearer the pre-1960 average, or whether they will continue to fluctuate at a higher level than this.

The present age of first exploitation for haddock is about 2 years. Mesh assessments for Sub-area IV haddock show that an increase in mesh size should lead to an increase in the yield per recruit, small long-term gains being predicted for an increase in mesh size to about 90 mm.

A reduction in effort should also increase the yield per recruit for Sub-area IV haddock, although the gains expected in this way might be quite small.

Estimates of the fishing mortality rate (F) of haddock in Division VIa suggest that this is about 0.5 for fish aged 2 years and older.

F.1.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

Tables 9 and 10 give estimates, for some countries, of the percentages and quantities of the total Sub-area IV landings that come from the Norwegian zone of the North Sea.

F.2 HADDOCK IN DIVISION IIIa

There is some transport of eggs and larvae to the Skagerrak from the North Sea, but spawning also takes place locally.

Most of the haddock taken from the Skagerrak come from within the Danish 12-mile limit and from waters between the Danish 12-mile limit and the median line between Denmark and Norway. These haddock are probably part of the North Sea haddock stock.

A relatively very small quantity of haddock is taken from the Norwegian side of the Skagerrak. These are thought to be independent of other haddock stocks.

There appears to be no migration of haddock between the North Sea and the Kattegat.

G. WHITING

G.1 NORTH SEA (SUB-AREA IV) WHITING

G.1.1 General Biology

Spawning times and areas

Whiting eggs are to be found distributed widely throughout the North Sea. The spawning season is long, eggs being found in the south in January, and small larvae in the north in September.

G.1.2 Distribution and Migrations

Juvenile fish distribution

The pelagic stage tends to be longer than for cod and haddock. 0-group fish are mainly found in Division IVa and in the southeast of

Division IVb (Figure 20). I- and II-group whiting are found widely distributed throughout almost the whole of the North Sea (Figure 21).

Distribution and migration of adults

Adult whiting are distributed continuously throughout the whole of the North Sea.

Tagging results, although limited, suggest that like cod and haddock, whiting may be sub-divided into groups between which there is relatively little interchange of individuals.

G.1.3 State of Exploitation

In the 1950s the mean yield was 75 000 tons. In the 1960s the recruitment to the fisheries increased, resulting in a mean yield for 1966-75 of 148 000 tons with a maximum of 216 000 tons in 1969. A considerable part of the catch is taken as by-catch in Recommendation 2 fisheries. If all countries changed to 80 mm mesh, it is expected that the total catch would be increased by about 50 000 tons. The gain would, however, be unevenly distributed among countries.

G.1.4 Distribution of Fisheries

Estimates of the percentages and quantities of the Sub-area IV whiting landings coming from the Norwegian zone of the North Sea are given in Tables 9 and 10.

G.2 WHITING IN DIVISION IIIa

Part of the pelagic larvae and young found in the area have been carried there by currents from the North Sea, but spawning also takes place locally. 0-group fish are found in shallow water in the autumn, and during the winter they migrate into deeper water.

The catches are dominated by these juveniles and fluctuate from year to year depending on year class strength. The increased level of recruitment observed in the North Sea has not influenced the catches in the Skagerrak and Kattegat.

Under NEAFC Recommendation 6, vessels not exceeding 150 bhp are allowed to land undersized whiting from the Division without restriction as to quantity.

There appears to be no migration of whiting between the North Sea and the Kattegat.

H. NORTH SEA PLAICE

H.1 General Biology

The spawning of the North Sea plaice occurs generally in areas less than 50 metres in depth, as shown in Figure 22. The most important spawning ground is in the Southern Bight, the others being situated south of the Dogger Bank, off the German Bight and off the northeast coast of England. Smaller spawning areas are found in the Moray Firth and the Firth of Forth (Harding *et al.*, 1975).

Plaice also make a spawning migration from the southern North Sea to the eastern English Channel. There they join the spawning population of the resident English Channel plaice, and return to the North Sea when spawning has been completed (Houghton, 1976).

The spawning season lasts from December to April, although the peak occurs in January (Harding *et al.*, 1975).

H.2 Distribution and Migrations

Nursery areas

The young fish spend the first one or two years of life in the shallow water close to the coast. The main nursery grounds are along the Danish, German and Dutch coasts (the Wadden Sea), but also along the English North Sea coast. In the German Wadden Sea, 0-group plaice first arrive in May. This immigration continues until November (Rauck, 1973), during which time they are taken as by-catch in the shrimp fishery, but from October the faster-growing juvenile plaice (those which arrived between May and July) emigrate offshore. The later arrivals remain in the inshore area during the winter, and appear as I-group plaice in the shrimp fishery the following year (Rauck, *op.cit.*).

As they grow, the plaice move out to deeper water, and join the adult spawning population at age 3-5 years.

Adult distribution

Plaice are found to a maximum depth of about 80 metres. In the North Sea they occur throughout the southern and central North Sea (Divisions IVc and IVb) but only in certain parts of the northern North Sea (Division IVa).

H.3 Exploitation and Management

The fishery

Throughout most of the early period up to World War II, the fleet

consisted of sailing trawlers, steam otter trawlers and small cutters. Fishing was undoubtedly concentrated in the southern North Sea, with a particular emphasis on the grounds adjacent to the nurseries. However, at least with the English steam trawl fleet, there was a considerable northern North Sea fishery, and although this was mainly directed at other species, plaice catches were made from the representative plaice grounds in Divisions IVb and IVa. As with World War I, World War II did not see a complete closure of the fishery, for the continental cutters continued to fish close in on the eastern side. Immediately after World War II, fishing recommenced with the return of the English fleet to the Southern Bight and the remainder of the cutters to the eastern grounds outside the mined areas. During the mid-1950s, however, fishing spread throughout the area of plaice distribution in Divisions IVc and IVb, and in the early 1960s in Division IVa. German and Danish vessels, possibly relatively unchanged in gear, size and power, are probably still fishing their traditional grounds in the eastern North Sea but the English fleet, which changed progressively to motor propulsion in the 1950s, has effectively left the Southern Bight for the central, southeast and northern North Sea, a steady decline in the number of English vessels probably being offset, particularly at Lowestoft, by increases in engine power, the use of heavy gear with synthetic nets and chains, and precision Decca-fix fishing. In addition, with the demise of the southern North Sea herring fishery during the 1950s, flatfish effort has been augmented by the rapid development of Dutch beam trawling, a method of fishing later taken up by Belgium too. Most of this new effort is concentrated in Division IVc, and the southerly portion of Division IVb (Bannister, 1975).

Stock fluctuations

In the period 1967-71, total stock biomass (ages 2 years and older as calculated from VPA) fluctuated around 700 000 tons, but although the strong 1972 year class reversed a downward trend from this level in 1974, the stock biomass appears to have been declining since then and has been forecast as 400 000 tons for the beginning of 1978 (Anon., 1977). However, the latest assessment indicates that there is currently no reason to suppose that the spawning stock is in danger.

Management

Regulation by mesh size and minimum legal landing size has been in force for some time, and TACs were introduced in 1975. Total allowable catches as recommended, together with those agreed on and the actual catch for each year, are shown below (quantities are given in '000 metric tons):

Year	Recommended TAC	Agreed TAC	Reported catch
1975	115	126	108
1976	85	99.9	109
1977	71	99.9	
1978	95		

Catch statistics

Annual catches in Divisions IVa, IVb and IVc for the period 1966-76 are given in Tables 11, 12 and 13, and the long-term trends are shown in Figure 23 (Bannister, op.cit.). Since 1966, 100 - 130 thousand tons have been taken each year from the North Sea.

I. NORWAY POUT

I.1 General Biology

The Norway pout is a small gadoid restricted to the temperate zone of the northeast Atlantic. Although caught by demersal trawls it feeds on planktonic organisms close to the sea bed, and its distribution is centred between depths of 100 m and 250 m.

Spawning occurs in the major areas of Norway pout distribution, but detailed information is available only for the northern North Sea (Figure 24). The spawning season is March-April in the North Sea but in May off Iceland. Spawning first occurs at an age of 1 or 2 years, possibly depending on abundance.

I.2 Distribution and Migrations

Juveniles

The distribution of pelagic 0-group Norway pout corresponds closely to the spawning areas in the northern North Sea (Figure 25). Subsequent dispersal is indicated by the much wider distribution of the 1-group recorded by the International Young Herring Surveys in winter, especially in the central North Sea and Skagerrak.

Little is known about the distribution of immature fish in other areas, although larvae have been recorded at low density along most of the Norwegian coast.

Adults

The limits of Norway pout distribution are shown in Figure 26. Within the area shown, the greatest concentrations occur in the northern North Sea, and the density is much lower in the northern parts of the range.

No migrations of Norway pout are known. Raitt (1968) concluded from the incidence of an eye parasite that no emigration occurs from the west to the east of Scotland, but some dispersal in the other direction cannot be ruled out. There is no information for other areas, but presumably concentration towards the spawning areas occurs from adjacent areas.

I.3 Exploitation and Management

Development of the fisheries in the North Sea (and Skagerrak)

Fishing for Norway pout with small-meshed bottom trawls with a light footrope commenced during the late 1950s. Since then an increasing trend in the annual landings has been observed, reaching a maximum of approximately 736 000 tons in 1974. It should be noted, however, that the recorded landings in previous years were not necessarily exact, owing to lack of adequate sampling of mixed catches. The Norwegian fishery, for instance, has to a large extent depended upon the availability of blue whiting in the Norwegian Deep, and a considerable proportion of the landings recorded as Norway pout has been blue whiting. These by-catches have been extracted using results of extensive sampling in recent years (from 1972 onwards), and the estimated Norway pout catch figures are given in Table 14.

The fishery is conducted by several countries, of which Denmark, Norway and the Faroes contribute the bulk of the landings. The catches are mainly reduced to fish meal and oil.

Fisheries in other areas

In recent years fisheries for Norway pout have gradually developed locally off the coast of Norway between 62°N and 64°N, and in the north Minch (Scottish west coast) and around the Faroes and Iceland (Figure 26).

Off Norway the landings mainly consist of blue whiting, great silver smelt and silvery pout, whereas the contribution of Norway pout is rather small. This has been accounted for in Table 14, which gives the landings by ICES fishing areas. By-catches in the Minch fishery are small. No detailed information on catch composition in the Norway pout fisheries around the Faroes or Iceland were available to the Working Group, but off the southwest coast of Iceland up to 30% - 40% of the landings recorded as Norway pout consist of blue whiting.

Management units

Since 1-group and older Norway pout are rarely found in midwater, it is unlikely that they migrate across deep water. It, therefore, seems appropriate to consider the Icelandic, Faroese and Norwegian coastal areas as having stocks separate from the North Sea stock, although some recruitment from one to another by larval drift cannot be ruled out.

In the North Sea around the British Isles the situation may be more complicated. The age composition differs between the North Sea and the Scottish west coast, but it is not known whether this is due to different mortality rates in the two areas or to emigration of fish from the North Sea. Since there is no direct evidence of the latter, the North Sea is treated here as a single management unit. Within the North Sea, the major concentrations are found in the north and there are no obvious discontinuities in the distribution within this area.

Regulations

Norway pout is one of the NEAFC Recommendation 2 species which may be fished with trawl of mesh size less than 50 mm, but not less than 16 mm. Apart from this, no direct regulatory measures have been applied to the stocks. The Norwegian fishery in the North Sea, however, was indirectly affected in 1975 as it was stopped in late November because the national whiting quota had been fished by that time.

I.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

The Danish and Faroese fisheries mainly take place in the north-western North Sea and the Norwegian fishery in the Norwegian Deep. From the former area most catches are landed during the last half of the year, whereas in the latter area summer appears to be the peak fishing season (Table 15).

Most trawlers fishing for Norway pout conduct fishing on an annual basis (throughout the year), but part of the (Norwegian) fleet divert towards sandeel fishery in the summer.

Distribution of Norway pout catches in the North Sea by statistical rectangles from 1972-76 is shown in Figures 27-31.

J. SANDEEL

J.1 General Biology

The lesser sandeel (Ammodytes marinus, Raitt) is by far the most abundant of the five or six species of North Atlantic sandeels. Spawning takes place in late December in the central and southern North Sea and perhaps somewhat later in the northern part. The eggs are buried in the sand, and hatching seems to take place when the eggs are incidentally freed from the substratum by the action of water movement. Hatching thus takes place over an extended period of time and as late as April-May pelagic sandeel larvae in all stages are caught in plankton hauls.

The occurrence of its small fry is associated with the distribution of the adult sandeel. As data on the distribution of the demersal eggs are insufficient for any assessment to be made, it can tentatively be concluded that spawning occurs in the major parts of sandeel distribution and is not confined to restricted spawning areas.

J.2 Distribution and Migrations

Immature distribution

Older larvae are dispersed over the main part of the central and southern North Sea. At about 5 cm of length the young sandeel assumes the demersal habit of the adult and occurs in the same habitats from late summer and onwards.

Adult distribution

The distribution of A. marinus is boreal/boreo-arctic and confined to the continental shelf. The northern limit is about 73°N (Novaja Zemlja), while 49°N (western end of the English Channel) is the southernmost habitat hitherto recorded. A. marinus is absent from the northeastern Baltic.

The sandeel is common on clean, coarse sand within the 100 m depth contour. Dense concentrations often occur in association with relatively high current velocities, e.g. over bank ridges and along edges of shallower ground.

In the southern North Sea A. marinus is most abundant at depths of 20-40 metres. Major concentrations are found on the banks off East Anglia, on the western part of the Dogger Bank, Borkum Riff, Sylt Grounds, Horns Reef and the Jutland Reef. Since 1969 the commercial fisheries have exploited additional areas in deeper waters like Inner Shoal, Ling Bank and the western edge of the Norwegian Deep

to Viking Bank. It is not clear whether this recent development is due to an expanded area of distribution of the North Sea sandeel or to a considerable increase in the size of the stock.

Migrations

Tagging experiments indicate that the adult sandeel undertakes little seasonal migration, at least in the southern North Sea. In the post-larval stage the young sandeel is assumedly capable of active movements towards areas of suitable substratum but there is no evidence of special nursery areas from which an emigration of adolescent sandeels takes place.

J.3 Exploitation and Management

Gear and fishing season

Fishing for sandeel is almost exclusively carried out using a light bottom trawl with a small-meshed cod end (less than 16 mm). In the central and southern North Sea single tow is used as the rule while pair trawling may also be applied at greater depths in the northern North Sea.

The fishing season includes March to October, and more than 70% of the yearly landings are taken in May and June. This seasonality is associated with a life pattern peculiar to the sandeel. It spends the major part of its life buried in the bottom substratum interrupted by relatively short periods of high activity during which it becomes available to fishing.

The main period of activity is April to July when feeding takes place.

The main fishing season in the northern North Sea takes place somewhat later than in the south.

Management units

Owing to the sandeel's affinity to sandy bottom its distribution is markedly discontinuous. From the lack of evidence of migration habits in adult sandeels, it may be deduced that larval drift is the main means of interchange between separate concentrations. The current-systems in the North Atlantic make it unlikely that the sandeel stocks around Iceland and the Faroes are intermingling with other stocks. They are supposedly self-contained and may be regarded as separate management units.

At the present state of knowledge of the biology of the sandeel, it is not possible to define management units in that area.

Regulations

According to NEAFC Recommendation 2, paragraph 1, fisheries for sandeel may be carried out within the North Sea using trawl nets having meshes smaller than 16 mm in the period 1 March to 31 October. In this period not more than 10% by weight of the catch may consist of other species than sandeel (NEAFC Recommendation 5 (A)).

J.4 Distribution of Catches in Relation to Zones of Extended Fisheries Jurisdiction

In Division IIIa the main catches are taken in the Skagerrak, while sandeel fishing in the Kattegat is rather sporadic.

The distribution of the fisheries in the North Sea covers that of the adult sandeel. Until 1970 the landings were almost exclusively taken in the central and southern North Sea. After 1970 an important fishery developed in Division IVa(east) and accounted for almost 2/3 of the total North Sea catch in 1974. It is at present not clear whether this extension of the fishing area is of a permanent character.

Distribution of sandeel catches in the North Sea by statistical rectangles from 1972-76 is shown in Figures 32-36.

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Table 1. NORTH SEA HERRING.
TACs recommended by the Liaison Committee,
those agreed by NEAFC, and catches actually
achieved.

Period	1974	1975	1976	1977
TAC advice Liaison Committee	310 + 15%	362 + 15% (Apr. 74) 136 000 (Apr. 75)	140 000 (Apr. 75) No directed fishery advised (Oct. 75)	No catch
NEAFC agreement	488 000 from 1.3.74 until 30.6.75 (Mar. 74)	No separate quota for 2nd half of 1975	160 000 (Apr. 76)	
Catch	330 628	364 709	183 243	

Table 2. Distribution of NORTH SEA HERRING catch by ICES Divisions in 1965.

	IVaW	IVaE	IVb	IVc-VIIId,e
Belgium	227	-	47	502
Denmark	-	49 700	109 000	-
Faroe Isl.	3 111	-	-	-
France	2 009	5 294	7 037	2 140
German Demo- cratic Republic	-	-	-	-
Germany, Fed.Rep.	4 489	23 428	48 529	586
Iceland	-	1 757	-	-
Netherlands	11 515	6 912	47 551	14 342
Norway	196 488	323 361	1 041	-
Poland	35 878	16 200	44 815	1 237
Sweden	-	132 182	-	-
UK(England)	-	-	8 524	2 970
UK(Scotland)	19 239	-	1 330	-
USSR	20 095	27 227	-	-
Total	293 051	586 061	267 874	21 777

Source: Data provided by Working Group members.

Table 3. Distribution of NORTH SEA HERRING catch by ICES Divisions in 1970.

	IVaW	IVaE	IVb	IVc-VIIId,e	IIIa
Belgium	750	50	-	400	-
Denmark	61 423	1 800	70 108	-	30 107
Faroe Isl.	40 884	5 898	11 623	-	-
France	818	48	2 433	8 183	-
German Demo- cratic Republic	-	-	-	-	-
Germany, Fed.Rep.	177	10	6 405	558	-
Iceland	20 587	1 220	1 144	-	6 453
Netherlands	177	281	28 815	16 945	-
Norway	160 784	3 501	28 817	-	7 581
Poland	2 069	123	2 836	29	-
Sweden	4 470	5 560	24 640	-	26 930
UK(England)	-	-	8 731	971	-
UK(Scotland)	17 767	1 929	2 189	-	-
USSR	17 066	1 012	-	-	-
Total	326 932	21 432	187 741	27 086	71 071

Source: Data provided by Working Group members.

Table 4. Distribution of NORTH SEA HERRING catch by ICES Divisions in 1975.

	IVaW	IVaE	IVb	IVc-VIIId,e	IIIa
Belgium	-	-	-	2 361	-
Denmark	12 982	7 436	92 009	984	29 944
Faroe Isl.	19 722	-	9 662	-	8 342
France	595	-	4 958	14 157	-
German Dem. Rep.	-	-	2 607	-	-
Germany Fed.Rep.	1 459	-	4 273	6	108
Iceland	7 679	1 502	7 108	-	1 209
Netherlands	2 238	24	28 267	5 411	-
Norway	23 497	52	7 215	-	196
Poland	6 310	-	759	-	-
Sweden	-	-	3 500	-	12 348
UK(England)	-	-	6 403	72	-
UK(Scotland)	6 633	-	2 229	-	-
USSR	11 562	-	8 822	125	-
Total	99 679	9 014	177 810	23 116	52 129

Source: Data provided by Working Group members.

Table 5. Total HERRING landings in '000 tons. Skagerrak 1966-76.

1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
144.7	279.7	280.0	113.3	71.1	61.6	67.0	84.6	55.5	52.1	17.0

* Preliminary.

Table 6. Percentage of annual catch landed per month by the Danish human consumption HERRING fishery in the Skagerrak 1968-69 and 1975-76.

Month	Period 1968-69	Period 1975-76
Jan	25.6	0.3
Feb	6.2	1.6
Mar	5.7	1.5
Apr	2.7	1.3
May	1.3	3.6
Jun	0.9	14.4
Jul	12.7	43.2
Aug	19.1	16.4
Sep	7.1	8.1
Oct	4.3	7.9
Nov	7.8	1.0
Dec	6.6	0.7

Source: Data provided by Working Group members.

Table 7. SPRAT.
Landings in thousand tons 1966-76.

Division IIIa

Year	Skagerrak			Kattegat	
	Denmark	Sweden	Norway	Denmark	Sweden
1966	2.1	2.0	1.0	2.5	2.3
1967	2.1	2.0	3.3	3.6	1.9
1968	0.5	3.1	2.1	2.6	1.5
1969	0.8	1.9	1.7	0.8	1.6
1970	1.1	2.4	2.4	3.1	6.0
1971	0.7	2.4	2.9	1.5	9.6
1972	0.8	3.3	2.4	1.4	17.9
1973	19.4	2.5	3.2	19.3	16.2
1974	17.3	2.0	1.4	31.6	18.6
1975	12.9	2.1	2.1	60.7	20.9
1976*	12.8	2.6	0.8	27.9	12.6

* Preliminary.

