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The Propagation of Cod *Gadus morhua* L.

DISTRIBUTION OF EGGS AND LARVAE OF GADOID FISHES FROM STAD TO LOFOTEN DURING APRIL 1976-1982

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ABSTRACT

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Fish eggs and larvae have been sampled during the study of herring larvae distribution. Since 1976 these findings have been recorded. Most of the gadoid eggs are difficult to identify, but identification of larvae and knowledge of spawning periods and areas may reduce the errors in mapping distribution of eggs of a single species. Eggs with a diameter of 1.20 to 1.59 mm, most probably of cod, and eggs with a diameter of 1.0 to 1.19 mm, probably of saithe, Norway pout or blue whiting, were most abundant. Highest densities were found off Møre and in the Lofoten-Vestfjorden area. Both categories of eggs were usually found in highest numbers during the second half of April. Eggs and larvae of blue whiting were recorded from Stad to Træna.

INTRODUCTION

The Norwegian continental shelf is a very important fishing area in the North Atlantic. The shelf is also the spawning area for many of the most economical important fish species in the North Atlantic. The eggs and larvae are transported northwards by the currents to the nursery grounds along the Norwegian coast, in the Barents Sea and off West-Spitsbergen.

The currents in the investigated area are described by Sætre and Ljøen (1971).

The Institute of Marine Research has since 1948 been annually sampling fish eggs and larvae at different localities along the Norwegian coast (Wiborg, 1954; Dragesund and Hognestad, 1966; Hognestad, 1969; Bjørke, 1981; Dragesund, 1970; Dragesund and Nakken, 1973; Gjøsæter and Sætre, 1974). The sampling has taken place during the spring and summer seasons and has partly been aimed at the study of single species, such as, for example, herring and cod.

After 1966 a closer sampling grid was introduced from Stad to Vestfjorden and the sampling was aimed at the study of the herring larvae only.

Findings of oil along the Norwegian coast and the consequent oil spill contingency plans introduced the need for increased and updated knowledge about the occurrence and distribution of fish eggs and larvae. These younger stages, with strongly reduced ability to choose their surroundings, are more vulnerable to the effects of oil than the older ones. Therefore, utilizing the sampling schemes already working, it was decided from 1976 onwards to identify and record all fish eggs and larvae caught with zooplankton gears.

The aim of the present paper is to present some of the results of this work and to comment on the occurrence and distribution of eggs and larvae of gadoid fishes.

Eggs and/or larvae of the following gadoid species have been recorded in the investigated area (References to author of first recording): Cod (*Gadus morhua* L.) (Damas, 1909), haddock (*Melanogrammus aeglefinus* (L.)) (Damas, 1909), Norway pout (*Trisopterus esmarkii* (Nilsson)) (Wiborg, 1954, 1956), whiting (*Merlangus merlangus* (L.)) (Damas, 1909), saithe (*Pollachius virens* (L.)) (Damas, 1909), silvery pout (*Cadiculus argenteus thori* (Schmidt)) (Damas, 1909), tusk (*brosme brosme* (*Ascanius*)) (Damas, 1909), ling (*Molva molva* (L.)) (Damas, 1909), blue ling (*Molva dypterygia* (Pennant)) (Damas, 1909) and rockling (*Gaidropsaurus* spp. (Dannevig, 1919).

Some of these species have also been recorded more recently in this area (Aldonov and Serebryakov, 1981). Eggs and/or larvae of other gadoid species have been recorded in fjords south of the investigated area. These are: Blue whiting (*Micromesistius poutassov* (Risso) (Lopes, 1979), lesser fork-beard (*Raniceps raninus* (L.)) (Lopes, 1979), pollack (*Pollachius pollachius* (L.)) and poor cod (*Trisopterus minutus* (L.)) (Dannevig, 1930).

Local names used in the text are shown in Fig. 1.

MATERIALS AND METHODS

The material used in this report is derived from the herring larvae surveys made in April. During these surveys the area is usually covered twice and samples are taken with a Gulf III sampler (Ziljstra, 1970). The samples are taken as double oblique hauls from 60 m to the surface. During 1976 and 1977 the mesh size was 500 micron and the following years 273 micron. From 1979 onwards this material was worked up within 12 h of preservation in 4% formalin.

To determine the spawning period of Norway pout material from a permanent oceanographic station off Bud was used (Fig. 1). Vertical hauls from 250 to 0 m were taken with a 0.1 m^2 Juday net at intervals from one week to one month, most frequently during spring time. The samples included are from the period 1976-1981.

Descriptions by Seaton and Bailey (1971) and by Russell (1976) were used for identification purposes.

RESULTS AND DISCUSSION

Identification

Russell (1976) states that gadoid eggs without oil globules are almost impossible to distinguish in material from

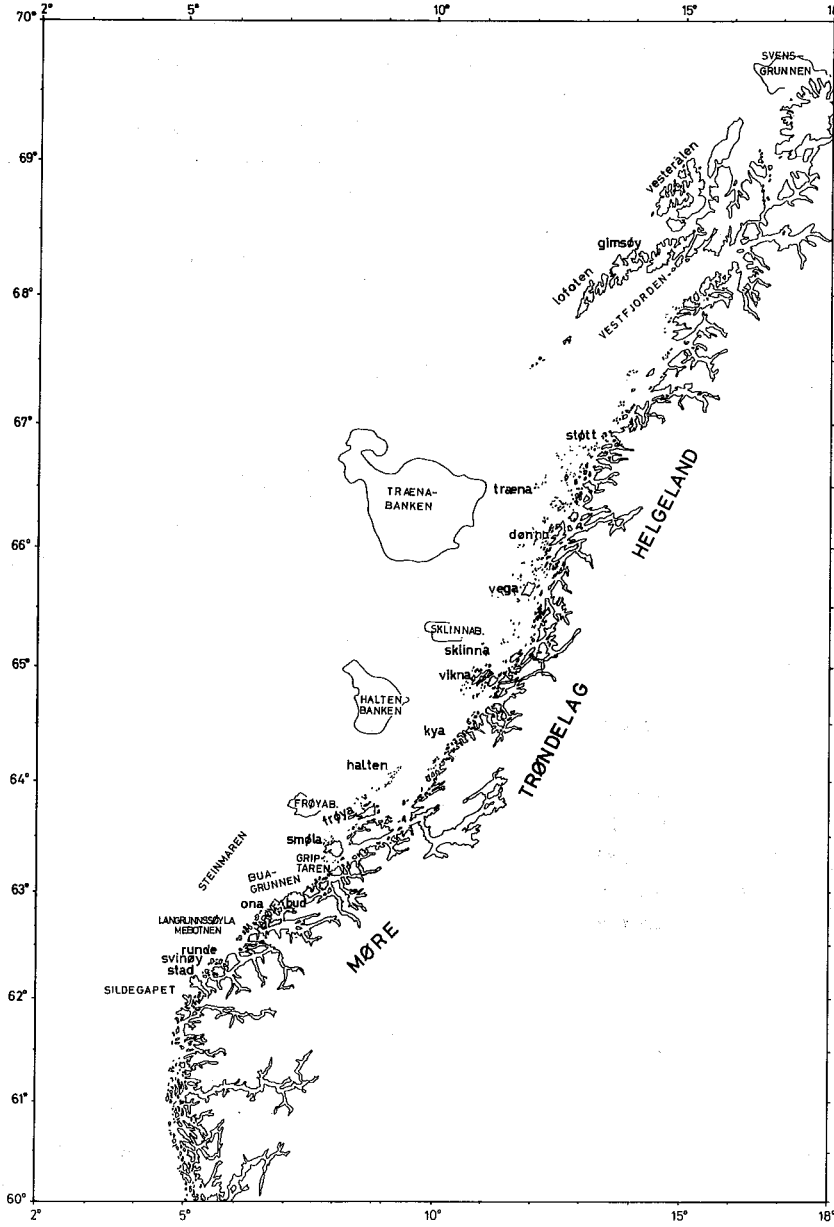

Fig. 1. Local names used in the text.

preserved plankton samples, except for those of haddock and cod which are identifiable in their latest stages of development. According to Seaton and Bailey (1971) eggs of blue whiting are also identifiable from preserved materials, at least from the area west of Scotland. Similar eggs are classified as eggs of blue whiting in the present work.

The majority of the unidentified eggs in the present material had diameters between 1.00 and 1.59 mm. These were split into two sizegroups, one including eggs with diameter from 1.00 to 1.19 mm and the other eggs with diameter from 1.20 to 1.59 mm.

Identified gadoid eggs without oil globules vary in diameter from 0.95 to 1.89 mm (Russell, 1976). According to Russell (1976) similar eggs could originate from other species. Taking into account species that are recorded to spawn or may spawn in the investigated area during April, such eggs could originate from lemon sole (*Microstomus bitt* (Walbaum)), witch (*Glyptocepthalus cynoglossus* (L.)) or flounder (*Platichys flesus* (L.)). Of these, eggs of lemon sole and flounder are identifiable at later stages of development (Russell, 1976). Fig. 2A shows the diameter of eggs of overlapping size (from Russell, 1976) expected to be found in the investigated area during April. Fig. 2B shows measurements of eggs of haddock, cod and Norway pout from Norwegian waters. The haddock eggs were from southern Norway and sampled from 28 females spawning in captivity throughout the spawning season (Moksness and Riis-Vestergård, 1982).

