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SPRAT SPAWNING IN TWO FJORD AREAS OF WESTERN NORWAY IN 1982 AND 1983

by

Else Torstensen
Flødevigen Biological Station
N-4800 ARENDAL Norway

ABSTRACT

A southern and a northern fjord at Western Norway were surveyed for sprat spawning from the end of May until July, six times in 1982 and four times in 1983.

Sprat spawned in both areas and the surveys covered just a part of the spawning season.

It is allowed for the stage duration, using the mean temperature for the sampling depths at each station and cruise. Thus the daily egg production was estimated for each station and for each of the fjord areas as a whole for each cruise. The spawning curves show peak spawning at the end of May - first part of June. From the area underneath the egg production curves the total egg productions were estimated. Attempts are made to estimate the size of the spawning stocks from the egg productions and published data on fecundity.

INTRODUCTION

There is an annual sprat fishing in the fjords of Western Norway, in the period from July to the end of the year. According to Sund (1911) the sprat in these fjords are recruited from spawning in Skagerrak-Kattegat. However, local spawning has been shown as well (Bjerkan 1930, Gundersen 1954, Bakken 1965).

Increased assessment of sprat in the Skagerrak-Kattegat and North Sea area raised the question of consequences for the sprat stocks in the fjords. To obtain more information of local spawning, spawning area and spawning time, preliminary egg surveys were started in 1982.

Two fjord systems were chosen for surveying. From the assumption that recruitment mainly takes place by drifting by the Norwegian Coastal Current, the southern (Ryfylke) and the northern (Nordfjord) fjords were selected. The southern area has earlier been surveyed by Bjerkan (1930), Dannevig (1954) and Bakken (1965), while the northern fjord has never been surveyed for sprat eggs and larvae.

MATERIALS AND METHODS

The locations of the fjord areas are shown in Fig. 1. The two areas were surveyed from the end of May to the beginning of July (Tabell 1), with six cruises to both areas in 1982 and four cruises in 1983.

Plankton was sampled with a modified Bongo sampler, 20 cm Ø, with 500 um mesh in the nets. The volume of water filtered was measured by flowmeter.

The hauls were made as oblique tows. In 1982 the depth intervals were 50-25 and 25-0 m and in 1983 30-15 and 15-0 m, with 5 min tows at each 5 m depth. The travelling speed was 3 knots. The samples were preserved in 2-4% formalin in seawater.

The eggs were sorted out and the sprat eggs identified as egg without visible embryo (corresponding to stage IA and IB in Thompson et al. 1981) and egg with embryo. The number of eggs without visible embryo below 1 m^2 surface was calculated for each station, and used for the estimations.

The temperature was measured on the surface and by a Bathy-thermograf recorded down to 50 m depth.

RESULTS AND DISCUSSION

Sprat spawned in Ryfylke and Nordfjord in 1982 and 1983. The distribution and abundance of the eggs are shown in Fig. 2-5. The distribution pattern was essentially the same in the two years in both fjord areas. However, there were differences between the fjords. In the northern fjord the eggs were more or less distributed throughout the fjord, with greatest abundance in the middle part. In Ryfylke the egg distribution was more restricted, and the number of eggs per m^2 not as high as in Nordfjord.

From the mean temperatures for the upper 15 m given in Table 2 it is difficult to see any relation between temperature and egg abundance.

86-96% of the mean numbers of the sprat eggs were sampled in the upper 25 m in 1982. Therefore the sampling depths were changed in 1983. The vertical distribution in 1983 is summarized in Fig. 6. Considering the individual stations in both areas, the stations with the highest number of eggs had 90-95% of the eggs in the upper 15 m. As there is fresh water outflow in the surface layer in both fjords, with a discontinuity layer within the upper 5 m in summer, the vertical distributions indicate a concentration of sprat eggs beneath this layer.

The daily egg production for the survey area as a whole for each cruise was estimated by multiplying the number of eggs per m^2 for each station by the area represented by that station, and

plotted against the mid-day for each cruise in Fig. 7 and 8. It is allowed for the stage duration using the mean temperature for the sampling depths at each station and cruise, and according to development times given in Thompson et al. (1981) the eggs were from 1.1 to 2.1 days old. From Fig. 7 and 8 it is shown that the spawning season for sprat in both areas exceeds the survey periods. The spawning pattern varied, but both in Ryfylke and Nordfjord there was an increased spawning activity in the end of May and first part of June. Two peaks in sprat spawning activity have been shown in fjords on the eastern coast of Norway, in April/May and June (Ellingsen 1979) and an earlier spawning in Ryfylke and Nordfjord seems to be confirmed by the occurrences of sprat larvae and their length distribution (Table 3).

The total egg production for the survey period is calculated from the area underneath the curves for daily egg production. Using the fecundity data from Bailey and Pipe (1977), 971 eggs per g, and an assumed 1:1 sex ratio, the spawning stock in the two fjord areas have been estimated:

	Ryfylke		Nordfjord	
	Tot. egg production	Tonn	Tot. egg production	Tonn
1982	190×10^9	392	71×10^9	146
1983	120×10^9	248	335×10^9	690

Stock size estimated from a restricted period of the total spawning season is inevitably underestimated. Apart from the exceeded spawning season, there are other factors of uncertainty connected with the estimation. To get more precise estimation of the size of the spawning stock, more effort should be put into:

- sampling method
- stage determination of preserved egg material
- vertical distribution and temperature
- time of egg development
- the fecundity of sprat in Norwegian waters.

