

«Cruise report»

RV Håkon Mosby 25.03-08.04.2006

**Distribution and abundance of Norwegian spring spawning
herring larvae on the Norwegian shelf in March-April 2006**

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, Petter Fossum, Reidar Johannesen (instrument), Laura Rey and Erling Kåre Stenevik (cruise leader).

Narrative

The survey started in Bergen on 25 March at 12:00. The first station was taken at 62°07N, 07°04E on 25 March at 22:22 UTC. The survey continued until the northern limit of the larval distribution was found at the inner part of Tromsøflaket and the last station was taken at 70°30N, 20°00E on 8 April at 10:15 UTC. The vessel then headed for Tromsø. During the survey a total of 169 CTD and larval stations were conducted in addition to 55 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 selected stations, 20 herring larvae (2a and older) was measured and preserved individually in liquid nitrogen for later analyses of larval condition.

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 $98.86 \cdot 10^{12}$. This is the highest number of larvae recorded since the time series started in 1981 (table 1). The mean size of the larvae was relatively low (11.9 mm) compared with previous years with the exception of 2005 where it was even lower (11.5 mm). This is probably due to the relatively early survey period these two years. Most of the larvae were in 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 all areas stage 2a dominated (Figure 2). This is the stage when the larvae are dependent on external food resources to grow. The southernmost area had, however, a high fraction of 1c and 1d larvae which are stages when the yolk sac is being emptied. This higher fraction of younger larvae on southern stations is most likely due to the fact that the survey started in the south. In area 2 which is the area on and close to Røstbanken, relatively high concentrations of yolk sac larvae were observed indicating that there had been a recent late hatching of larvae in this area.

As shown in figure 3, 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. The distribution this year was somewhat different from last year. Last year the highest concentrations were found in the Haltenbanken and Sklinnabanken area while this year the highest concentrations were observed just north of the Møre spawning grounds and very few larvae were found on Haltenbanken indicating that there was only limited spawning activity on this bank in 2006. Relatively high concentrations of larvae were also found south of Vestfjorden while no larvae were observed on three stations inside Vestfjorden. On most of the sections 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 4), which were found in the southern part of the survey area 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 62°N. Since the survey has not covered the area south of 62°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 5).

Acknowledgements

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References

Doyle, M.J. 1977. A morphological staging system for the larval development of herring, *Clupea harengus* L. *J. mar. biol. Ass. U.K.* 57: 859-867.

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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	Index 1	Index 2	Year	Index 1	Index 2
1981	0.3		1995	18.2	36.3
1982	0.7		1996	27.7	81.7
1983	2.5		1997	66.6	147.5
1984	1.4		1998	42.4	138.6
1985	2.3		1999	19.9	73.0
1986	1.0		2000	19.8	89.4
1987	1.3	4.0	2001	40.7	135.9
1988	9.2	25.5	2002	27.1	138.6
1989	13.4	28.7	2003	3.7	18.8
1990	18.3	29.2	2004	56.4	215.1
1991	8.6	23.5	2005	73.91	196.7
1992	6.3	27.8	2006	98.9	389.0
1993	24.7	78.0			
1994	19.5	48.6			

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 (%)	0.95	7.43	5.55	20.35	65.52	0.2	0

Table 3. Number of saithe larvae (numbers in 10^{12}) on the Norwegian shelf during the period 1996-2006.

Year	Total	North of 62°N	South of 62°N	Fraction (%) south 62°N
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	-	-
2006	1767	1767	-	-