Division IVa east

Norway, west coast fjords

Year	Norway
1966	10.7
1967	10.2
1968	6.4
1969	11.8
1970	6.4
1971	4.4
1972	6.9
1973	8.8
1974	3.3
1975	2.4
1976*	1.8

* Preliminary

Source: Data provided by Working Group members.

Table 8. Nominal catch (metric tons) of SAITHE in Sub-area IV and Division IIIa, 1966-76.
(Data for 1966-75 from Bulletin Statistique).

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Belgium	161	74	94	135	36	44	59	55	33	81	80
Denmark a)	4 310	5 495	7 756	5 566	63 300	46 200	39 600	34 500	47 188	37 949	53 656 c)
Faroe Islands	-	-	-	2	-	18	182	552	581	287	408
France b)	19 282	13 559	34 139	24 631	38 873	38 330	26 696	32 961	28 619	24 396	29 753 d)
German Dem. Rep.	6 634	901	903	5 998	4 250	6 398	10 674	7 668	5 816	5 882	2 088
Germany, Fed. Rep.	7 462	7 036	6 066	7 242	6 022	4 217	8 665	12 003	20 589	18 622	36 456
Iceland	-	-	5	2	18	97	4	23	5	1	-
Netherlands	8 177	13 395	16 842	18 214	20 460	18 136	12 532	9 232	14 504	8 917	6 101 e)
Norway	14 183	10 842	8 683	8 159	11 201	15 184	23 256	15 219	9 246	12 483	34 300
Poland	655	104	43	-	-	4	186	7 512	22 203	35 304	35 819
Spain	-	-	-	-	-	-	190	108	308	249	...
Sweden	3 643	6 318	8 212	4 322	1 921	4 523	3 899	1 876	1 187	913	...
U.K. (England & Wales)	6 172	5 408	3 925	3 819	2 664	3 162	3 744	3 378	4 353	3 472	6 335 d)
U.K. (Scotland)	3 254	3 911	6 001	3 838	5 293	6 106	10 797	10 834	10 956	8 898	13 034
U.S.S.R.	22 388	11 527	11 405	32 830	68 062	110 200	99 883	83 333	104 500	110 743	105 606
Total	96 321	78 570	104 074	114 758	222 100	252 619	240 367	219 254	270 088	268 197	323 636

- * Preliminary a) 1970-1975 revised, ICES was advised that the figures for previous years were underestimated.
b) 1971-1975 figures revised (March 1977). c) Lacking some landings from foreign ports (Working Group figure used 66 073).
d) From Working Group data. e) As reported on Statlant 27 A forms for 1976.

Nominal catch (metric tons) of Saithe in Division IIIa,
1974 and 1975.
(Data from Bulletin Statistique)

Country	1974	1975
Denmark a)	14 818	16 932
German Dem. Rep.	662	-
Germany, Fed. Rep.	9	4
Iceland	-	+
Norway	778	890
Sweden b)	...	561
U.K. (England & Wales)	3	12
Total	16 270	18 399

- a) 1974-75 figures revised (March 1977).
b) 1974 figure included in IV.

Table 9. Percentages of Sub-area IV landings coming from the Norwegian zone of the North Sea^{x)}.

Species Country	Cod	Haddock	Whiting
Belgium	<5	<5	<5
Denmark ¹⁾	25	35	13
France	0.5	1.2	0.5
Germany, ²⁾ Fed.Rep.	6	26	13
Netherlands	1-5	10-25	4-10
Norway ³⁾	80	60	50
Poland ²⁾	30	30	15
UK(England)	N.A.	N.A.	N.A.
UK(Scotland) ⁴⁾	27	24	9
USSR	N.A.	N.A.	N.A.

1) Based on 1975 data.

2) Approximate figures for 1970-73.

3) Average figures 1972-76.

4) Averages for 1974 and 1975.

N.A. Not available to the Working Group.

x) From rectangle and other data provided by Working Group members.

Table 10. 1975 landings from Sub-area IV sub-divided according to the Norwegian zone and the remainder of Sub-area IV (based on percentages in Table 9).

Country Species	Cod		Haddock		Whiting	
	NZ	Other	NZ	Other	NZ	Other
Belgium ¹⁾	189	7 377	55	2 154	82	3 197
Denmark	11 586	34 758	11 526	21 404	8 052	53 889
France	43	8 624	56	4 590	100	19 979
Germany, F.R.	987	15 470	623	1 773	58	388
Netherlands ²⁾	582	22 681	323	1 578	985	13 093
Norway	2 214	553	6 103	4 068	6 619	6 619
Poland	897	2 094	446	1 039	133	755
UK(Scotland)	10 073	27 235	15 525	49 161	2 517	25 452
Sub-total	26 571	118 792	34 657	85 767	18 546	123 372
Remainder unallocated	42 329		63 579		11 491	

NZ: Landings from the Norwegian zone of the North Sea.

Other: Landings from the remainder of the Sub-area IV.

1) Assuming 2.5% in the Norwegian zone (see Table 9).

2) Using the midpoint of the range of values in Table 9 for the percentage in the Norwegian zone.

Table 11. Nominal catch (metric tons) of PLAICE in Division IVa, 1966 - 1976
(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Belgium	15	4	5	7	3	1	3	3	+	1	-
Denmark ^{a)}	5 175	549	...f)
Faroe Islands	-	-	-	-	-	-	-	1	-	1	-
France	1 765 ^{b)}	1 467	55	56	9	-	-	-	-	1	...f)
Germany, Fed. Rep.	66	95	13	40	28	1	7	13	11	34	31
Netherlands	4	11	1	+	5	-	-	34	42	425	331 ^{g)}
Norway	33 ^{c)}	35 ^{c)}	38 ^{c)}	26 ^{d)}	22 ^{d)}	18 ^{d)}	19 ^{d)}	15	13	13	27 ^{b)}
Poland	-	-	-	-	-	-	-	1	-	153	40
Sweden ^{e)}	370	593	776	772	608	588	626	432	431	...h)	53 ^{b)}
U.K. (Eng. & Wales)	829	1 154	2 656	1 641	1 464	4 042	5 409	6 126	2 490	3 350	...f)
U.K. (Scotland)	2 789	2 982	3 078	2 570	2 427	2 436	1 750	2 142	2 076	1 615	1 907
U.S.S.R.	-	-	-	-	-	-	-	397 ^{b)}	-	-	-
Total	5 871	6 341	6 622	5 112	4 566	7 086	7 814	9 164	10 238	6 142	2 389

* Preliminary

a) 1966-1973 included in IVb

b) Includes IVb,c

c) 1966-1968 includes IVb,c

d) 1969-1972 includes IVb

e) 1966-1974 includes IVb and IIIa

f) Included in IVb

g) As reported on STATLANT 27A forms for 1976

h) Included in IVb

Table 12. Nominal catch (metric tons) of PLAICE in Division IVb, 1966 - 1976
(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Belgium	1 408	1 314	1 255	1 017	1 155	1 572	2 393	3 639	3 764	4 466	1 635
Denmark ^{a)}	29 055	28 287	30 369	35 227	32 807	22 278	24 494	23 266	14 639	22 170	25 169 ^{h)}
France	... ^{b)}	146	141	153	22	-	1	155	-	12	228 ^{h)}
Germany, Fed. Rep.	4 300	5 195	5 237	5 017	5 491	3 292	4 282	5 436	3 222	4 006	4 091
Netherlands	4 846	7 438 ^{e)}	12 629 ^{f)}	19 968	24 863	24 396	33 101	36 987	37 577	37 985	34 652 ^{j)}
Norway ^{c)}	-	-	-	... ^{b)}
Sweden ^{d)}	35 ^{g)}	... ^{b)}
U.K. (Eng. & Wales)	25 104	28 803	25 942	28 024	32 668	27 938	25 681	23 849	20 996	16 504	23 912 ^{g)} ^{k)}
U.K. (Scotland)	2 567	2 727	2 732	2 411	2 276	1 774	1 660	2 673	1 926	1 651	1 374
U.S.S.R.	-	-	-	-	-	-	-	... ^{b)}	9	-	29
Total	67 280	73 910	78 305	91 817	99 282	81 250	91 612	96 005	82 133	86 829	91 090

* Preliminary

a) 1966-1973 includes IVa

b) Included in IVa

c) 1966-1972 included in IVa

d) 1966-1974 included in IVa

e) Not including 8 655 tons caught mostly in IVb, rest in IVc

f) Not including 3 096 tons caught mostly in IVb, rest in IVc

g) Includes IVa, c

h) Includes IVa, c (from Data form 5)

j) As reported on STATLANT 27A forms for 1976

k) A difference between the total U.K. catch reported on Data form 5 and Scottish catches reported on Recommendation 12 forms

Table 13. Nominal catch (metric tons) of PLAICE in Division IVc, 1966 - 1976
(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976 [#]
Belgium	5 067	5 460	4 316	3 452	3 202	3 500	3 135	2 491	2 438	1 687	1 326
Denmark	-	-	-	-	-	-	-	-	-	12	...d)
France	...a)	117	1 114	1 121	1 375	1 380	1 061	1 200	519	523	...d)
Germany, Fed. Rep.	35	+	-	14	+	3	29	2	+	+	-
Netherlands	20 832	13 801 ^{c)}	17 510 ^{c)}	19 452	21 212	20 106	18 947	20 927	16 819	12 883	11 474 ^{e)}
Norway ^{b)}	-	-	-	-	-	-	-	...a)
Sweden	-	-	-	-	-	-	-	-	-	...d)	...a)
U.K. (Eng. & Wales)	1 045	1 017	971	684	707	596	552	425	368	436	...d)
U.K. (Scotland)	-	-	-	-	-	-	-	-	-	-	+
U.S.S.R.	-	-	-	-	-	-	-	...a)	30	-	8
Total	26 979	20 395	23 911	24 723	26 496	25 585	23 724	25 045	20 174	15 541	12 808

[#] Preliminary

a) Included in IVa

b) 1966-1968 included in IVa

c) See footnotes "e" and "f" in Table 12.

d) Included in IVb

e) As reported on STATLANT 27A forms for 1976

Table 14. NORWAY POUT.
Estimated landings by ICES fishing
areas, 1966-76 ('000 metric tons).

Year	Fishing areas							
	IIa	IIb	IIIa ¹⁾	IV	Va ²⁾	Vb	VI	VII
1966	0.8	-	12.8	53.0	-	-	-	0.2
1967	0.5	-	13.5	182.6	-	+	-	0.2
1968	0.8	-	17.6	451.8	-	-	-	0.1
1969	2.0	-	16.4	113.5	0.9	-	-	+
1970	1.7	-	16.2	238.0	2.9	-	-	0.2
1971	1.1	-	26.1	305.3	3.0	-	2.0	0.2
1972	0.8	-	17.3	444.8	+	+	3.9	0.2
1973	1.3	-	23.8	345.8	8.5	-	11.0	0.3
1974	0.4	-	10.7	735.9	14.1	+	6.9	7.6
1975	2.2	+	19.9	559.7	4.3	+	8.7	9.7
1976	1.0	-	37.9	445.0	27.8	+	13.5	4.8

+ = less than 100 tons.

1) Including minor quantities of great silver smelt, Argentina silus.

2) Including an unknown by-catch of blue whiting and other species.

Source: ICES statistics revised by the Working Group.

Table 15. Monthly landings of NORWAY POUT in 1975 and 1976 ('000 metric tons).

Month	West of 2°E						East of 2°E ^{x)}			
	Denmark		Norway		Scotland		Denmark		Norway	
	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976
Jan	14.9	3.9	0.7	0.1	0.8	1.2	2.3	0.4	1.7	1.9
Feb	11.4	6.9	2.2	0.2	4.5	1.9	3.8	1.0	11.0	5.1
Mar	5.3	4.8	2.7	0.1	2.3	1.3	0.8	2.7	7.3	4.8
Apr	1.3	12.4	4.9	1.0	0.5	0.2	1.9	7.3	6.5	7.2
May	0.6	9.8	1.0	4.6	0.7	0.1	10.1	1.8	25.9	10.3
Jun	0	0.7	3.9	0.9	1.1	0.3	14.8	0.6	26.2	13.6
Jul	12.4	19.7	11.3	3.5	3.1	1.2	18.7	5.7	12.3	6.3
Aug	23.1	29.6	22.4	8.6	1.7	3.1	13.8	0.7	10.1	6.8
Sep	24.0	36.5	11.6	6.8	1.5	0.7	4.0	0.5	4.5	5.5
Oct	40.3	29.5	18.6	2.2	3.1	1.9	0.2	0.3	10.0	1.9
Nov	21.4	31.1	8.3	9.8	2.4	2.8	1.4	0.5	8.1	3.6
Dec	15.3	33.8	0.2	2.6	1.1	2.6	1.0	0.3	<0.1	1.5

x) Including Tampen Bank (61°30' - 62°N, 0° - 2°E).

Source: Data supplied by national laboratories.

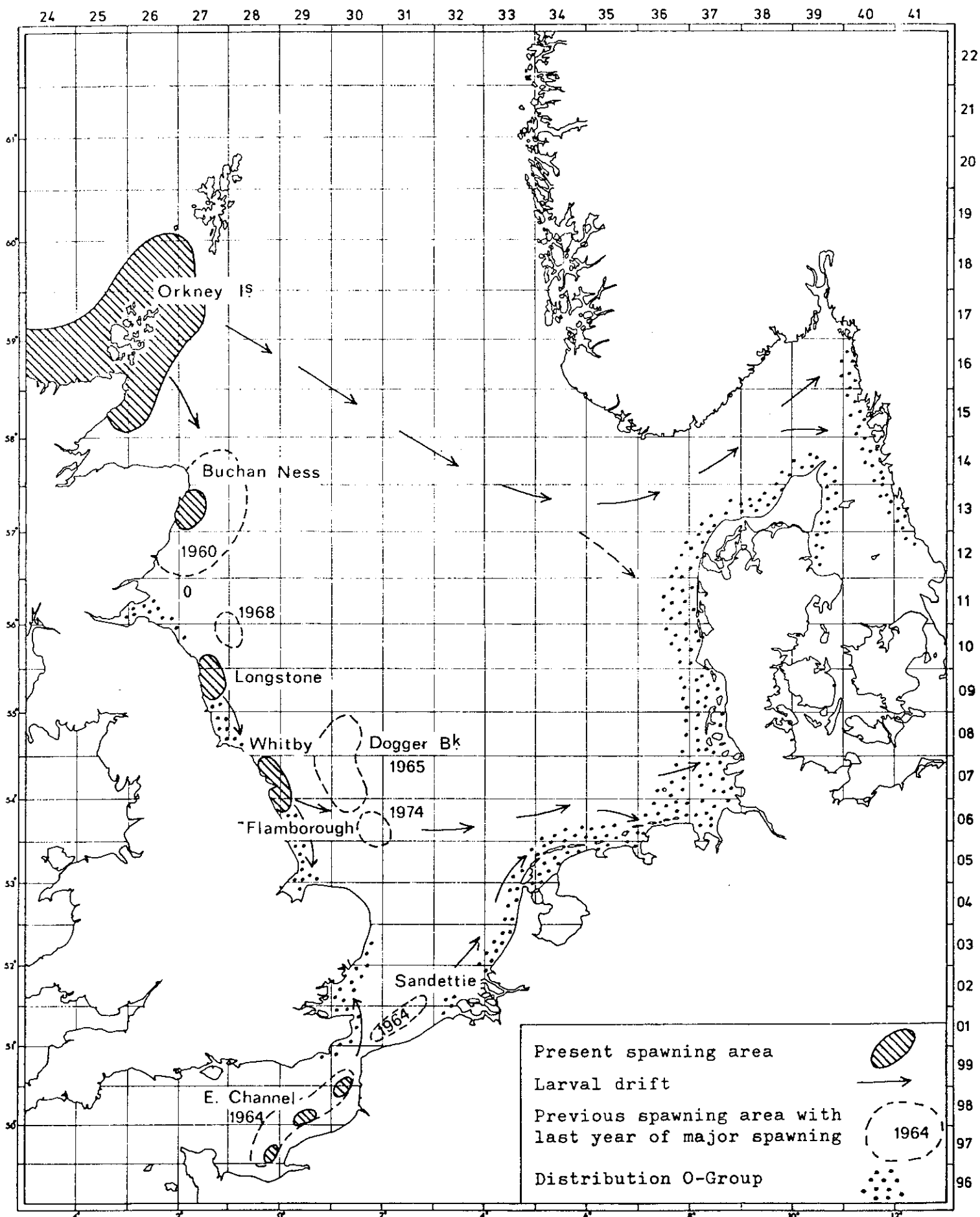


Figure 1. NORTH SEA HERRING (autumn spawners).
Source: ICES and national larval surveys.

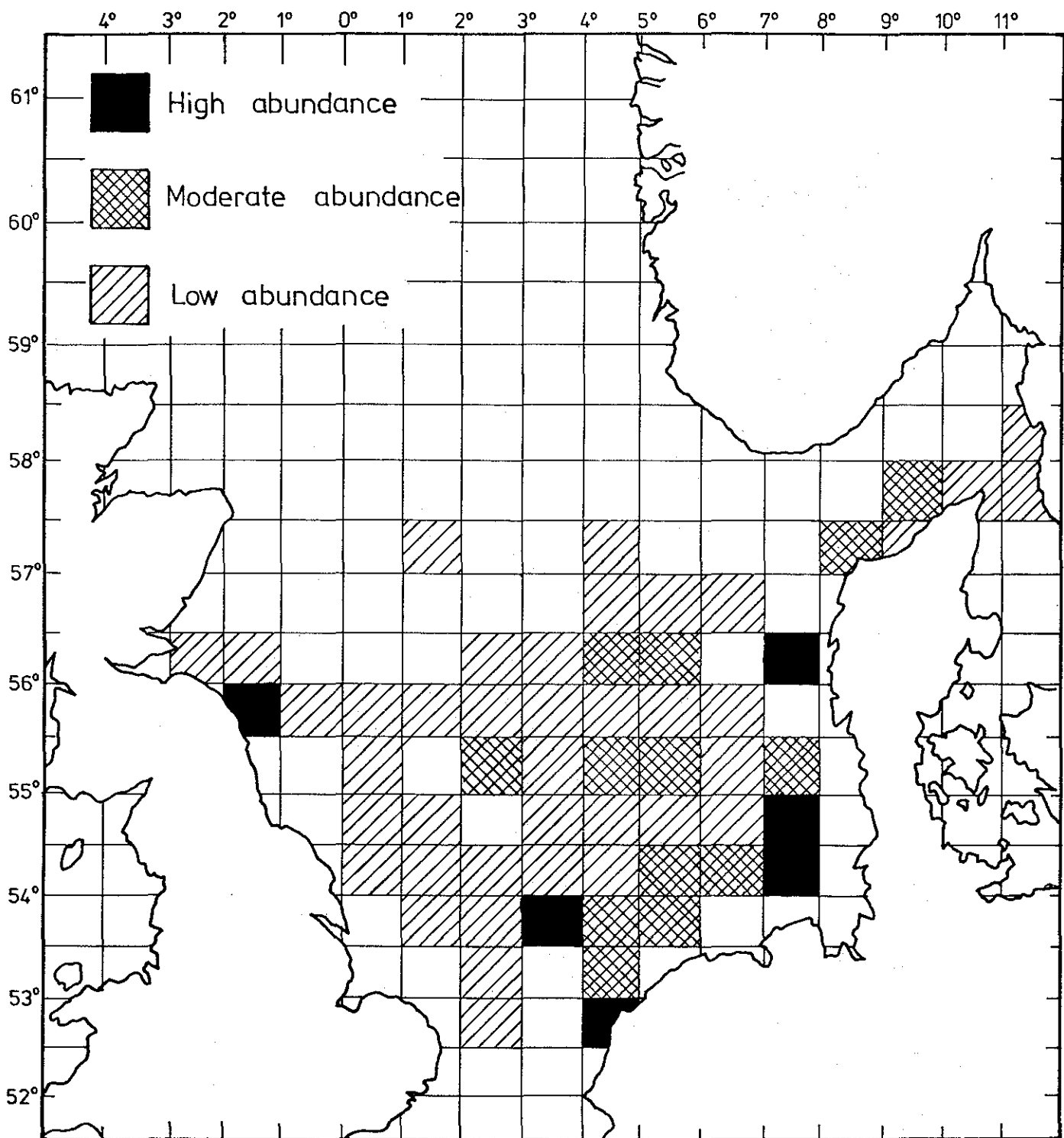


Figure 2. NORTH SEA HERRING.
Distribution of juveniles as 1-ringers.
Source: ICES Young Herring Surveys. 1963-74.

