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The mortality of cod eggs, the spawning of cod and the biomass of the spawning stock in the Bornholm Basin

by

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Introduction.

In 1976 the total number of cod eggs spawned in the Bornholm basin was estimated (Bagge and Müller 1977). A station grid-net including 26 stations was surveyed 7 times between March 24 and May 31. The theoretical distribution of eggs and the total number of eggs in each of the surveys were estimated by fitting a 2-dimensional normal distribution to the found egg concentrations. Using the total number of eggs estimated per survey, the incubation time, the duration of the spawning period and the egg mortality, the total number of cod eggs spawned during the whole spawning period was computed from 3 differential equations.

The total number of eggs per survey, the incubation time and the duration of the spawning period are known parameters, but the mortality of cod eggs had to be assumed, therefore this year a preliminary attempt to estimate the mortality of cod eggs has been done.

In 1977 the station grid-net in the Bornholm basin has been worked 8 times with the Bongo net (300 and 500 micron), but as large quantities of Sagitta was caught this year the upworking of the samples has been delayed to an extent that it was not possible to compute the total number of eggs spawned for comparison with the results for 1976.

Distribution of cod eggs.

March (fig. 1).

In total 18 stations were run but only on 6 of those cod eggs were found. The center of distribution was in the deepest part of the basin. 11.6% of the total number of fish eggs were cod eggs. Only 1 cod larva was found indicating that the spawning had just started. The maximum number of cod eggs was 45 per m^2.

April (figs. 2-4).

Three surveys were made in April. Of those 2 covering the same period (April 12-16) in order to compare results between ships. 17 and 26 stations were run and a mean of 12.6 and 11.6 cod eggs below 1 m^2 were found. 7.7 and 7.9% of the total number of fish eggs were cod eggs respectively. On 4 and 10 stations no cod eggs were found. The center of distribution was still in the deepest part of the basin but few nautical miles to the west of that in March. The maximum

number of eggs was 35 and 45 per m^2.

The third survey (April 23-25) showed the same distribution but the number of cod eggs below 1 m^2 has increased. 1o.6% of the total number of fish eggs were cod eggs. The maximum number of cod eggs found was 76 per m^2.

May (fig. 5).

One cruise (May 5-9) including 2o stations was run. The spawning center covered now the whole area inside to 8o m contour line. 11.6% of the total number of fish eggs were cod eggs. The maximum number of cod eggs found was 119 per m^2.

June (figs.6-8).

Three surveys were made in June. Among those 2 covered the same period (June 5-1o) in order to intercalibrate. The spawning center was still in the same area as in May but with maximum values in the northern part. 22 and 25 stations were run and a mean of 51.2 and 56.8 cod eggs per m^2 were found by the 2 vessels respectively. 9.2 and 14.6% of the total number of fish eggs were cod eggs. The maximum number of eggs found was 186 and 156 per m^2.

The last cruise (June 15-19) showed a decreasing spawning intensity. The maximum number of cod eggs found was 14o per m^2. 12.8% of the total number of fish eggs were cod eggs.

Hydrography: (figs. 9 and 1o).

The hydrographical conditions during the period of investigation in 1976 and 1977 are shown in figs. 9 and 1o. It appears that below 6o m the temperature in 1977 was about $2^{o}C$ higher than in 1976 and the oxygen content more than 2 ml/l less.

The number of cod eggs in 1976 and 1977.

Due to the difficulties mentioned in the introduction it was not possible to compute the total number spawned during the entire spawning period 1977 for comparison with 1976. (Bagge and Müller 1977).

To get an impression of that any way the mean numbers of cod eggs per m^2 per survey has been calculated from mean densities and corresponding areas. The results are shown in table 1.

It appears that the number of cod eggs per m^2 during the period with the highest spawning intensity in 1977 is only about 6o% of the number found in 1976, may be indicating a decrease in the biomass of the spawning stock.

Mortality of cod eggs (figs. 11 and 12.)

A preliminary attempt to estimate the mortality of cod eggs has been done in the area near Christiansø the 18th - 24th of May 1977 (fig. 11).

A preceeding experiment with a driftboy exposed to the current in a depth of 6o-7o m showed that the drift of the cod eggs in this area was negligible so that the cod eggs spawned in that depth could be considered stationary any way with wind force below 5 beaufort.

Two experiments were carried out, one to the east of the island including 3 samples, the second to the west of the island including 2 samples.

The samples were taken with Bongo net. The mesh size in both nets being 5oo µ.

Immediately after collection the cod eggs were separated and sorted into developmental stages similar to those of Apstein (19o9) but grouped in 4 stages at $6^{o}C$.

Stage	Apstein (19o9).	Age of eggs.	Mean age.
I	1 - 6	o - 3 days	1.5 days
II	7 - 9	4 - 6 "	5 "
III	11 -17	7 -11 "	9 "
IV	18 -22	12 -16 "	14 "

In fig. 12 the natural log to the number of eggs per stage of development is plotted against the mean age in days for each of the samples corresponding and regressions calculated. As the spawning had stopped to the west of the island only stage II - IV are dealt with. Further a fit to the mean numbers of eggs per stage is made. It appears that to the west of the island the slopes found were o.28, o.35 and o.44, mean o.35 and to the east o.38 and o.44, mean o.41 corresponding to a mortality of about 25-36% per day or a total mortality of 99.3 - 99.7% (14 days) in that area in May provided that the spawning intensity has been constant during the periods corresponding to stages of development delt with.

References:

Apstein, C. 1909: Die Bestimmung des Alters pelagisch lebender Fischeier. Mitt. dt.Seefischver. 25, 364-373.

Bagge, O. and A. Müller 1977: The spawning of cod in the Bornholm Basin and the size of the spawning stock. Meeresforsch. 25, 172-185.

Grauman, G.B. 1974: Investigations on the spawning of Baltic cod in 1968 to 1970. Rapp. R.-V. Réun. Cons.int.Explor.Mer. 166, 7-9.