The cod eggs from southern Norway were collected from a basin with spawning cod throughout the spawning season (Sivertsen, 1935). The cod eggs from northern Norway were artificially fertilized throughout the spawning season (Solemdal and Sundby, 1981). The eggs of Norway pout were sampled from four females and artificially fertilized (Solemdal, Institute of Marin Research, Bergen, personal communication, 1983).

It is seen from Fig. 2B that no cod eggs had a diameter smaller than 1.20 mm. It is thus conceivable that few eggs with diameter 1.0 to 1.19 mm originate from cod.

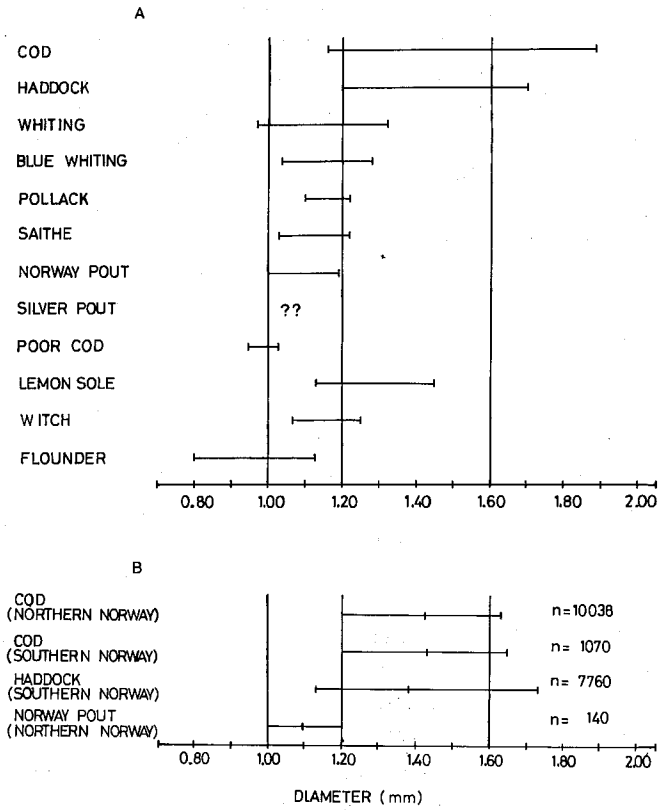

Fig. 2. A) Egg diameter of gadoid species and of species with egg diameters overlapping gadoid eggs. Figures from Russell (1976). B) Measurements of diameters of gadoid eggs from Norwegian waters.

Moksness and Riis-Vestergaard (1982) recorded haddock eggs with a diameter smaller than 1.20 mm (Fig. 2B). Using these authors figures it can be calculated that only 1.3% of the haddock eggs had a diameter smaller than 1.20 mm. The haddock eggs from southern Norway might of course be slightly different from those from the investigated area in size. Cod eggs, however, from southern Norway did not differ much in

size from eggs from northern Norway (Fig. 2B) and probably haddock eggs do not either. It is thus conceivable that of eggs smaller than 1.2 mm in diameter very few could originate from cod or haddock.

From Fig. 2A and 2B it is seen that eggs between 1.00 to 1.20 mm could originate from all the species on the figure maybe except for cod and haddock. Table 1 shows the recordings of identified eggs and/or larvae of these species in the present material.

TABLE 1

Numbers of identified eggs and larvae recorded in the Gulf III samples for the whole sampling period. The species represented are gadoids and species with egg diameters overlapping gadoid eggs. See text. *Not identified.

Species	Cod	Haddock	Norway pout	Pollack	Saithe	Blue whiting	Whiting
Eggs	470	11	*	*	*	22	*
Larvae	26	6	4	0	19	8	0

TABLE 1 (cont.)

Species	Poor cod	Lemon sole	Witch	Flounder	Silvery pout
Eggs	*	0	*	0	*
Larvae	0	0	0	0	0

It is seen from the Table that of species with egg diameter in the size category 1.00 to 1.19 mm only larvae of Norway pout, saithe and blue whiting were found. Most probably unidentified eggs of these species constituted the majority of the eggs represented in Figs. 12-18, since no

larvae were recorded of the other species with eggs in this size category.

The number of larvae found could indicate a majority of saithe eggs. On the other hand, saithe is known to spawn in February-March and most of the eggs would thus have been hatched at the time of sampling.

In a previous publication (Bjørke, 1981) I categorized eggs without oil globules with diameter 1.00-1.19 mm as saithe eggs. Saithe eggs were then identified after the description made by Ehrenbaum (1905-1909). A high number of identified saithe eggs compared to those of Norway pout led to the conclusion that the majority of unidentifiable eggs in this size group must have originated from saithe. A closer examination showed, however, that the separation of the two species was not well defined after all. Therefore the same material is defined as eggs without oil globules with diameters 1.00-1.19 mm in the present work. Unidentified eggs in the other size group, 1.20-1.59 mm, could, according to Figs. 2A and 2B originate from cod, haddock, whiting, blue whiting, pollack, saithe, lemon sole and witch. The number of identified eggs of cod (Table 1) indicate that the majority of eggs belong to this species, although the number of larvae of haddock, saithe and blue whiting indicate presence of unidentified eggs of these species. From Icelandic waters Fridgeirsson (1978) measured 100 eggs of saithe and found a range in diameter from 1.051 to 1.169 mm with a mean of 1.104. Although these measurements were few and not throughout the spawning season, they indicate that few saithe eggs from boreal waters are larger than 1.20 mm. It is thus conceivable that Figs. 3-9 show the distribution of cod eggs, although presence of unidentified eggs of haddock and blue whiting can not be disregarded.

Cod

The North-East Arctic cod is the main stock in the area. The stock gathers to spawn along the Norwegian coast from

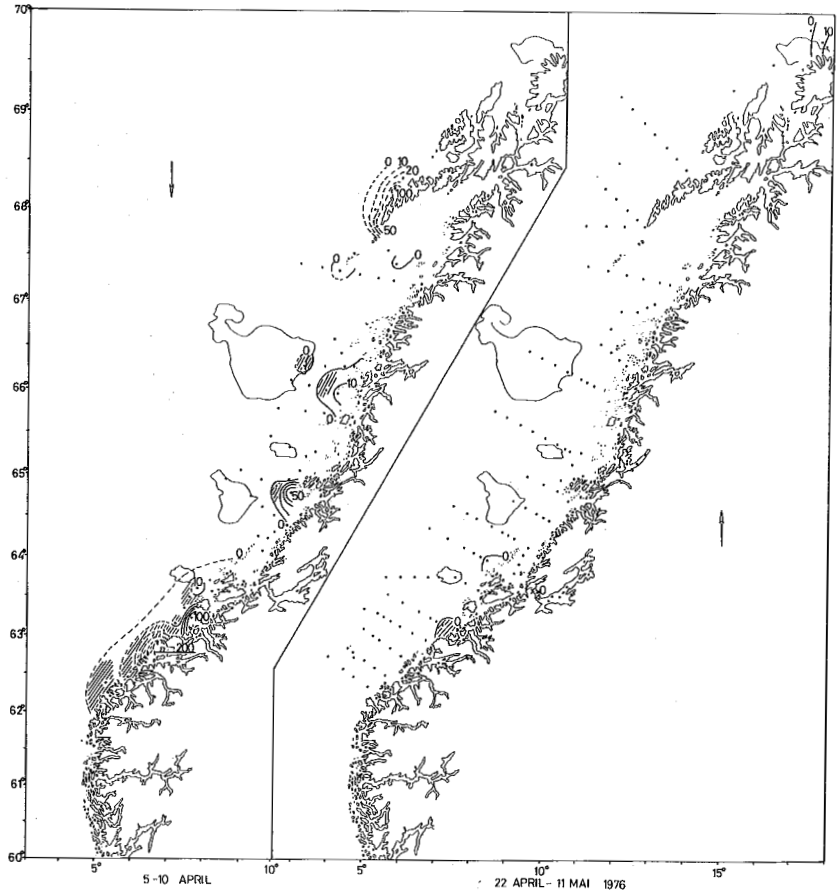

Fig. 3. Distribution of eggs with a diameter of 1.2-1.59 mm, most probably of cod, in 1976, in numbers per m^2 surface. Hatched area shows findings of eggs younger than 7-10 days. Dots show station grid. Arrows show main course of sampling. Dates indicate the period eggs were found.

late January to the middle of April. The spawning is most intensive during the last week of March and the first week of April. Spawning takes place close inshore, mainly in the Vestfjord, but also occurs sporadically along the shelf from