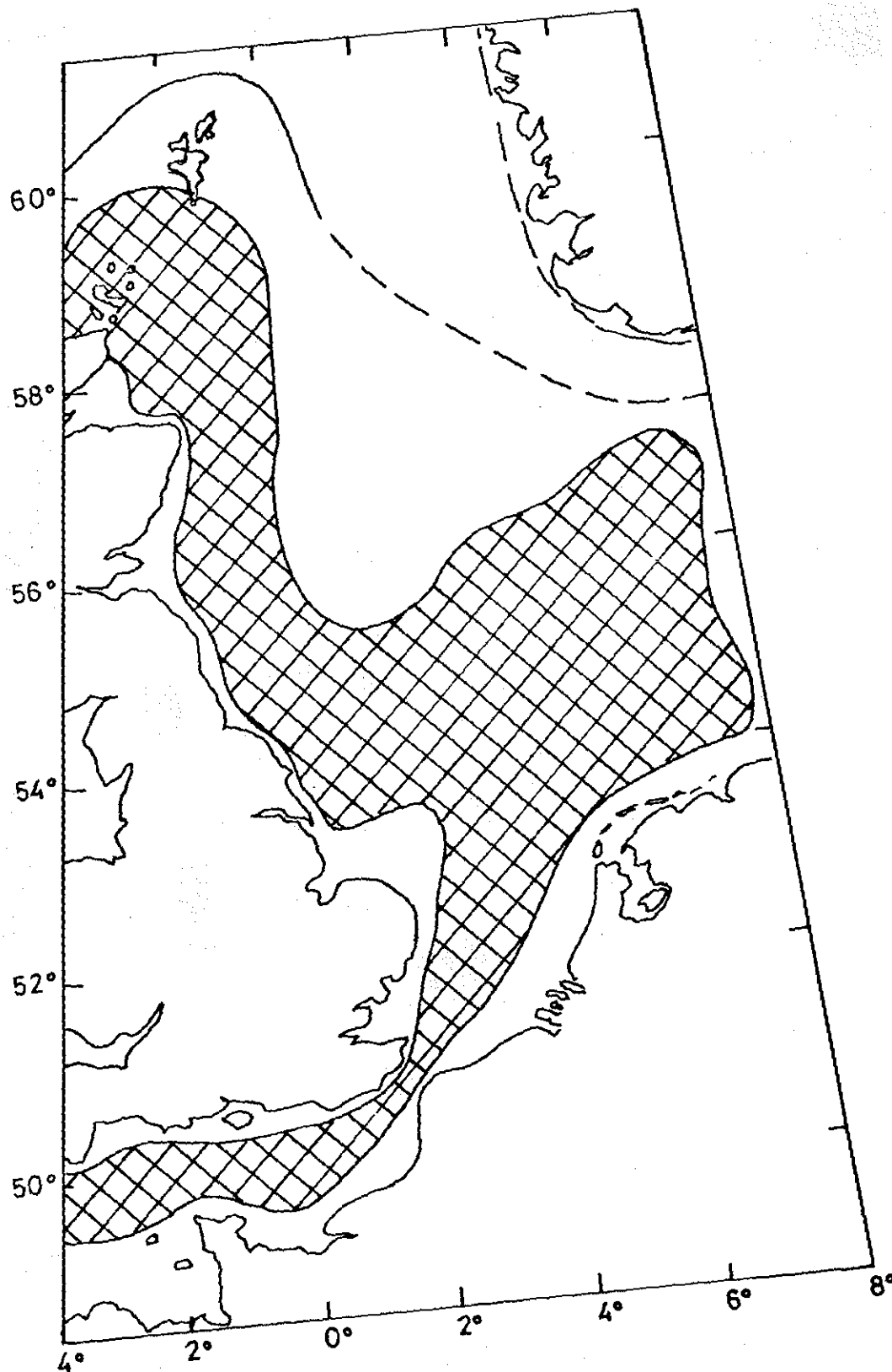


Figure 3. NORTH SEA SPRAT.
Main areas of egg and larval distribution.
Source: National data from various
laboratories.

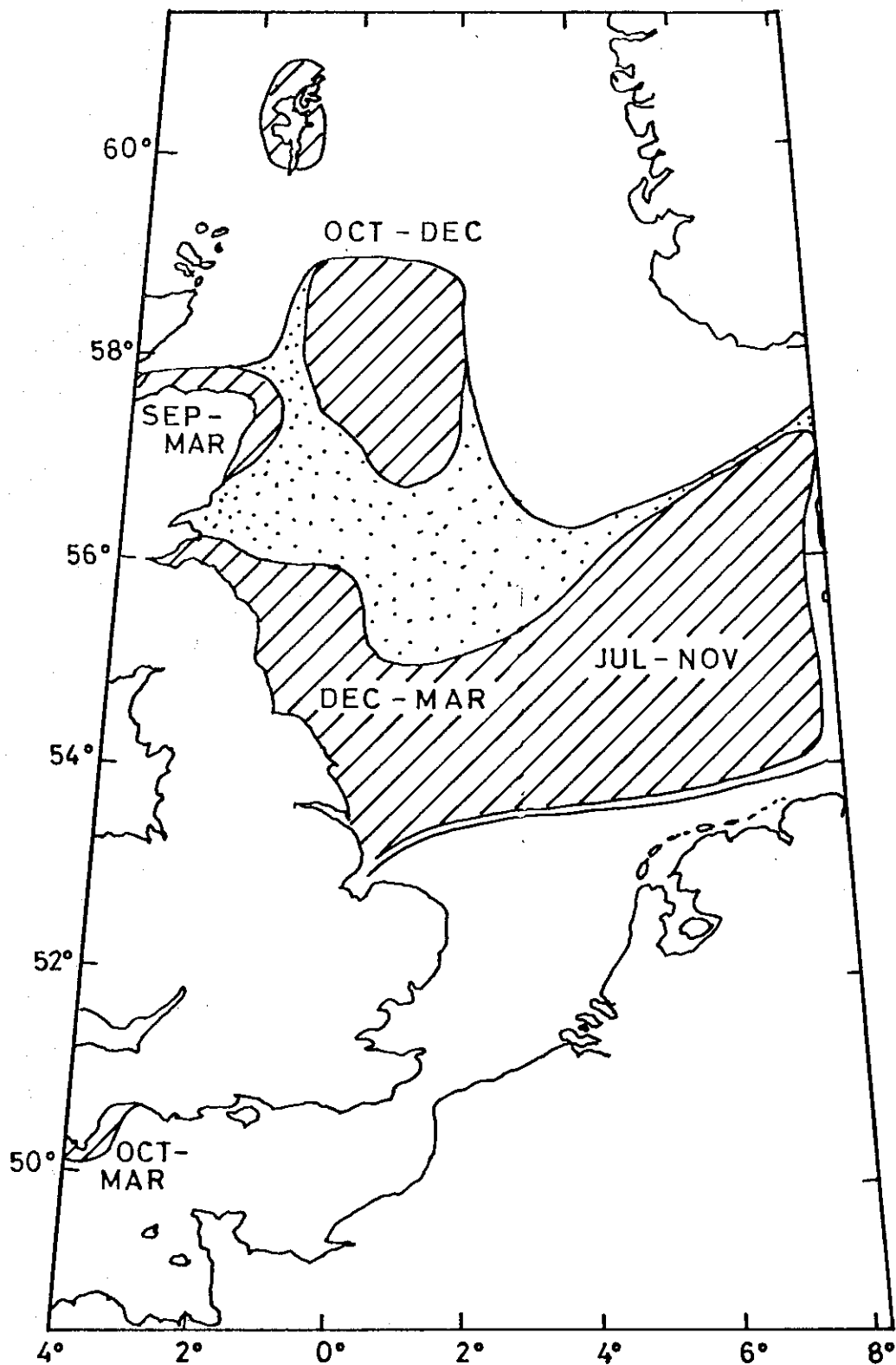


Figure 4. NORTH SEA SPRAT.
Main areas of fishing 1974-76.
Source: Information supplied by
Working Group members.

Figure 5. SPRAT spawning areas, and the main direction of larval drift.

Source: Data from national laboratories.

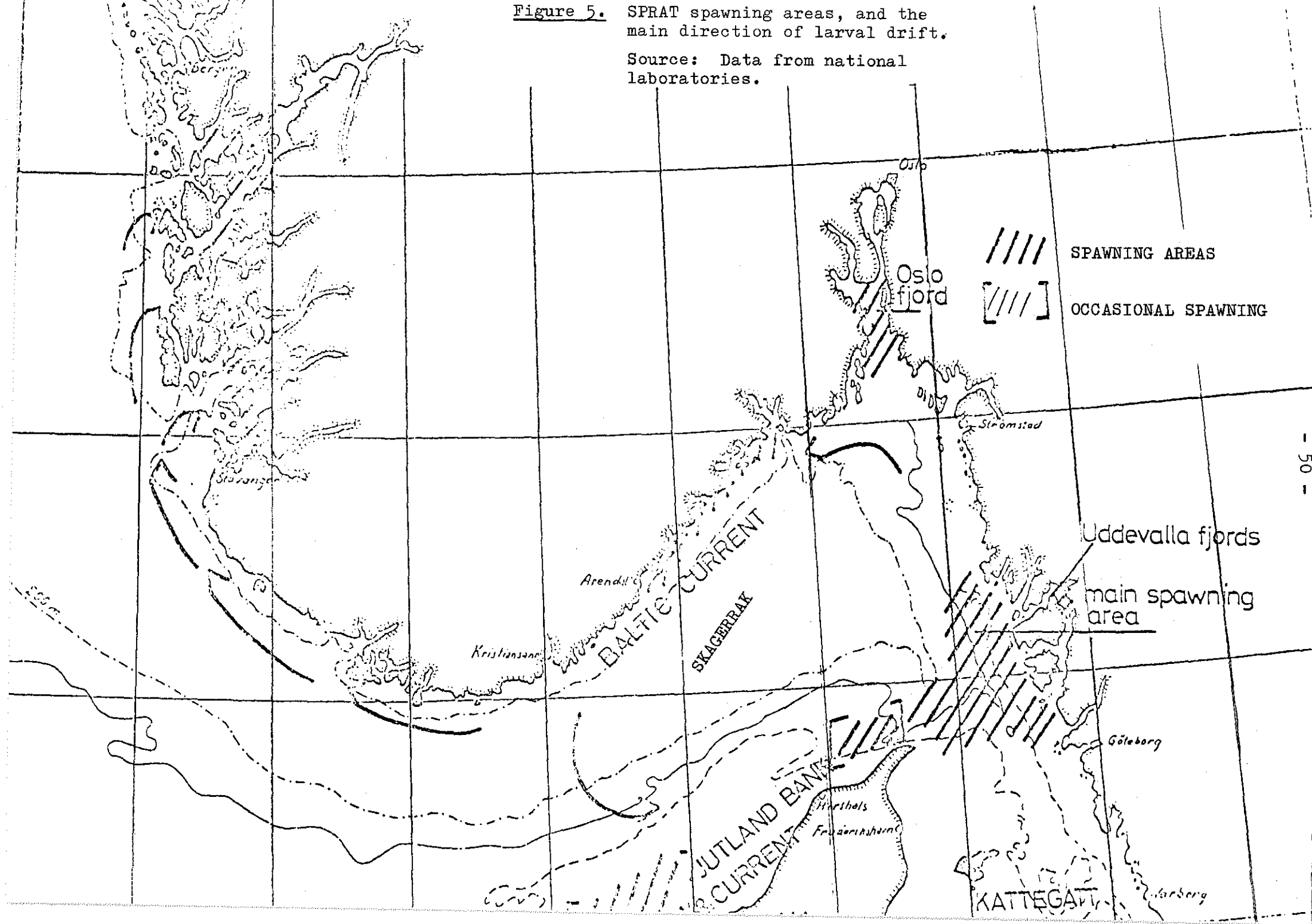
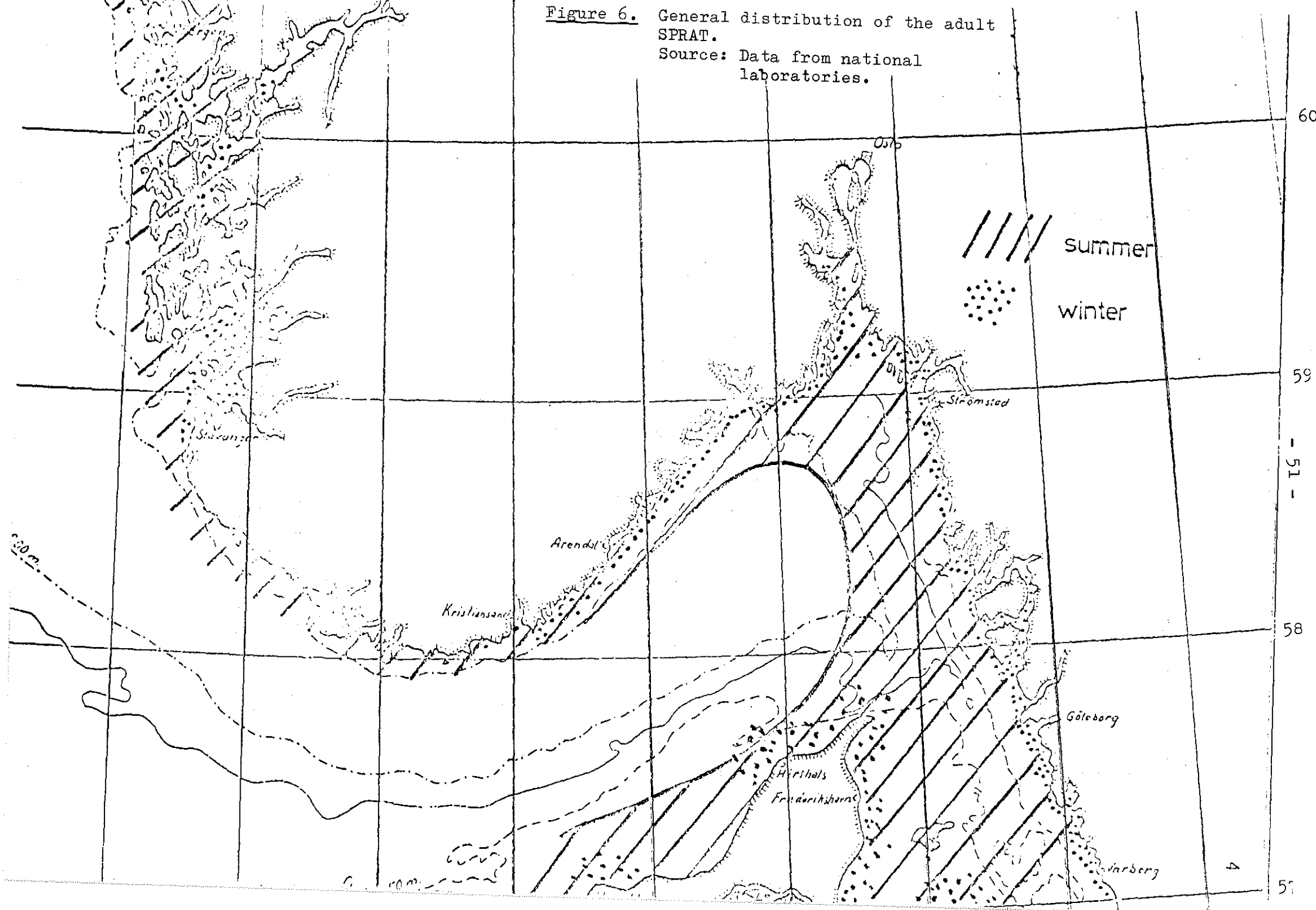


Figure 6. General distribution of the adult
SPRAT.
Source: Data from national
laboratories.



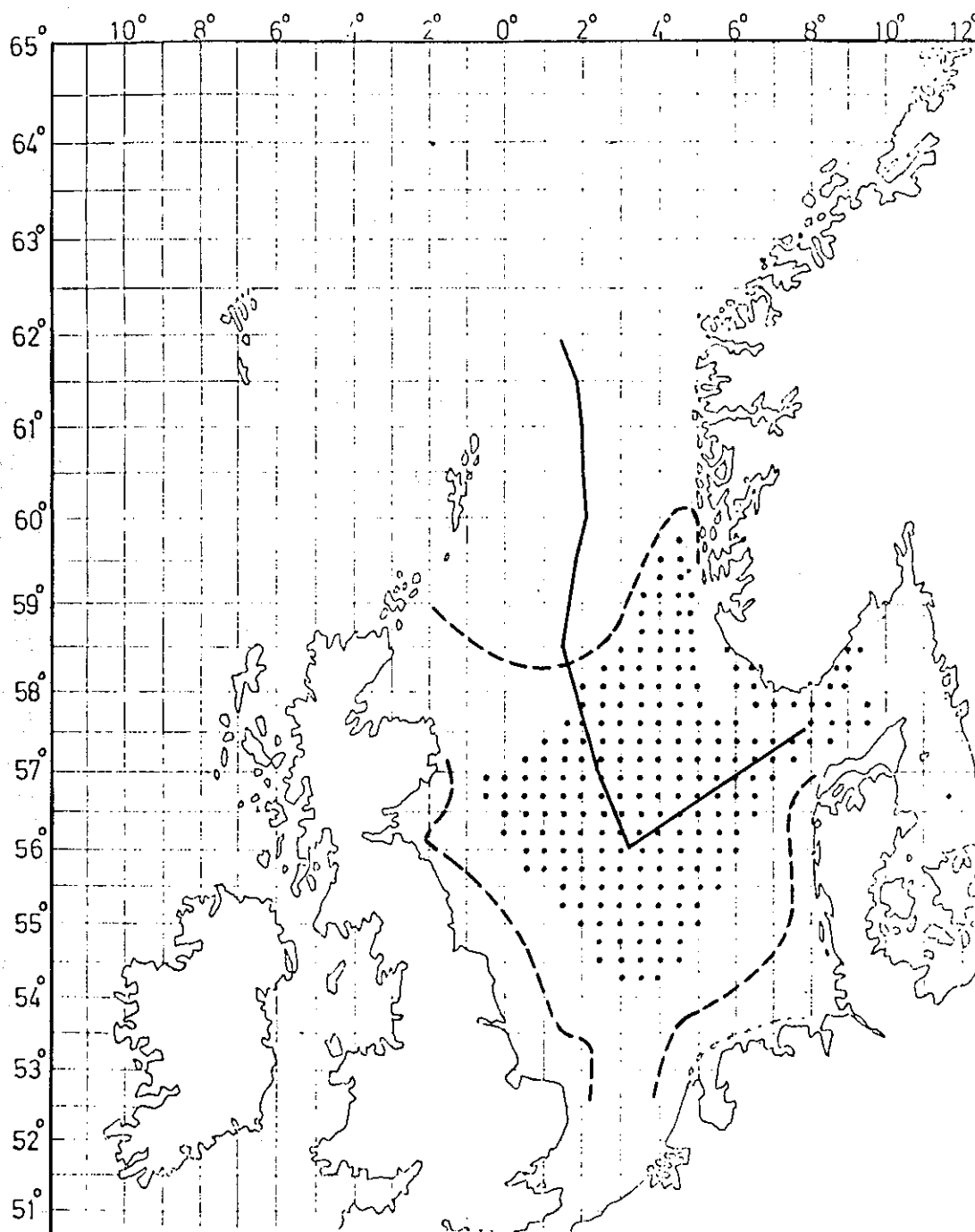


Figure 7. NORTH SEA MACKEREL.
Main spawning area (> 100 eggs per m^2) and
general total range of spawning.
Source: Data from national laboratories.