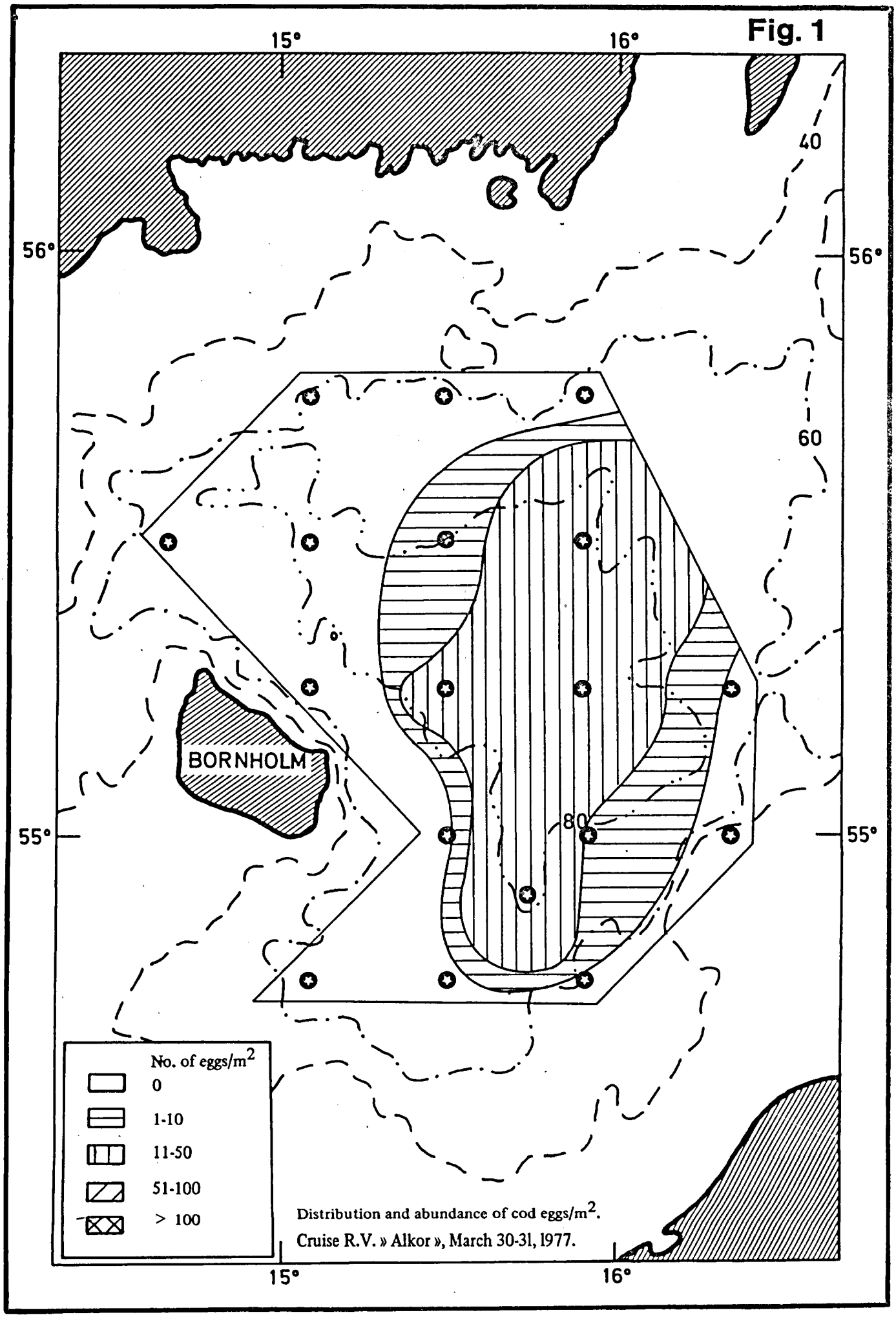
Westernhagen, H. v. 1970: Erbrütung der Eier von Dorsch (Gadus morhua), Flunder (Pleuronectes flesus) and Scholle (Pleuronectes platessa) unter kombinierten Temperatur- und Salzgehaltsbedingungen. Helgoländer wiss. Meeresunters. 21, 21-102.

Table No. 1.

The mean number of cod eggs per cruise below 1 m^2 in the Bornholm Basin in 1976 and 1977.

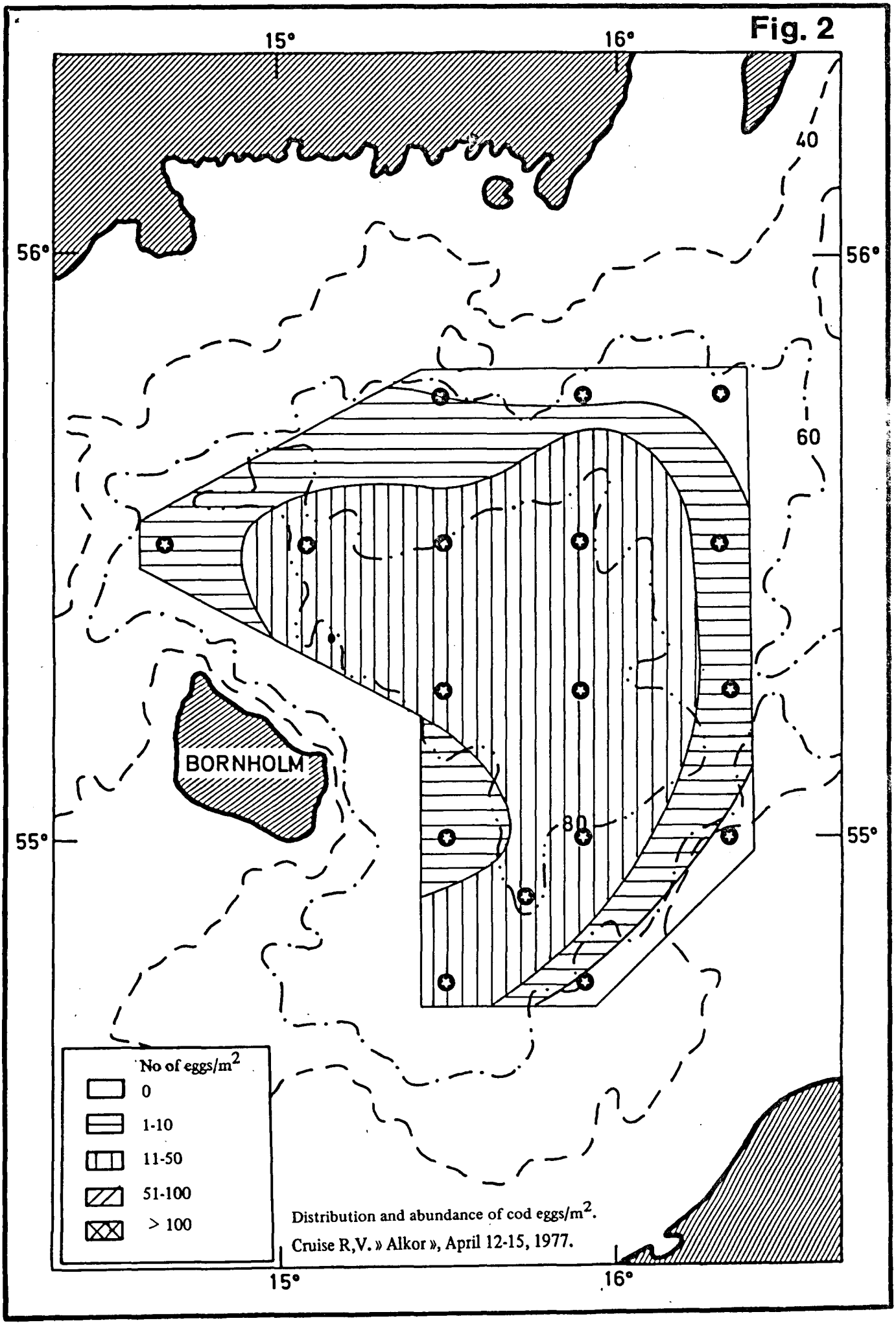
1976.		1977.	
Dana 24-28/3	8.3	Alkor 3o-31/3	9.3
Dana 7-9/4	11.6	Alkor 12-15/4	12.3
Alkor 6-8/4	11.3	Dana 14-16/4	11.6
Havfisken 11-13/5	18.9	Dana 23-25/4	27.1
Alkor 12-13/5	85.5	Havfisken 5-9/5	34.2
Anton Dohrn 2o-22/5	93.5	Havfisken 5-9/6	51.2
Havfisken 26-31/5	69.9	Solea 9-1o/6	56.8
		Havfisken 15-19/6	35.6