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Tabell 1. The coverage of Ryfylke and Nordfjord, 1982 and 1983

	Coverage no.	Ryfylke	NOrdfjord
1982	1.	20-23 May	26-27 May
	2.	29 May-1 June	3-4 June
	3.	6-9 June	11-13 June
	4.	14-17 June	18-20 June
	5.	22-25 June	29-30 June
	6.	2-5 July	6-8 July
1983	1.	25-28 May	31 May. 1 June
	2.	3-6 June	8-11 June
	3.	13-16 June	19-21 June
	4.	23-26 June	28-29 June

Table 2. The mean temperature of the water masses in the upper 15 m in Ryfylke and Nordfjord in 1982 and 1983

	Temperature (^{o}C)					
	Coverage no.					
	1	2	3	4	5	6
1982						
Ryfylke	8.6	9.9	12.8	12.1	11.5	12.7
Nordfjord	9.4	11.1	10.1	-	10.9	10.2
1983						
Ryfylke	7.5	8.4	8.3	12.0		
Nordfjord	8.9	8.8	10.3	10.5		

Table 3. Length distribution (%) of sprat larvae

	Coverage no	Length groups (mm) <5	5-10	11-15	>15	N	$\bar{l}$ (mm)
Ryfylke							
1982	1.	-	-	100.0	-	3	12.7
	2.	66.6	33.3	-	-	3	4.0
	3.	-	92.3	7.7	-	13	7.5
	4.	4.3	91.3	-	4.3	23	8.3
	5.	-	33.3	66.6	-	3	12.3
	6.	2.5	32.5	46.3	18.8	80	12.1
1983	1.	15.6	59.4	15.6	9.4	32	8.3
	2.	0.3	57.6	27.3	12.1	29	10.1
	3.	7.0	30.2	46.5	16.3	36	12.1
	4.	5.5	48.4	32.0	14.2	219	10.5
Nordfjord							
1982	1.	40.0	40.0	20.0	-	5	7.0
	2.	33.3	50.0	16.7	-	6	4.8
	3.	-	100.0	-	-	1	7.0
	4.	-	-	-	-	-	-
	5.	60.0	20.0	20.0	-	5	5.6
	6.	20.0	20.0	40.0	20.0	10	11.3
1983	1.	13.6	36.4	31.8	18.2	22	10.0
	2.	-	-	71.4	28.6	7	14.0
	3.	20.0	46.7	26.7	6.7	15	8.1
	4.	55.7	38.6	1.4	4.3	70	5.6

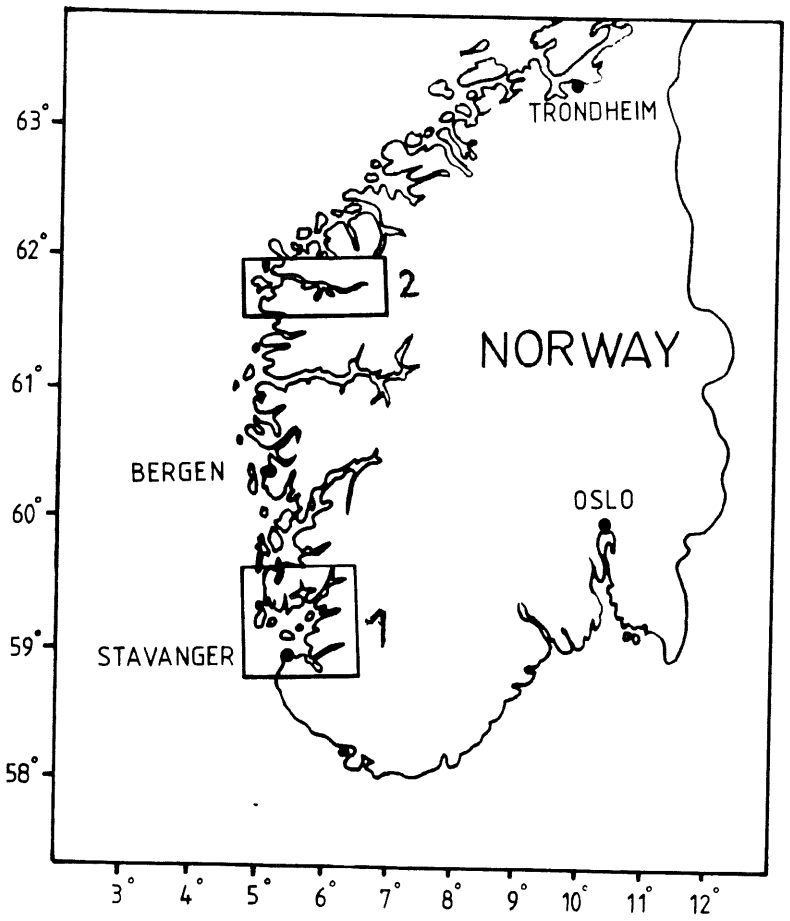


Fig. 1. The location of the surveyed fjord areas on the West Coast of Norway, 1) Ryfylke, 2) Nordfjord