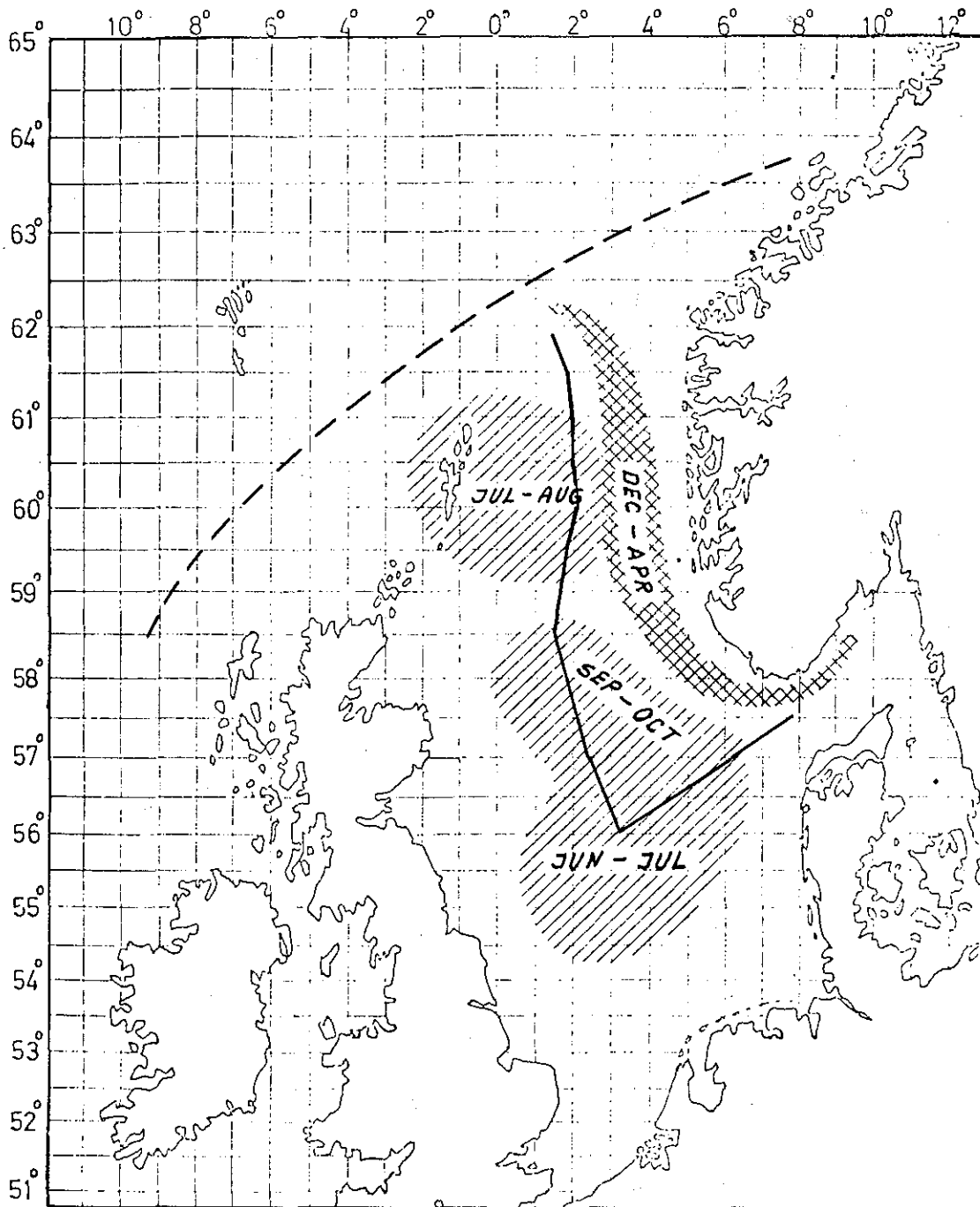


Figure 8. NORTH SEA MACKEREL.
Areas of main concentrations in summer-autumn and
the overwintering area (cross-hatched). Range of
distribution indicated.
Source: Information supplied by the Working Group.

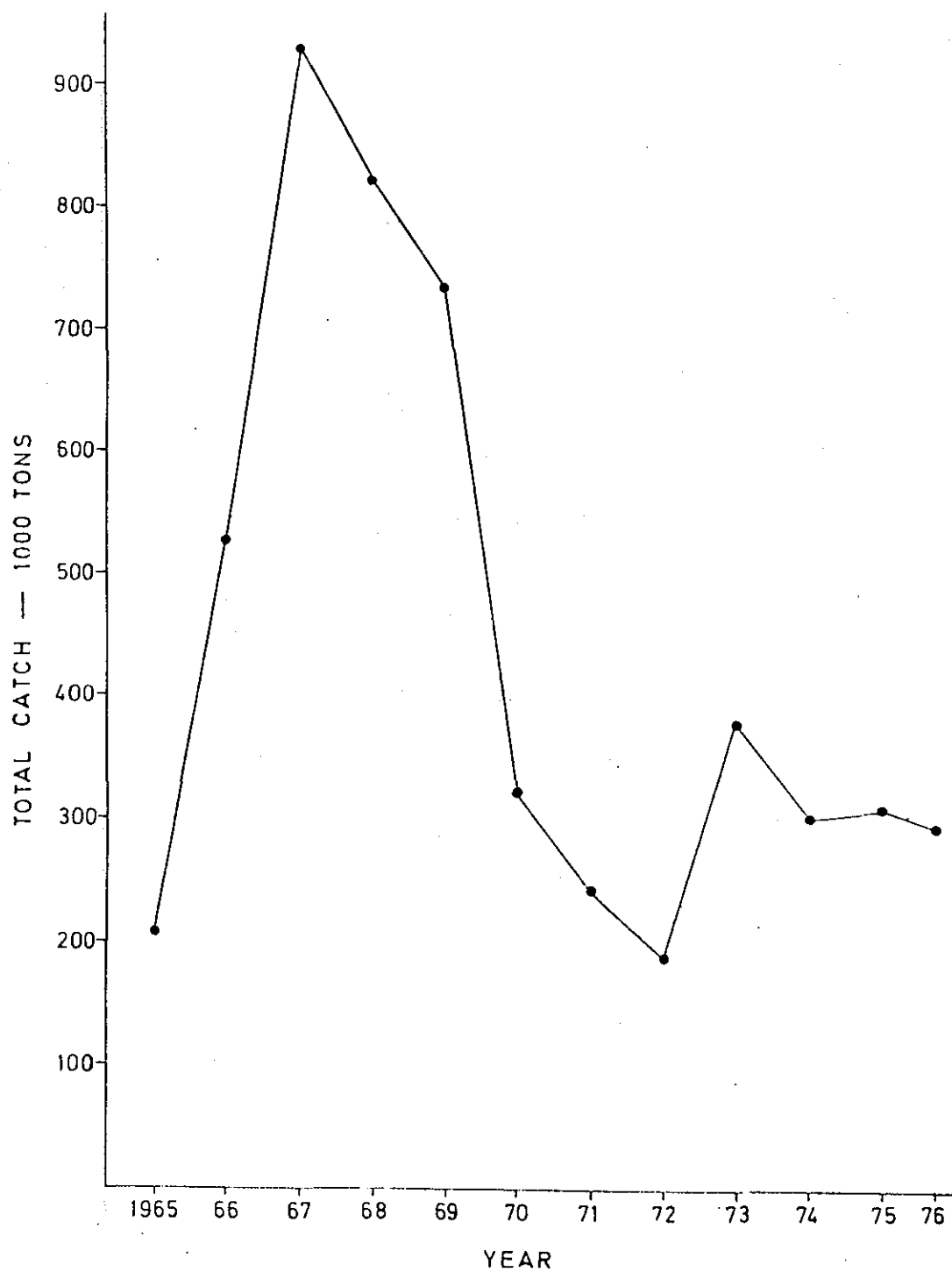


Figure 9. MACKEREL.
Total catch in the North Sea, Skagerrak and Kattegat 1965-76.

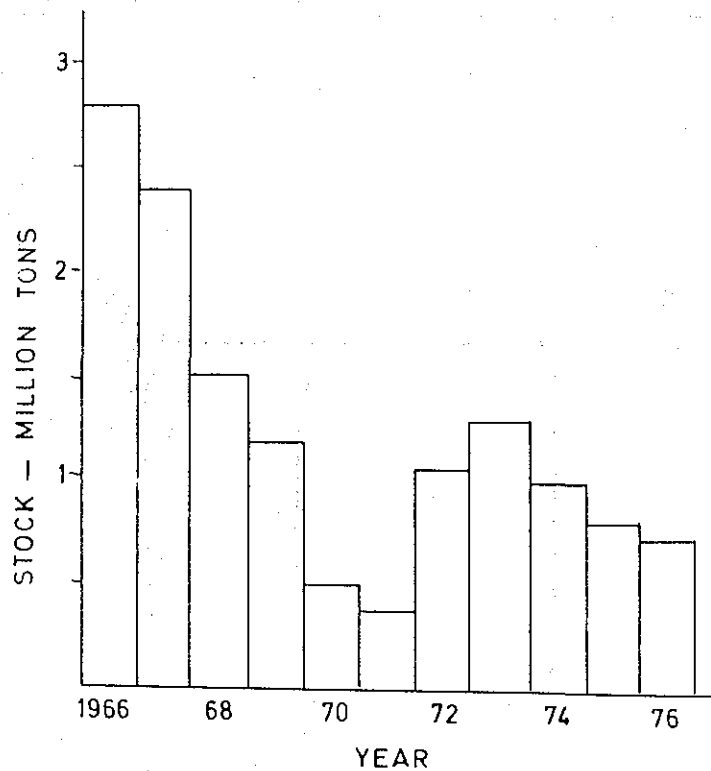


Figure 10. NORTH SEA MACKEREL.
Estimates of stock size (adults ≥ 2 years)
at the beginning of the year.

Source: From Norwegian tagging experiments.

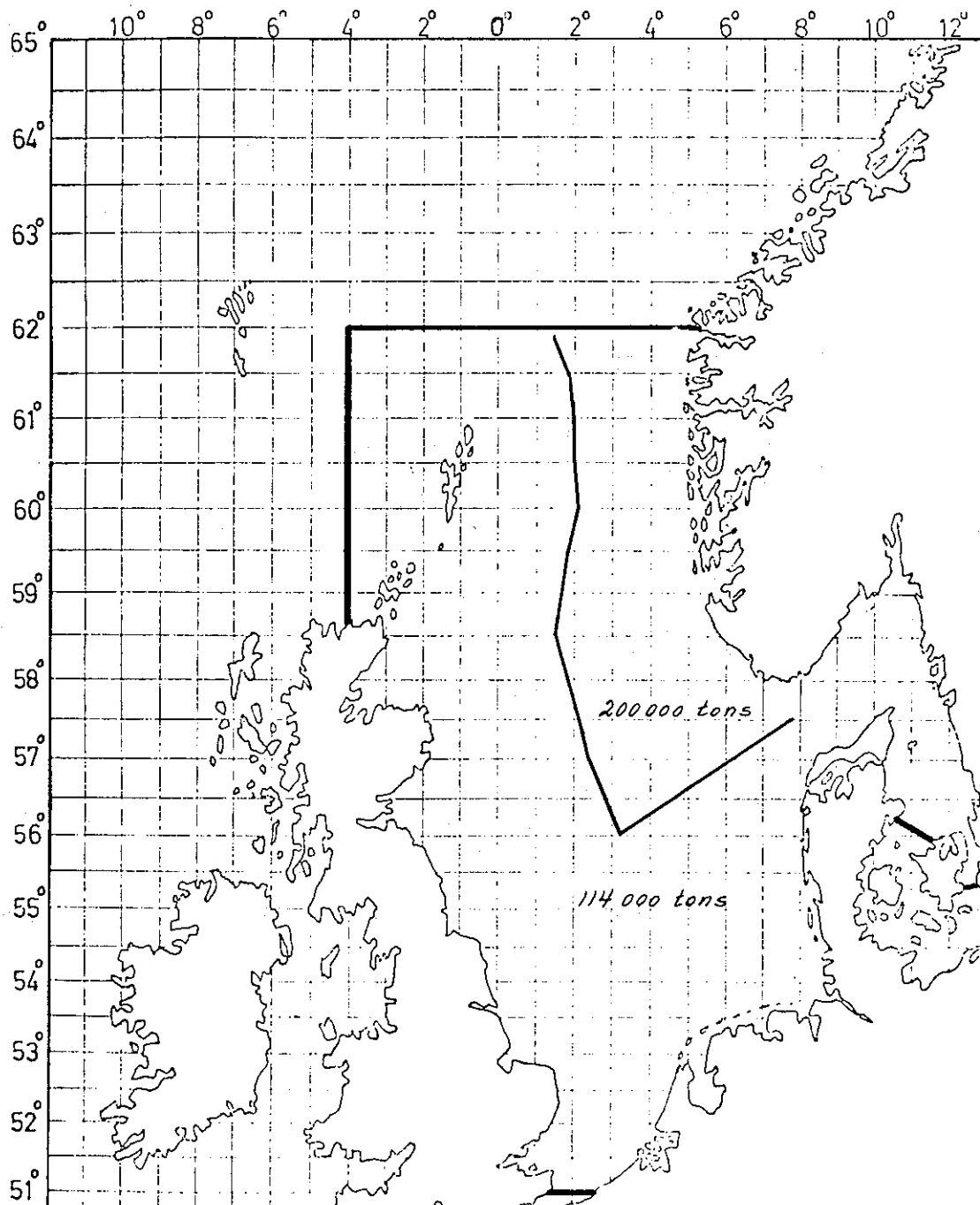


Figure 11. MACKEREL.

Catch by fisheries zones in 1975 in Sub-area IV
and Division IIIa estimated by the Working Group.

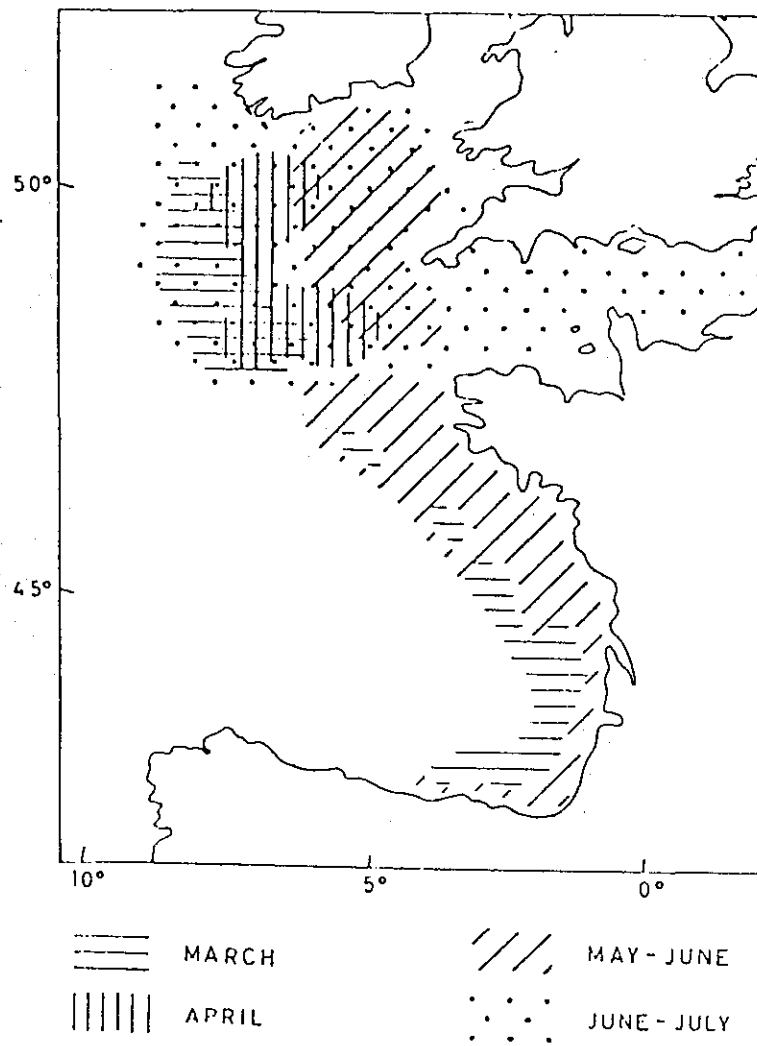


Figure 12. MACKEREL, Western stock. Spawning areas (from egg distribution).

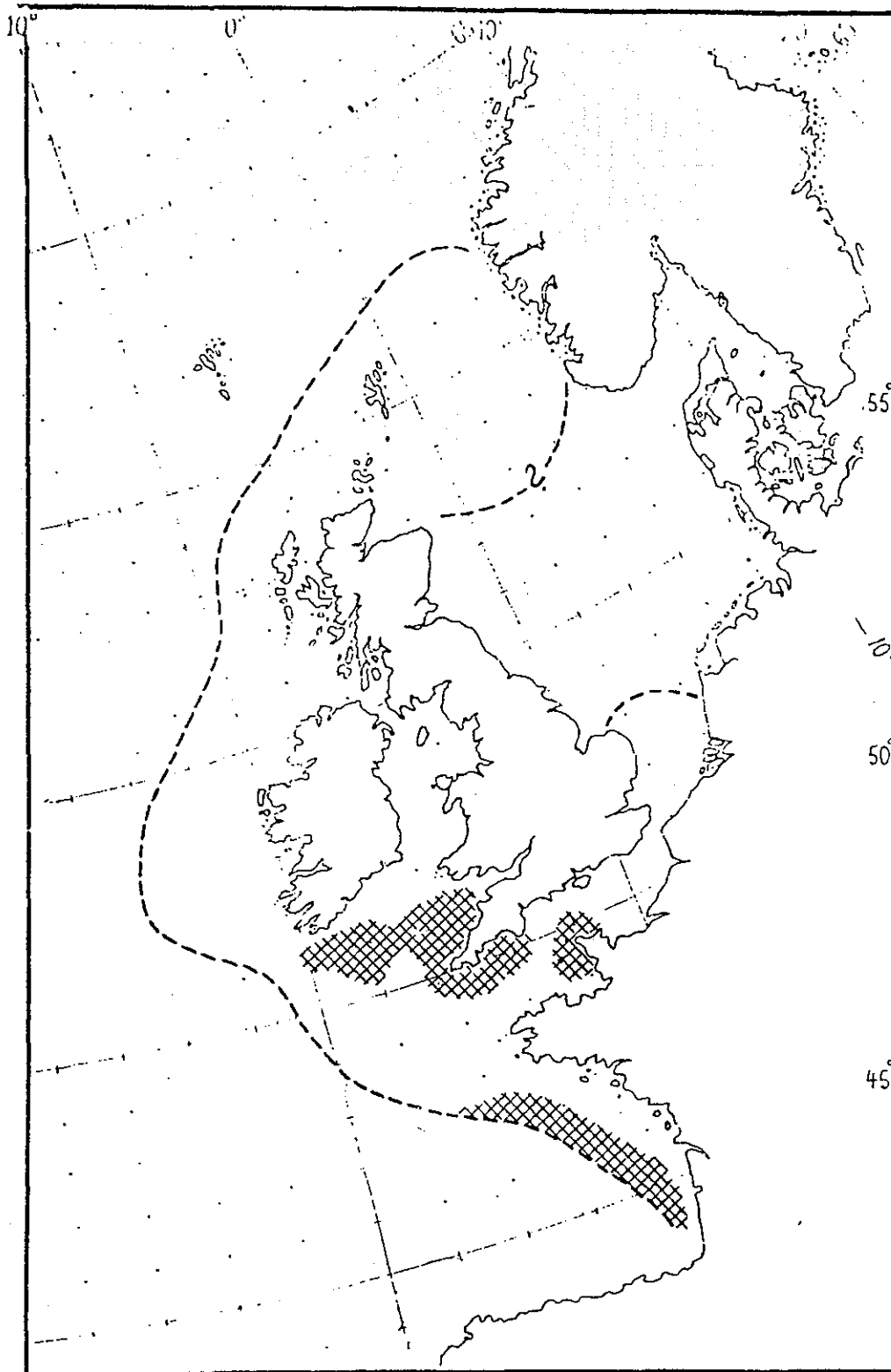


Figure 13. MACKEREL, Western stock.
Total range of distribution and overwintering areas (hatched). The northern boundary indicates the limit of the summer distribution.
Source: Information compiled from national surveys.

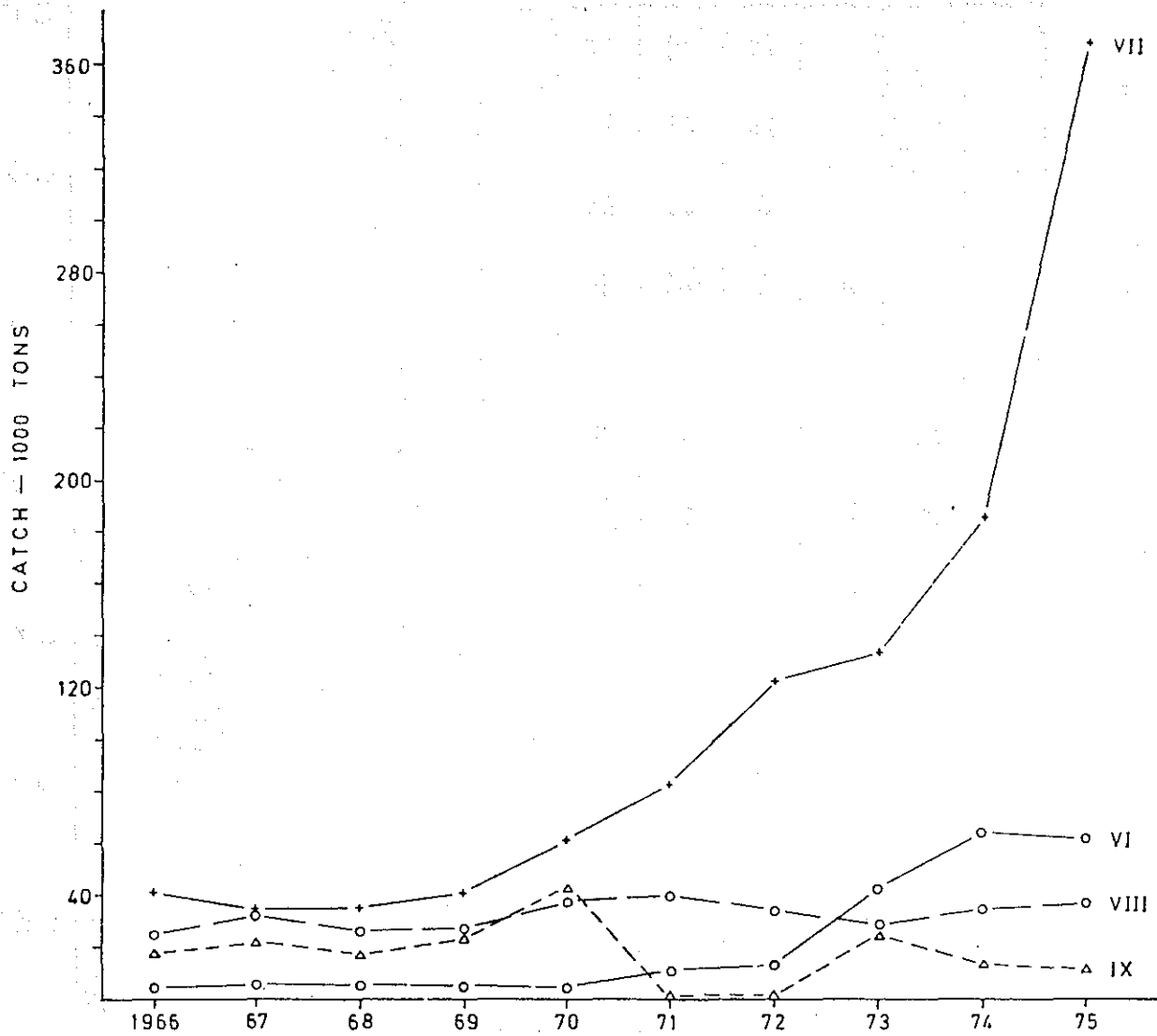


Figure 14. MACKEREL, Western area. Catches in Sub-areas VI, VII, VIII and IX, 1966-75.