Fig. 1



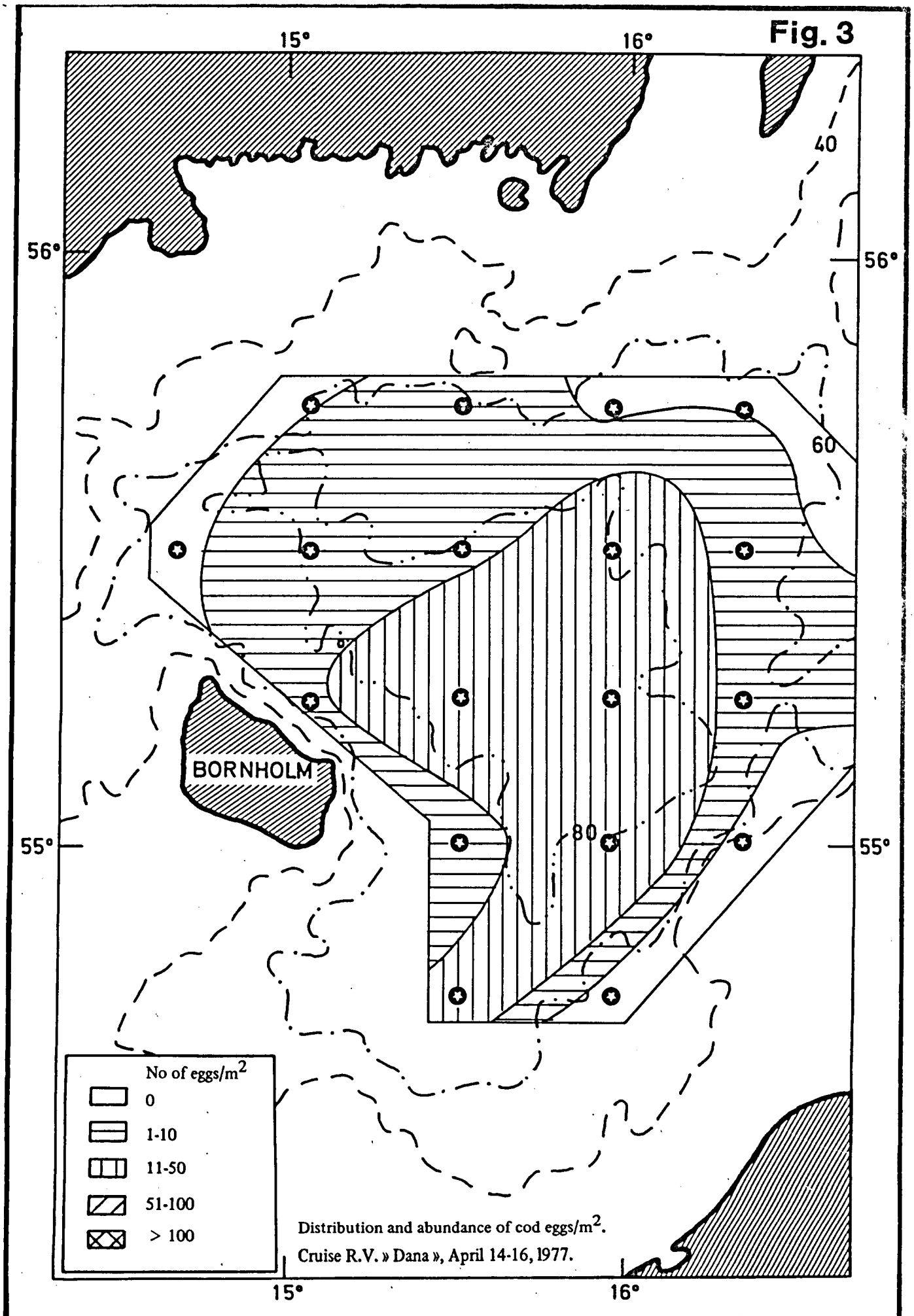
Distribution and abundance of cod eggs/m^2.
Cruise R.V. » Alkor », March 30-31, 1977.