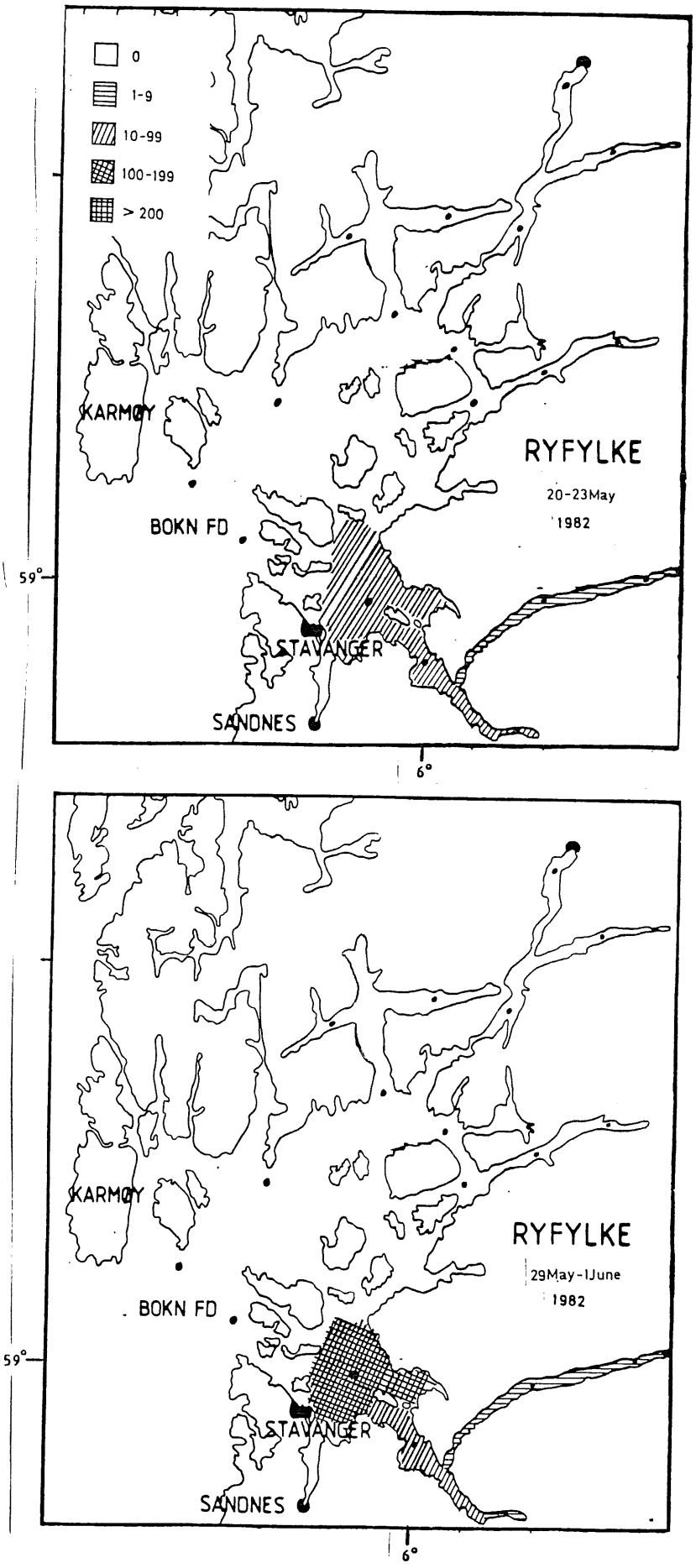
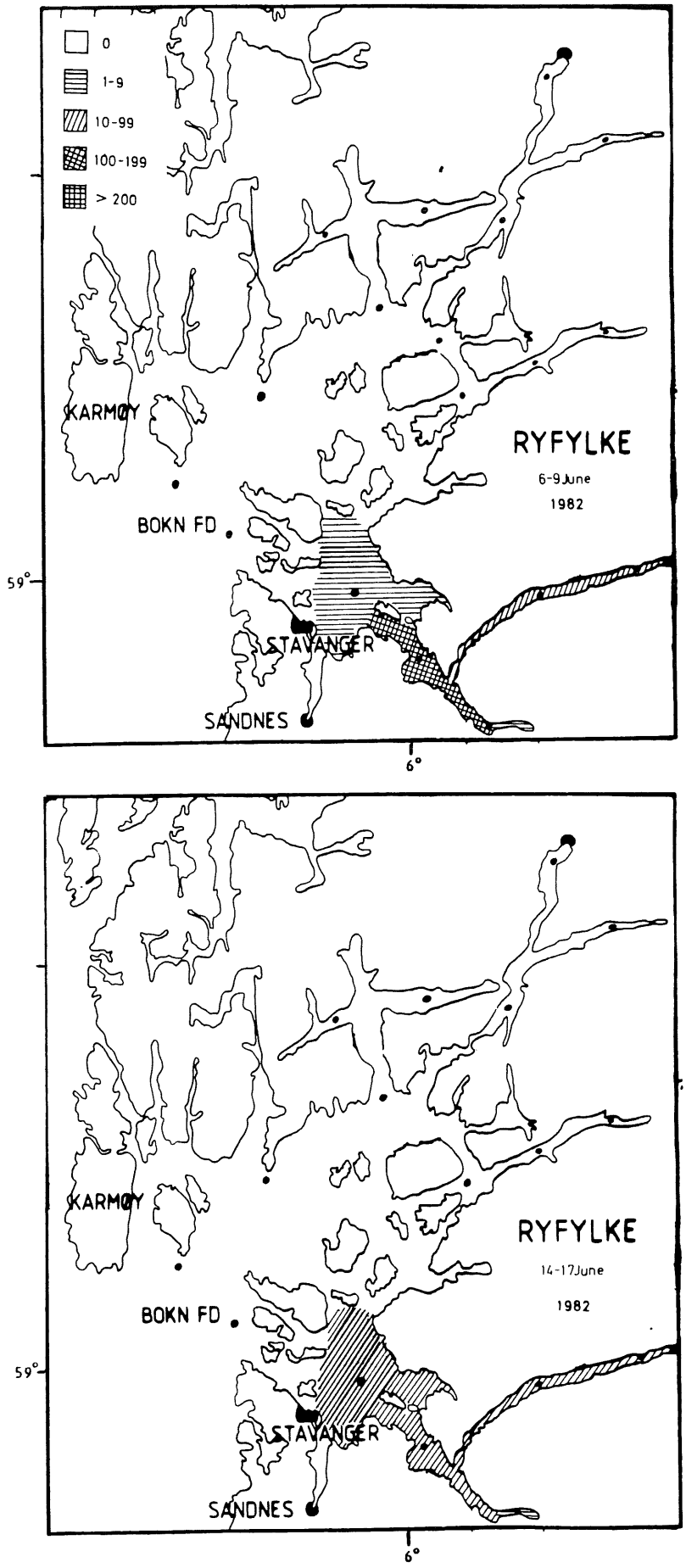