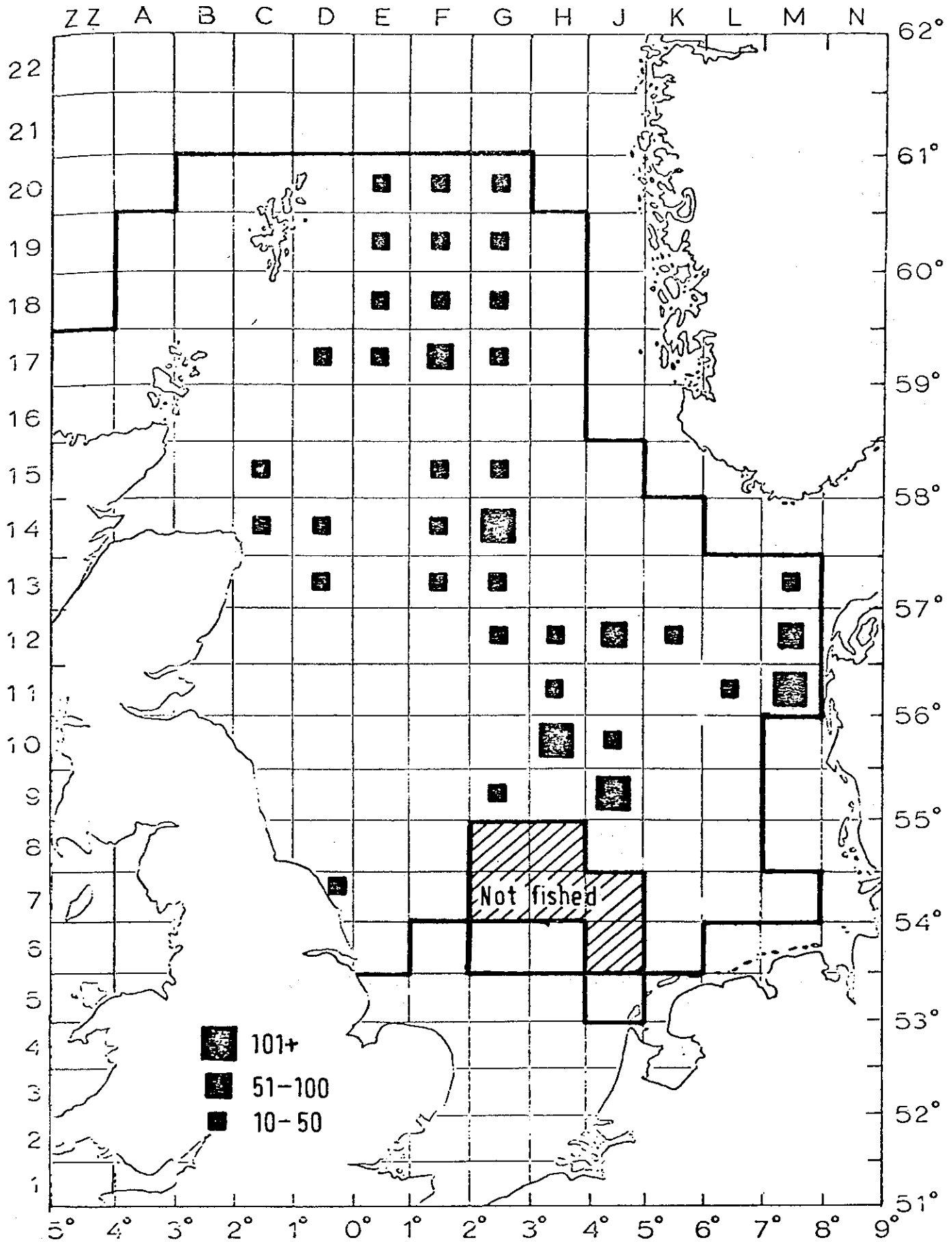


Figure 15. Mean numbers of 0-group COD per statistical rectangle based on results from all surveys, 1969-75. Heavy line shows area which has been fished although not all statistical squares have been fished each year.

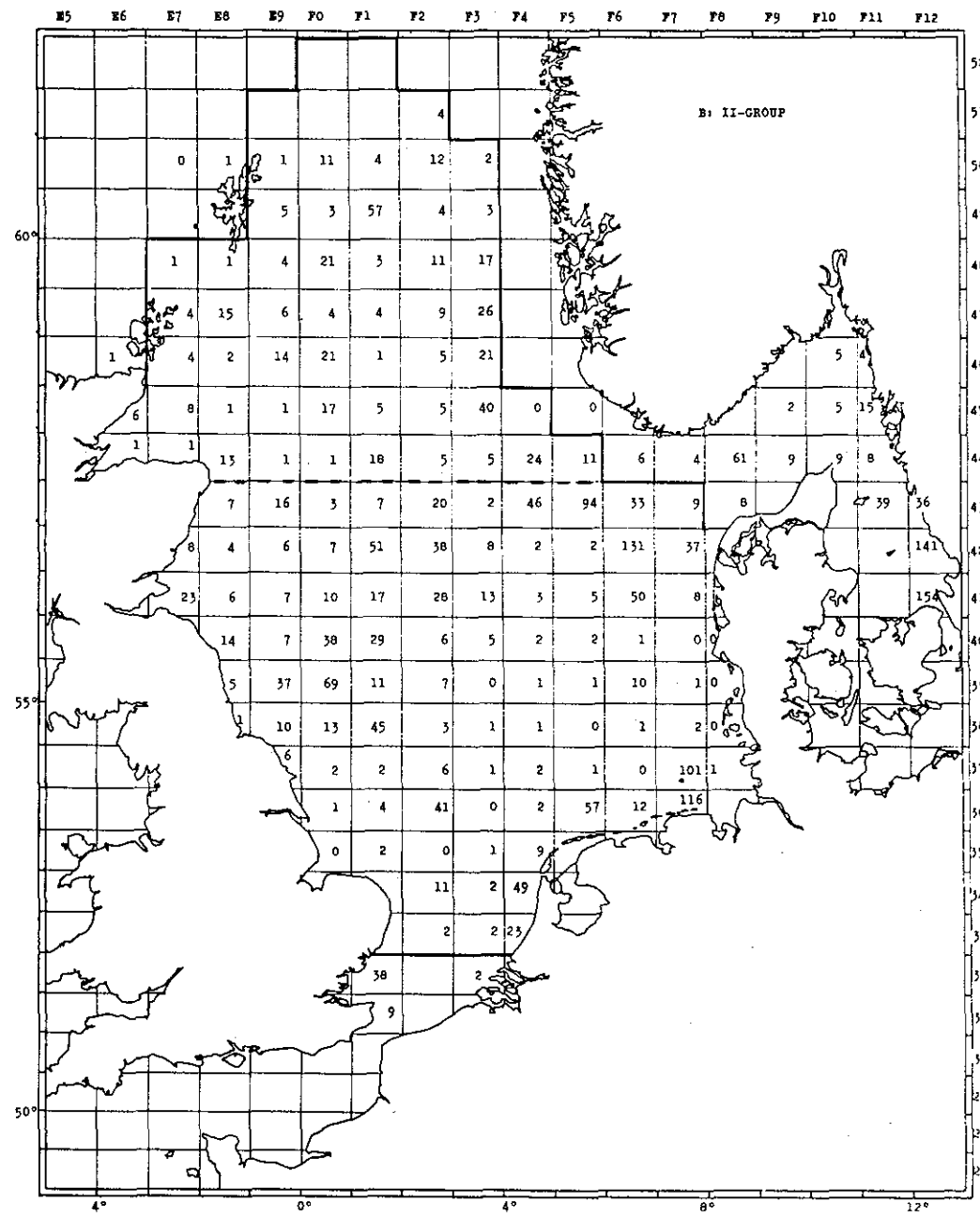
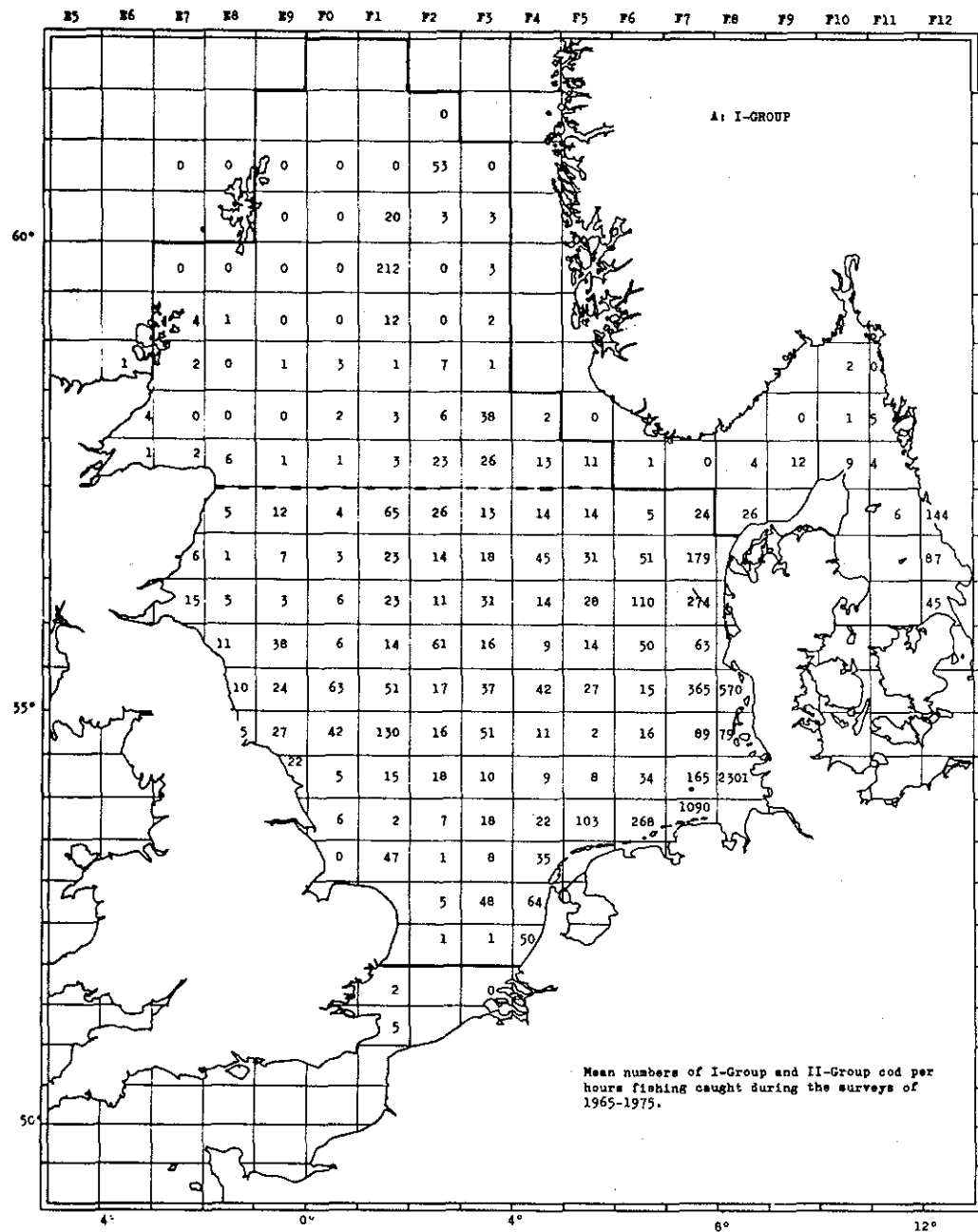


Figure 16. I and II group COD.

Source: ICES, C.M.1976/F:5, from Young Herring Surveys, 1965-75.

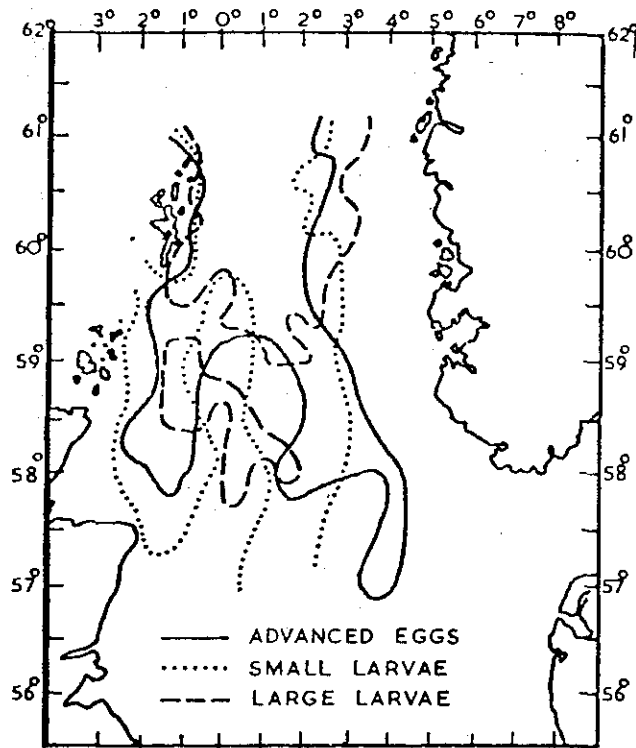


Figure 17. Distribution of HADDOCK eggs and larvae over all cruises in northern North Sea, 1952-57.
Source: Saville (1959).

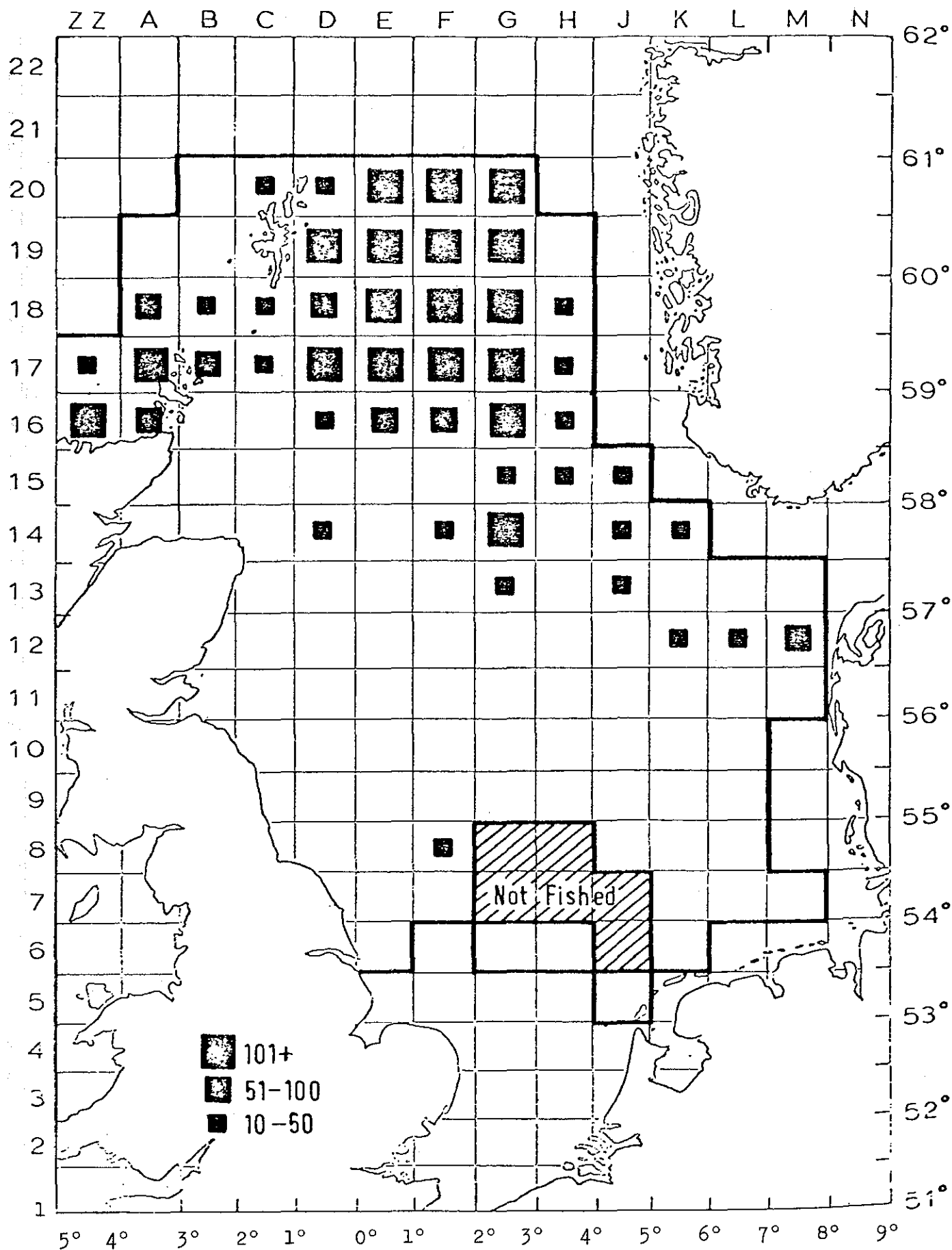


Figure 18. Mean numbers of 0-group HADDOCK per statistical rectangle.
Source: Based on results from all surveys, 1969-75.

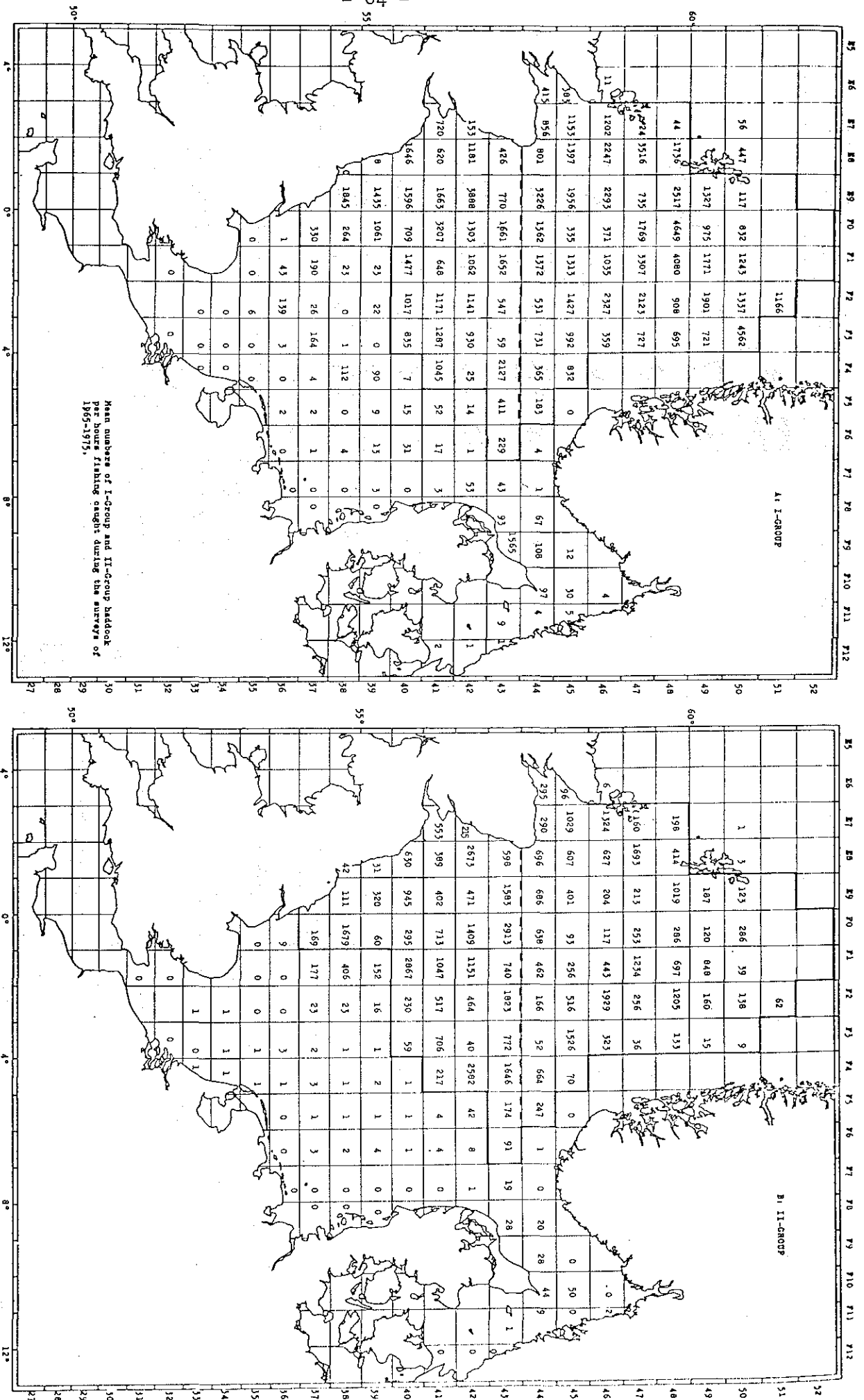


Figure 19. I and II group HADDOCK.

