International Council for the Exploration of the Sea.

C.M. 1981/G:77
Environmental Quality Committee.

VERTICAL DISTRIBUTION OF PELAGIC FISH EGGS IN RELATION TO SPECIES, SPAWNING BEHAVIOUR AND WIND CONDITIONS

by

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ABSTRACT

1. The mean reduction of egg diameter from March to April is from 1.45 to 1.39 mm and 1.44 to 1.38 mm for artificially and naturally spawned eggs of Arcto-Norwegian cod, respectively. This means a reduction of volume of about 11%.

2. The neutral buoyancy of cod eggs ranges from 29.5-33.0 $^{o}/_{oo}$ salinity. Eggs of captive fish show a tendency of higher specific gravity.

3. The neutral buoyancy of the cod eggs is not correlated to egg size, but to the weight of the eggshell.

4. Computed ascending velocities in the natural environment of Lofoten range from 0.2 mm s^{-1} to 1.7 mm s^{1}, and show an approximately Gaussian distribution with a mean ascending speed of 1 mm s^{-1}.

5. Since the spawning of Arcto-Norwegian cod is strictly connected to the thermocline at temperatures of 4-6^{o}C, spawning can occur both pelagically and close to the bottom.

6. Norway pout and other gadoids are also spawning in Lofoten, and occasionally their eggs are found in majority. Their vertical distribution have maxima in deeper water, indicating a higher specific gravity than for cod eggs.

7. During calm wind conditions the concentration of cod eggs increases rapidly towards the sea surface. Large variation in the upper centimeters of the sea is found during such conditions. Increasing wind rapidly mixes down the eggs in the upper meters. As the wind speed maintains, larger parts of the water column are influenced by the wind mixing. At south-westerly wind of 10 ms^{-1} and at 24 hours duration more than 50% of the eggs are found below 30 m depth.

1. INTRODUCTION

The vertical distribution of pelagic fish eggs is influenced by several factors:

1. The spawning behaviour of the fish, differing from species to species (depth, spawning period, diurnal cycle etc.).
2. The physical characteristics of the egg (density and size).
3. The physical conditions in the sea (wind effects, currents and density structure).

The data on physical properties of cod eggs were collected in Lofoten during the years 1968-72 (Solemdal 1970). The other aspects were studied during an investigation on monitoring the cod spawning and drift of the eggs in Lofoten during the years 1975-81 (Ellertsen *et al.* in press, a, Ellertsen *et al.* 1981, Furnes and Sundby 1981). This is a part of a project dealing with growth, survival and drift of the larvae of Arcto-Norwegian cod (Ellertsen *et al.* in press, a, b, Ellertsen *et al.* 1980, Tilseth and Ellertsen, 1981).

The mechanisms of how egg size and specific gravity adapt to the salinity environment have been studied both in the laboratory and in the field (Solemdal, 1967, 1971, 1973, Coombs, 1981 a, b, Alderdice and Forrester 1971). The effects of the physical conditions on the vertical distribution are demonstrated by Pommeranz (1973) on plaice eggs in the southern North Sea, and Iversen (1973) on mackerel eggs in the Skagerrak and the northern North Sea. Theoretical contribution to the dynamics of particle movements in water are given by Hutchinson (1967) and Smayda (1970).

The present investigation was carried out

1) To obtain better knowledge of mechanisms governing the drift and spreading of eggs.
2) To evaluate the significance of wave action on egg mortality as proposed by (Rollefsen 1930).
3) To increase our knowledge on the spawning behaviour of Arcto-Norwegian cod and its influence on the distribution of the eggs.

2. MATERIAL AND METHODS

During the years 1968-72 the fish eggs were collected by Zaitzev surface sampler, Clarke-Bumpus planktonsampler and a small Juday net, 0.1 m^2 surface and 180μ mesh size.

Eggs were collected with electrical pumps in 1980 and 1981. A system for plankton profiling based on a Flygt 2051, a centrifugal pump with capacity about 350 l/min., is described in Tilseth and Ellertsen (1981). The water is filtered on deck. For sampling the upper centimetres the pump was connected to a styropor floater (fig. 1). At depths between 0.5 and 4 m the pump was connected to a surface floating buoy. At greater depth the pump was connected directly to the winch on deck. The other pump system is based on a fluid filled electric propeller pump, Pleuger, with a capacity of 2950 l/min. The water is filtered *in situ* through a small Juday net fitted to the pump, fig. 2. When filtration is finished, the system is hauled on deck, the net washed and the sample collected as from an ordinary Juday-net haul. (Solemdal 1981).

Running cod females were collected from Danish seine and purse seine catches in Lofoten. Only a few cod females, 4-5%, will have running eggs when investigated immediately after capture, even during the peak of spawning. This phenomenon may be attributed to the handling during capture. More likely, it is a combination of the portion spawning and maximum spawning during the night.

The cod eggs were fertilized immediately in a sperm suspension in surface seawater. Measurements on neutral buoyancy were performed on the 2-4 cell stage, in waterbath of 4-6°C according to Solemdal (1971). The measure error is in the order of $\pm$ 0.5°/oo S.

Diameter measurements were made with a Watson-Image-Shearing-Eyepiece. The eggs are grouped in developmental stages on live eggs in seawater of 4-6°C, with 0.003 mm accuracy described in Ellertsen *et al.* (1981).

The dry-weights of the eggs were determined by heating to 105°C until constant weight after washing the eggs in distilled water. During cooling the samples were placed in a dessicater. The weight of dried eggshells (chorions) was determined by squeezing the eggs, washing them thoroughly with distilled water and heating to 105°C to constant weight. In addition to ship measurement of wind and sea state, wind data from the meteorological station Skrova have been used.

3. RESULTS

A. Physical properties of eggs from Arcto-Norwegian cod.

During the years 1969-72 cod eggs were sampled in the central spawning area in Lofoten, usually on Høllа outside Svolvær. The eggs were sampled during calm days and close to the surface. The measurements of egg diameters from the 4 years are shown in fig. 3, with the measurements from March and April separated. The figure demonstrate the general reduction of egg size with time during the spawning season.

Reduction in egg size during the spawning season is also demonstrated on artificially fertilized eggs from cod females caught at different times during the spawning season, fig. 4. About 60 eggs from each of the 161 cod females are measured and the figure shows the frequency of the mean egg diameters. Values of diameter, standard deviation, diameter range and numbers for March and April, 1969-1972 are given in table 1.

The extreme values of cod eggs are 1.19 mm and 1.62 mm for artificially fertilized eggs, and 1.20-1.62 mm on naturally spawned eggs. However, the size range within a egg batch from a single cod female is normally only about 0.06 mm.

Neutral buoyancy from artificially fertilized eggs in Lofoten, March-April 1969-72, table 2 is larger in April than in March for all years except for 1969. This year the cod females used for artificial fertilization were kept upto 14 days in a well-boat. Only the difference in 1972 is statistically significant on the 0.05 level.

In Fig. 5 the neutral buoyancy is plotted against the weight of the eggshell as % of the total eggweight, measured as dry weights. The material used is part of the artificially fertilized egg material from Lofoten 1970-72.