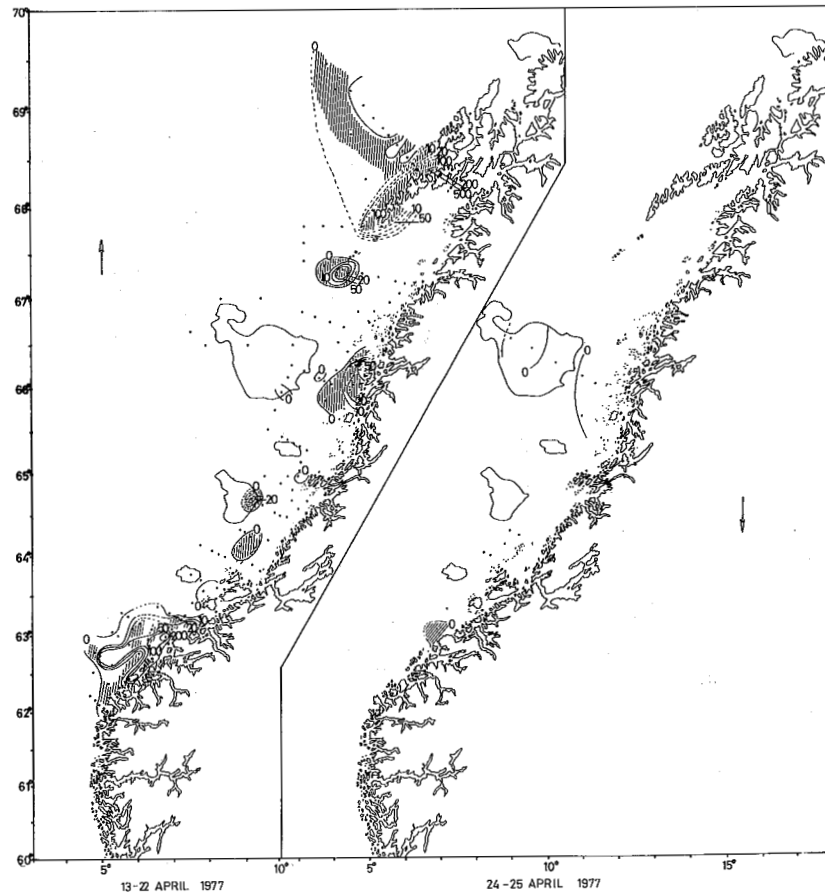

Fig. 4. Distribution of eggs with a diameter of 1.2-1.59 mm, most probably of cod, in 1977, in numbers per m^2 surface. Legend as for Fig. 3.

60°N to about 70°N. Developing planktonic eggs and larvae drift in a northerly direction over the Norwegian shelf. Smaller stocks inhabit Norwegian and Soviet coastal waters, and are restricted to these areas (Anon., 1979). Serebryakov and Aldonov (1984) report spawning from 62° to 74°30'N.

As mentioned above unidentifiable eggs with diameter 1.20

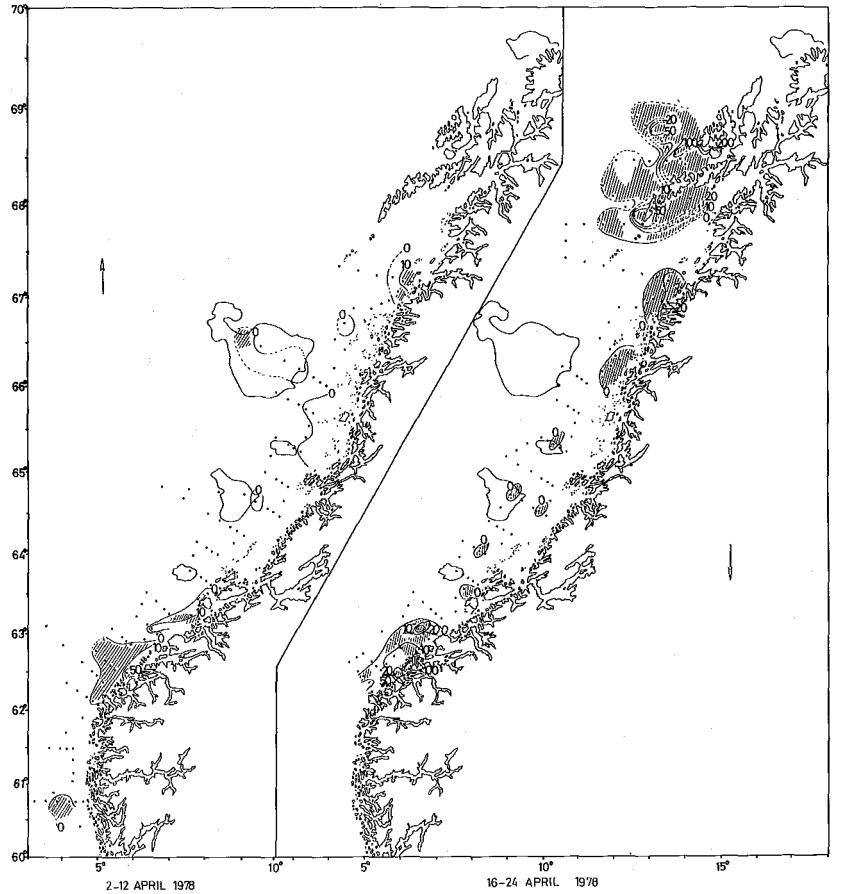

Fig. 5. Distribution of eggs with a diameter of 1.2-1.59 mm, most probably of cod, in 1978, in numbers per m^2 surface. Legend as for Fig. 3.

to 1.59 mm in the present material originate most probably from cod. These eggs will for the sake of convenience be called cod eggs although presence of unidentified eggs of haddock and blue whiting in the material can not be disregarded.

Most frequently, and in highest numbers, eggs of cod are

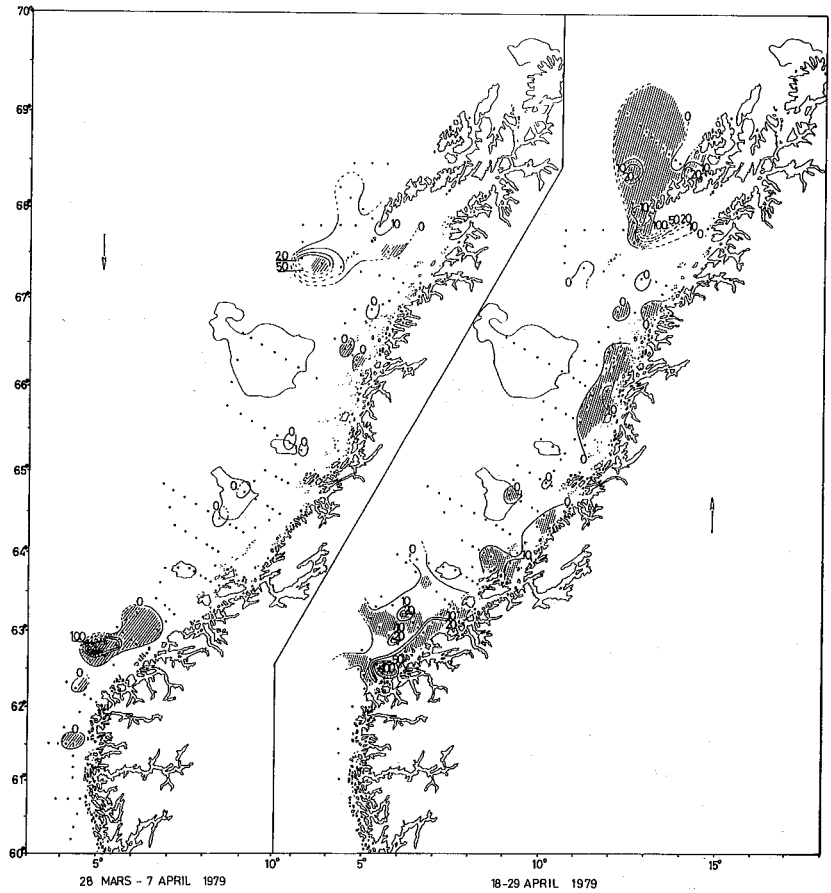

Fig. 6. Distribution of eggs with a diameter of 1.2-1.59 mm, most probably of cod, in 1979, in numbers per m^2 surface. Legend as for Fig. 3.

found off Møre (Figs. 3-10A). Nearly every year eggs are found in the area NW of Runde, at Buagrunnen, Langrunnssøyla and Mebotnen. In these areas the number of eggs per m^2 surface often exceeds 200. In 1979 and 1980 isolated patches of eggs were recorded outside Ona.

North of Møre eggs were found nearly every year in the

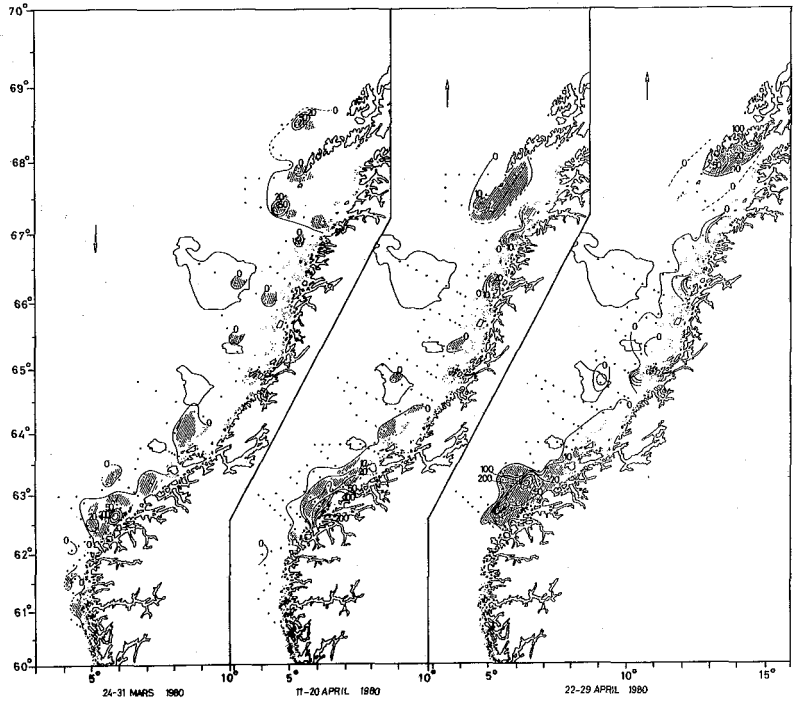

Fig. 7. Distribution of eggs with a diameter of 1.2-1.59 mm, most probably of cod, in 1980, in numbers per m^2 surface. Legend as for Fig. 3.