Source: From Young Herring Surveys, 1965-75.

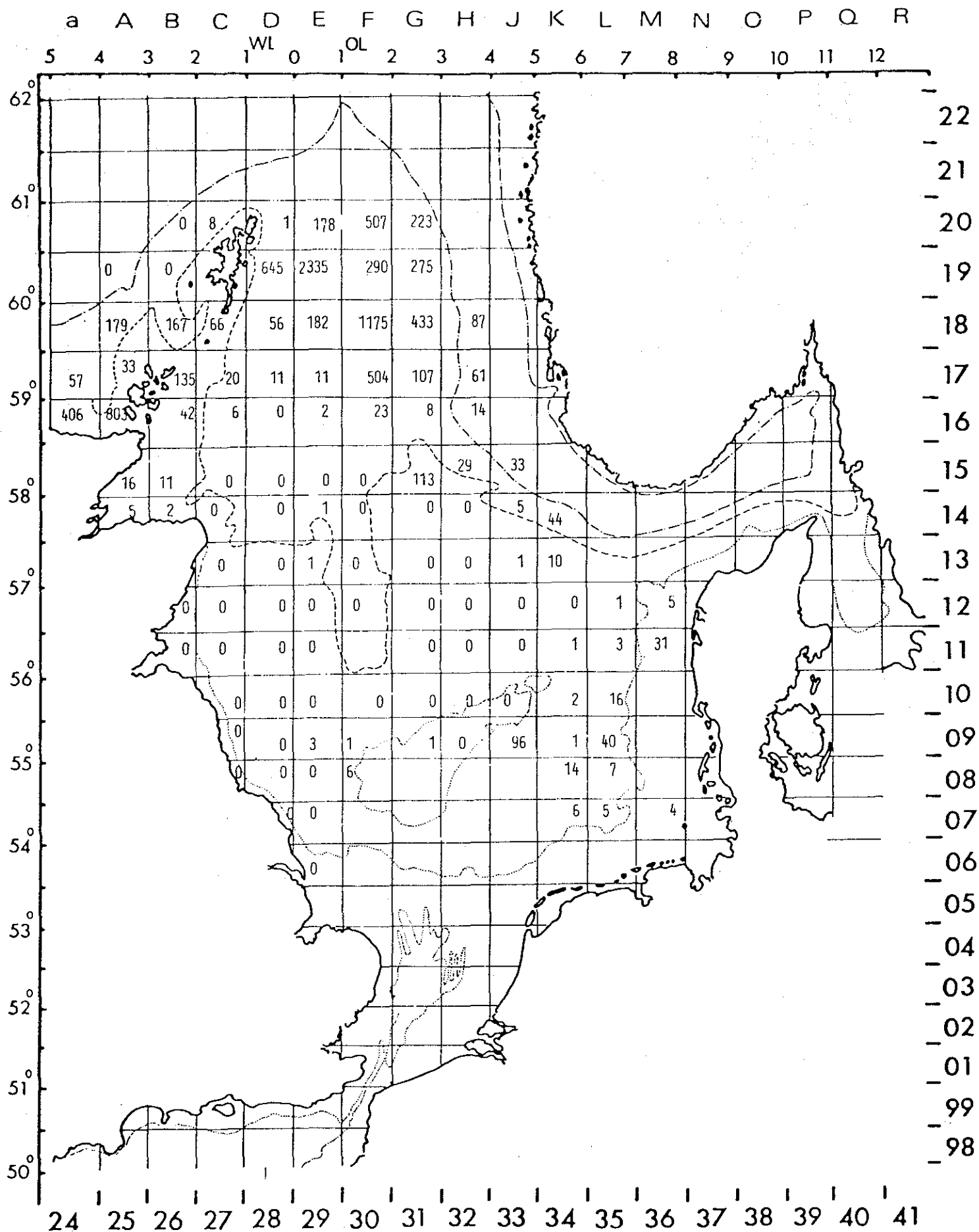


Figure 20. O-group WHITING.
Source: 1975 survey.

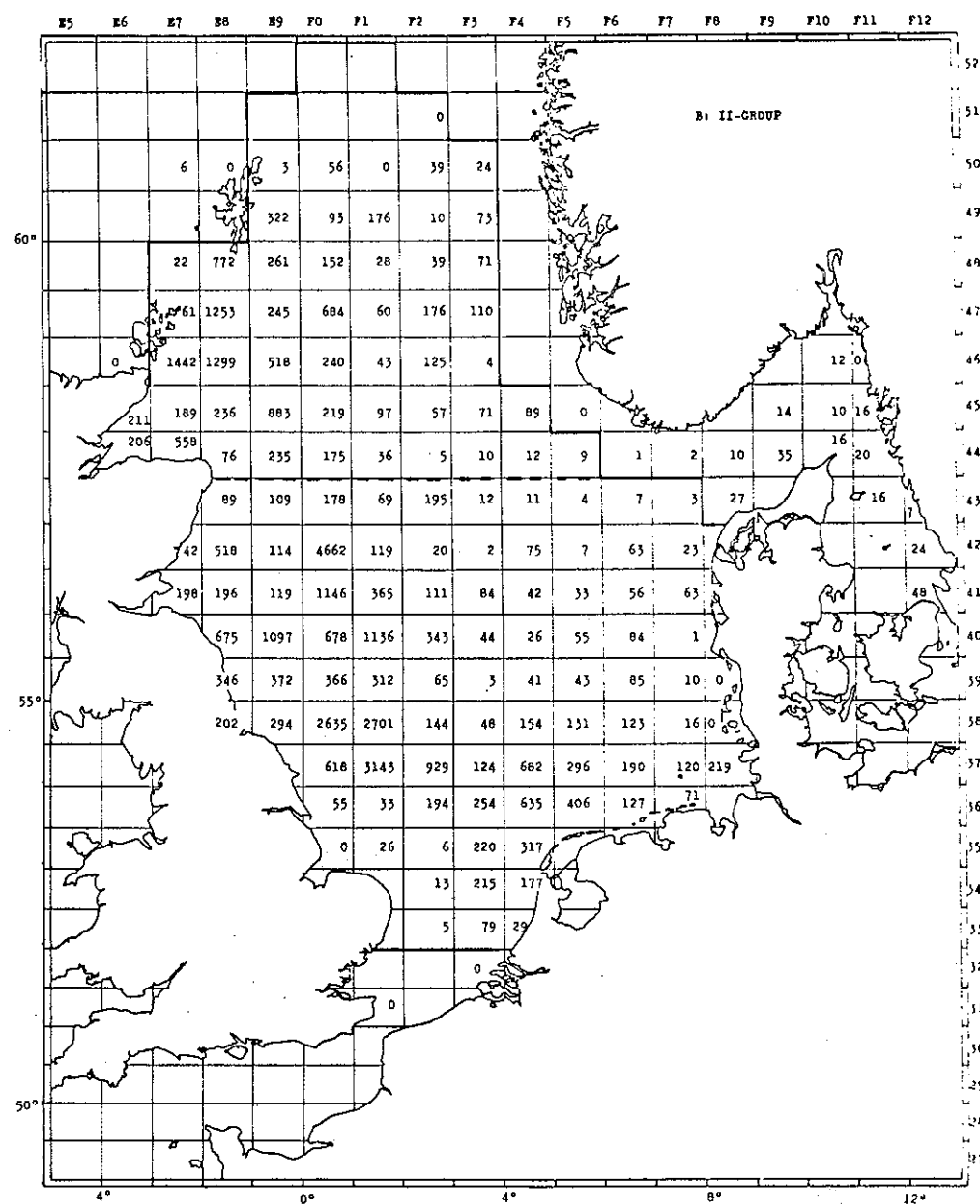
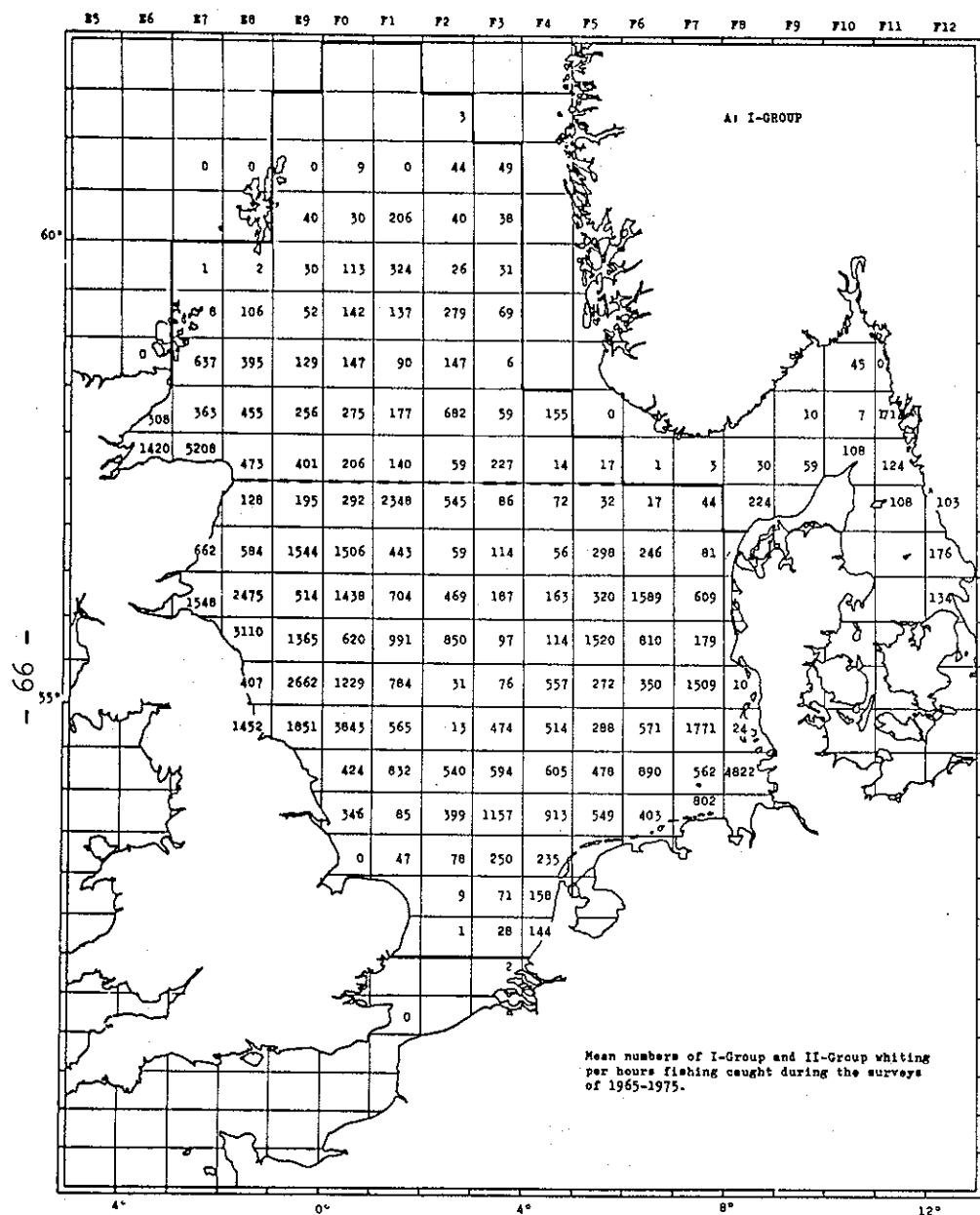
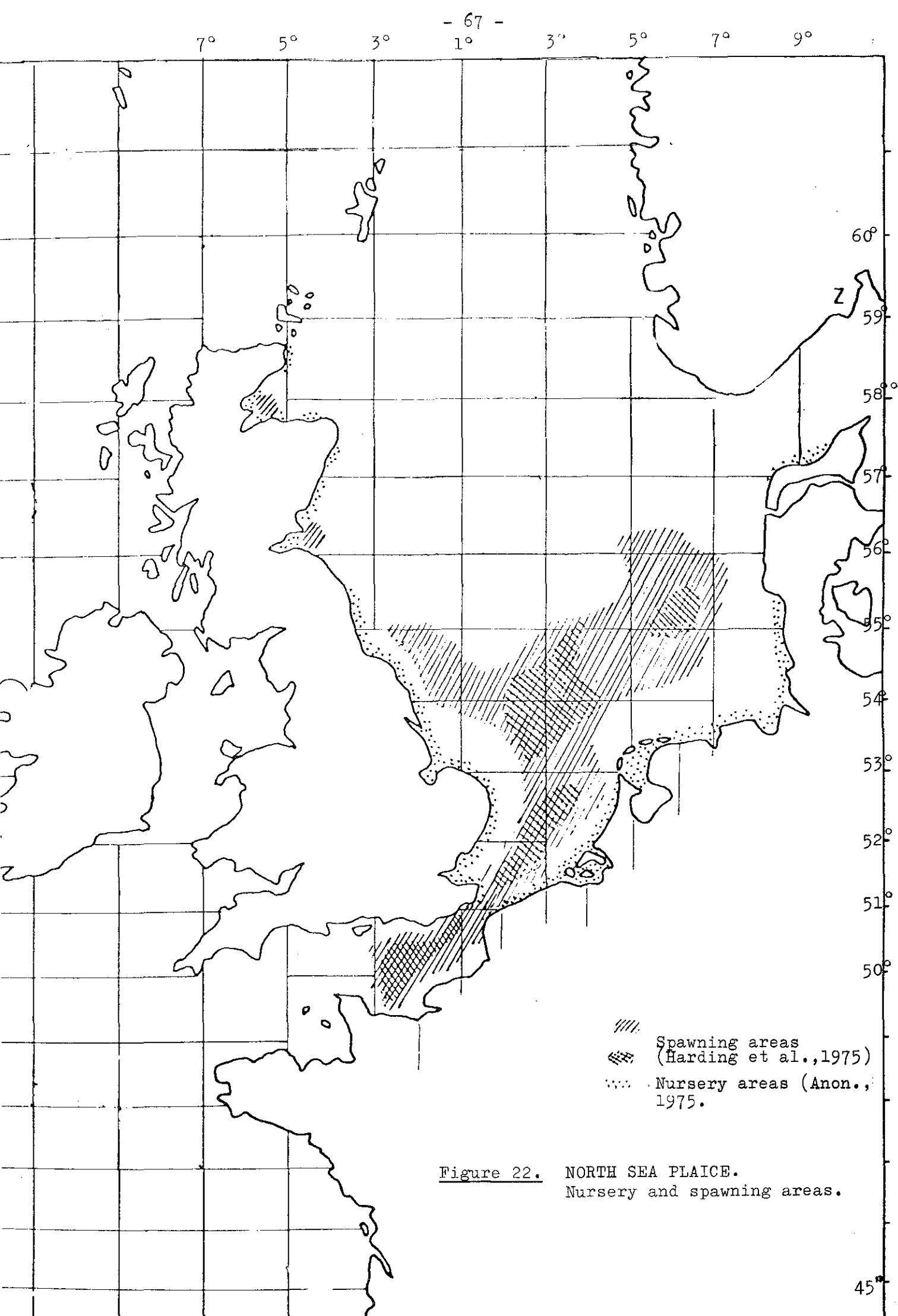


Figure 21. I and II group WHITING.
Source: From Young Herring
Surveys, 1965-75.



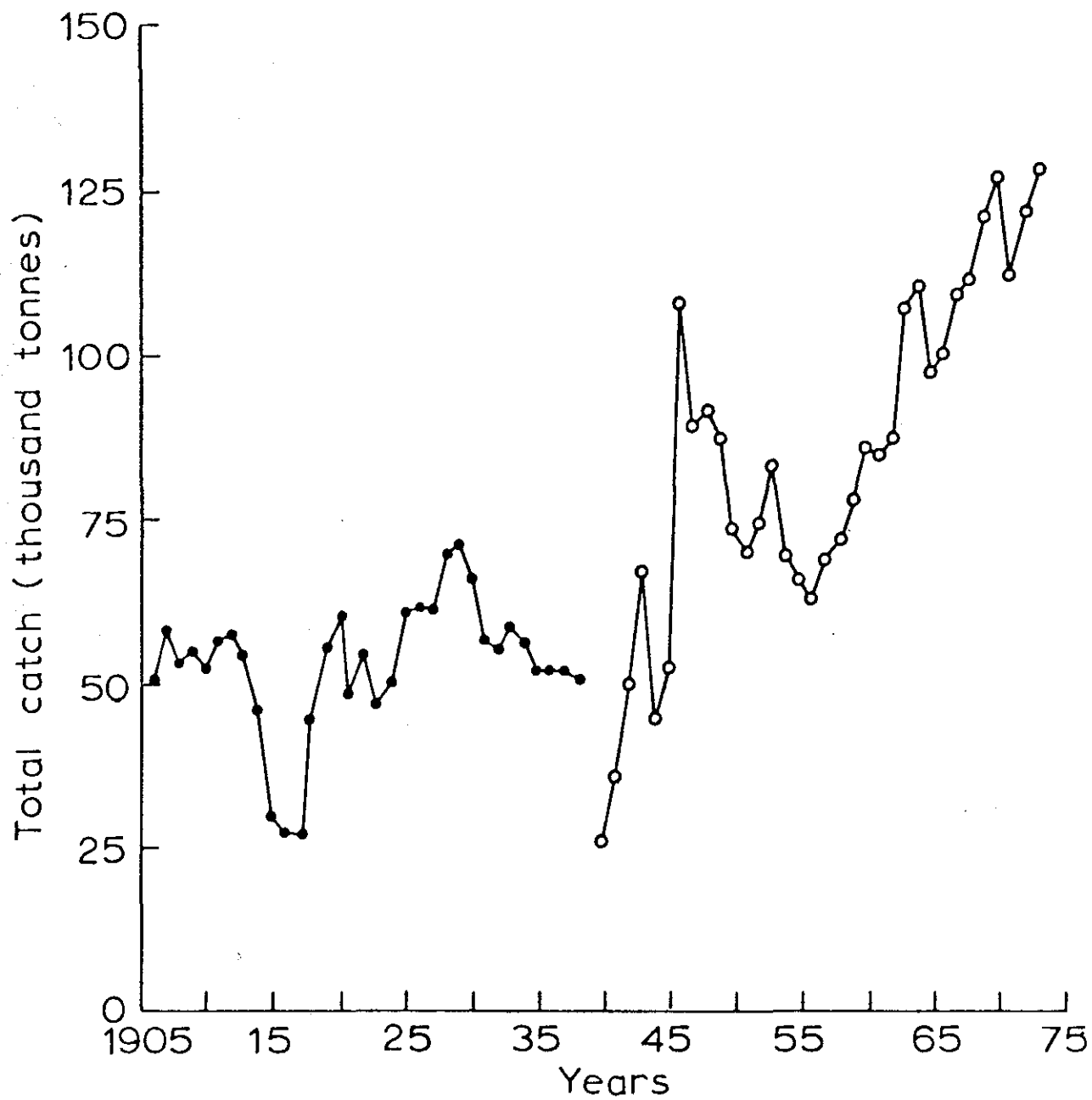


Figure 23. Trend in the total catch of PLAICE from 1906.
Source: Bannister (1975).