Fig. 2



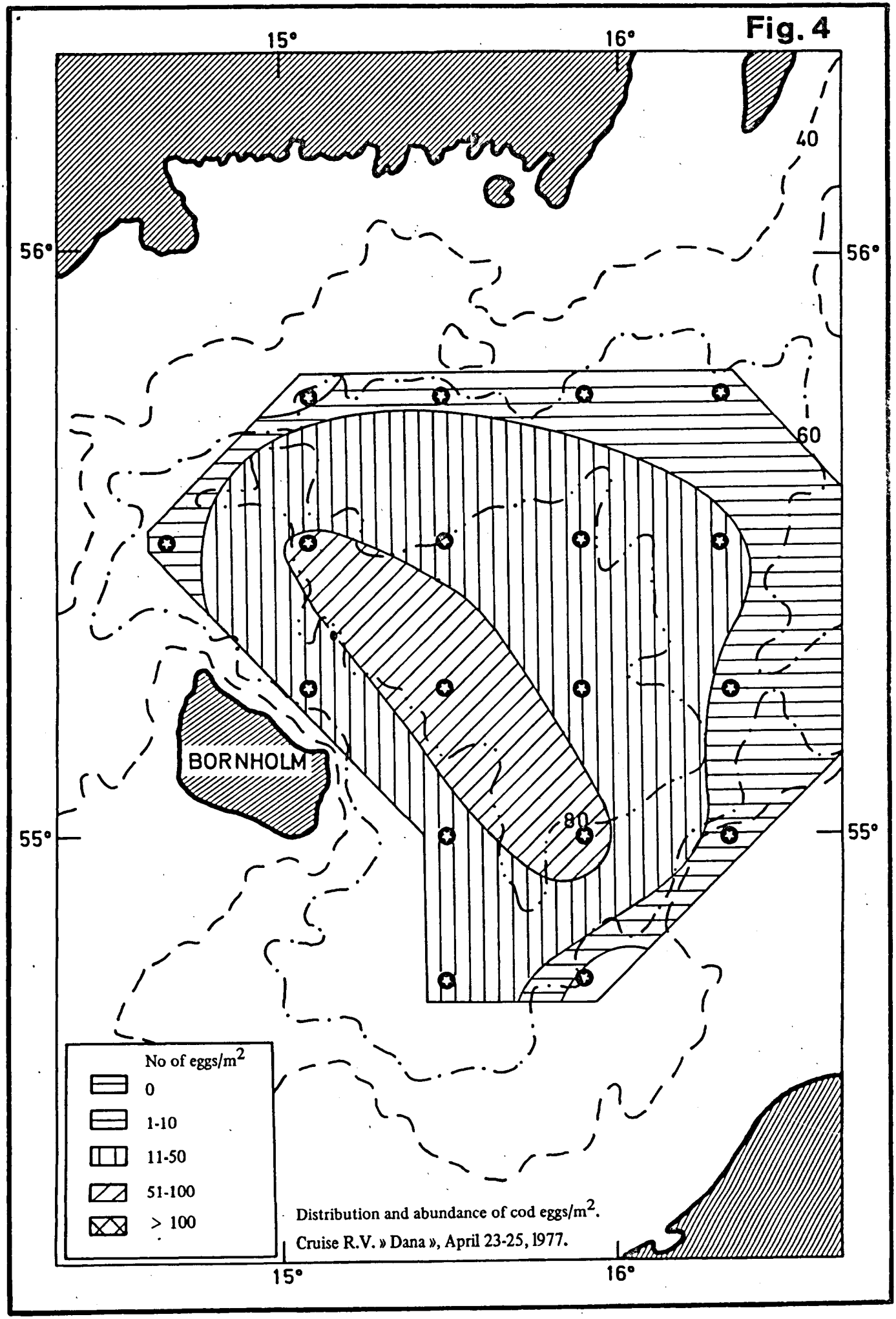
Distribution and abundance of cod eggs/m^2.
Cruise R,V. » Alkor », April 12-15, 1977.

Fig. 3



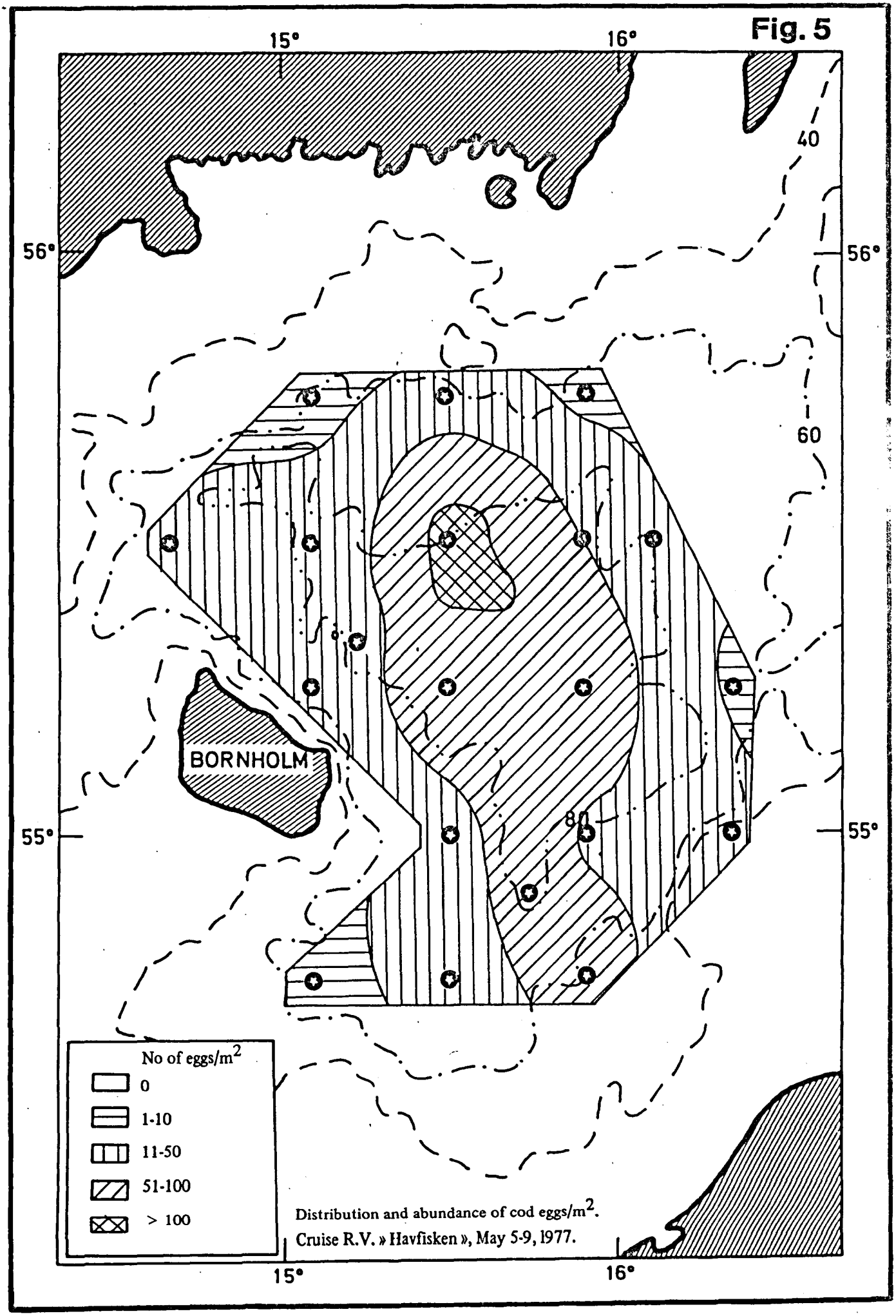
Distribution and abundance of cod eggs/m^2.
Cruise R.V. » Dana », April 14-16, 1977.