In fig. 6 the eggsize and corresponding neutral buoyancy of artificially fertilized eggs from Lofoten in the years 1970-72 are given. The material from 1969 is omitted due to artificial conditions in the well-boat.

Given the salinity of the natural environment, the neutral buoyancy and the diameter of the eggs, ascending speed may be computed. At the spawning sites in Lofoten the salinity of the upper 50 m layer, above the halocline, is homogeneous and rather constant from year to year during the spawning period (compared to the variations of the neutral buoyancy measurement of the eggs). Table 3 shows the mean salinity and standard deviation through the water colomn for the mean year 1936-1977 for March and April.

Comparing the neutral buoyancy measurements with the mean salinity of the environment gives a mean density difference $0.0017 g/cm^3$.

The ascending speed may be computed by using the so called Stoke equation when the Reynolds number $Re = \frac{V \cdot d}{\mu} < 0.5$ (V is the speed, d the linear dimension of the egg, and μ the molecular viscosity). In this regime speed is proportional to d^2 and μ^{-1}. When Reynolds number exceeds 0,5, viscous forces become less important and the turbulent forces increase. In this regime ascending speed is proportional to d and $\mu^{-1/3}$.

Fig. 7 shows the frequency distribution of computed ascending speeds in "natural environment", e.g. the spawning sites in Lofoten for the mean year, based on the buoyancy and diameter measurements presented in fig. 6. Mean ascending speed from this is 0.96mm/sec. However, the standard deviation is rather large, 0.38mm/sec.

B Spawning Behaviour

In fig. 8 the temperature profile and vertical distribution of cod eggs are given, from Hølla, Lofoten, 26 March 1968. There was dense pelagic shoals of spawning cod in depths of 50-70 metres. Total depth was 120 metres. During the period 23-25 March the wind was easterly 0-3m/sec., increasing on 26 March to east 6-10m/sec. The figure clearly shows the spawning at 50-70 metres, the development stages of the eggs being exclusively 2-4 cells, which is a few hours after fertilization.

Fig. 9 shows a similar situation with respect to spawning in Austnesfjorden 27 March 1981. There were calm wind conditions at this time. The vertical profile of cod eggs is separated in 3 stages showing high density of newly spawned eggs close to the bottom where the fish are registered. The temperature profile shows concentrations of cod in the transition layer, 4-5°C, as also shown in fig. 8. The distribution of older cod eggs is different in the upper layer in Fig. 8 and 9. Fig. 8 show a complicated variation towards sea surface, while Fig. 9 show increasing values towards the sea surface.

C. Species differences

Pelagic eggs other than cod are common in the spawning area of the Arcto-Norwegian cod in Lofoten. The most numerous of them are other gadoids, Norway pout (Boreogadus esmarcki) saithe (Pollachius virens), haddock (Gadus aeglefinus) and whiting (Merlangus merlangus). Some of the species have eggs which are difficult to separate, and routinously only cod eggs are identified. The amount of "other" eggs is more pronounced in the beginning and at the end of the spawning season of the cod, which is maximal during last half of March-beginning of April. Their vertical distribution is different from cod eggs. This is demonstrated in table 4, which shows Juday-net samples from 30-0 and 100-30, Hølla, Lofoten during 12-27 March 1981. Eggs other than cod eggs amount to 45% and have a significantly deeper distribution.

In fig. 10 the same vertical distribution of cod eggs as shown in fig. 9 is given together with the vertical distribution of "other" eggs. It is clearly shown that the development stages are very different. The cod eggs are newly spawned close to the bottom. The "other" eggs have advanced stages distributed near the bottom, showing that no ascending has occurred.

According to the analysis of egg samples with a sensitive electrophoritic method (isoelectric focusing) the majority of "other" eggs in Austnesfjorden at this time, 26-27 March, were Norway pout. (Jarle Mork, unpublished observations)

D. Wind effects

Wind speed and direction in March 1981 from Skrova, Lofoten are given in fig. 11. From this figure some stations are selected to show the effect of wind stress and wave action on the vertical distribution of cod eggs.

In fig. 12 the vertical distribution on a calm day on Høl1a, Lofoten, 27 March 1981 is shown, together with density and temperature profiles. The sea surface at this point of time was slick and very high concentration of cod eggs was measured on the upper 7 cm of the sea. However, only two hours later the concentration in the upper 7 cm has droppped. Except for the surface value the two profiles are rather equal with a rapid decrease of the egg concentration towards depth. This situation is similar to that shown in Fig. 9.

Fig. 13 shows a profile near Henningsvær, Lofoten 28 March 1981. Wind direction at this point of time was north-easterly, and the speed had been increasing to 9 m s^{-1}. The cod eggs are more or less evenly mixed down to about 30 m depth. This situation is similar to that shown in fig. 8.

An indication of how increasing wind speed gradually increased the vertical mixing is shown in fig. 14. This figure is based on separate Juday net hauls during the spawning seasons in 1976 and 1977. The abscissa shows the frequency of cod eggs older than 2 days in the deep Juday net hauls (100-30 m). The ordinate shows the mean wind velocity for the previous 24 hours. Only situation with south westerly wind has been used to get equal wave effect.

DISCUSSION

1. The methods.
The method of measuring neutral buoyancy (Solemdal 1971) is rather rough, with measure error of about ± 0.5°/oo salinity, as also given by Sundnes *et al.* (1965). The tests were carried out on batches of several hundred eggs artificially fertilized, from individual cod females. Within an egg batch there is a range of neutral buoyancy of about 1-2 per mille salinity. The neutral buoyancy is defined as the salinity where no eggs are floating, but a large fraction of the eggs are found in the

water column after 30 minutes. There will also be a fraction of live eggs on the bottom of the column. The neutral buoyancy values are therefore mean values.

Using artificial fertilized eggs to determine neutral buoyancy is disputed (Coombs 1981), arguing that the physiological stress will alter the density of the eggs. Changes in specific gravity will occur when running females are kept in water of different salinities, due to osmotic changes in the ovary (Solemdal, 1967, 1971, 1973). After fertilization the specific gravity of the eggs is not influenced by the external (Solemdal 1973). High specific gravity of cod eggs is also recorded from cod females kept in normal salinity in a well-boat for 14 days in 1969 (Solemdal 1970). Neutral buoyancy of more than 34°/oo from this year are shown in table 2. However, fertilizing eggs immediately after capture with "soft" gears as Danish seine and purse seine are unlikely to effect the neutral buoyancy of the eggs. As shown in fig. 3 and 4, the size distribution of artificially fertilized and naturally spawned eggs is similar, indicating that the artificially fertilized eggs are normal in this character. Neutral buoyancy tests on naturally spawned eggs were not carried out due to the rough method and the larger range in specific gravity of naturally spawned egg batches.

2. Neutral buoyancy.

Fig. 6 does not indicate any correlation between egg size and neutral buoyancy. There seems to be a small increase in neutral buoyancy from March to April for all years except 1969, when the cod females were kept in a well-boat.

The main factor determining the specific gravity of fish eggs is the thickness of the eggshells (chorion) (Lønning & Solemdal 1972, Solemdal 1973), but the relations of egg size and thickness of the eggshells within the cod population are unknown. Davenport _et al._ (in press) gives values of 65-9μ for the eggshell in a cod population in Northern Norway, but no data on egg size are given.

