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«Cruise report»

RV Håkon Mosby 18.03-02.04.2005

Distribution and abundance of Norwegian spring spawning herring larvae on the Norwegian shelf in March-April 2005

by

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Objectives

The objectives of this survey were to map the distribution of herring larvae and other fish larvae on the Norwegian shelf and to collect data on hydrography, nutrients, chlorophyll and zooplankton. The data is used to calculate an index of the abundance of herring larvae which is used by the ICES Northern Pelagic and Blue Whiting Fisheries Working Group in the assessment of the spawning stock on Norwegian spring spawning herring. The index is part of a time series which started in 1981.

Participation

The scientific members during the cruise were:

Julio Erices, Berit Endresen, Reidar Johannesen (instrument), Laura Rey and Erling Kåre Stenevik (cruise leader).

Narrative

The survey started in Bergen on 18. March at 12:00. Most years, this survey have covered the area taking stations from north to south and since the vessel had to be back in Bergen after the survey it was decided to steam northwards to Fugløya where the northernmost station was and start the scientific work there. The first station was taken at 70^{o}30N, 19^{o}59E on 21. March at 21:30 UTC. The survey continued until the southern limit of the larval distribution was found outside Stad and the last station was taken at 62^{o}07N, 04^{o}52E on 1. April at 10:00 UTC. The vessel then headed for Bergen where we arrived on 2. April at 01:00 local time. During the survey a total of 161 CTD and larval stations were conducted in addition to 54 WP II hauls for zooplankton biomass and species composition.

Methods

The cruise tracks with larvae stations are shown in figure 1. CTD casts were taken on each station to collect data on temperature, salinity and oxygen between the surface and 10 m above bottom. If bottom depth was greater than 500 m, the CTD was lowered to 500 m for the deepest measurement. On every third station, water bottles were used on standard depth to collect data on nutrients and chlorophyll *a* from the surface to 100 m depth.

Fish larvae were sampled with two different nets. During daytime, Gulf III sampler (375 μm) was used while during nighttime, T-80 net (375 μm) was used. The Gulf III was towed in a double oblique haul down to 75 m depth while the vessel maintained a speed of five knots. The T-80 net was hauled vertically from 150 m to the surface while the ship was not moving. The reason why two types of sampling equipment were used is that the T-80 underestimates the number of bigger larvae (> 11 mm) larvae during daytime because of avoidance. The Gulf III, however, samples representatively both during daytime and nighttime, but because of the high speed the larvae caught in this net is in a much worse condition. It is therefore sometimes difficult to measure the length of these larvae and to classify them in stages because the gut and yolk sac may be torn off. All herring larvae were counted and a maximum of 50 larvae from each station were staged according to Doyle (1977) and the standard length was measured. Other larvae were identified as far as possible and their standard length measured.

On every third station, a WP II net (180 μm) was used to sample zooplankton. This net was hauled vertically from 200 m depth to the surface and the sample was split in two. One of the sub-samples was dried for measuring biomass and the other preserved on formaldehyde for later analyses of species and stage composition.

Results

The number of herring larvae found this year was very high and the total number was estimated to be $73.9*10^{12}$. This is the highest number of larvae recorded since the time series started in 1981 (table 1). The mean size of the larvae was, however relatively low (11.5 mm) compared with previous years. This is probably due to the relatively early survey period this

year. Most of the larvae were in the late yolk sac and early first feeding stages (Table 2) and very few older larvae were found. In order to investigate if there were differences in hatching time along the coast, the stations were grouped in five areas (figure 1). In the two northernmost areas (area 1 and 2) more than 40% of the larvae were in stage 1d which is the stage immediately after absorption of the yolk sac (figure 2). In area 2 (the Røstbanken area) there were also larvae in early yolk sac stages 1a and 1b. In the three southern areas, most of the larvae were older (stage 2a) indicating that spawning had started earlier on the southern spawning ground compared to further north. These results are, however, preliminary. Since the survey started in north, the northern spawning grounds were covered a few days before the southern grounds and this will influence the stage distribution observed in the different areas. In addition, stage 2a is a long lasting stage while 1d is a short stage. Otolith microstructure analysis will be required to age the larvae and based on this the hatching date can be estimated more accurately. However, the preliminary results are in accordance with the results from the herring spawning survey (Slotte and Tangen, 2005) which showed that the herring on the southern spawning ground was in a later stage of maturity than the herring further north during the survey period (14. February-6. March), indicating earlier spawning in the south. The preliminary results suggest that the main hatching of larvae occurred during mid March on the northern spawning grounds and early to mid March on the southern grounds.