Fig. 4



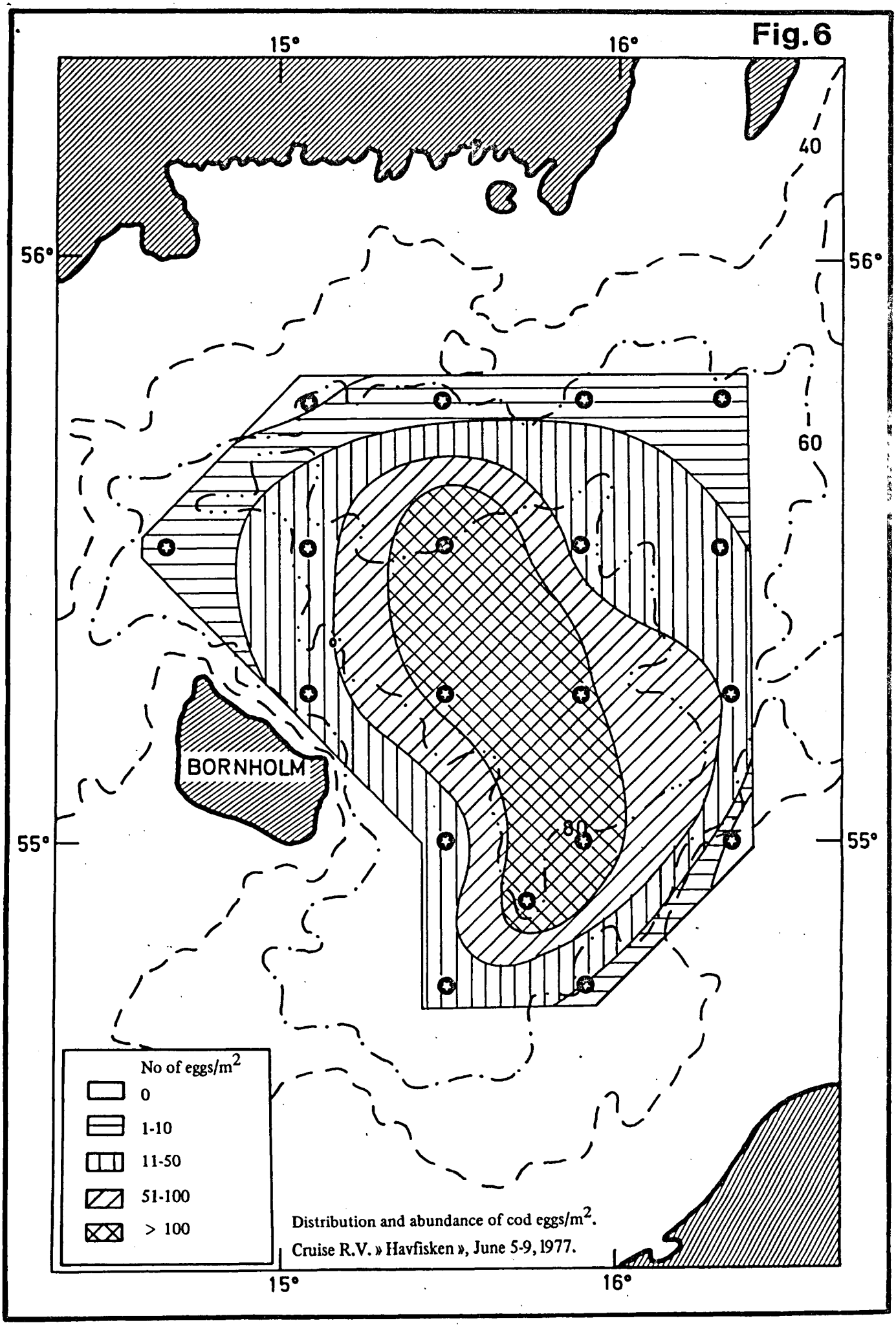
Distribution and abundance of cod eggs/m^2.
Cruise R.V. » Dana », April 23-25, 1977.

Fig. 5



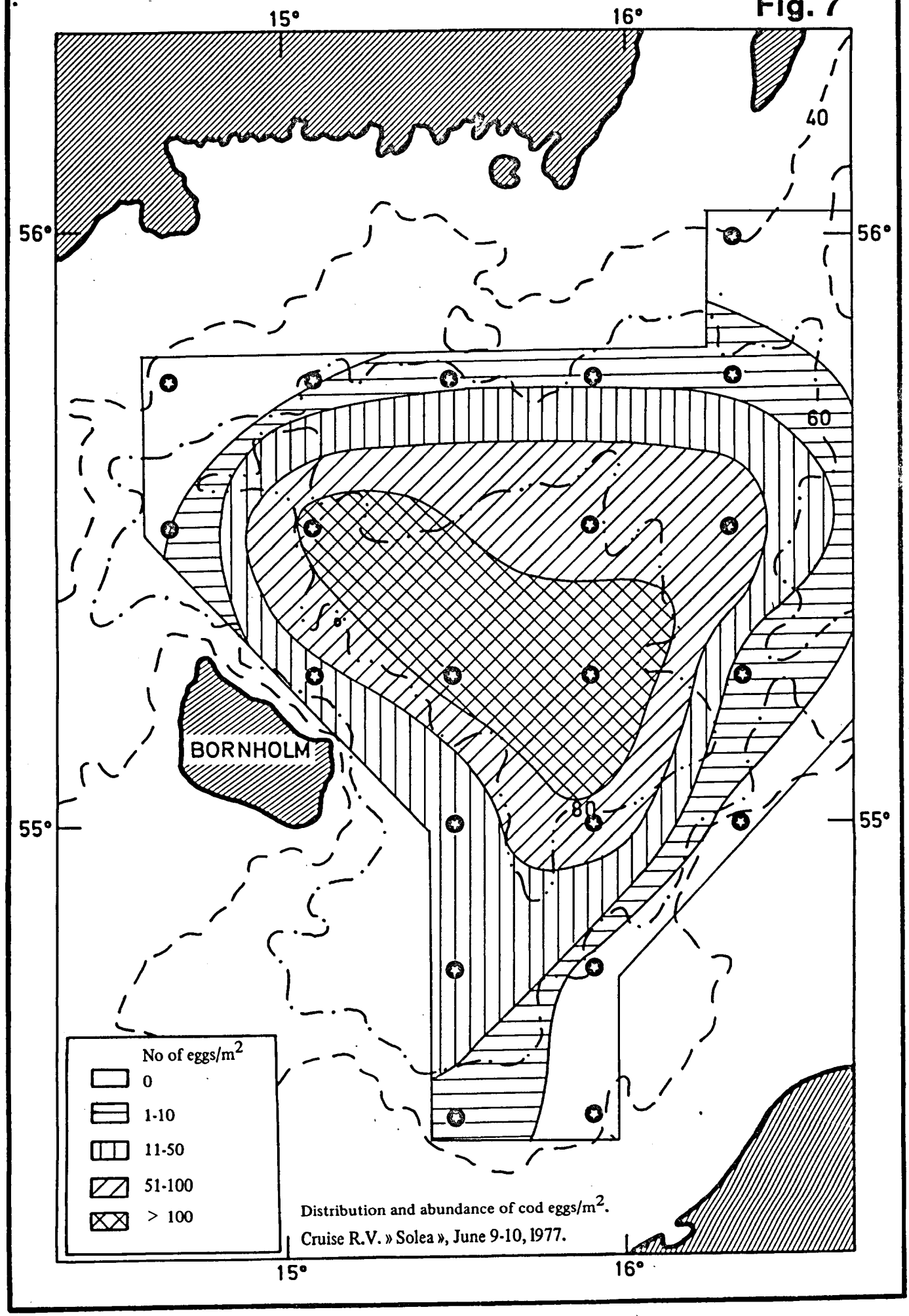
Distribution and abundance of cod eggs/m^2.
Cruise R.V. » Havfisken », May 5-9, 1977.