In the present material the weight of the eggshells as % of total dry weight of the egg, fig. 5, indicates a correlation with neutral buoyancy, but not with egg size. Similar values are found for plaice (Solemdal 1970 b). The neutral buoyancy is not influenced by pressure shown by Sundnes et al. 1965.

The computed ascending speeds, fig. 7, are made with the spawning sites of Lofoten as a reference. This is, however, one of the low salinity areas on the Coast of Northern Norway. Other spawning areas of the Arcto-Norwegian Cod have 0.5-1.0 ^{o}/oo higher salinities of the surface waters. This will increase the ascending speed on the average about 20%, while the eggs with the highest density will have their ascending speed increased by more than 100%.

3. Egg size.
The reduction of egg size during the spawning period is decided for a number of species (Hiemstra 1962). This is clearly demonstrated both for naturally spawned and artificially fertilized eggs of Arcto-Norwegian cod in the present paper, figs. 3 and 4 and table 1. The reduction in mean egg volume of the total material between March and April is the same for artificially fertilized and naturally spawned eggs 0.18 mm^3 or about 11^{o}/o . The reduction in egg diameter is smallest for artificially fertilized eggs in 1969. As stated earlier, material for artificial fertilization this year were stripped from cod females kept in a well-boat, with temperature significanly below the normal spawning temperature. As also shown for neutral buoyancy the values for 1969 are effected by the stressed situation, table 2.

The reason for the reduced egg size as the spawning proceed is caused by the portion spawning of the cod. Running eggs from the first spawned portions being the best vascularized and thus the largest (Mayenne 1941).

In captivity cod female was found to spawn 9 egg portions during 6 weeks and the egg diameter was reduced from 1.42 to 1.27 mm (Solemdal et al. 1977).

The effect of age and size of the cod female on egg size seems to be small (Solemdal 1970).

An increase of the diameter of the cod egg from 1.2 mm (lower limit) til 1,6 mm (upper limit) will increase the ascending speed of about 60 percent, while an increase in net buoyancy from 0.0005 g/cm^3 (lower limit) to 0.003 g/cm^3 (upper limit) will increase ascending speed of about 3 times.

4. Spawning behaviour.

Echo recordings of pelagic shoals of spawning cod was first recorded by echo sounding at Høllа, Lofoten in 1934 (Sund 1935).

The spawning shoals of cod are concentrated in the thermocline 4.5-6°C, which fluctuates vertically, both annually (Eggvin 1932) and during short periods (Ellertsen et al. 1981, Furnes and Sundby, 1981). The location of the thermocline therefore determine both the horizontal and vertical distribution of the spawning cod in Lofoten. In figure 8 the cod are found pelagically at Hølla during intensive spawning in 50-70 meters depth, corresponding to the thermocline. Fig. 9 gives a vertical profile of the cod eggs temperature and density from Austnesfjorden, a shallower small fjord inside Vestfjorden, in March 1981. The thermocline has just moved into Austnesfjorden, and the cod is found spawning close to the bottom.

The intense spawning will affect the vertical profiles as shown both in figs. 8 and 9.

4. Species differences.

During the investigations in March 1981, the fraction of eggs, other than cod was considerable, table 4. In the deeper part of Hølla, the cod eggs were in minority.

A vertical profile from Austnesfjorden shows a similar distribution of eggs other than cod, mostly Norway pout, fig. 10. The deep vertical distribution of the old egg stages indicates a higher specific gravity than cod eggs. The high concentration of cod eggs close to the bottom in fig. 10 is due to the eggs being just spawned and rising to the surface. In Vestfjorden saithe eggs were also found in the deep layers.

5. Wind effects.

While high concentrations of cod eggs occur in the uppermost centimeters of the sea during calm weather, these eggs will rapidly be mixed down to greater depths when wind starts blowing. As the wind continues or increased larger parts of the water column are influenced by the turbulent forces. The time variations of the concentration of the upper centimeters seem to be much larger than the variations at greater depths. This is probably caused by surface effects such as convergence and divergence at small scales.

Rollefsen (1930) has suggested that wave action may cause large egg mortality. This is unlikely to occur, first because there is only a relatively small part in the upper meter of the sea even in calm weather, and second because the eggs rapidly will be mixed down when the wind starts blowing. This is also concluded by Pommeranz (1973) on plaice eggs in the North Sea.

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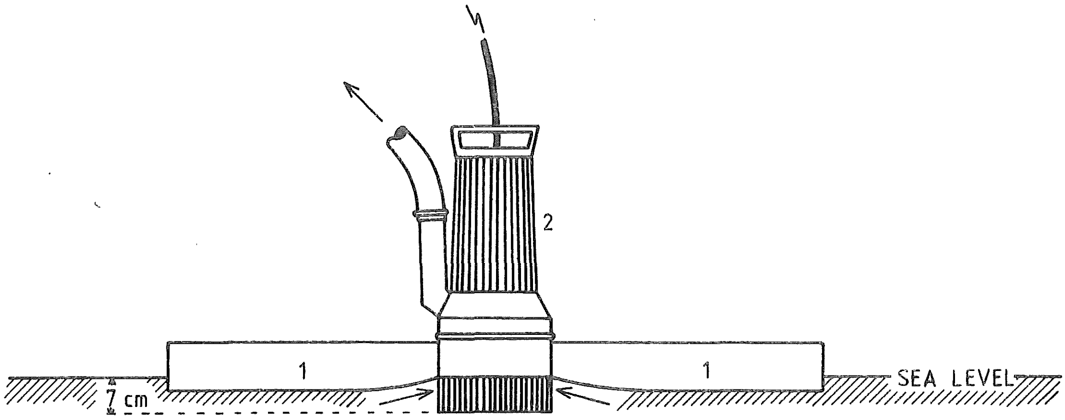

Fig. 1. Pump arrangement for sampling eggs from the top centimeters of the sea. 1) Styropor floater. 2) Flygt pump.

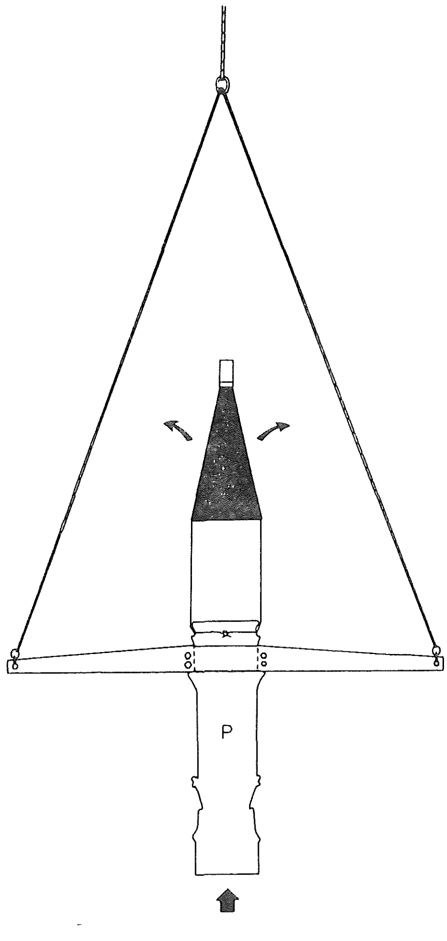

Fig. 2. The submersible Pleuger pump and the arrangement of filtrating water through a small Juday net <u>in situ</u>.