Fig. 2. The distribution and number of sprat eggs per m^2 in Ryfylke in 1982.



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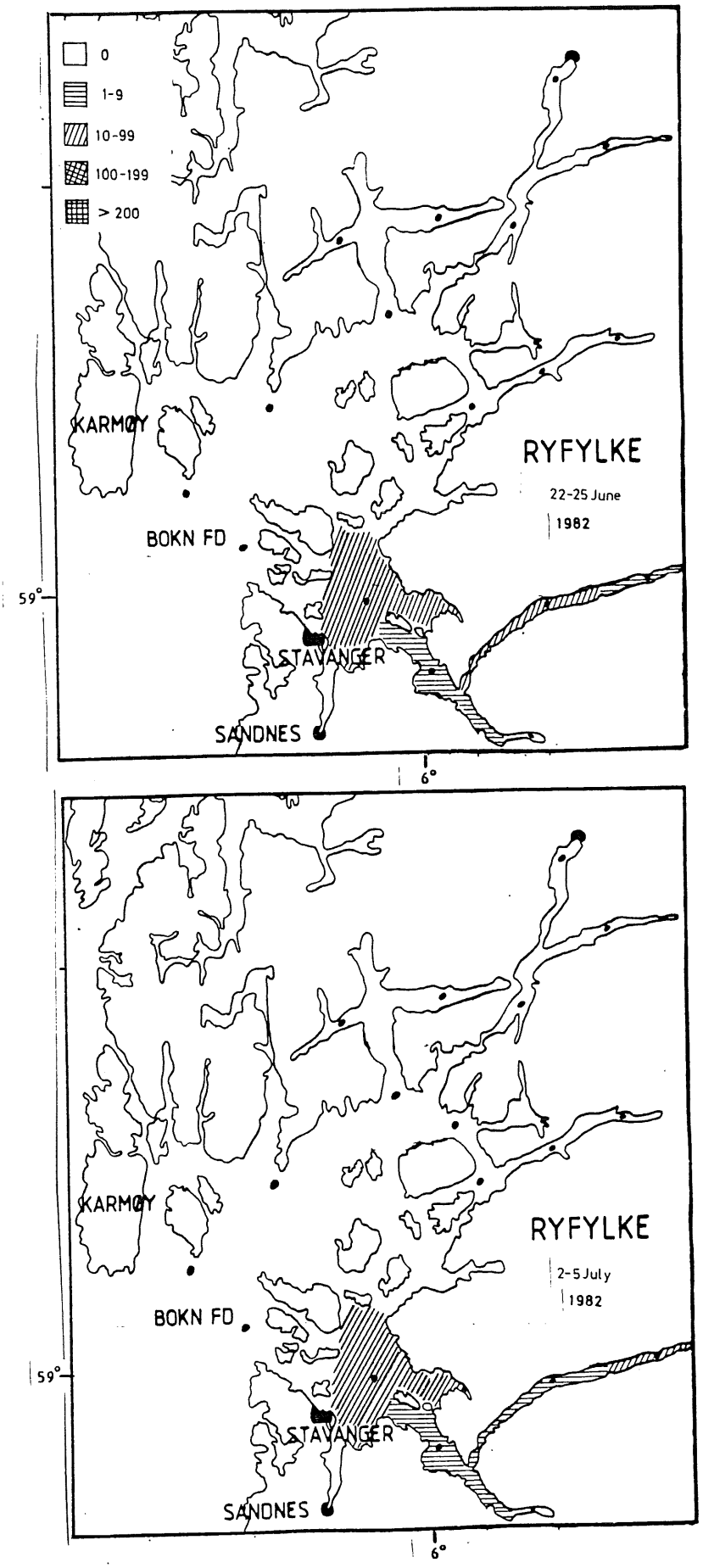