Halten area, the Vikna area and the Vega area. During the 1977-81 period eggs were recorded at Haltenbanken in small numbers. The Lofoten-Vesterålen area was irregularly covered during the investigations. South of Røst eggs were found every year except for 1978 and 1982. In 1982 the area was not sampled. Few eggs were found on Trænabanken. Fig. 10A shows where cod eggs have been recorded south of 67°N during April 1976-1982.

The eggs were recorded all along the coast with the highest densities off Møre. Patches with more than 50 eggs per m^2 surface have also been recorded off Vikna and Dønna.

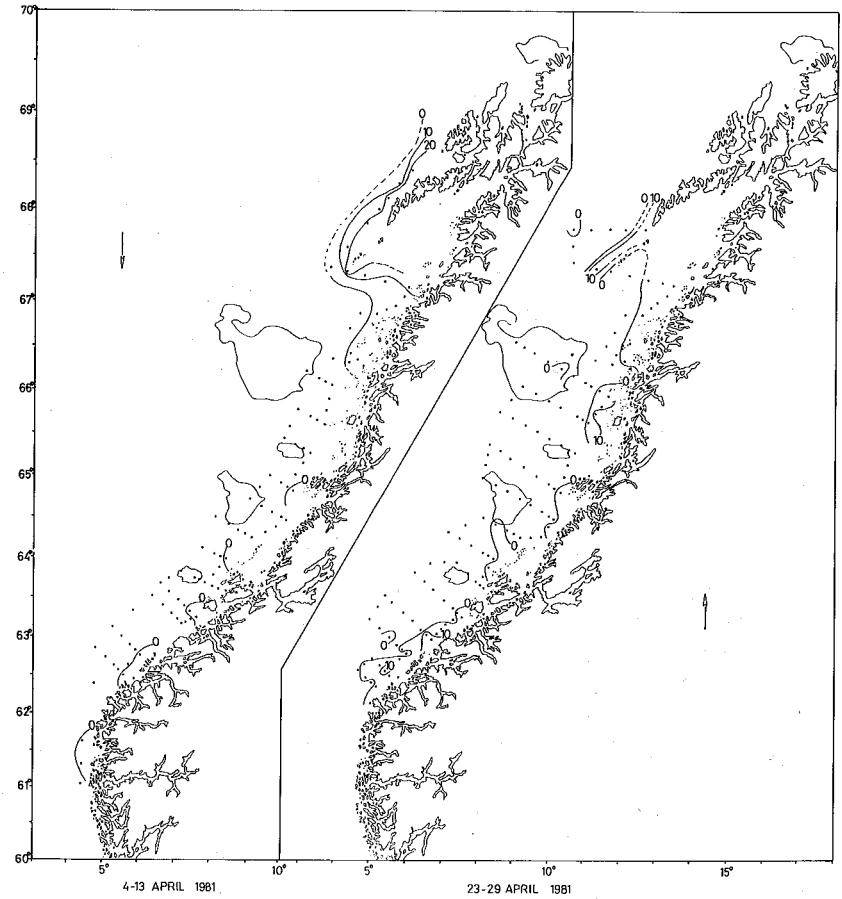

Fig. 8. Distribution of eggs with a diameter of 1.2-1.59 mm, most probably of cod, in 1981, in numbers per m^2 surface. Legend as for Fig. 3.

The distribution of identifiable cod eggs in late stages of development is shown for the whole period in Fig. 11A. Most of the eggs were found off Møre and so were the cod larvae, the distribution of which is shown in Fig. 11B. The larvae varied in length from 3.6 to 6.7 mm.

Usually eggs without oil globules with diameter 1.20 to 1.59 mm were found in highest numbers around the middle and

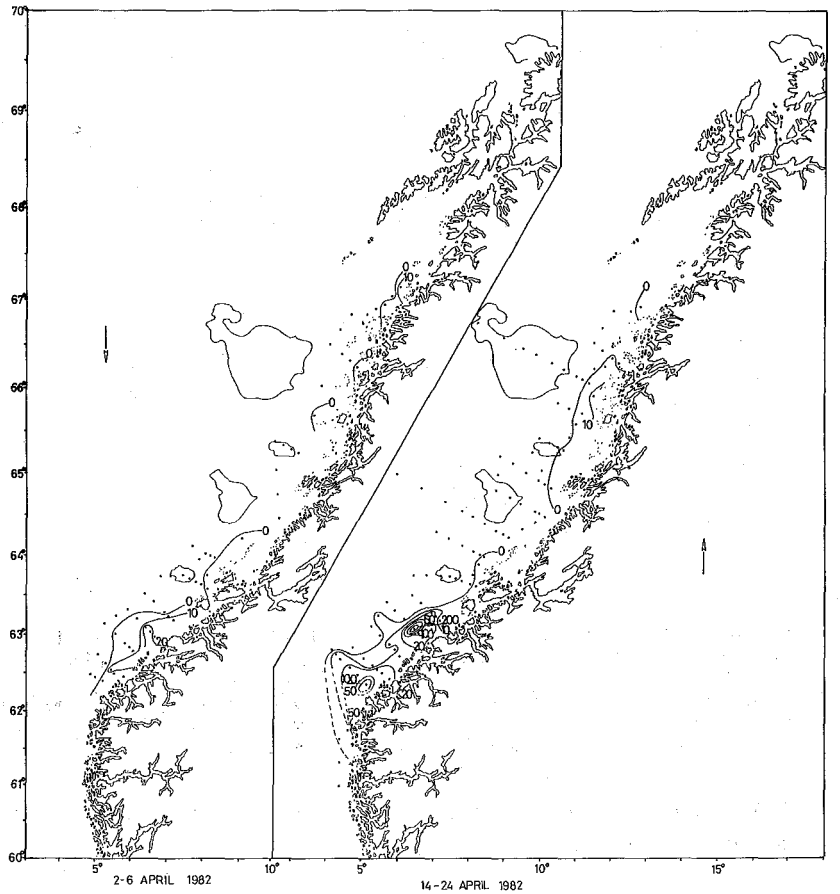

Fig. 9. Distribution of eggs with a diameter of 1.2-1.59 mm, most probably of cod, in 1982, in numbers per m^2 surface. Eggs younger than 7-10 days were recorded whenever eggs were found. Legends as for Fig. 3.

second half of April. This is not in contradiction to findings of a peak in spawning of cod during the end of March and first week of April as observed by Godø and Sunnanå (1984). During the latter half of April the eggs are more dispersed than at the peak of spawning, and the possibilities to be sampled are greater. In 1980 the number of cod eggs were high already at the end of March and also during the

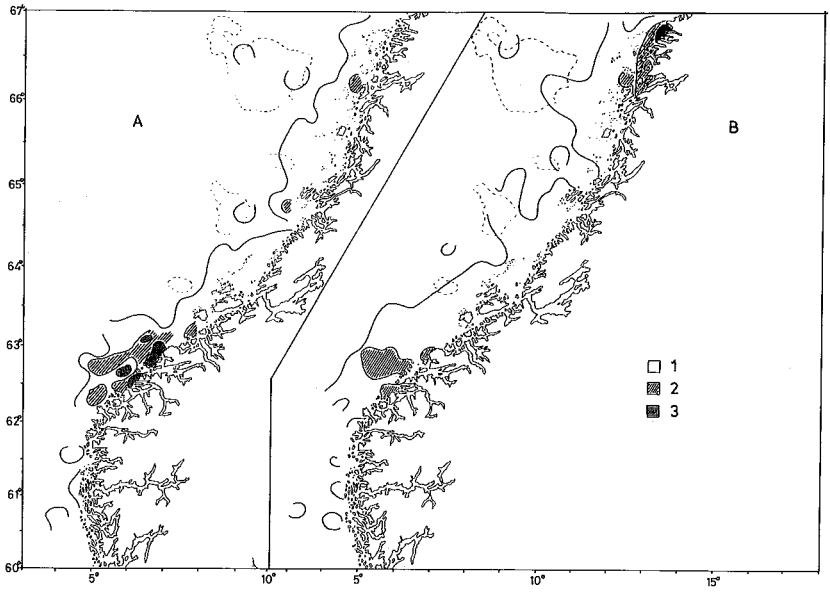

Fig. 10. A; Distribution of eggs without oil globules with a diameter of 1.20 - 1.59 mm, most probably of cod, during the period 1976-1982. B; Distribution of eggs without oil globules with a diameter of 1.00-1.19 mm during the period 1976-1982. 1; 0-50 eggs per m^2 surface, 2; 50-200 eggs per m^2 surface. 3; more than 200 eggs per m^2 surface.

middle and the end of April. The production of cod eggs seemed to be highest in that year.