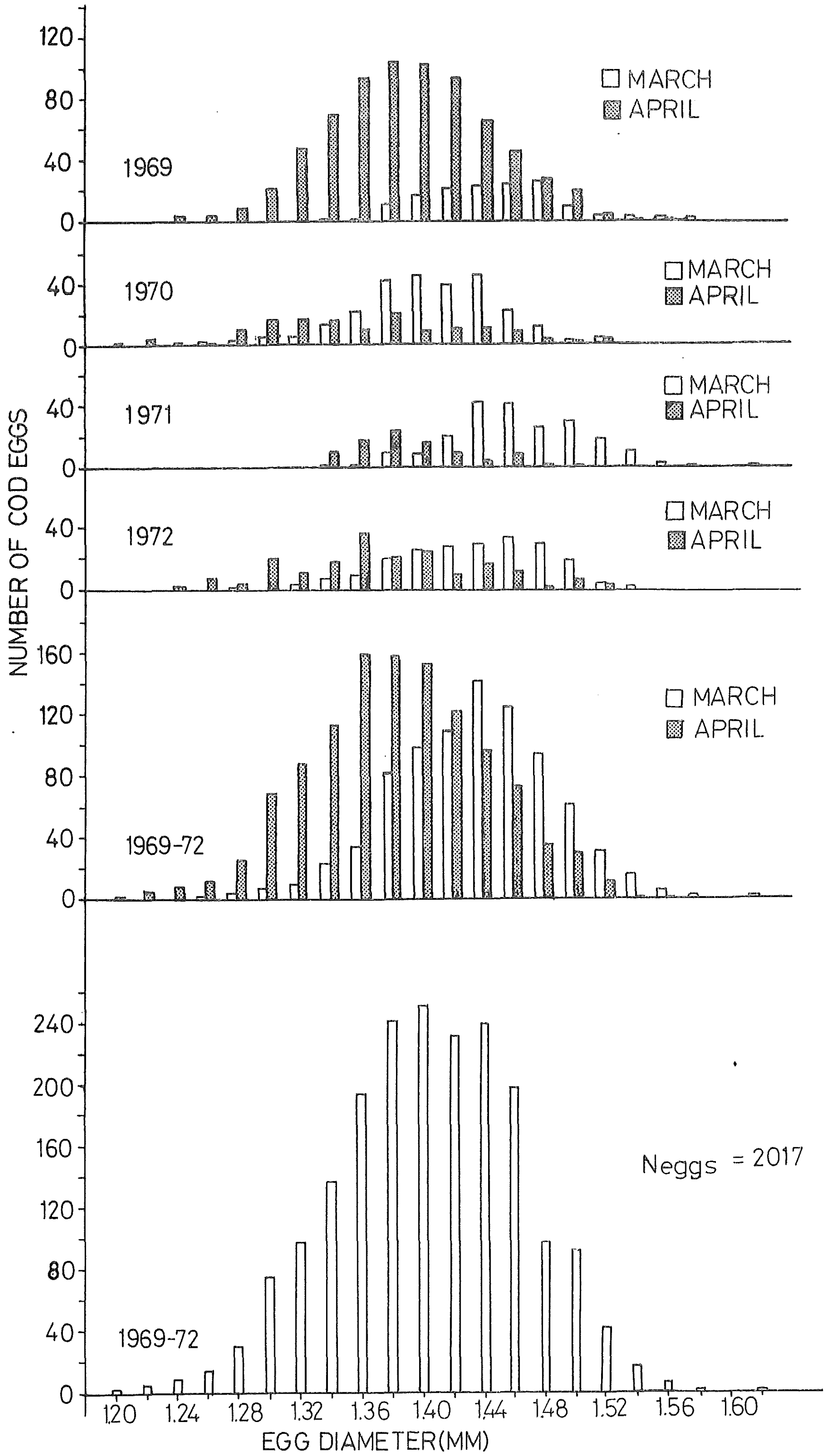

Fig. 3. Egg diameter of cod eggs sampled close to the surface in Lofoten during March and April 1969-1972.