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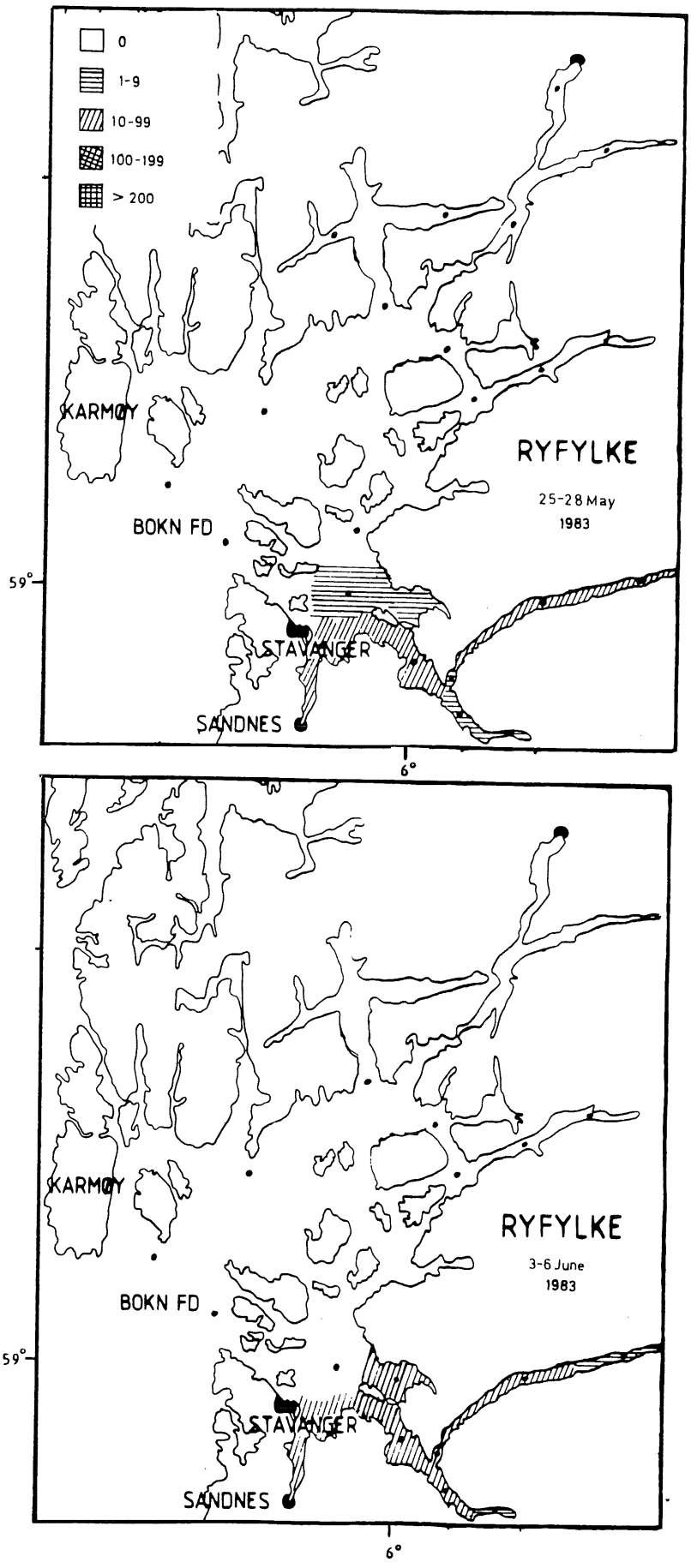
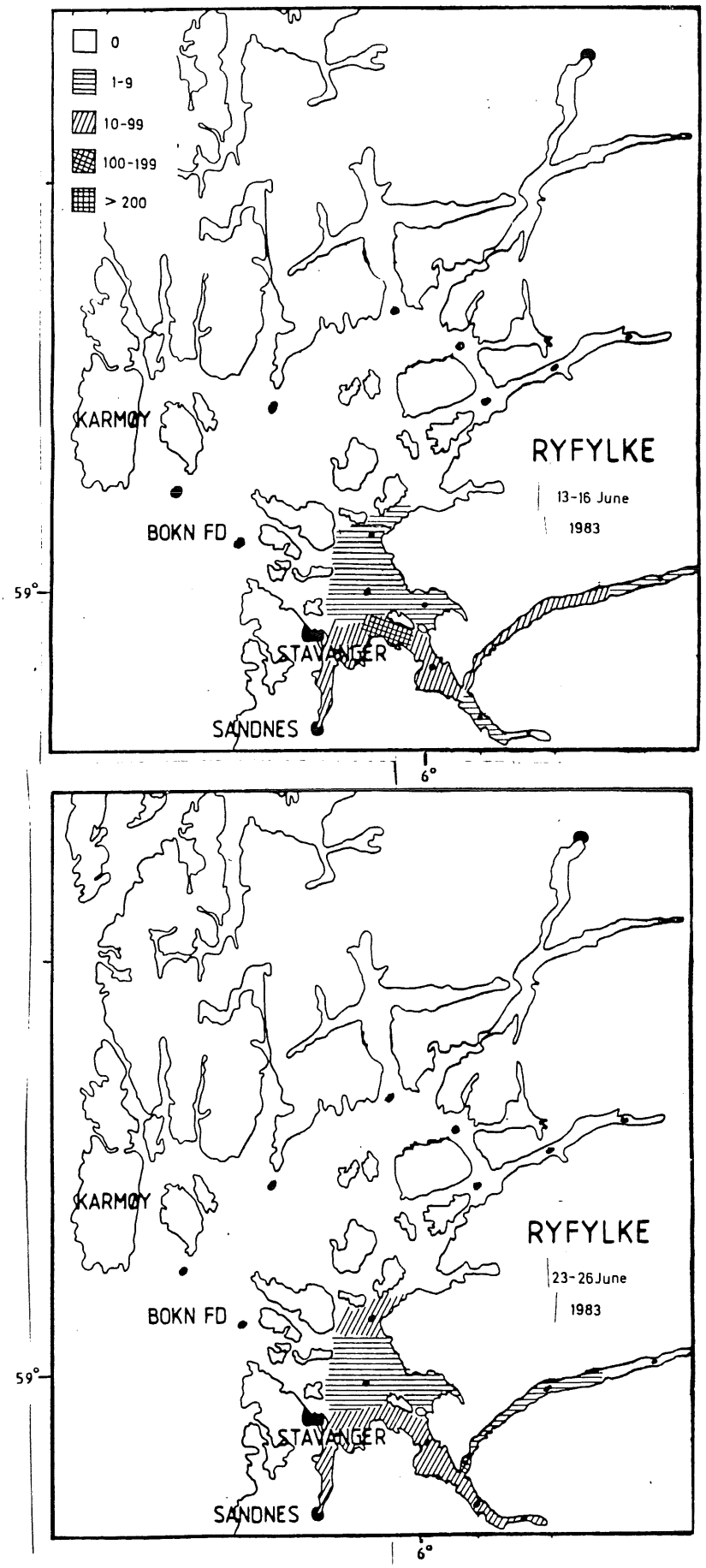