As shown in figure 3 and figure 4, herring larvae were observed throughout the sampling area. However, zero values were found both on the northernmost section near Fugløya and on the southernmost station near Stad. Since there have been very limited spawning activity on the traditional spawning grounds south of Møre (i.e. Karmøy) the later years, it was concluded that the survey covered the total distribution area of herring larvae. Similarly to previous years the herring larvae had a more northern distribution compared with historic distribution when spawning was mostly observed at the Møre spawning grounds. Highest concentrations of larvae were found on Haltenbanken where concentrations of more than 10 000 larvae m^{-2} were observed on two stations. Haltenbanken is an important retention area for herring larvae (Sætre et al., 2002), but is also an important spawning area in some years. During the herring spawning survey in February, 26% of the spawning stock was found in the Haltenbanken area (Slotte and Tangen, 2005) indicating that Haltenbanken was one of the major spawning areas this year. High concentrations of herring larvae were also found on the inner stations at Møre and on Sklinnabanken. In addition, a band of herring larvae was observed close to the coast from the spawning ground off Møre to the Vestfjord area. Also at Røstbanken herring larvae

were found in relatively high concentrations. The larvae were, however distributed farther from the coast in this area and on some sections the outer limit of herring larvae was not found due to restricted time of the survey. On most of the sections south of this, the western limit of the herring larvae distribution was found.

Herring larvae dominated the catch, but all other fish larvae were also identified and measured. The most frequent of these were saithe (figure 5), which were found mostly on Haltenbanken and outside Lofoten and Vesterålen. The total number of saithe larvae observed during these surveys since 1996 is shown in table 3. Previously, the data for saithe was split into a southern and northern component at 62oN. Since the survey has not covered the area south of 62^{o}N the last two years, only the number from north of this can be compared among years. When this is done the number of saithe larvae this year is the second highest in the time series. Only 2004 were higher. Cod larvae were almost exclusively found outside Lofoten and Vesterålen (Figure 6) while other larvae (mainly Norway pout and sandeel) were also found sporadically (figure 7).

Acknowledgements

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References

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Slotte, A. and Tangen Ø. 2005. Distribution and abundance of Norwegian spring spawning herring during the spawning season in 2005. Internal cruise reports. Institute of Marine Research, P.O. Box. 1870. N-5024 Bergen, Norway.

Sætre, R., Thorsesen, R., Søiland, H. and Fossum, P. 2002. The Norwegian spring-spawning herring – spawning, larval drift and larval retention. *Sarsia* 87: 167-178.

Table 1. Total number of herring larvae found on the Norwegian shelf during the period 1981 to 2005 (numbers in 10^{12}). Index 1 is the total number found during the survey while index 2 is the back-calculated number of newly hatched larvae using a 10% daily mortality rate. The age of the larvae is estimated from the duration of the yolk sac stages and the size of the larvae.

Year	Index1	Index 2	Year	Index 1	Index 2
1981	0.3		1992	6.3	27.8
1982	0.7		1993	24.7	78.0
1983	2.5		1994	19.5	48.6
1984	1.4		1995	18.2	36.3
1985	2.3		1996	27.7	81.7
1986	1.0		1997	66.6	147.5
1987	1.3	4.0	1998	42.4	138.6
1988	9.2	25.5	1999	19.9	73.0
1989	13.4	28.7	2000	19.8	127.5
1990	18.3	29.2	2001	40.7	131.9
1991	8.6	23.5	2002	27.1	113.9
			2003	3.7	18.9
			2004	56.4	175.7
			2005	73.91	

Table 2. Fraction of herring larvae in different developmental stages (Doyle, 1977) during the survey.

Stage	1a	1b	1c	1d	2a	2b-2d	ubestemt
Age (days)	0-2	3-5	6-7	8-9	10-24	24+	6
Fraction (%)	1.29	11.81	25.43	25.34	36.13	0.01	0

Table 3. Number of saithe larvae (numbers in 10^{12}) on the Norwegian shelf during the period 1996-2001.