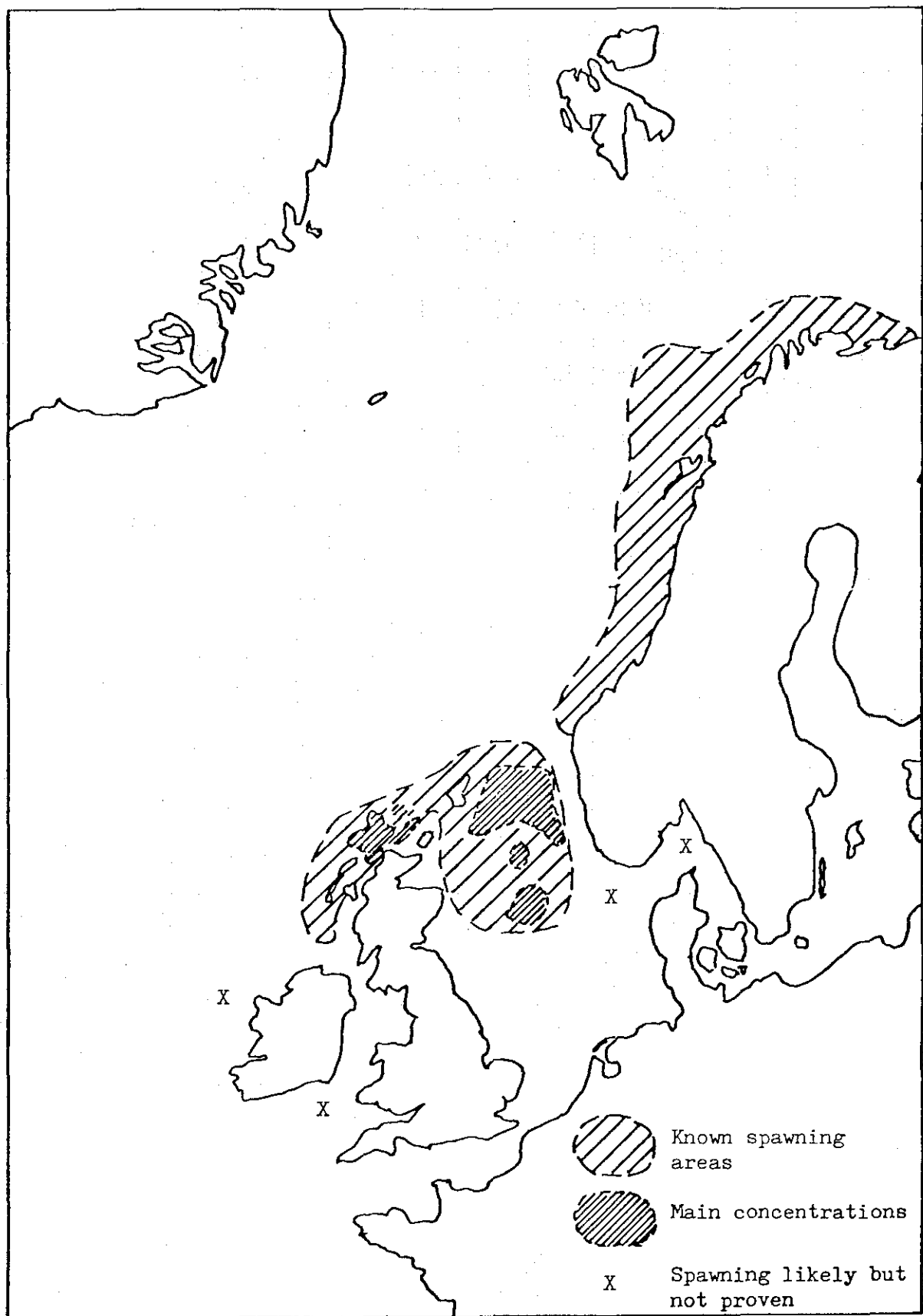


Figure 24. Spawning distribution of NORWAY POUT as shown by the distribution of eggs and small larvae in surveys.

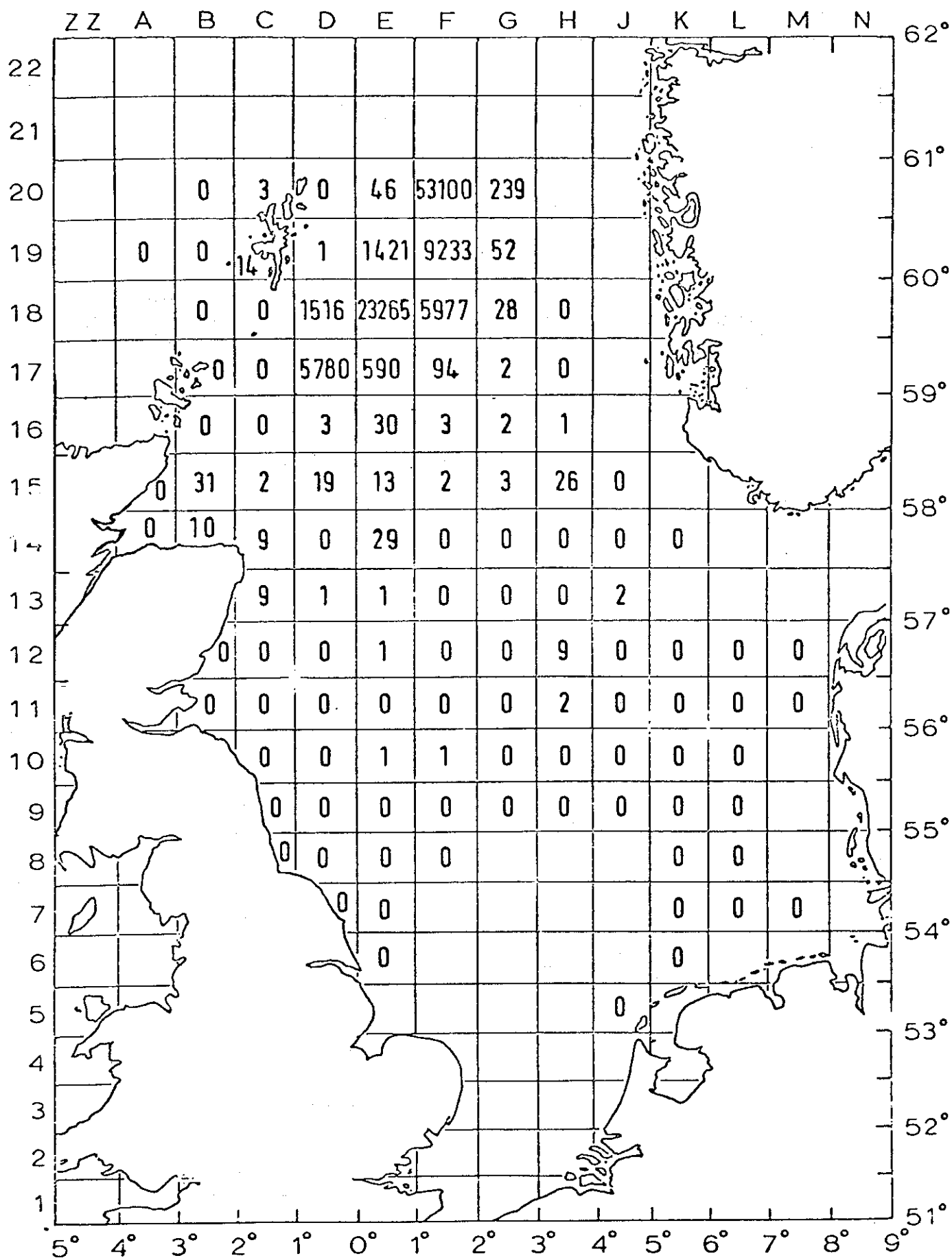


Figure 25. Mean numbers of 0-group NORWAY POULT per standard haul.

Source: From 1975 survey.

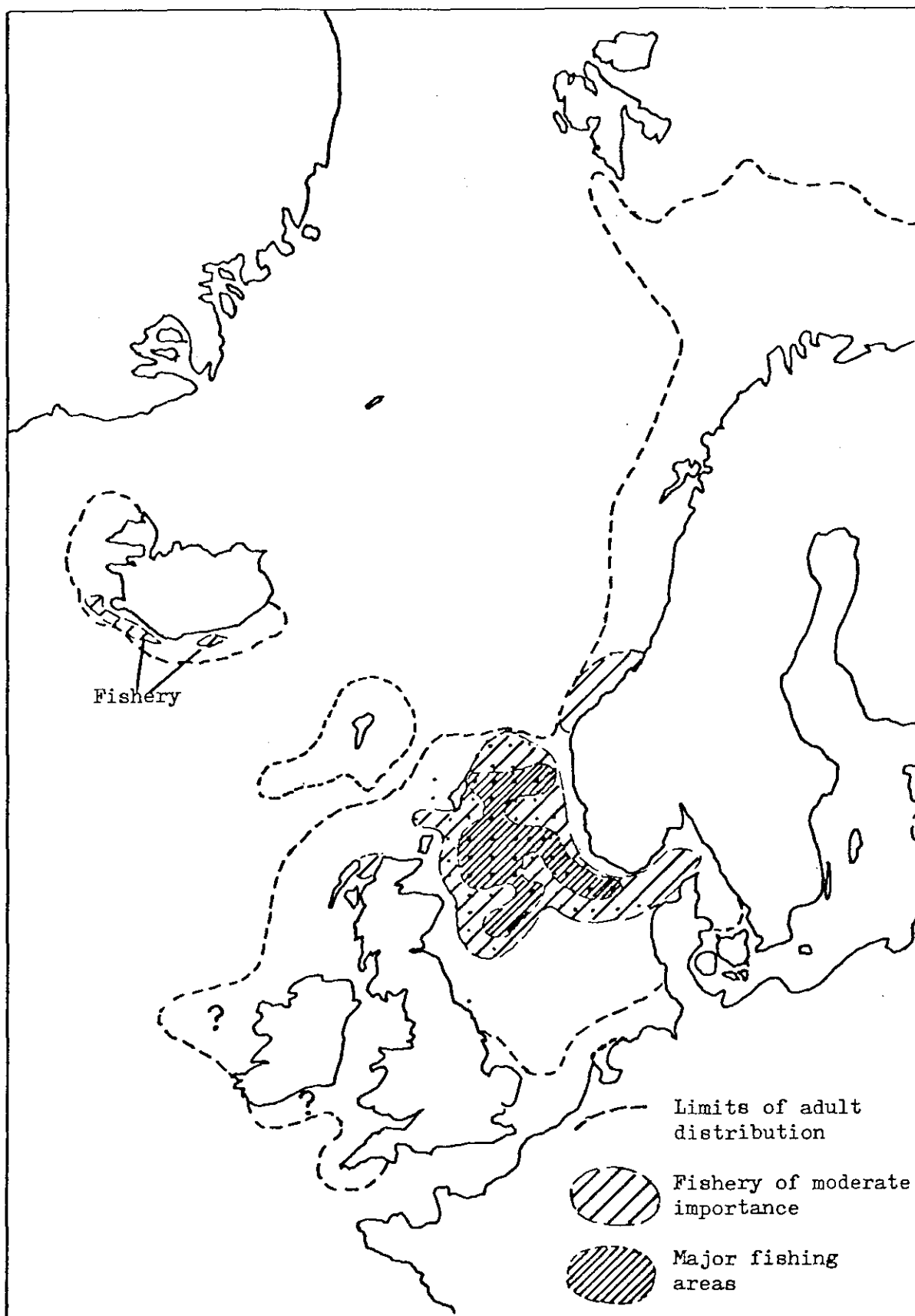
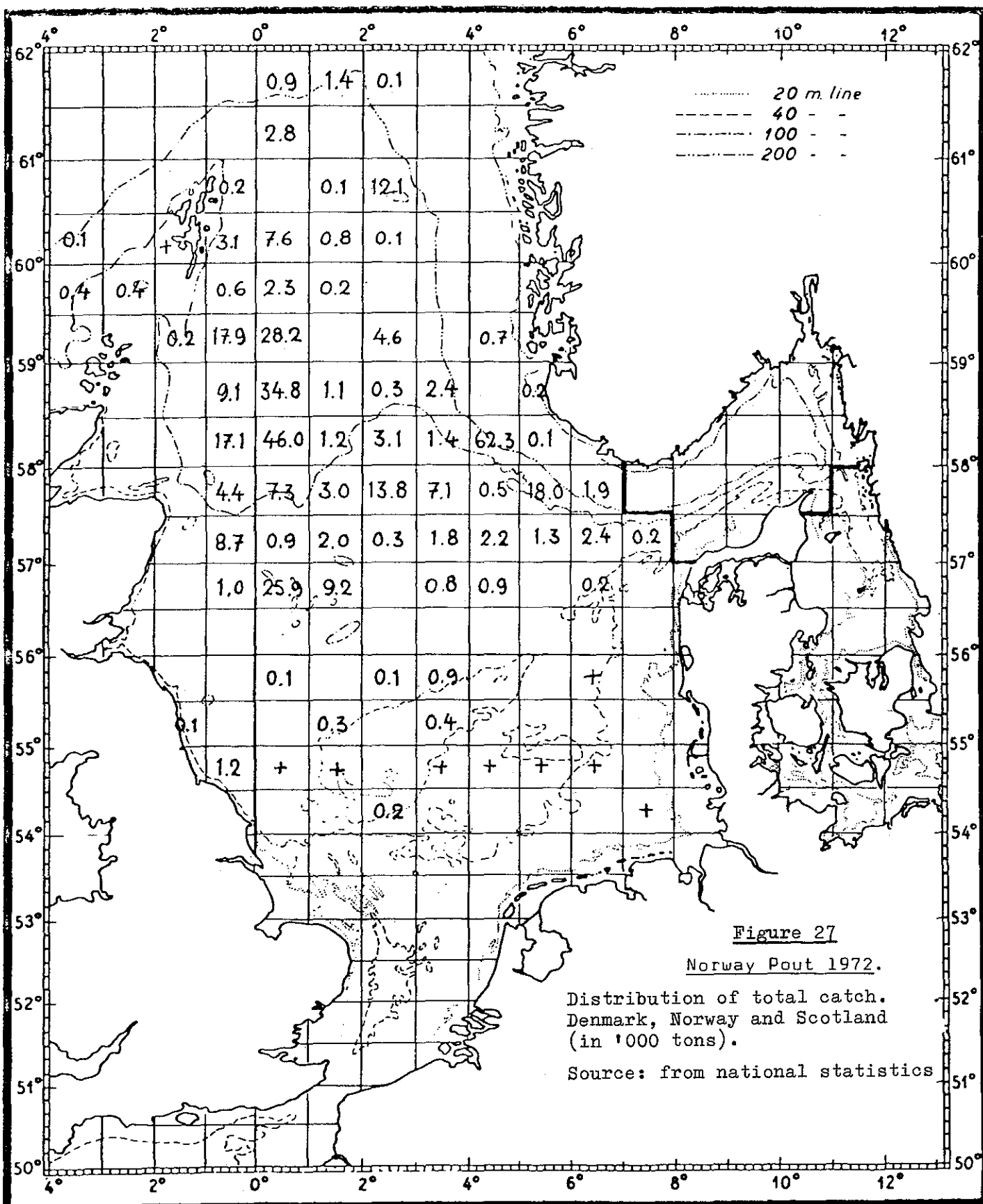
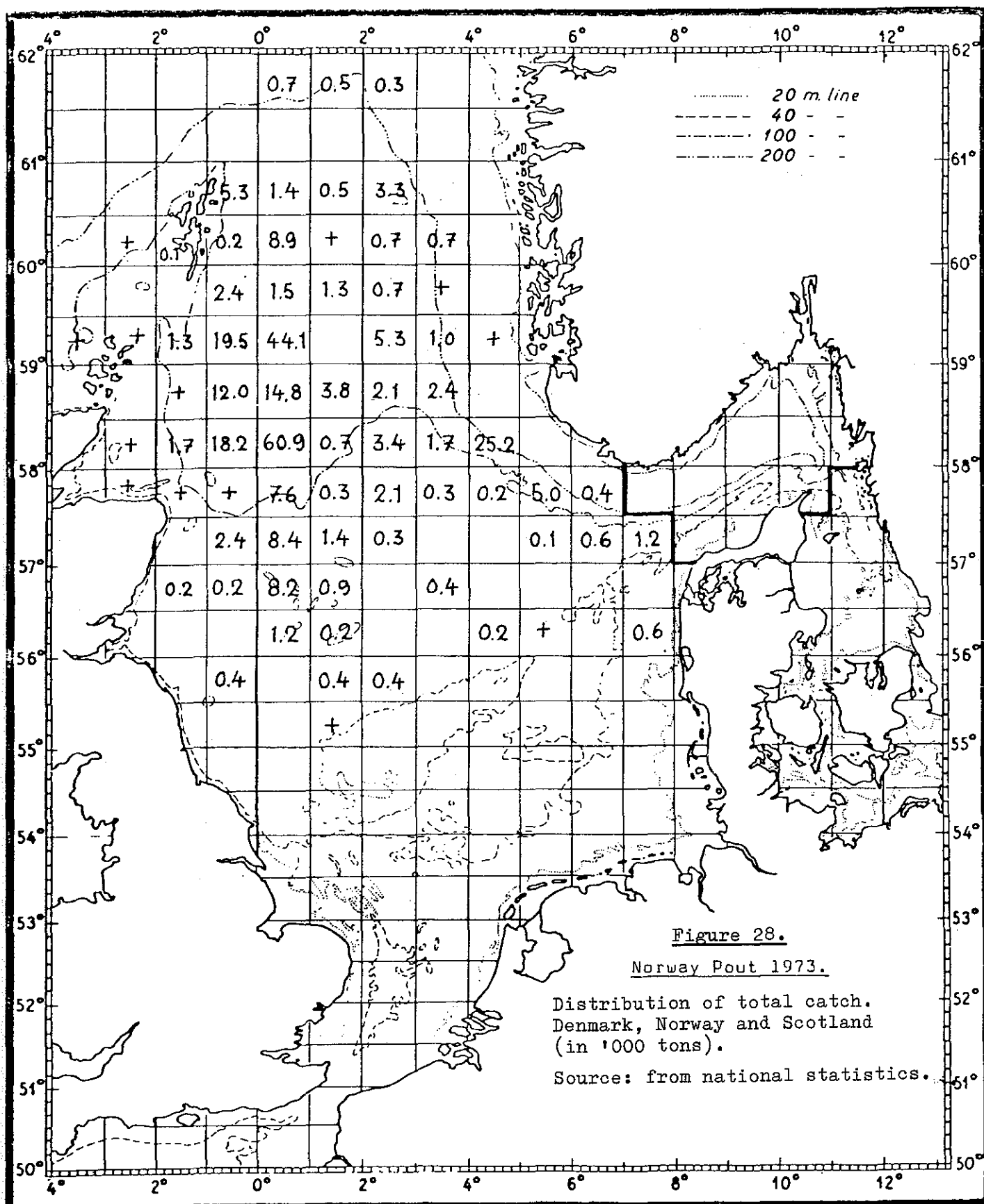
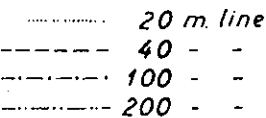


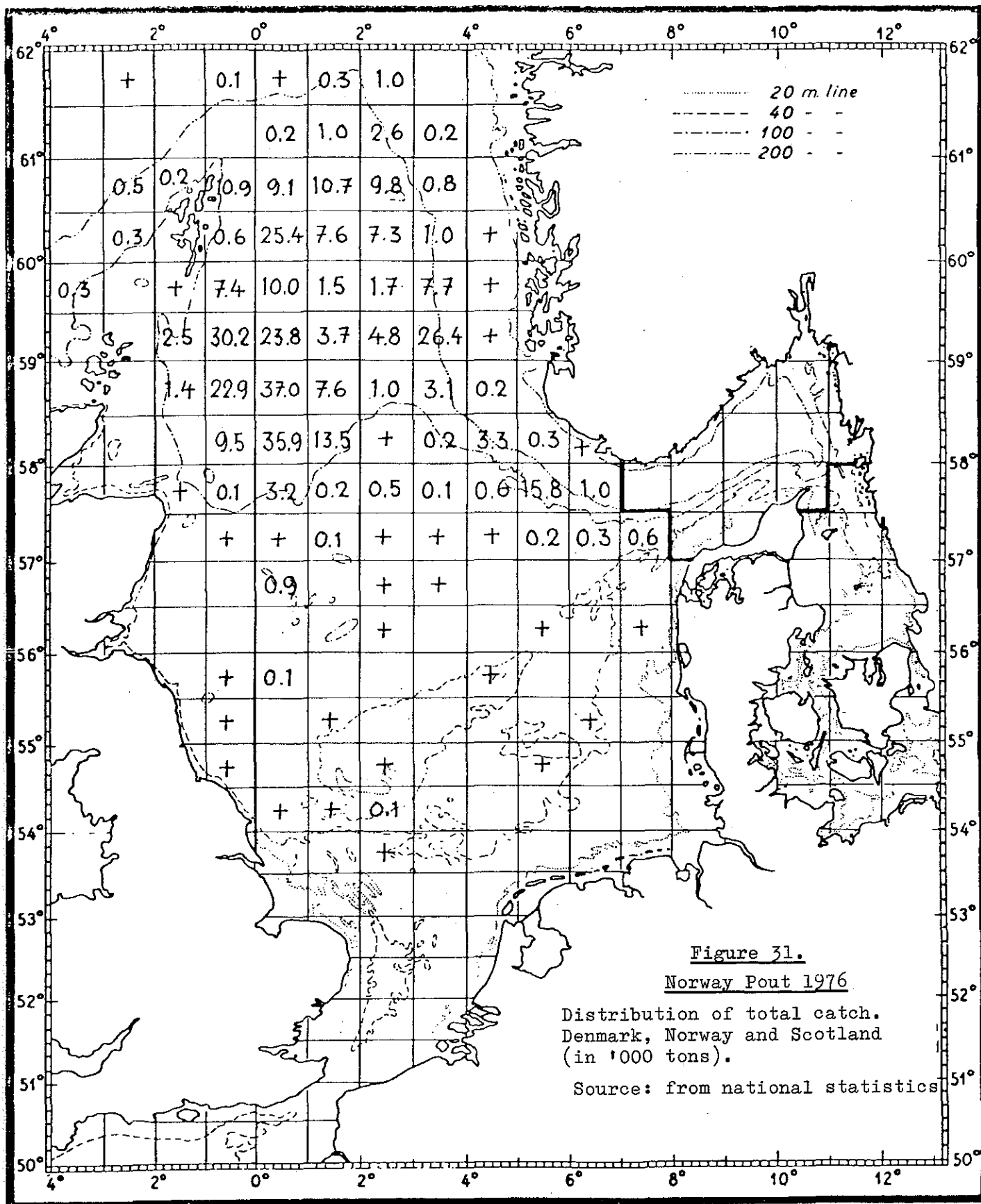
Figure 26. The distribution of adult NORWAY POUT and known fishing areas.
Source: Data supplied by national laboratories.