Fig. 3. The distribution and number of sprat eggs per m^2 in Ryfylke in 1983



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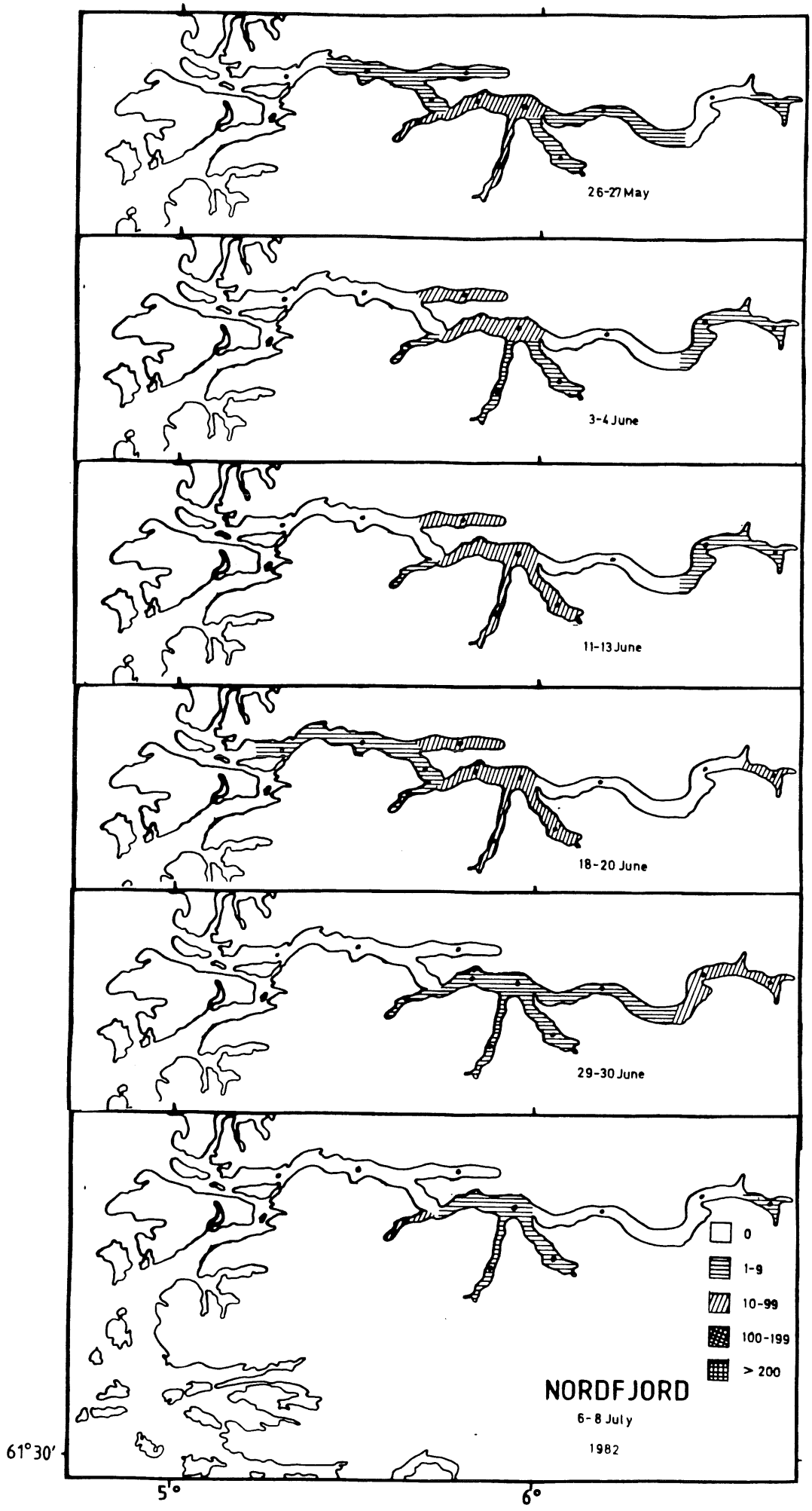