Year	Total	North of 62^0N	South of 62^0N	Fraction (%) south 62^0N
1996	401	344	57	14.2
1997	2	2	0	0
1998	152	146	6	4.0
1999	414	360	54	13.0
2000	244	81	163	66.8
2001	277	228	49	17.7
2002	553	442	111	20.1
2003	1191	1165	33	2.8
2004	2135	2135	-	-
2005	1188	1188	-	-

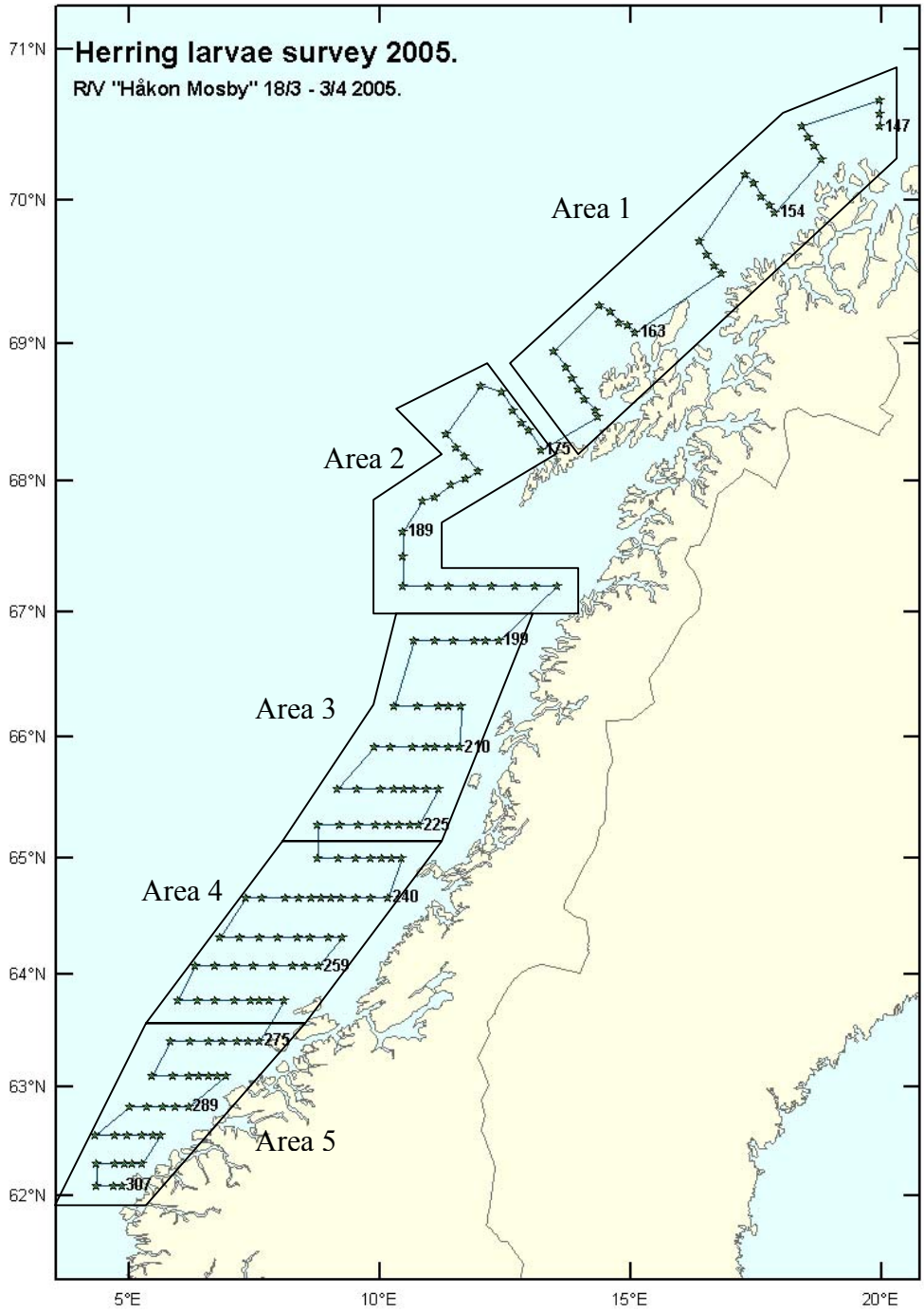

Figure 1. Cruise tracks with larvae stations (Gulf III and T-80). CTD casts were taken on every station and WP II on every third station.