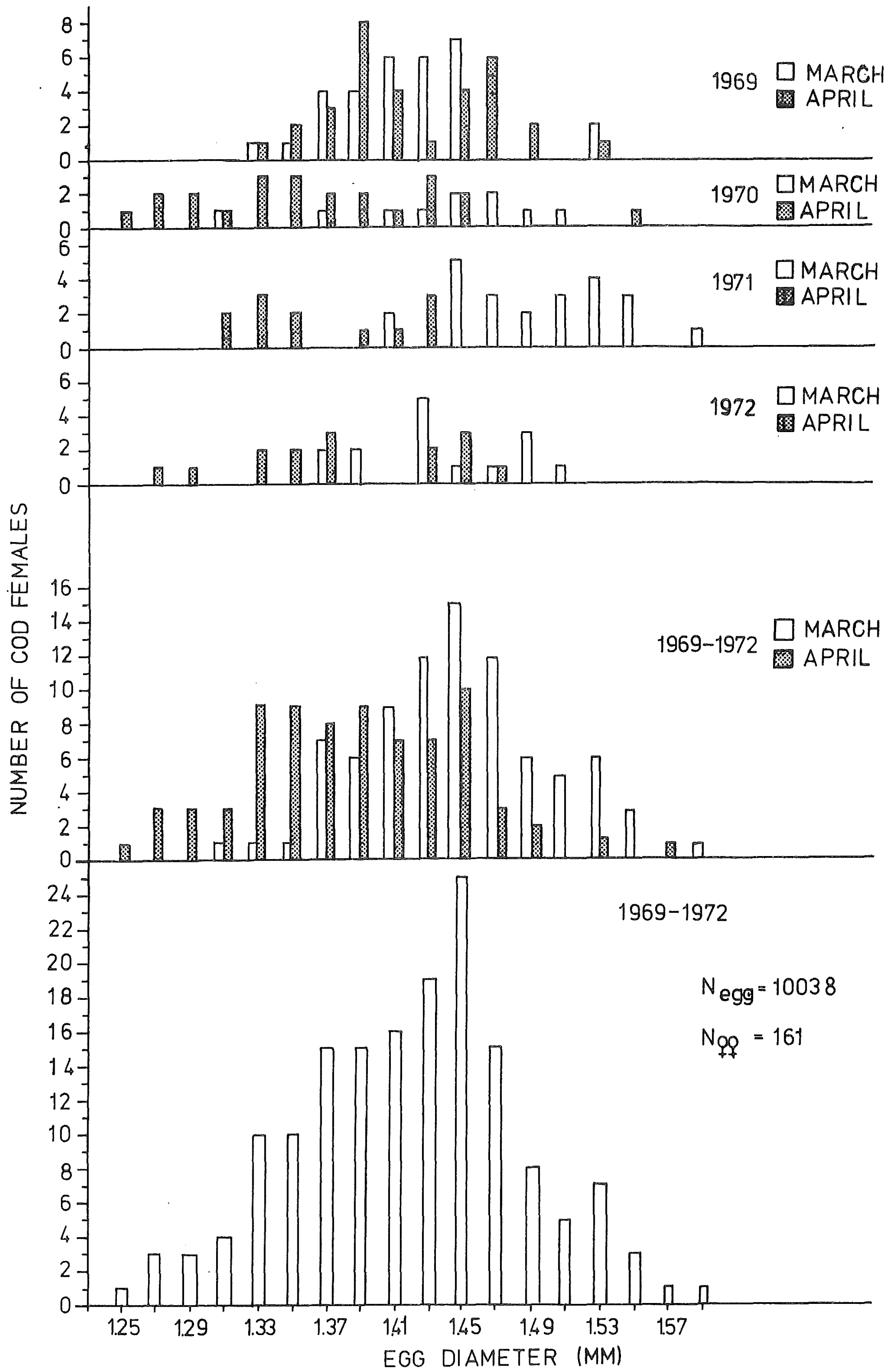

Fig. 4. Egg diameter of artificially fertilized cod eggs from Arcto-Norwegian cod females caught in Lofoten during March and April 1969-72. About 60 eggs were measured from each of the 161 .

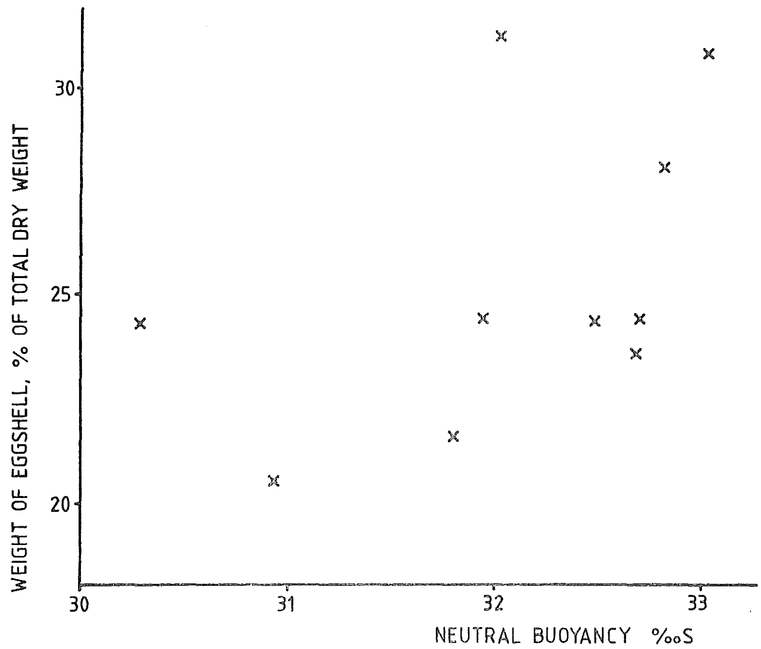

Fig. 5. Neutral buoyancy of artificially fertilized eggs of Arcto-Norwegian cod with corresponding weights of their eggshell, expressed as % dry weight of eggshell to the total dry weight of the egg.

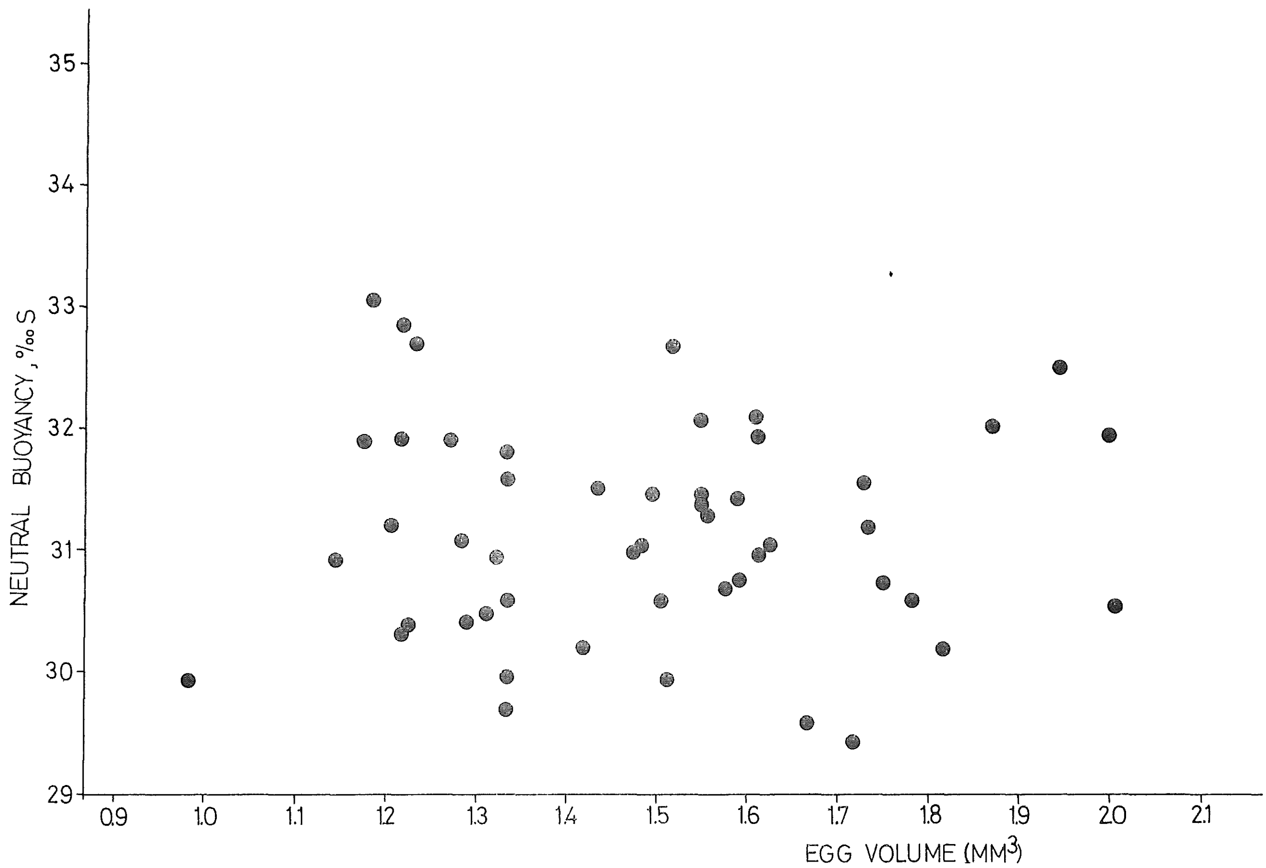

Fig. 6. Neutral buoyancy, expressed as $^{o}/oo$ salinity, and volume of artificially fertilized eggs of Arcto-Norwegian cod in Lofoten from the years 1970-72.