Fig.6



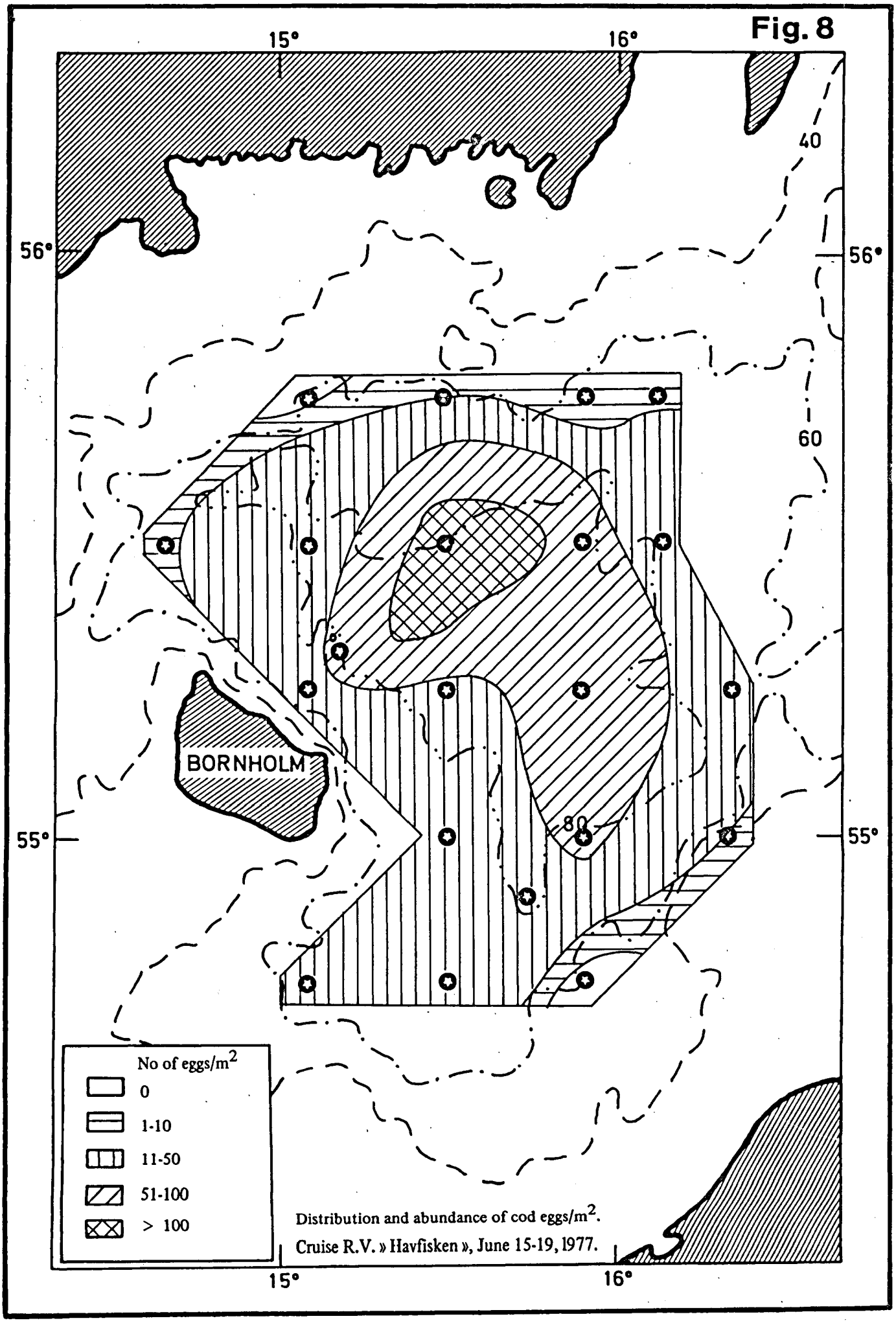
Distribution and abundance of cod eggs/m^2.
Cruise R.V. » Havfisken », June 5-9, 1977.

Fig. 7



Distribution and abundance of cod eggs/m^2.
Cruise R.V. » Solea », June 9-10, 1977.

Fig. 8



Distribution and abundance of cod eggs/m^2.
Cruise R.V. » Havfisken », June 15-19, 1977.