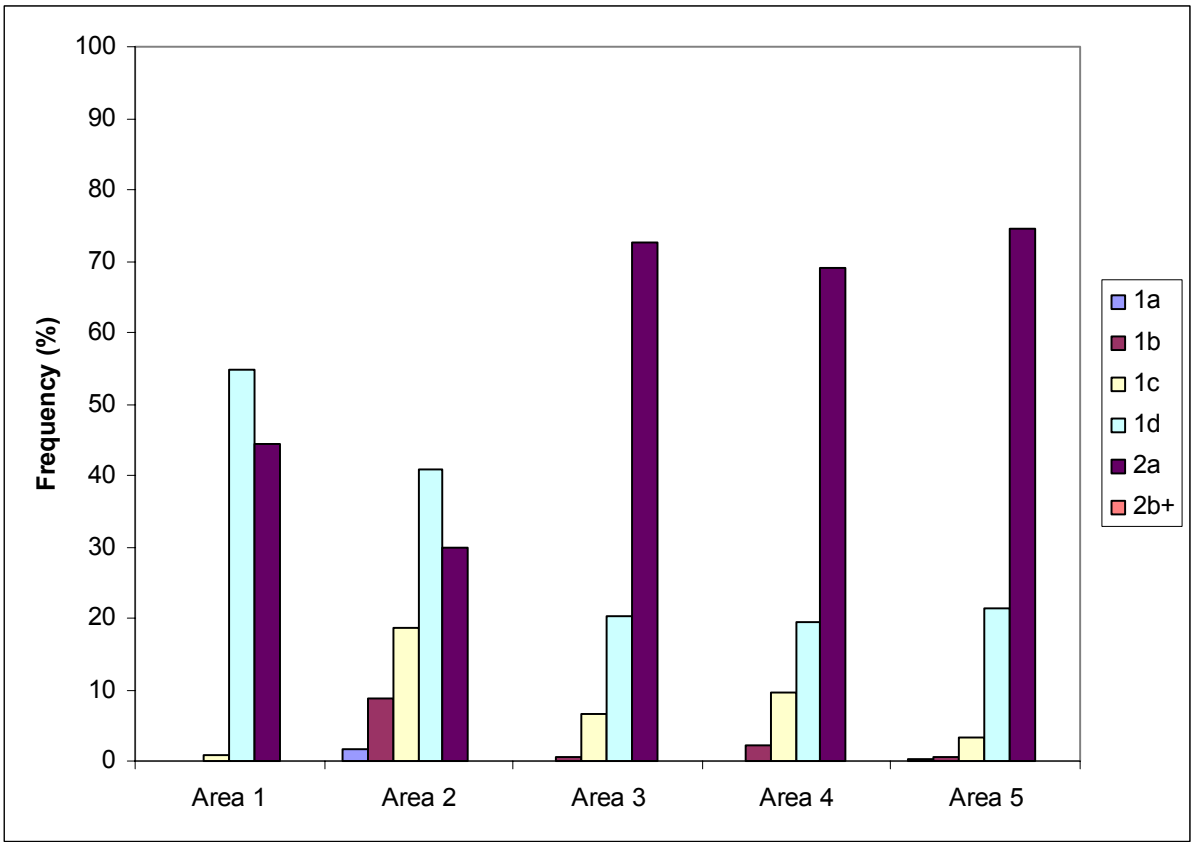

Figure 2. The figure shows the fraction of herring larvae in different developmental stages (Doyle 1977) in different areas on the Norwegian shelf. Area 1 is the northernmost area and area 5 is the southernmost area