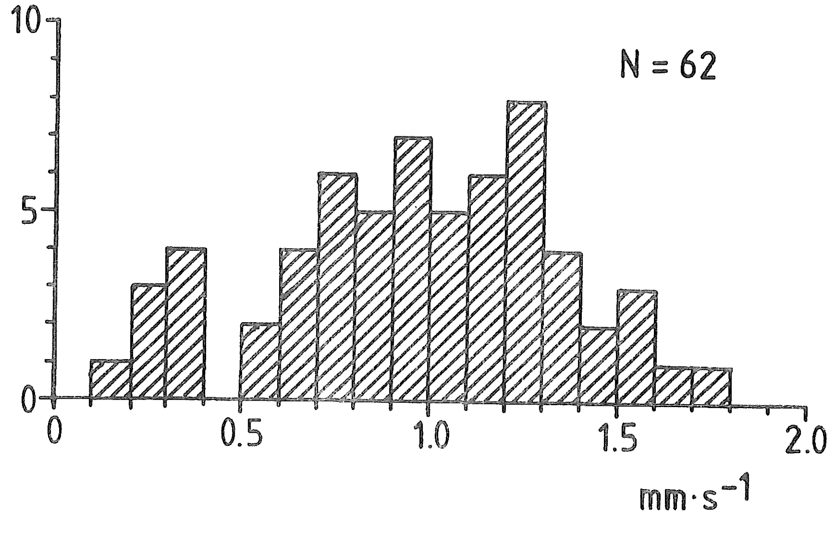

Fig. 7. Distribution of computed ascending speeds in the natural environment (Lofoten).

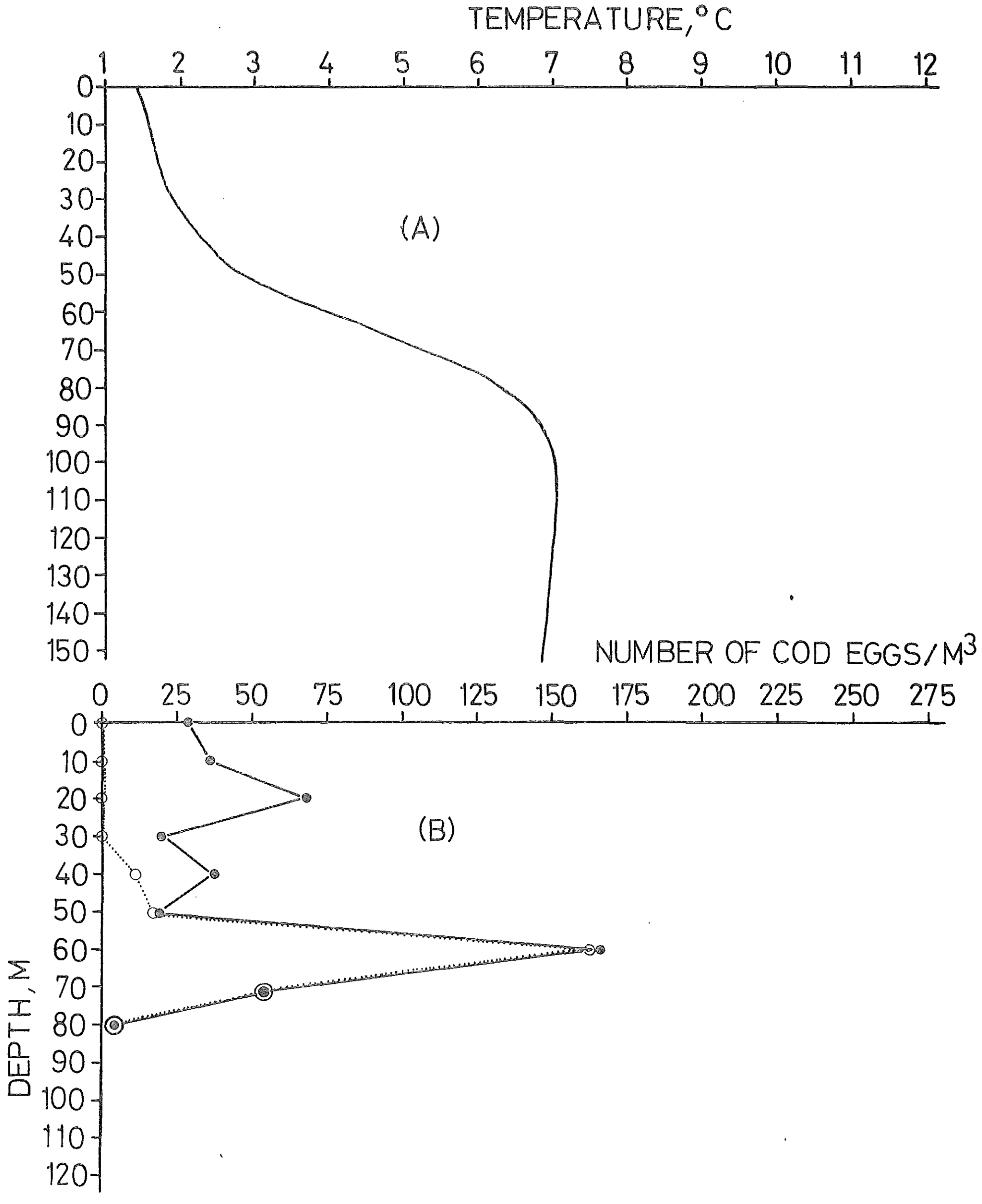

Fig. 8. Vertical profiles of temperature and concentrations of cod eggs the 26 March 1968 on Hølla, Lofoten. The dense fish registrations at 50-70 metres depth are not shown on the figure. Dotted line represents cod eggs at 2-4 cell stage, the unbroken line is the total egg concentration.

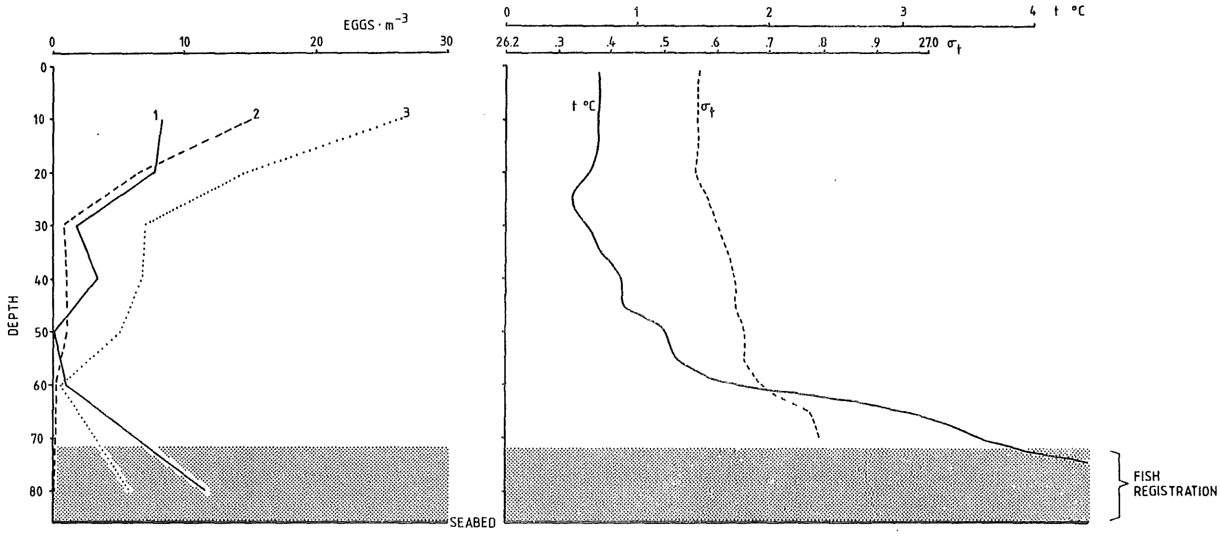

Fig. 9. Vertical profiles of temperature, t ^{O}C, density σ_t and concentration of cod eggs in Austnesfjorden, 26 March 1981, as eggs/m^3. The eggs are split in 3 age groups according to the scale given in Ellertsen et al. 1981:

1: < 16 C

2: > 16 C and < stad 2

3: Stad 2-6.