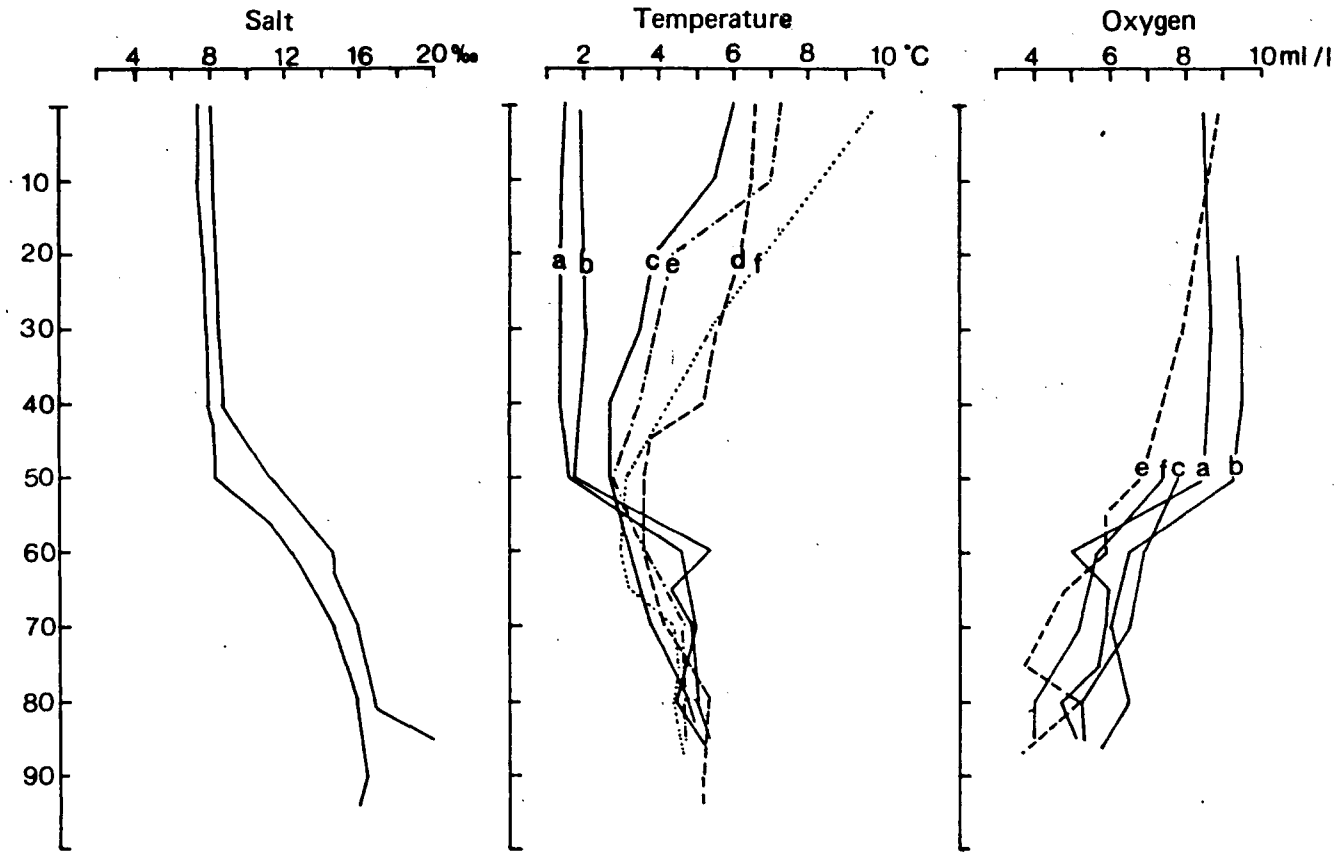


Fig.9. The results of the hydrographical observations

a: March 27. 1976 » Dana »
b: April 9. 1976 » Alkor »
c: May 13. 1976 » Havfisken »
d: May 13. 1976 » Alkor »
e: May 22. 1976 » Anton Dohrn »
f: May 30. 1976 » Havfisken »

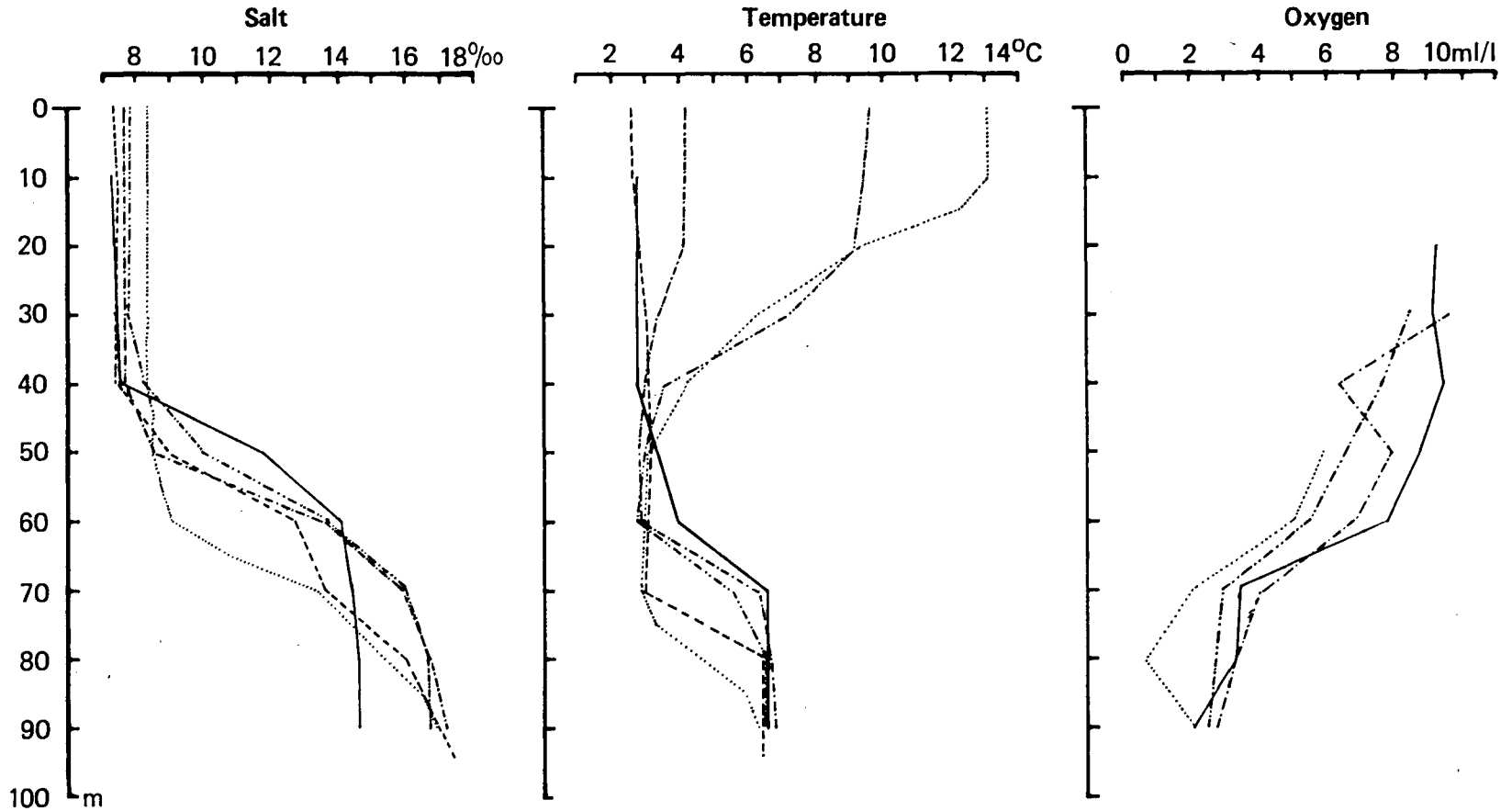


Fig.10. The results of the hydrographical observations

- – – – – – – – : March 31. 1977
- ——————— : April 14. 1977
- —·—·—·—·— : May 6. 1977
- —··—··—··— : June 8. 1977
- ····· : June 16. 1977