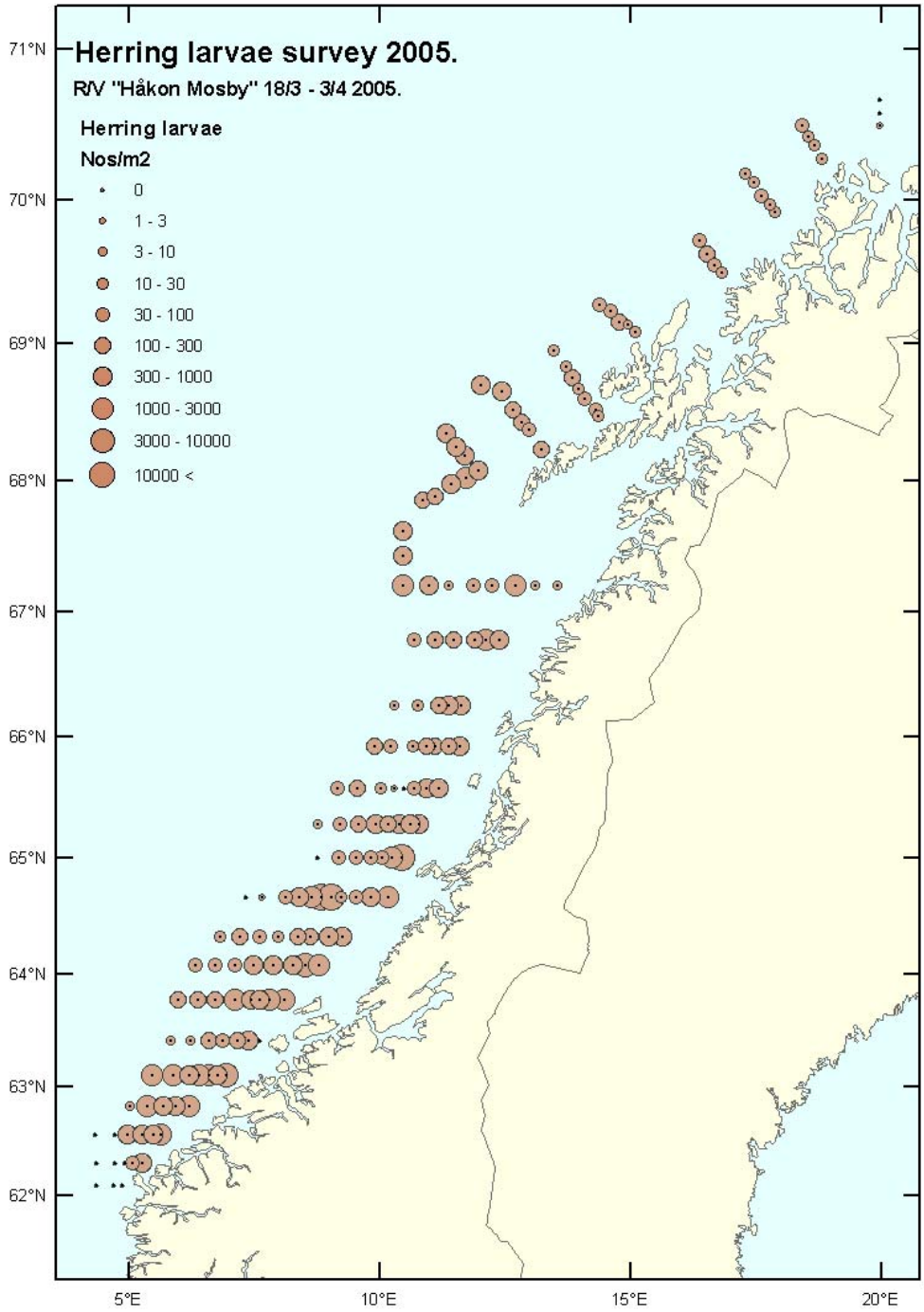

Figure 3. Concentration of herring larvae found on each station on the Norwegian shelf.