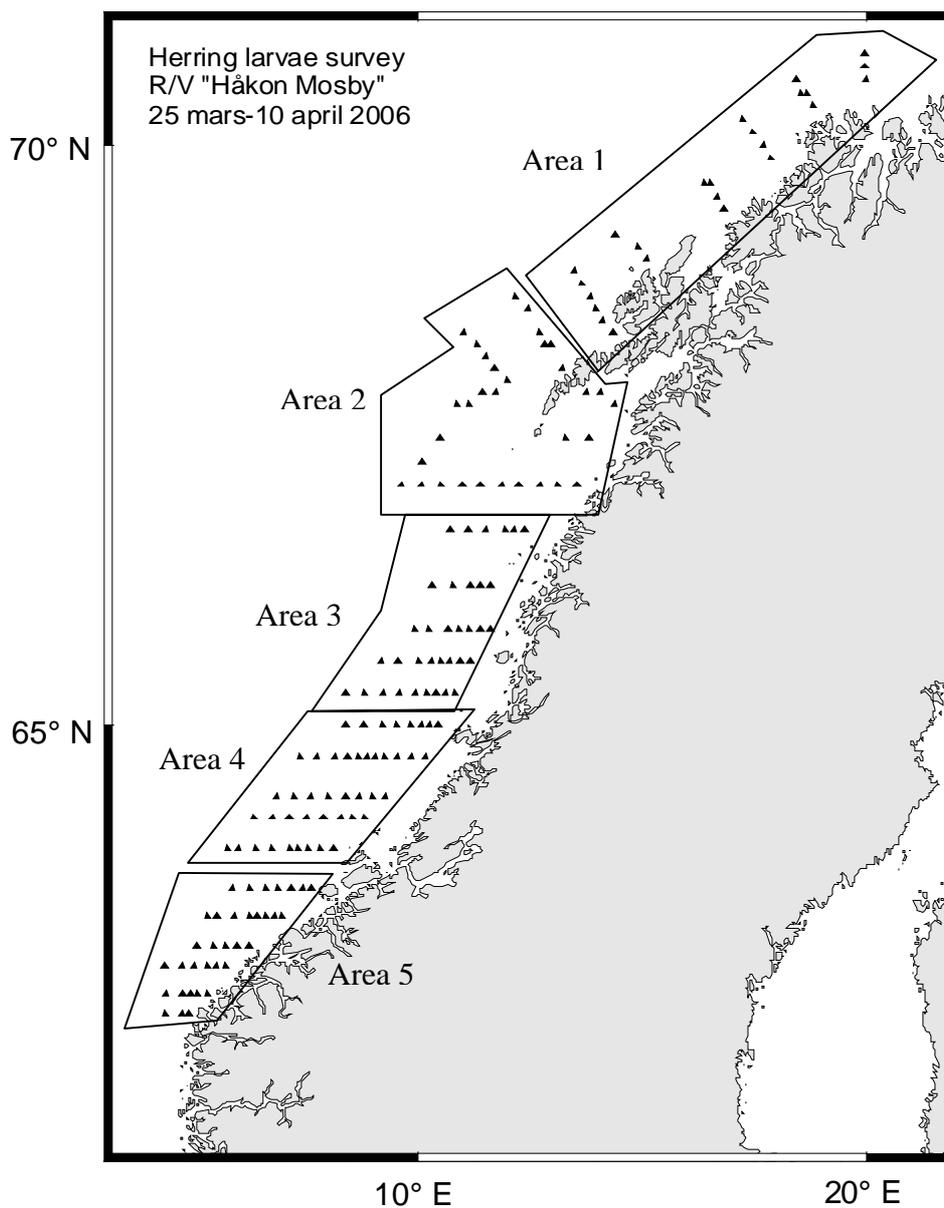


Figure 1. Cruise tracks with larvae stations (Gulf III and T-80). CTD casts were taken on every station and WP II on every third station.