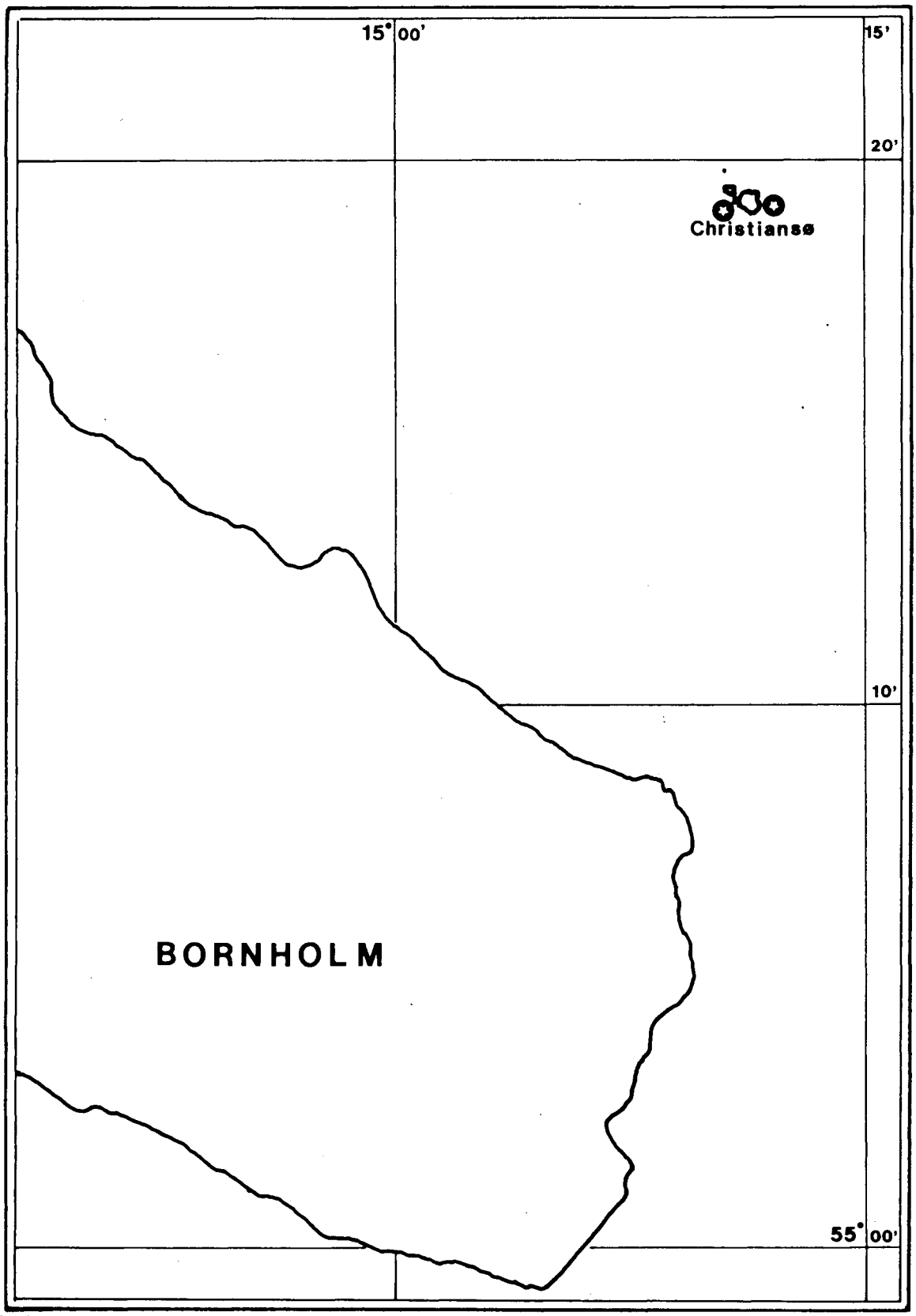
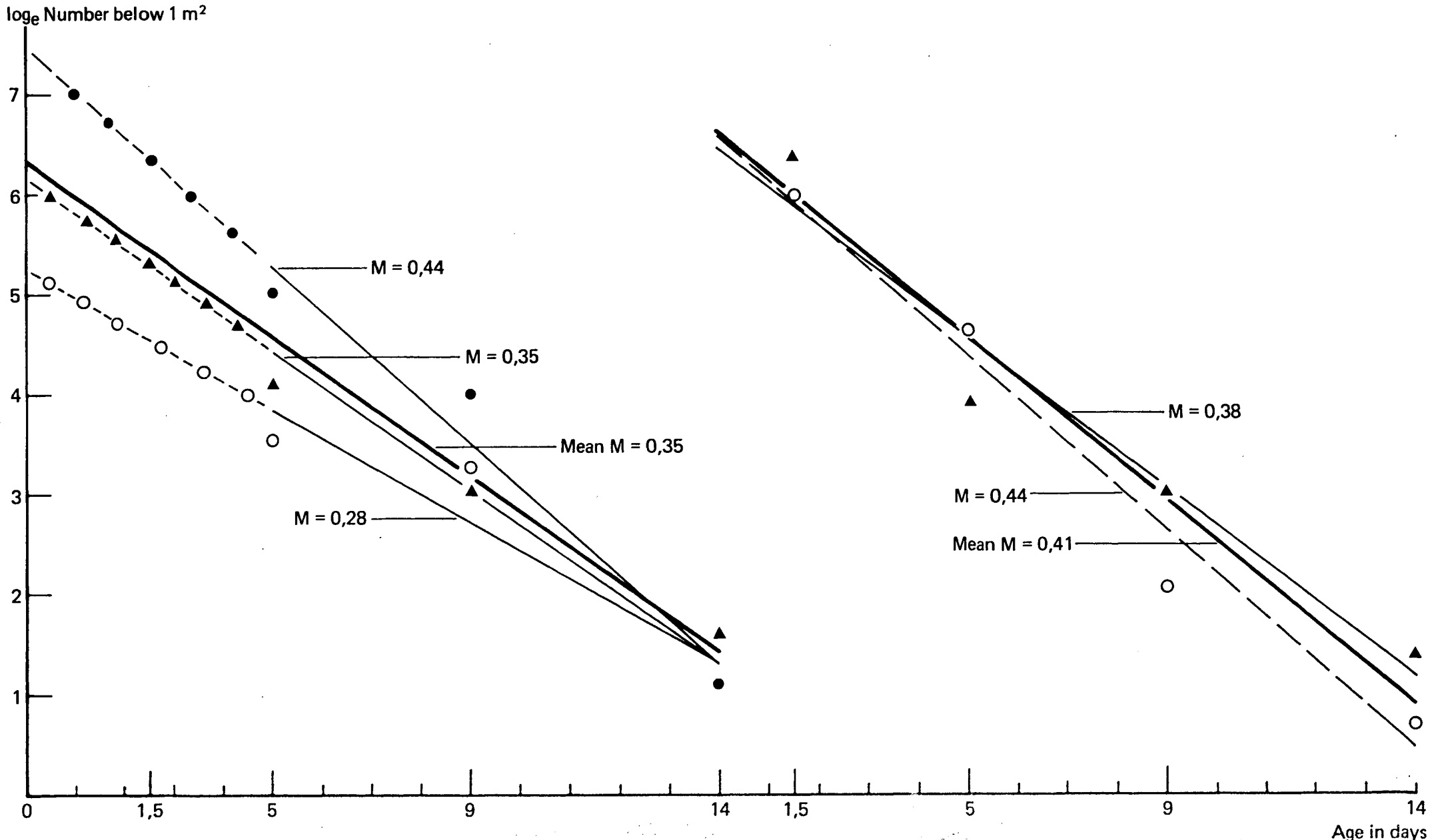


Fig.11. The two stations near Christiansø where mortality experiments were carried out.

Fig.12.


log$_e$ Number below 1 m^2
7
6
5
4
3
2
1
M = 0,44
M = 0,35
Mean M = 0,35
M = 0,28
M = 0,38
M = 0,44
Mean M = 0,41
0
1,5
5
9
14
1,5
5
9
14
Age in days