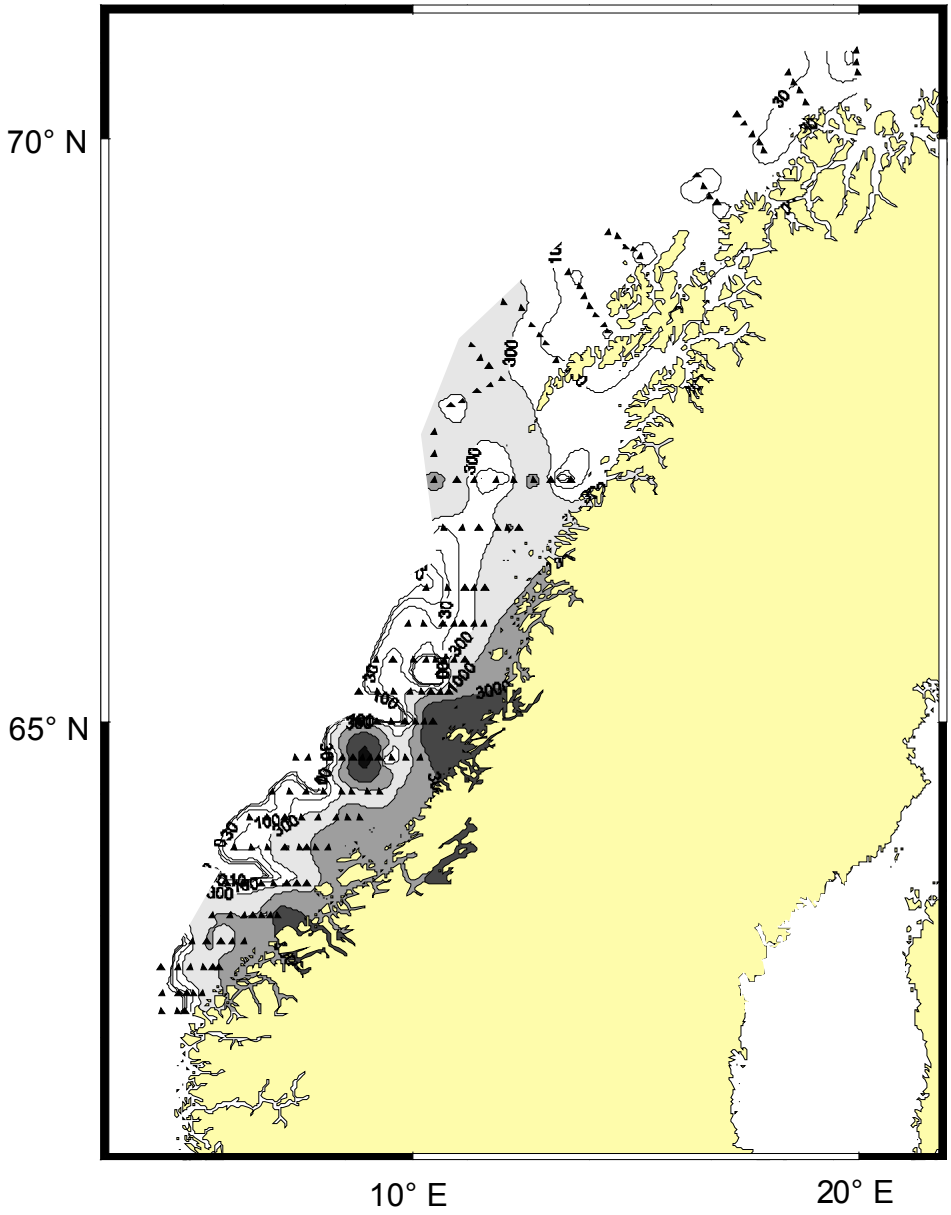

Figure 4. Distribution of herring larvae on the Norwegian shelf. Areas with concentrations of more than 300 larvae m^{-2} are indicated with filled contours.