Fig. 4. The distribution and number of sprat eggs per m^2 in Nordfjord in 1982

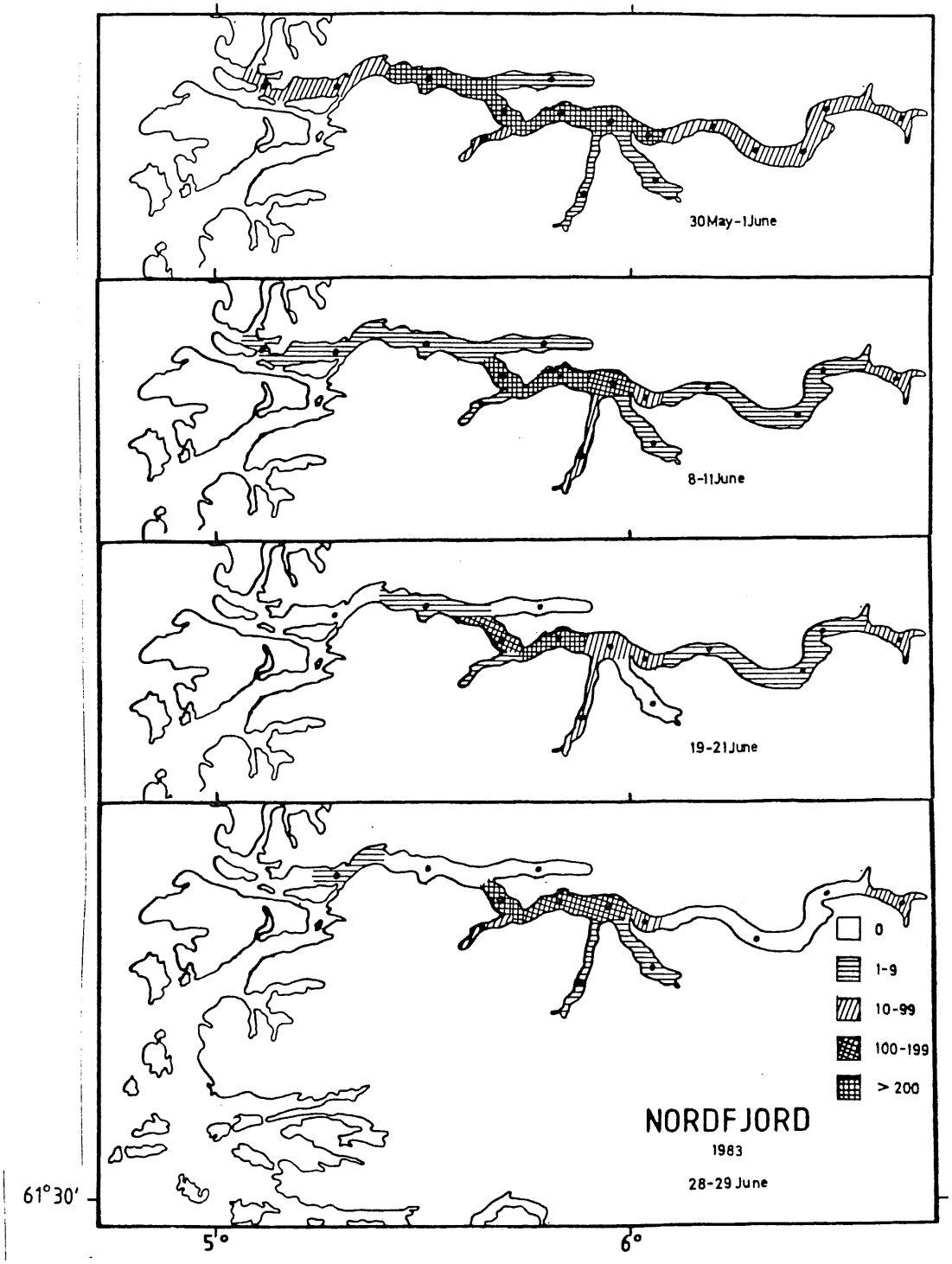

Fig. 5. The distribution and number of sprat eggs per m^2 in Nordfjord in 1983

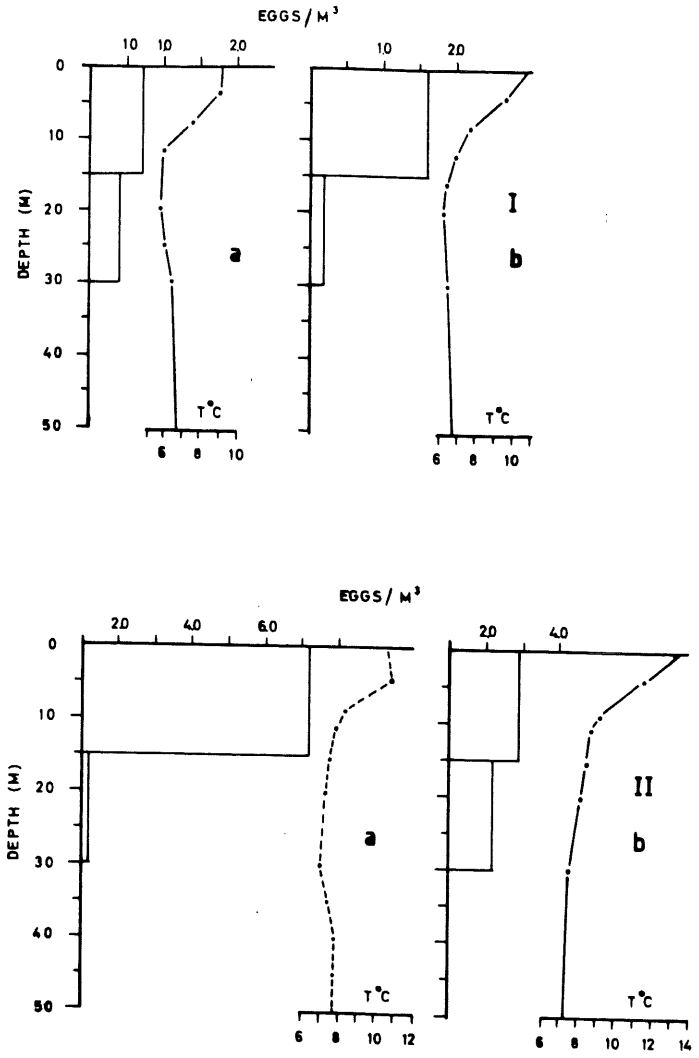

Fig. 6. The vertical distribution of sprat eggs without visible embryo in Ryfylke and Nordfjord in 1983. The numbers of eggs are the means of positive hauls. Alongside