Haddock

Spawning of haddock occurs in March-April in a diffuse area on the Norwegian continental shelf from 64°N to 72°N over depths of 350-600 m (Anon., 1979). Damas (1909) reports little spawning anywhere along the Norwegian coast, while Wiborg (1957, 1960a) reports findings of eggs, probably of haddock, along the continental shelf off Vesterålen and west of Haltenbanken. The eggs found off Vesterålen ranged from

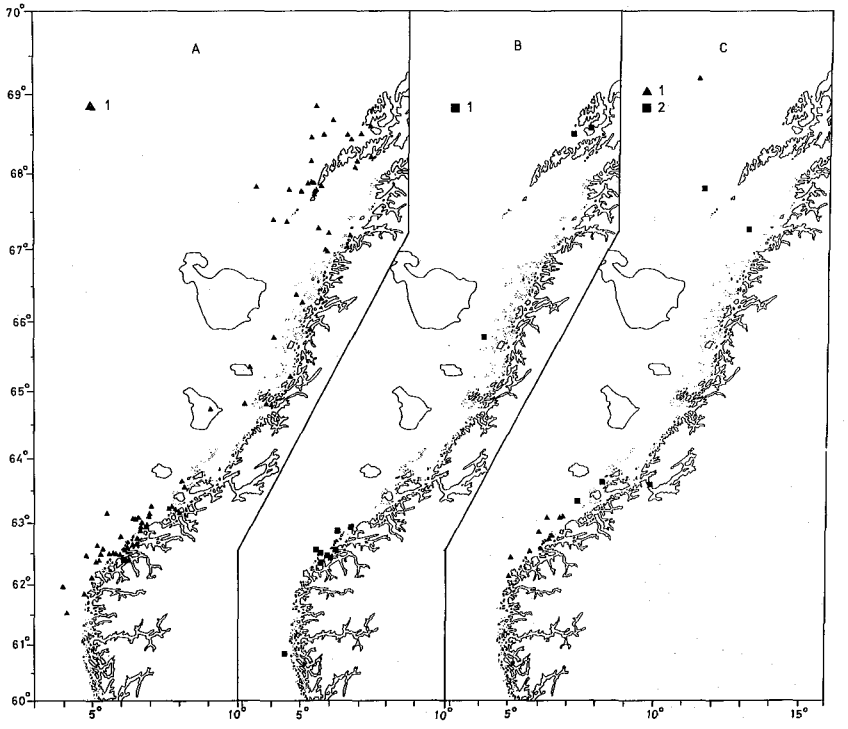

Fig. 11. Distribution of identified eggs and larvae during the period 1976-1982. A. Cod eggs. B. Cod larvae. C. 1) Haddock eggs. 2) Haddock larvae.

1.28 to 1.65 mm in diameter with a mean of 1.49 mm.

Fig. 11C shows the distribution of identified haddock eggs and larvae. The eggs and larvae were mainly found off Møre. A total of 6 larvae were found ranging in length from 6.5 to 11 mm. The rather low number of both eggs and larvae (Table 1) is most probably due to the station grid used during these investigations. Only a few samples were taken over areas indicated as spawning areas by Anon. (1979). The eggs and larvae found could have originated from spawnings outside the continental shelf and in the deeper fjords. It should not be disregarded, however, that some of the eggs

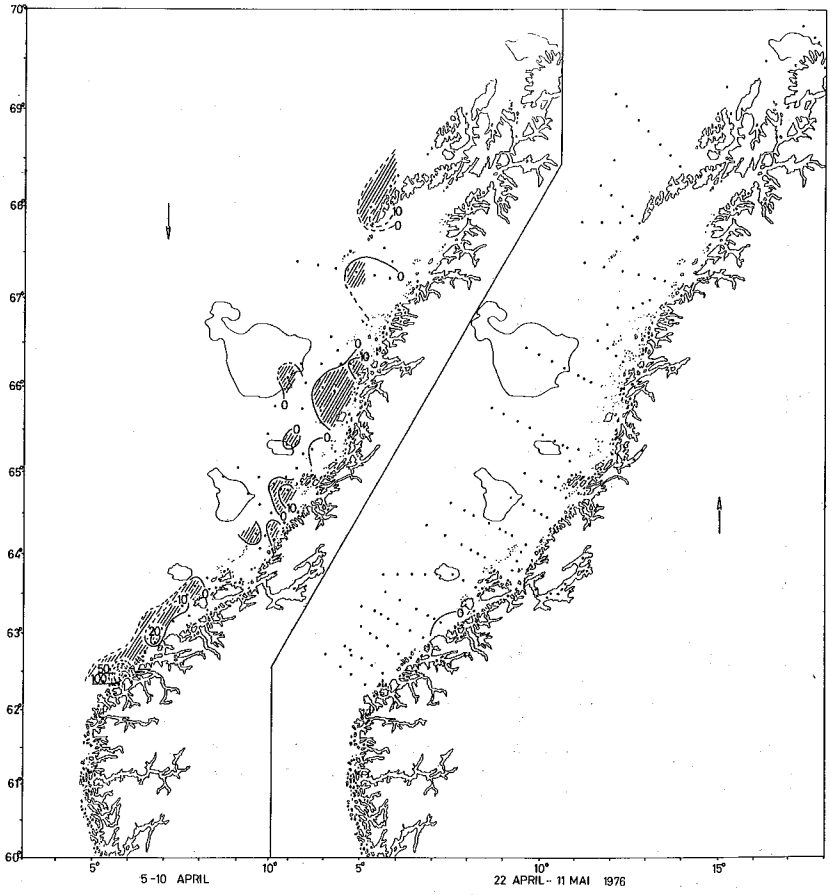

Fig. 12. Distribution of eggs without oil globules with a diameter of 1.0-1.19 mm in 1976, in numbers per m^2 surface. Hatched areas indicate findings of eggs younger than five days. Dots show the station grid. Arrows show the main course of sampling. Dates indicate the period eggs were found.

classified as cod eggs could be haddock eggs in an early stage development.

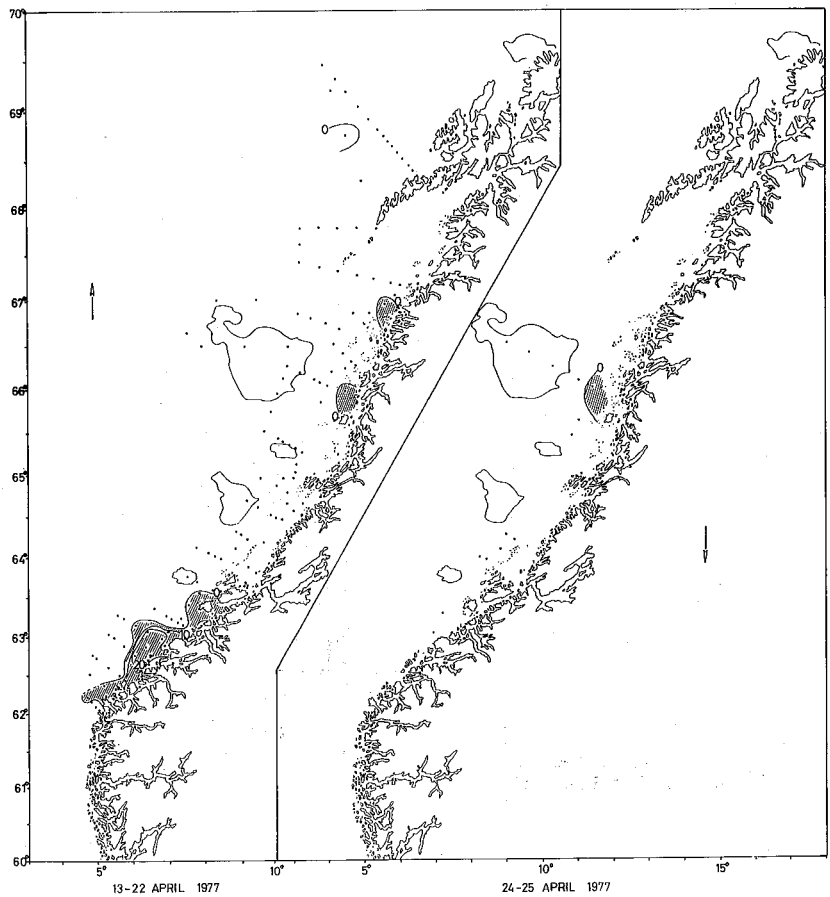

Fig. 13. Distribution of eggs without oil globules with a diameter of 1.0-1.19 mm in 1977, in numbers per m^2 surface. Legend as for Fig. 12.

Saithe, Norway pout and blue whiting

As mentioned above unidentifiable eggs without oil globules and with diameter 1.00-1.19 mm originate most probably from Norway pout, saithe and blue whiting.