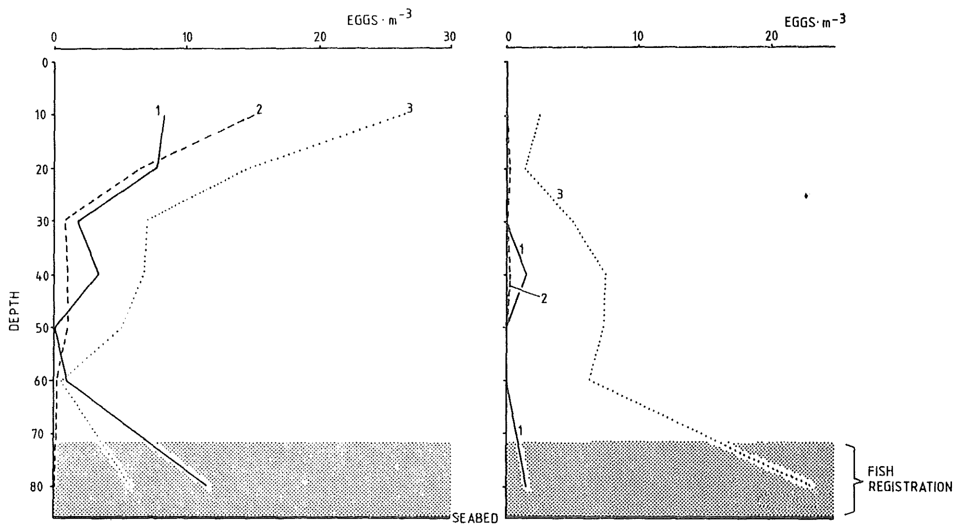

Fig. 10. Vertical profiles of cod eggs and other eggs, given as eggs/m^3, from the same station as Fig. 9. Developmental stages as in Fig. 9.

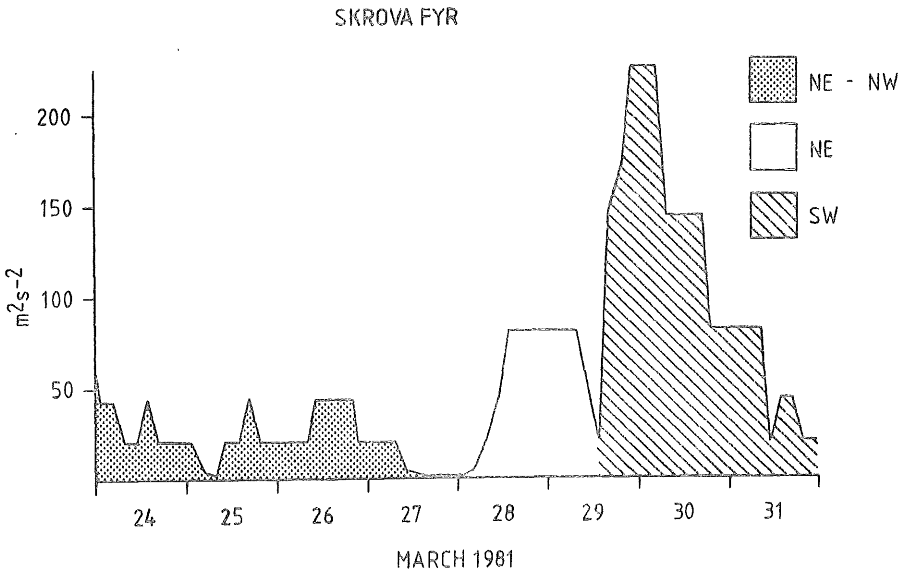

Fig. 11. U^2 (where U is the wind speed) at meteorological station Skrova, Lofoten for the period 24-31 March 1980. Different shading indicate wind direction.

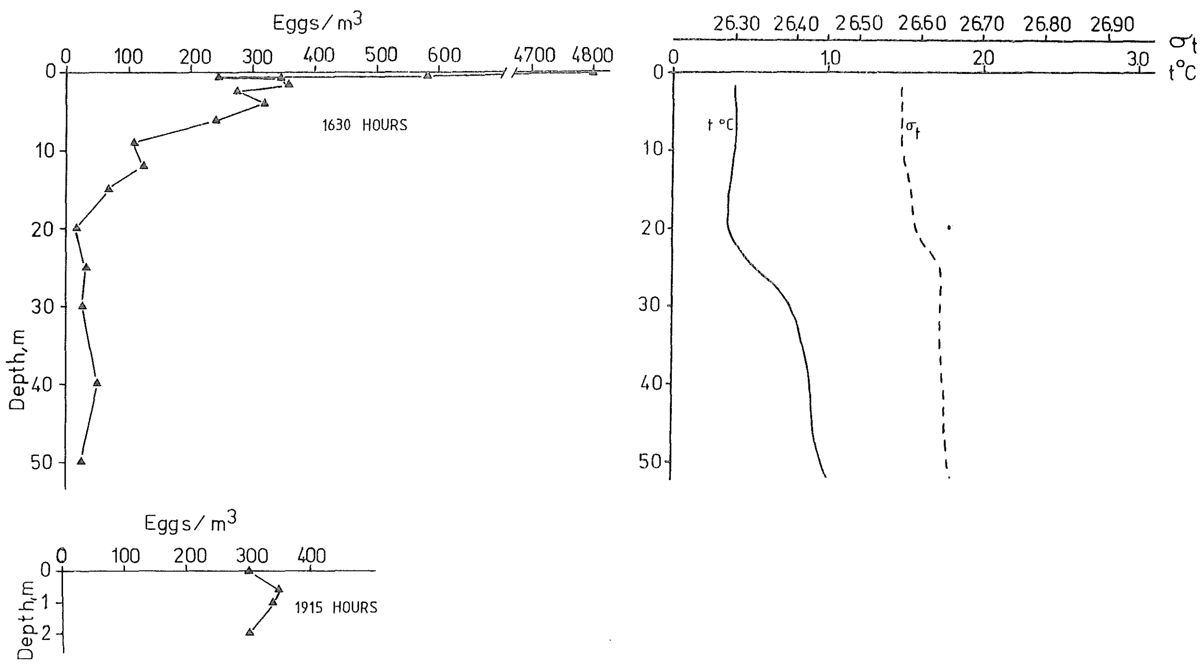

Fig. 12. Vertical distribution of cod eggs, number/m^3, temperature, t^oC, and density, σ_t at Hølla 27 March 1981 1630-1930 hours during a calm period (see Fig. 11).