each distribution is a representative profile of temperature
I: Ryfylke, a) 25-28 May, b) 13-16 June
II: Nordfjord, a) 30 May - 1 June, b) 19-21 June

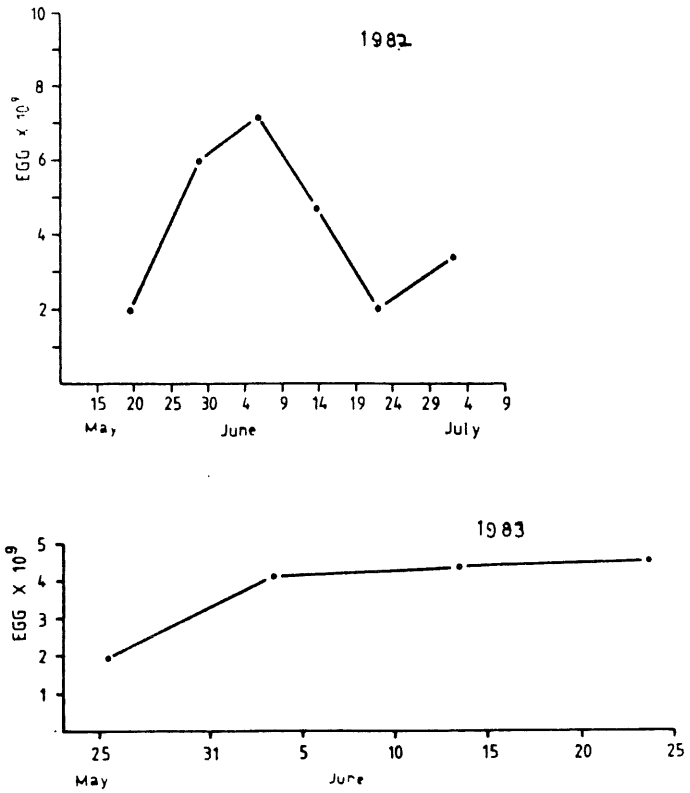

Fig. 7. Daily egg production in the southern fjord area (Ryfylke) in 1982 and 1983

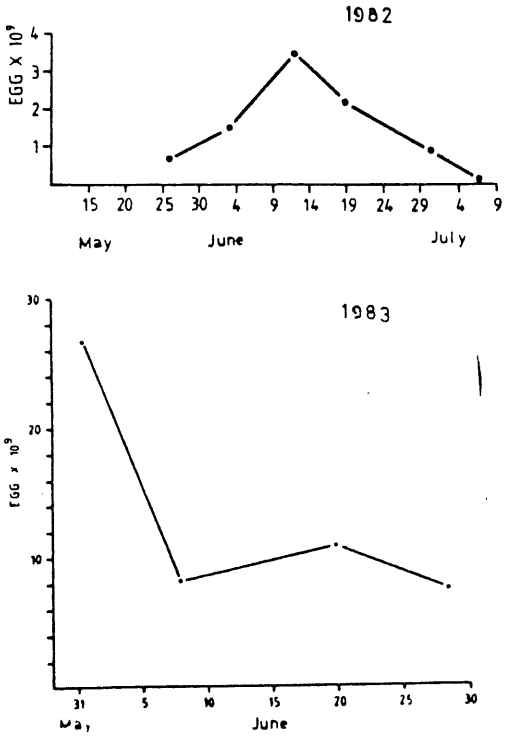

Fig. 8. Daily egg production in the northern fjord area (Nordfjord) in 1982 and 1983