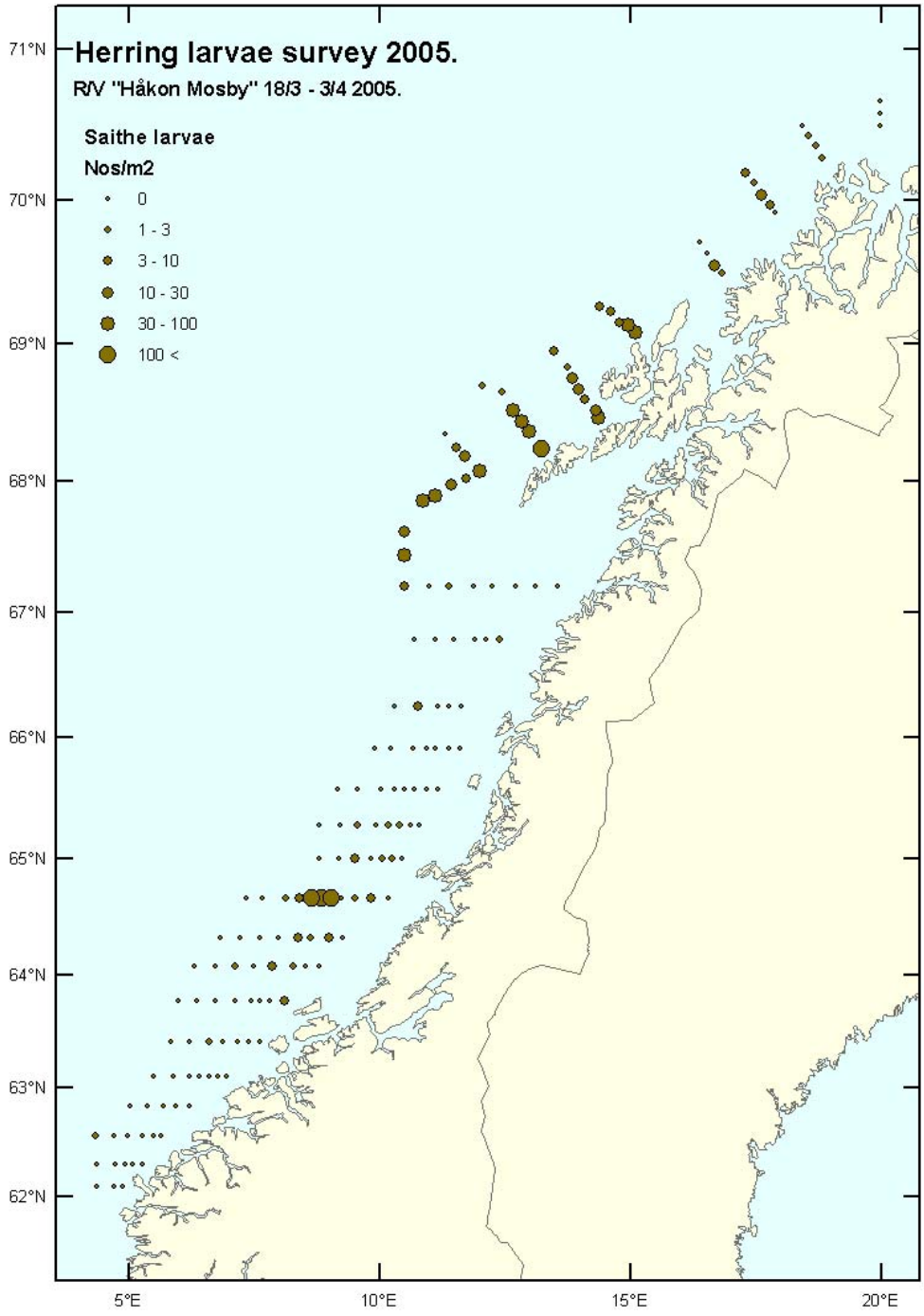

Figure 5. Concentration of saithe larvae found on each station on the Norwegian shelf.

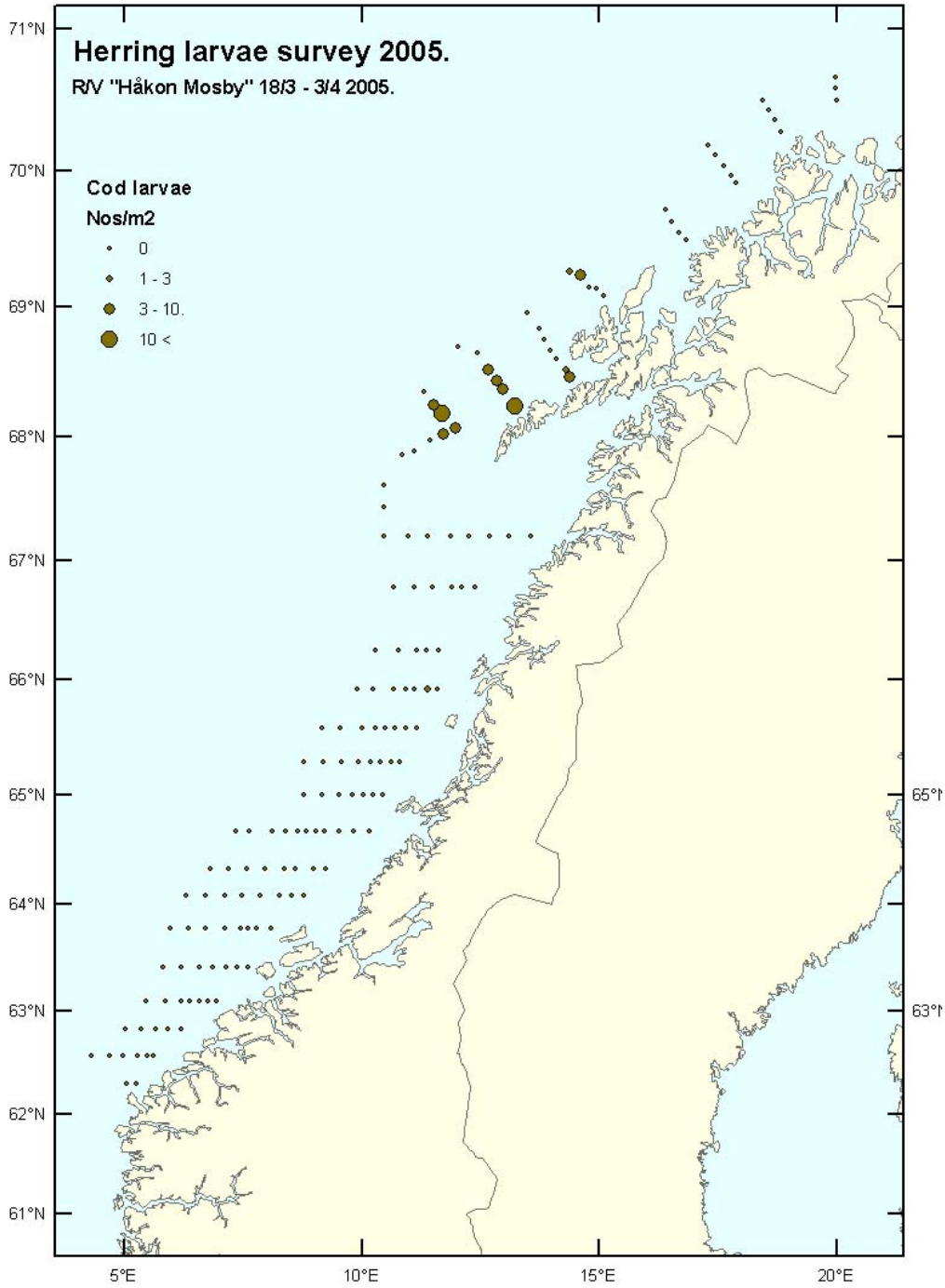

Figure 6. Concentration of cod larvae found on each station on the Norwegian shelf.