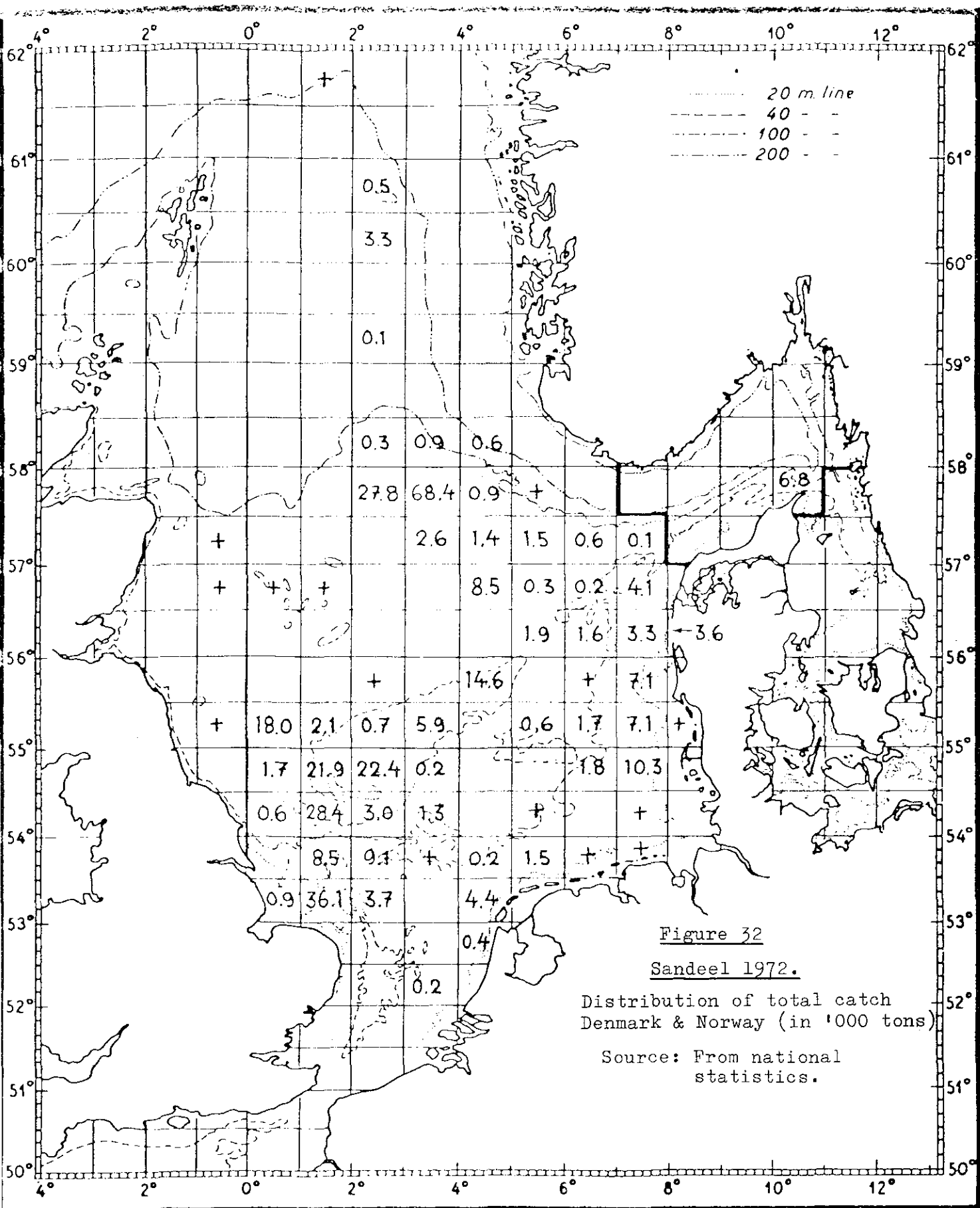
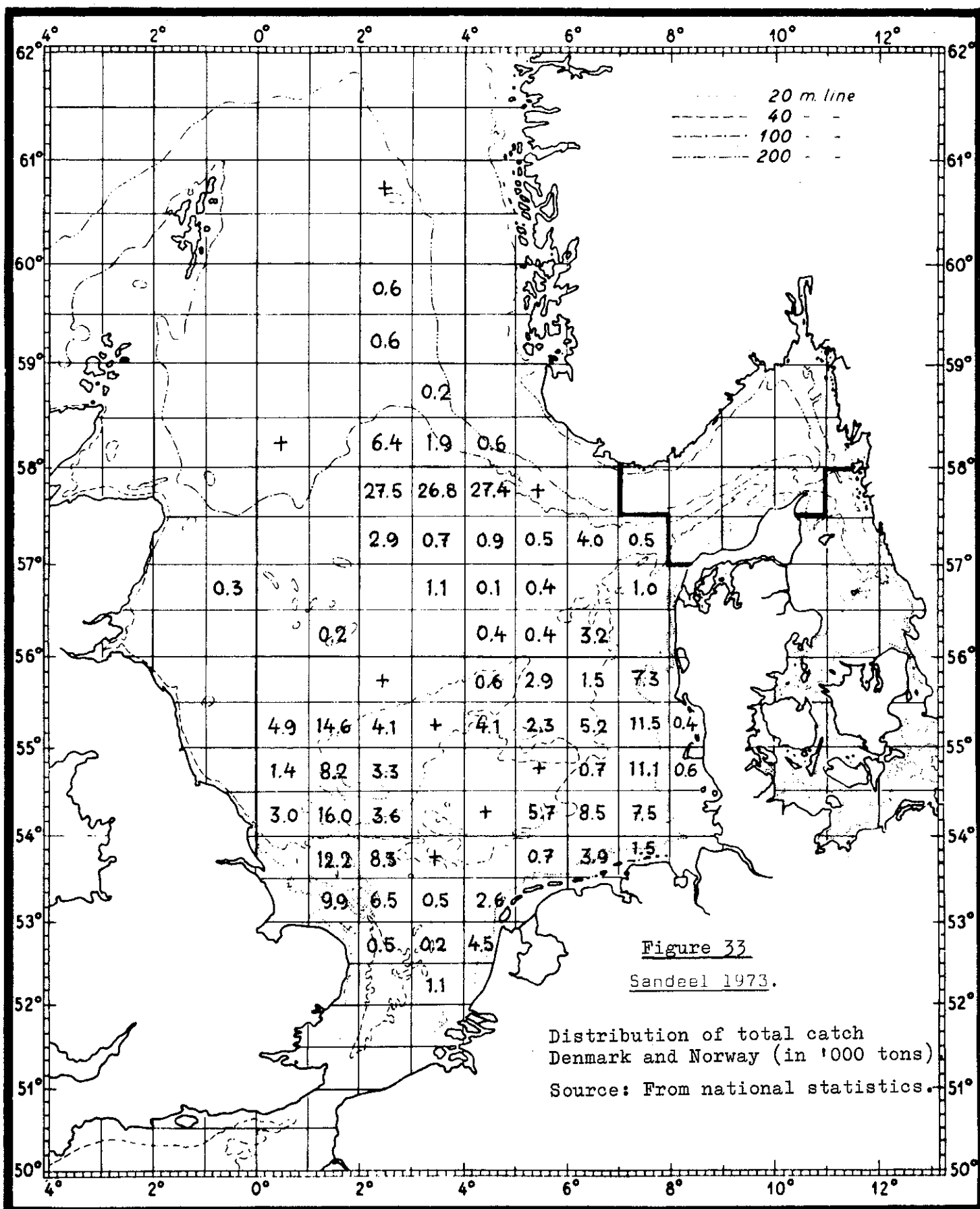


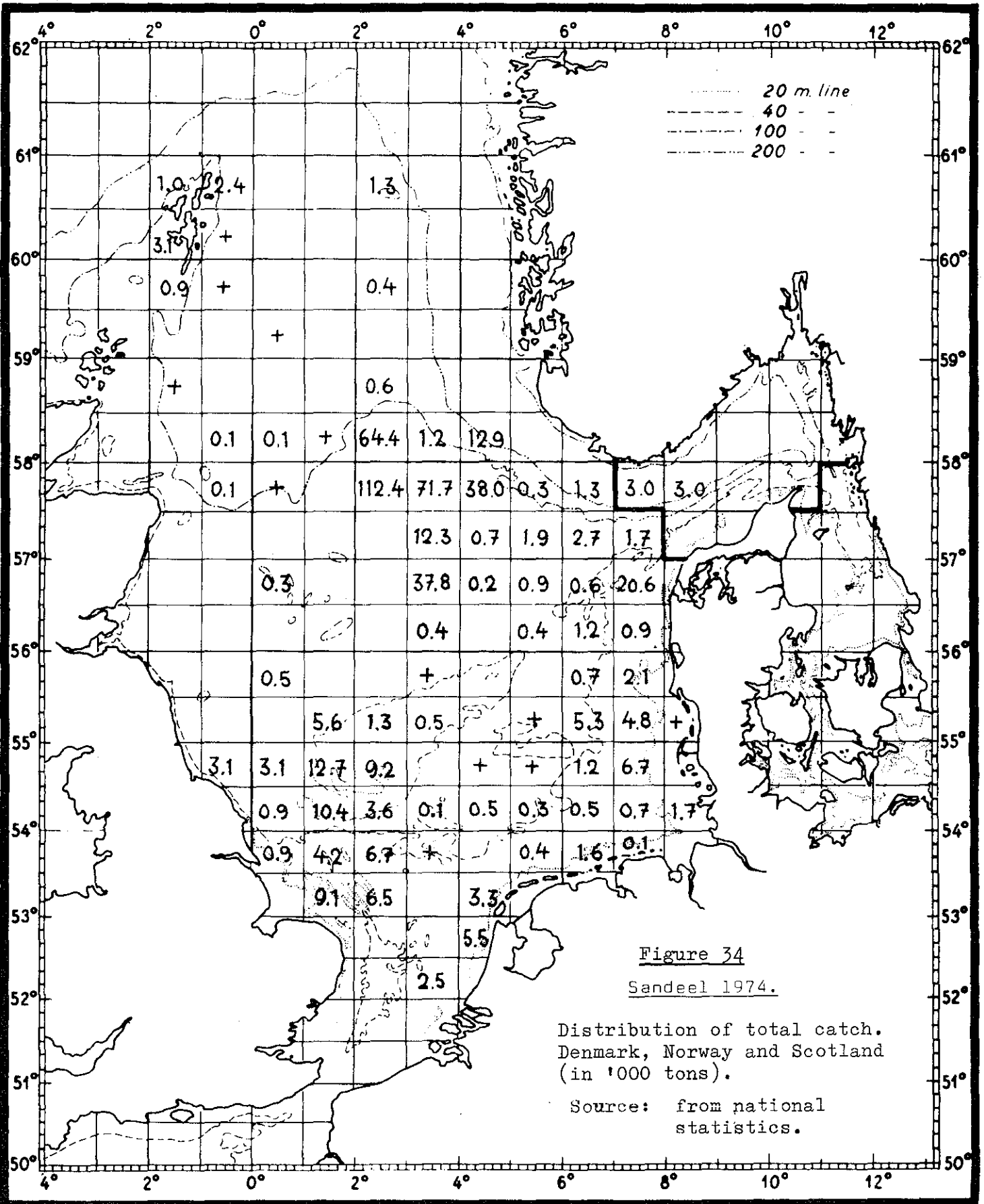
Figure 32

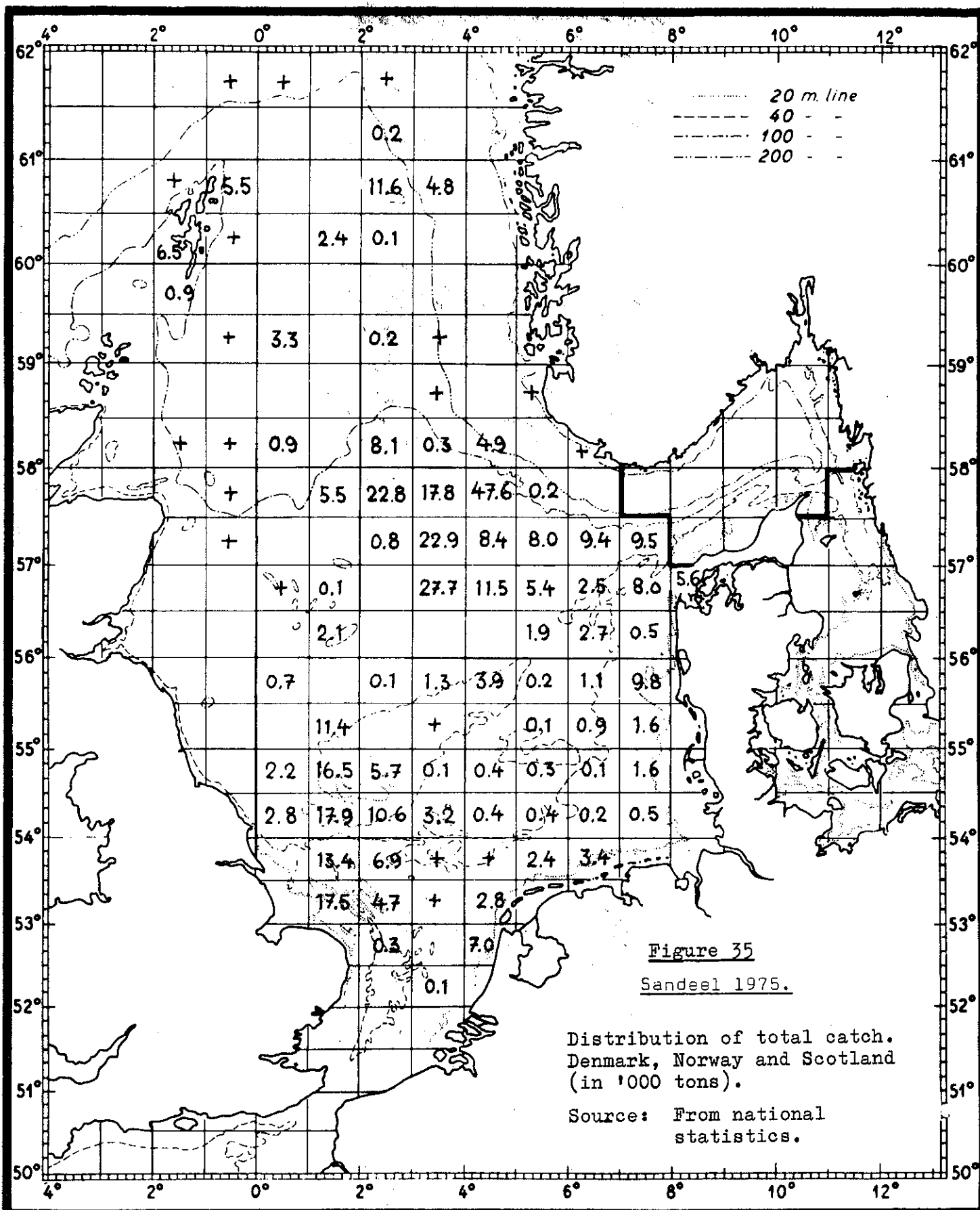
Sandeel 1972.

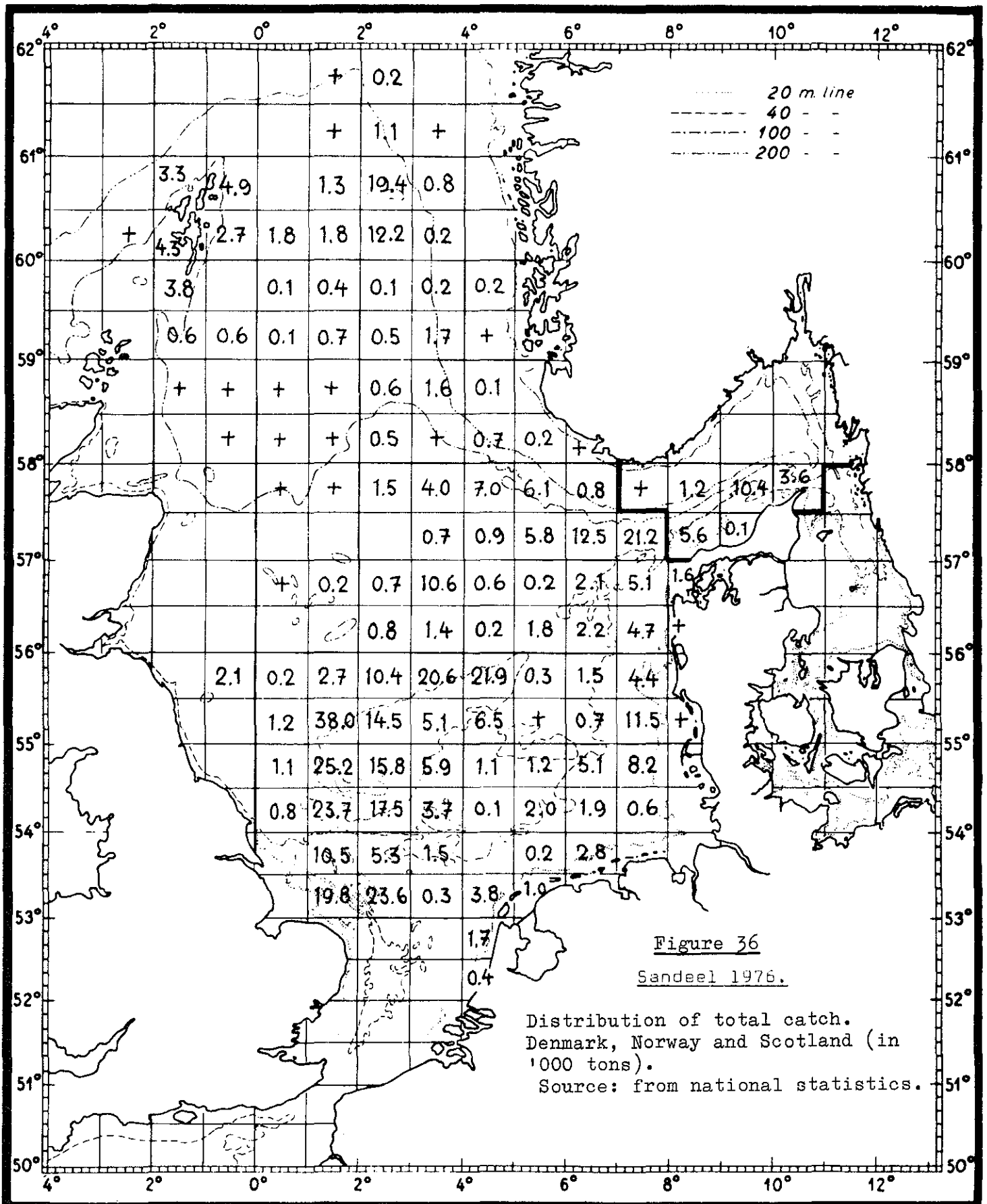
Distribution of total catch
 Denmark & Norway (in '000 tons)

Source: From national
 statistics.









Indication of spine colours

Liaison Committee Reports	Red
Reports of Advisory Committee on Marine Pollution	Yellow
Fish Assessment Reports	Grey
Pollution Studies	Green
Others	Black