Saithe in the North-East Arctic region spawn chiefly in February-March at 150-200 m depths. The most important

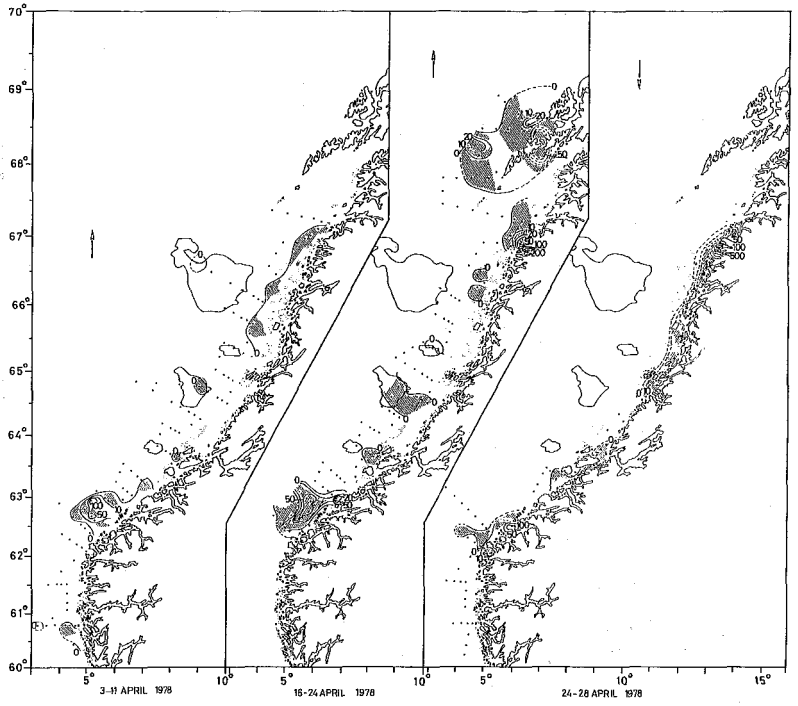

Fig. 14. Distribution of eggs without oil globules with a diameter of 1.0-1.19 in 1978, in numbers per m^2 surface. Legend as for Fig. 12.

spawning grounds are the Svinø area, Haltenbanken and the Lofoten area (Anon., 1979).

In the investigated area findings of larvae of Norway pout are reported from Stad to Vestfjorden, especially on the banks (Wiborg, 1954, 1956, 1960b, 1961, 1962). Spawning seems to occur in April-May (Wiborg, 1960b).

In the investigated area Bjørke (1983) found eggs and newly hatched larvae of blue whiting from March to June south of 66°N. He found indications of a peak in spawning in May.

Figs. 12-18 show the distribution of eggs without oil globules with diameters from 1.00 to 1.19 mm. Hatched areas indicate findings of eggs younger than 5 days (Fridgeirsson, 1978).

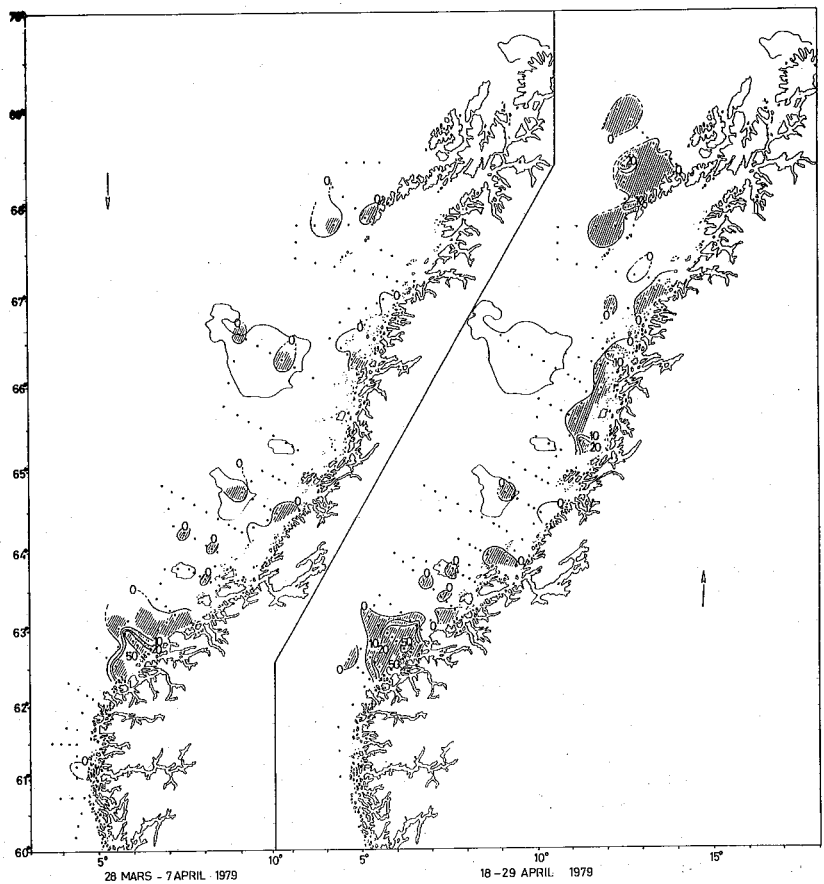

Fig. 15. Distribution of eggs without oil globules with a diameter of 1.0-1.19 mm in 1979, in numbers per m^2 surface. Legend as for Fig. 12.

Most frequently, and in highest numbers, eggs without oil globules and a diameter of 1.0 to 1.19 mm were found in the Møre area (Fig. 10B). Patches with more than 50 eggs per m^2 surface were found NW of Runde, on Langrunnssøyla and Mebotnen. In some years eggs were found around Smøla and on Haltenbanken, but in low numbers. North of Møre the highest number of eggs were recorded in the Lofoten area. Nearly every year eggs were found in small numbers in the Vega-Støtt

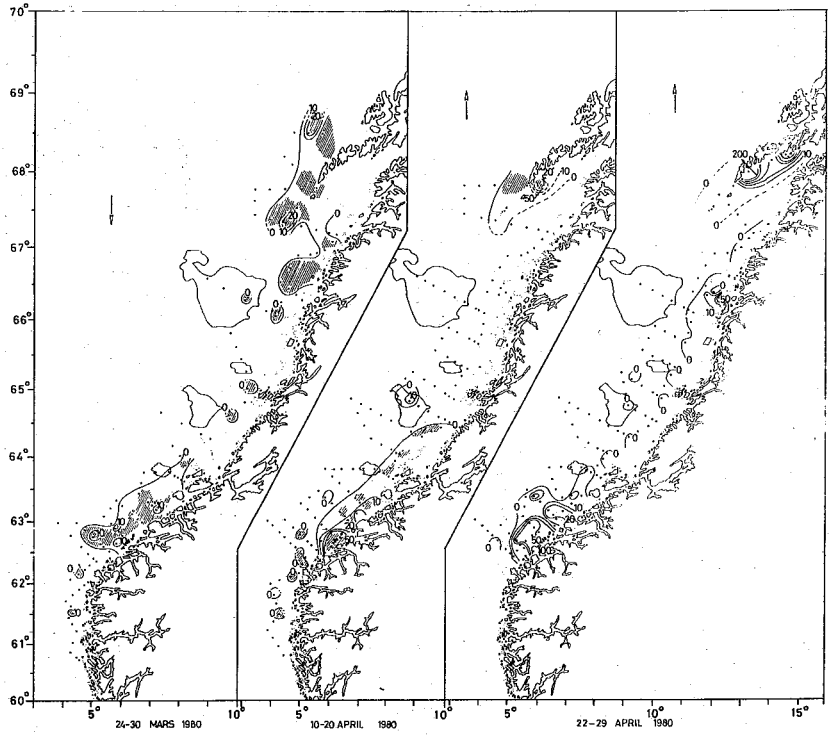

Fig. 16. Distribution of eggs without oil globules with a diameter of 1.0-1.19 mm in 1980, in numbers per m^2 surface. Legend as for Fig. 12.

area. Usually most of the eggs without oil globules and a diameter of 1.0 to 1.19 mm were found during the latter half of April.

Saithe

A total of 19 larvae of saithe were recorded during the period 1976-1982. They varied in length from 4 to 12 mm. Most of the larvae were found in the Møre area (Fig. 19A), but larvae were also recorded on Haltenbanken, near Vega and in the Støtt area. The distribution is in correspondance with earlier observations.

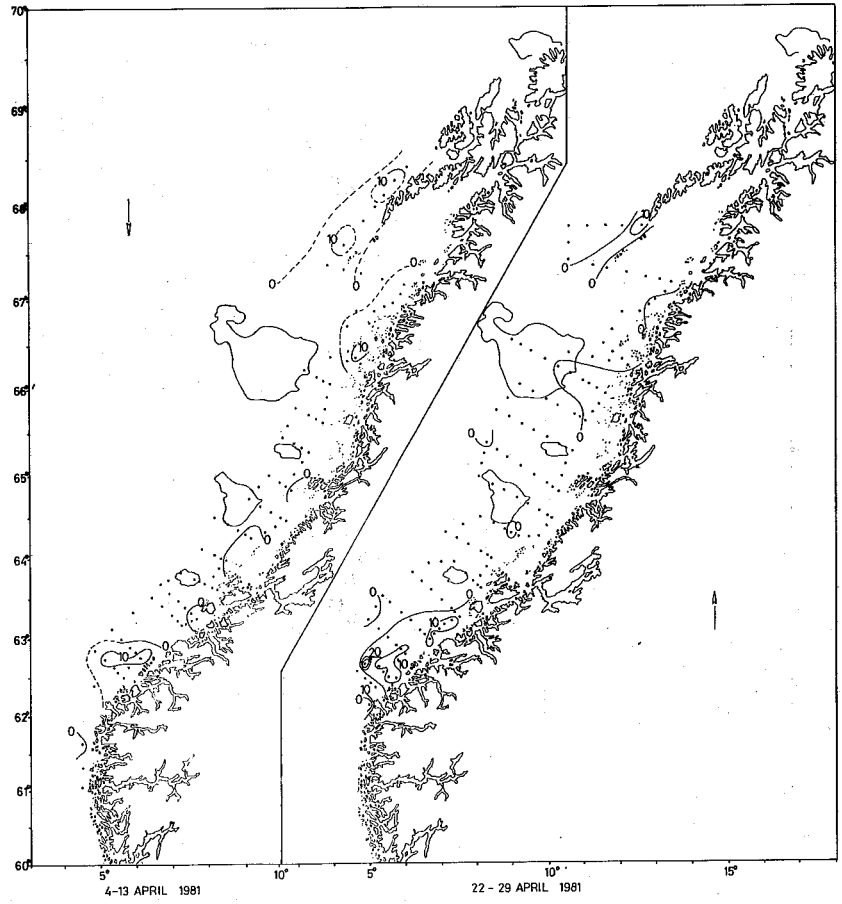

Fig. 17. Distribution of eggs without oil globules with a diameter of 1.0-1.19 mm in 1981, in numbers per m^2 surface. Eggs younger than 5 days were recorded whenever found. Legend as for Fig. 12.