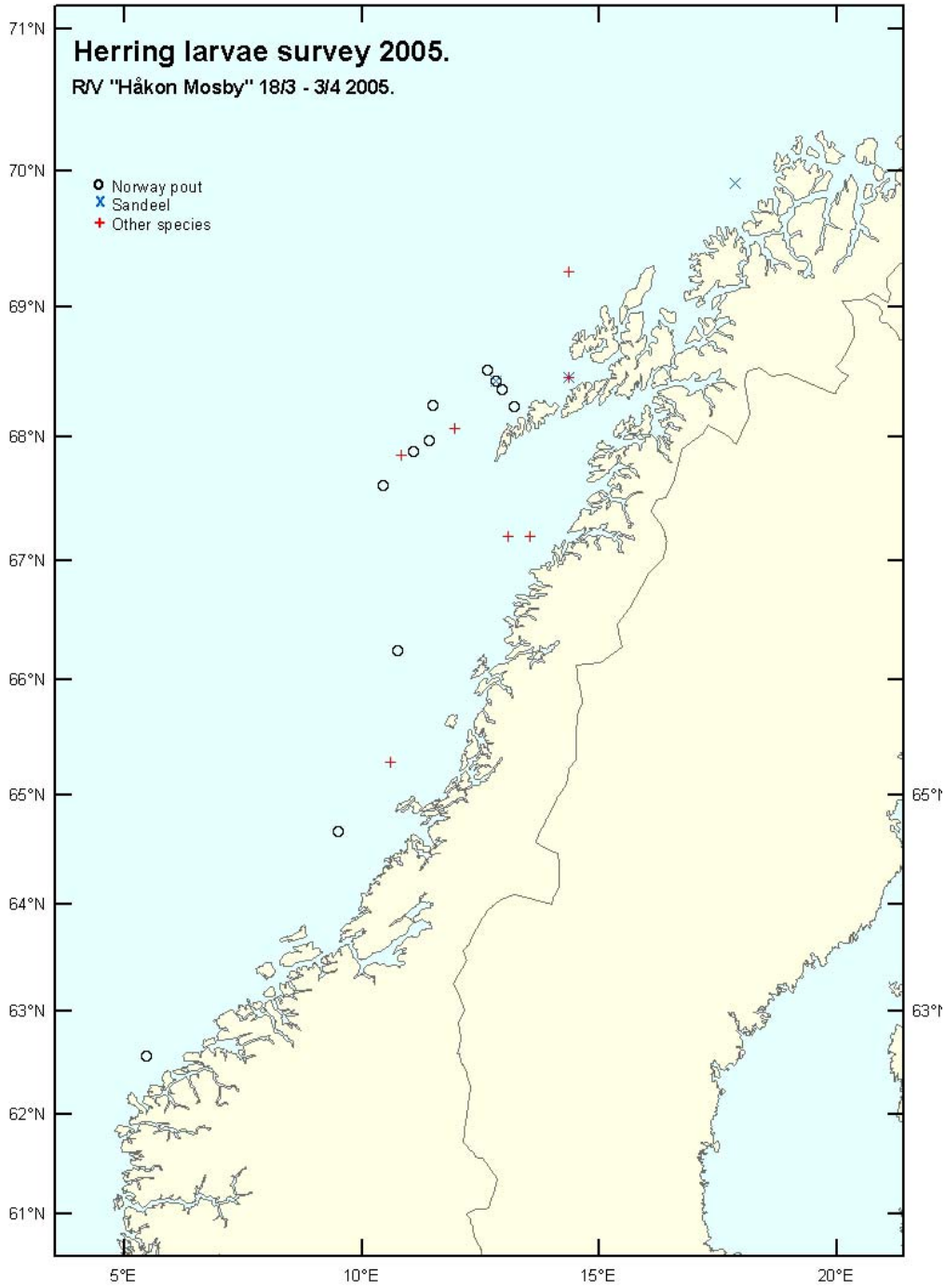

Figure 7. Distribution of other fish larvae found on the Norwegian shelf.