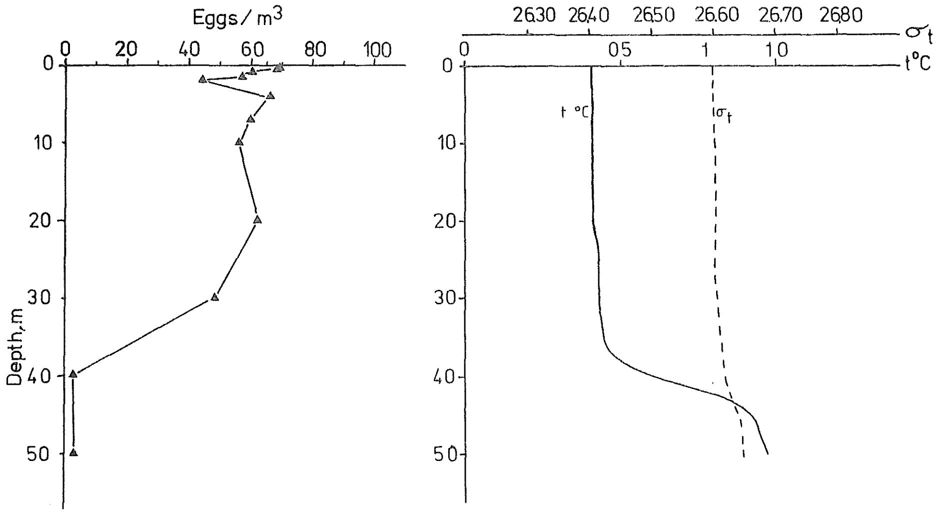

Fig. 13. Vertical distribution of cod eggs, number/m^3, temperature, t^oC, and density, σ_t at Henningsvær 28 March 1981 1630 hours after 3-4 hours duration of north-easterly wind of 9 ms^{-1}. (See Fig. 11).

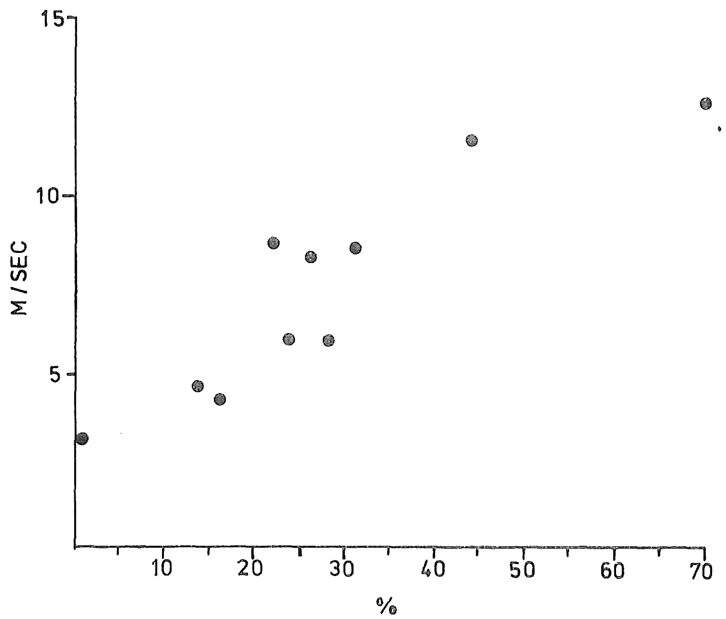

Fig. 14. Frequency egg number (2 days and older) in the deep Juday net hawl (100-30 m) compared to the total egg number (100-0 m) at Høllа as a function of the mean wind speed for the previous 24 hours at meteorological station Skrova. All events include south-westerly wind direction.

Table 1. Data on egg diameter from natural spawned eggs (N) and artificially fertilized eggs (A) from March and April 1969-72, Lofoten.

Year	Artificially fertilized (A) / Naturally spawned (N)	March					April				
		Diam. mm	SD	Range, mm	Nos. eggs	Nos.	Diam. mm	SD	Range, mm	Nos. eggs	Nos.
1969	A	1.43	±0.04	1.33-1.53	4239	37	1.41	±0.05	1.33-1.53	2759	26
	N	1.45	±0.05	1.35-1.58	148	-	1.39	±0.05	1.25-1.57	714	-
1970	A	1.44	±0.06	1.31-1.51	856	10	1.36	±0.07	1.25-1.55	564	23
	N	1.40	±0.05	1.26-1.53	264	-	1.36	±0.07	1.20-1.52	146	-
1971	A	1.49	±0.05	1.41-1.59	629	23	1.37	±0.05	1.31-1.43	276	12
	N	1.46	±0.05	1.35-1.63	218	-	1.39	±0.04	1.34-1.50	117	-
1972	A	1.44	±0.05	1.37-1.51	348	15	1.38	±0.06	1.27-1.47	367	15
	N	1.43	±0.05	1.26-1.55	213	-	1.38	±0.06	1.25-1.53	194	-
Mean 1969-72	A	1.45	±0.05	1.31-1.59	6072	85	1.39	±0.06	1.25-1.55	3966	76
	N	1.44	±0.05	1.26-1.63	843	-	1.38	±0.06	1.20-1.57	1171	-

Table 2. Neutral buoyancy from batches of artificially fertilized eggs of 52 Arcto-Norwegian cod females from March and April 1969-72. The mean values are calculated on the basis of the 1970-72 material.

	March	April
1969		
$^{o}/oo$ S	31,47	31,06
SD(n)	± 1.212(20)	±0.669(33)
Range	29.48-34.20	29.70-32.75
1970		
$^{o}/oo$ S	30.52	30.89
SD(n)	±0.488(5)	±0.650(11)
Range	29.73-31.01	29.86-31.97
1971		
$^{o}/oo$ S	31.81	32.12
SD(n)	±0.482(6)	±1.056(6)
Range	30.97-32.53	31.03-33.06
1972		
$^{o}/oo$ S	30.60	31.26
SD(n)	±0.679(12)	±0.709(12)
Range	29.43-31.57	29.86-32.15
Mean 1970-72		
$^{o}/oo$ S	30.90	31.30
Range	29.43-32.53(23)	29.86-33.06(29)

Table 3. Salinity for March and April for the mean year 1936-1977 at oceanographic station Skrova.

Depth m	March S^o/oo Mean	March S^o/oo St.dev.	April S^o/oo Mean	April S^o/oo St.dev.
1	33.31	0.37	33.37	0.36
10	33.31	0.37	33.39	0.36
20	33.36	0.36	33.45	0.33
30	33.41	0.34	33.51	0.30
50	33.55	0.30	33.72	0.24
75	33.88	0.30	34.07	0.28
100	34.24	0.30	34.35	0.26
125	34.50	0.27	34.56	0.22
150	34.67	0.22	34.71	0.19
200	34.83	0.17	34.86	0.11
250	34.91	0.12	34.94	0.06
300	34.98	0.06	34.98	0.06

Table 4. Proportion of cod eggs and other eggs taken by Juday-net (80 cm) on Hølla, 12-27 March 1981 in two depth ranges, 30-0 and 100-30 metres.

Depth metres	Cod eggs Nos.	Cod eggs %	Other eggs Nos.	Other eggs %
30-0	4050	77	1226	23
100-30	3421	41	4892	59
100-0	7471	55	6118	45