Norway pout

Larvae of Norway pout were found NW of Stad (Fig. 19A) and in some fjords in Møre and Trøndelag. It should be noted that only these fjords were investigated.

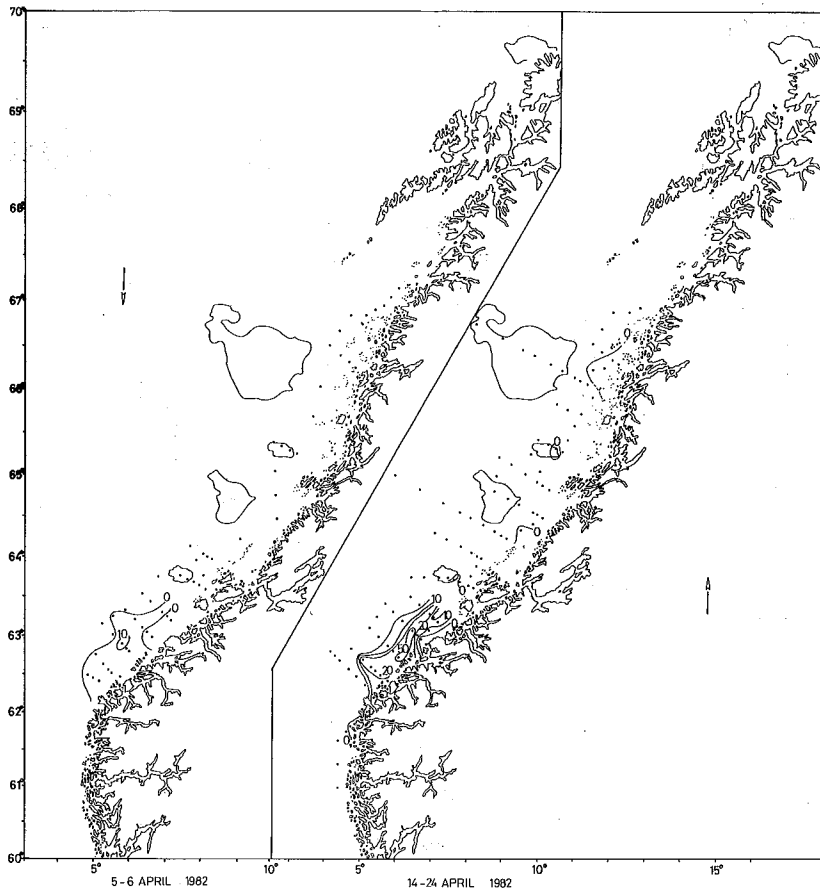

Fig. 18. Distribution of eggs without oil globules with a diameter of 1.0-1.19 mm in 1982, in numbers per m^2 surface. Eggs younger than 5 days were recorded whenever found. Legend as for Fig. 12.

The small number of larvae recorded in the present material might be due to the time of sampling. Wiborg (1954, 1962) found the highest number of larvae in the area during May. Most of the present material was sampled during April.

Findings of small larvae in some fjords indicate spawning in these areas.

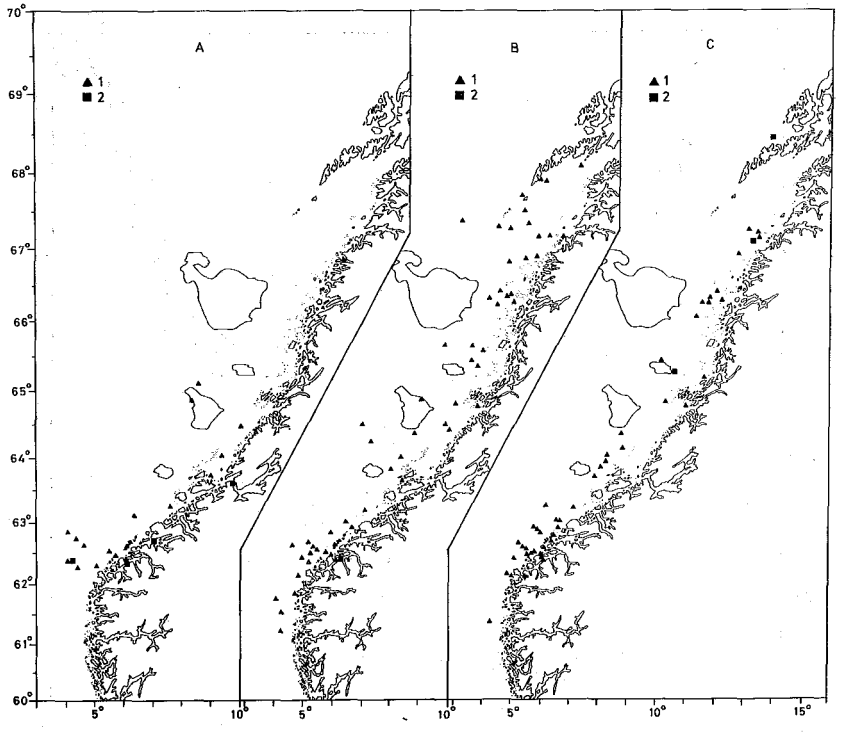

Fig. 19. Distribution of eggs and larvae of some species recorded during the period 1976-1982. A. 1) Saithe larvae. 2) Larvae of Norway pout. B. 1) Tusk eggs. 2) Tusk larvae. C. 1) Rockling eggs. 2) Rockling larvae.

Blue whiting

In Norwegian waters larvae of blue whiting are recorded in Nordfjord and off Svinø, 8-13 mm long, (Anon., 1976) and off Røst, 5-33 mm long (Zilanov, 1968). Monstad and Tangen (Institute of Marine Research, Bergen, personal communication, 1983) found 64 larvae in some fjords in the area from 59°N to 62°N. The length of the larvae varied from 11 to 31 mm, and they were sampled with a pelagic trawl in June. Eggs and/or larvae were recorded in Masfjorden and Fensfjorden (Lopes, 1979) and from Stad to Træna (66°N) (Bjørke,

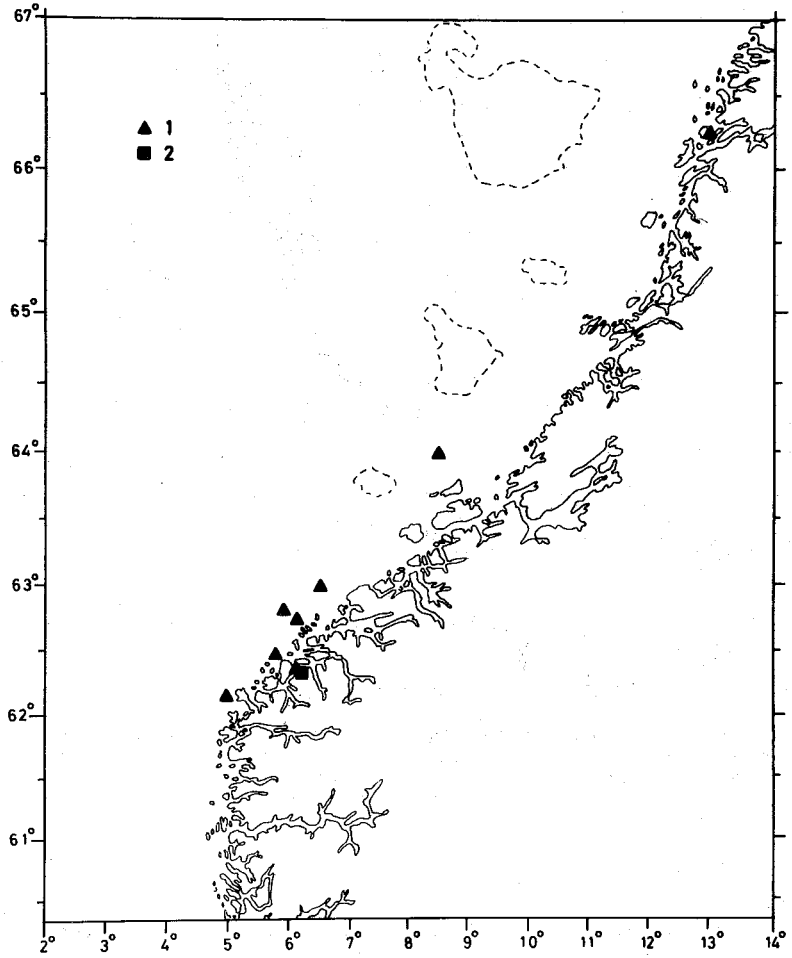

Fig. 20. Recordings of eggs and larvae of blue whiting. 1) Eggs. 2) Larvae.

1983). Bjørke (1983) found eggs and newly hatched larvae from March to June, with a maximum in May, indicating a peak in spawning this month. Monstad (Institute of Marine Research, Bergen, personal communication, 1983) found ripe stages of blue whiting on the Norwegian shelf during April 1983. At Bud, eggs and larvae were found from the beginning

of April to the beginning of June. From the Gulf III material, 22 eggs were found in the Møre area, outside Frøya and in the Træna area (Fig. 20). All the eggs were found during the latter half of April. A total of 8 larvae were found varying in length from 3.2 to 3.5 mm.

Whiting

In the investigated area Damas (1909) reports findings of eggs only in the fjords and not beyond the coast. Larvae were also only found in the fjords. In the present work eggs were not identified and no larvae were recorded.

Pollack

In the investigated area Damas (1909) reported spawning at least in some of the fjords. He assumed that spawning took place during summer, but this was not closely investigated. In the present work eggs were not identified and no larvae were found.

Silvery pout

Damas (1909) reported spawning in deep Norwegian fjords opening into the Norwegian Sea. In the present work eggs were not identified and no larvae were found.

Ling

Along the Norwegian coast the ling spawns from Skagerrak up to about 67^{o}N. Spawning takes place in March-July (Anon., 1979). In the present work eggs were not recorded and no larvae were found, although the larvae are reported to be found within the sampled depths (Russell, 1976).

Blue ling

Damas (1909) concluded that in the investigated area the blue ling spawns in the deeper fjords. In the present work no eggs were identified and no larvae were found.

Tusk

Along the Norwegian coast spawning takes place in April-June from Skagerrak up to about 70°N. Spawning occurs at depths from 50 to probably 500-600 m with a maximum at around 200 m. The spawning appears to be most intensive in five areas in the Northeast Atlantic, among them the Norwegian coast (Anon., 1979).

In the present work the highest numbers of eggs were found over the deeper parts of the continental shelf. The findings were evenly distributed along the coast with a slight concentration off southern Møre (Fig. 19B). Most of the eggs were in an early stage of development. Up to 23 eggs per m^2 surface were found per positive station. One larva 6 mm in length was found at the Møre coast in 1976.

Rockling

Anon. (1976) recorded eggs of rockling all along the coast from Vesterålen to Skagerrak. The spawning period extended from February to August (Anon., 1976).

In the present work rockling eggs were found evenly distributed along the coast with a slight concentration off Møre (Fig. 19C). Three rockling larvae were recorded varying in length from 2.8 to 22.0 mm.

Poor cod and lesser fork-beard

These two species have been recorded south of the investigated area. Neither eggs nor larvae were recorded in the present work.

REFERENCES

Aldonov, V.K. and Serebryakov, V.P., 1981. Ichtyoplankton survey in area of Norwegian shelf. Coun. Meet. int. Coun. Explor. Sea, 1981 (L:9): 1-23.

Anon., 1976. Some preliminary results from a synoptic experiment in the Norwegian coastal current (SEX 75). The Norwegian Coastal Current Project. University of Bergen. Report 1/76: 1-34.

Anon., 1979. The biology, distribution and state of exploitation of fish stocks in the ICES area. Part II. Int. Coun. Explor. Sea Coop. Res. Rep., 1977 (86): 1-202.

Bjørke, H., 1981. Distribution of fish eggs and larvae from Stad to Lofoten during April 1967-80. In: R. Sætre and M. Mork (Editors), The Norwegian Coastal Currents. University of Bergen, Bergen, pp. 583-603.

Bjørke, H., 1983. Spawning of blue whiting (*Micromesistius poutassou*) in Norwegian waters. Coun. Meet. int. Coun. Explor. Sea, 1983 (H:35): 1-8, (Mimeo.)

Damas, D., 1909. Contribution à la biologie des gadides. Rapp. P.-v. Réun. Cons. perm. int. Explor. Mer , 10: 1-277.

Dannevig, A., 1919. Fiskeegg og yngel i Lofoten. Rep. Norw. Fishery mar. Invest., 3(3): 1-63.

Dannevig, A., 1930. The propagation of our common fishes during the cold winter 1924. Rep. Norw. Fishery mar. Invest., 3(10): 1-133.

Dragesund, O., 1970. Factors influencing year-class strength of Norwegian spring spawning herring. FiskDir. Skr. Ser. HavUnders., 15: 381-450.

Dragesund, O. and Hognestad, P.T., 1966. Forekomst av egg og yngel av fisk i vest- og nordnorske kyst- og bankfarvann våren 1965. Fiskets Gang, 52: 467-472.

Dragesund, O. and Nakken, O., 1973. Relationship of parent stock size and year class strength in Norwegian spring spawning herring. Rapp. P.-v. Réun. Cons. perm. int. Explor. Mer , 164: 15-29.

Ehrenbaum, E., 1905-1909. Eier und Larven von Fishen. Nordishes Plankton, 1: 1-413.

Fridgeirsson, E., 1978. Embryonic development of five species of gadoid fishes in Icelandic waters. Rit. Fiskideild., 5(6): 1- 68.

Godø, O.R. and Sunnanå, K., 1984. Spawning area and distribution of larval and 0-group cod (*Gadus morhua* L.) at the Møre coast. In: E. Dahl, D.S. Danielssen, E. Moksness and P. Solemdal (Editors). The Propagation of Cod *Gadus morhua* L. Flødevigen rapportser., 1, 1984: 519-532.

Gjøsæter, J. and Sætre, R., 1974. The use of data on eggs and larvae for estimating spawning stock of fish populations with demersal eggs. In: J.H.S. Blaxter (Editor), The early life history of fish. Springer-Verlag, Berlin, pp. 139-150.

Hognestad, P.T., 1969. Forekomst av fiskelarver i nordnorske kyst- og bankfarvann våren 1969. Fiskets Gang, 55: 58-61.

Lopes, P. de C., 1979. Eggs and larvae of *Maurolicus muelleri* (Gonostomatidae) and other fish eggs and larvae from two fjords in western Norway. Sarsia, 64: 199-210.
Moksness, E. and Riis-Vestergaard, J., 1982. Spawning of haddock (*Melanogrammus aeglefinus*) in captivity. Coun. Meet. Explor. Sea, 1982(G:30) 1-9.
Russell, F.S., 1976. The Eggs and Planktonic Stages of British Marine Fishes. Academic Press, London, 524 pp.
Seaton, D.D. and Bailey, R.S., 1971. The identification and development of the eggs and larvae of the blue whiting *Micromesistius poutassou* (Risso). J. Cons. int. Explor. Mer, 34: 76-83.
Serebryakov, V.P. and Aldonov, V.K., 1984. Spawning grounds of the Arcto-Norwegian cod outside Vestfjorden. In: E. Dahl, D.S. Danielssen, E. Moksness and P. Solemdal (Editors), The Propagation of Cod *Gadus morhua* L. Flødevigen rapportser., 1, 1984: 479-500.
Sivertsen, E., 1935. Torskens gyting. FiskDir. Skr. Ser. HavUnders., 4(10): 1-29.
Solemdal, P. and Sundby, S., 1981. Vertical distribution of pelagic fish eggs in relation to species, spawning behaviour and wind conditions. Coun. Meet. int. Coun. Explor. Sea, 1981 (G:77): 1-12.
Sætre, R. and Ljøen, R., 1971. The Norwegian Coastal Current. Proc. from the POAC. Conf., Trondheim, 1971, 1: 514-553.
Wiborg, K.F., 1954. Forekomst av fiskeegg og -yngel i nordnorske farvann våren 1952 og 1953. Fiskets Gang, 40: 5-9.
Wiborg, K.F., 1956. Forekomst av fiskeegg og fiskeyngel i nordnorske farvann våren 1954 og 1955. Fiskets Gang, 42: 133-138.
Wiborg, K.F., 1957. Forekomst av fiskeyngel og fiskeegg i nordnorske farvann våren 1956 samt på stasjon M i Norskehavet i 1954-56. Fiskets Gang, 43: 188-190.
Wiborg, K.F., 1960a. Investigations on eggs and larvae of commercial fishes in Norwegian coastal and offshore waters in 1957-58. FiskDir. Skr. Ser. Havunders., 12(7): 1-27.
Wiborg, K.F., 1960b. Forekomst av egg og yngel av fisk i vest- og nordnorske kyst- og bankfarvann våren 1959. Fiskets Gang, 46: 522-528.
Wiborg, K.F., 1961. Forekomst av egg og yngel av fisk i vest- og nordnorske kyst- og bankfarvann våren 1960. Fiskets Gang, 47: 190-195.
Wiborg, K.F., 1962. Forekomst av egg og yngel av fisk i vest- og nordnorske kyst- og bankfarvann våren 1961. Fiskets Gang, 48: 161-164.
Zijlstra, J.J., 1970. Herring larvae in the central North Sea. Ber. dtsch. wiss. Komm. Meeresforsch., 21: 92-115.
Zilanov, J.K., 1968. Occurrence of *Micromesistius poutassou* (Risso) larvae in the Norwegian Sea in June 1961. Rapp. P-v. Réun. Cons. perm. int. Explor. Mer, 158: 122-125.