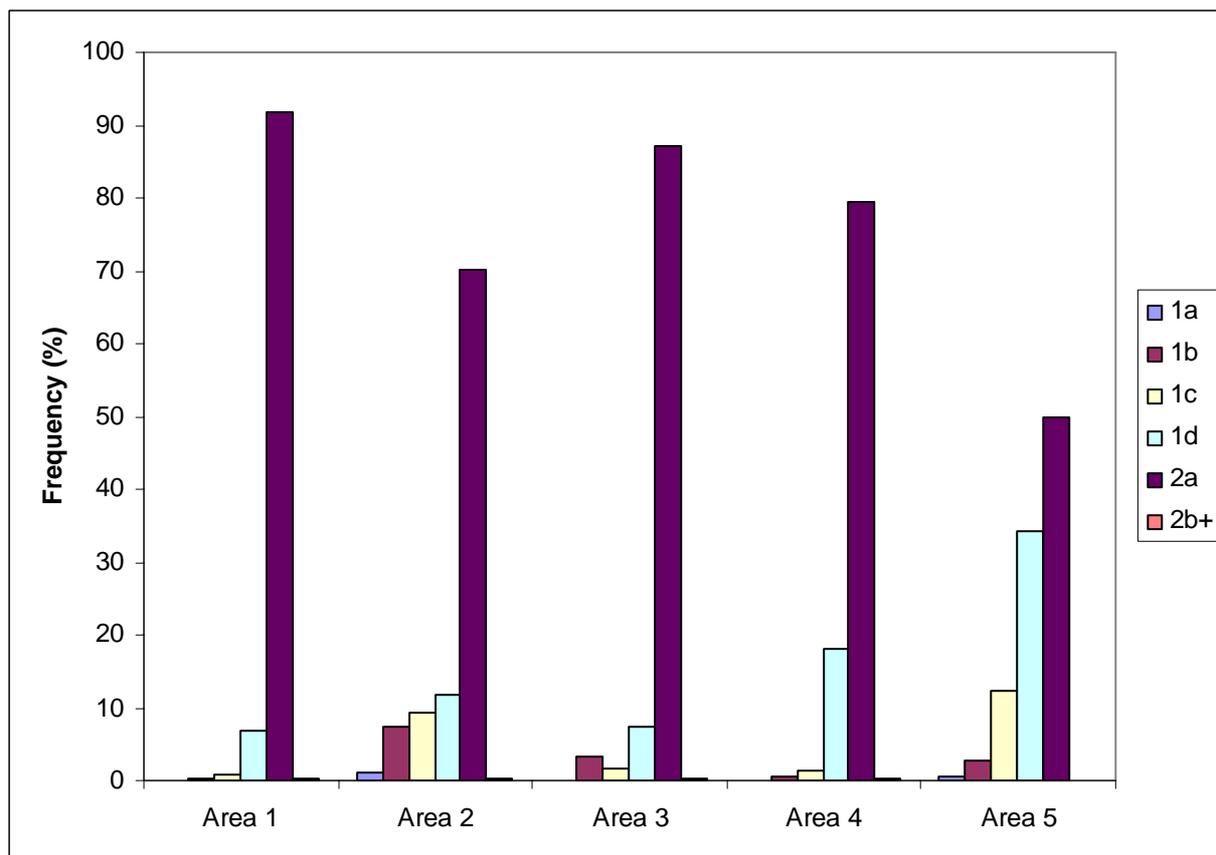


Figure 2. The figure shows the fraction of herring larvae in different developmental stages (Doyle 1977) in different areas on the Norwegian shelf. Area 1 is the northernmost area and area 5 is the southernmost area

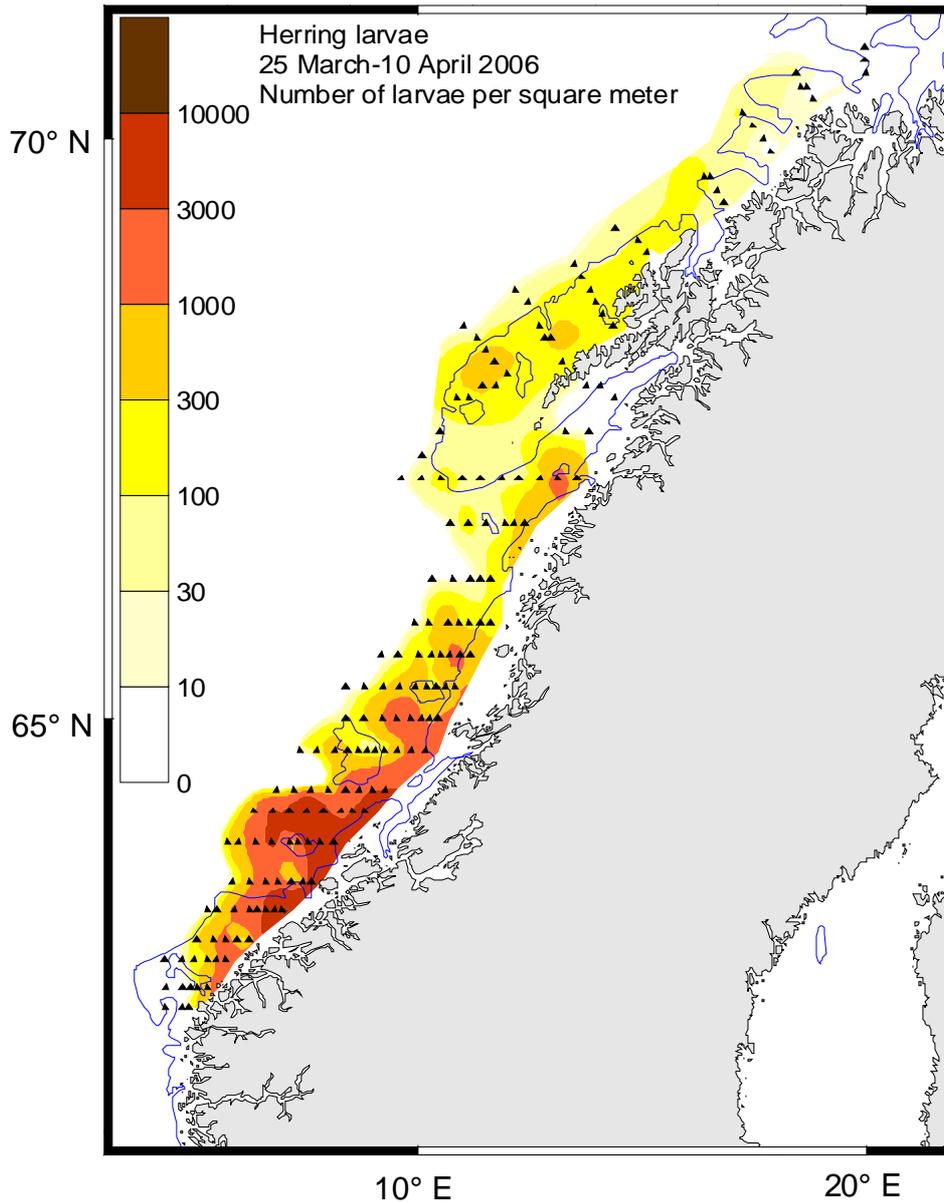


Figure 3. Distribution of herring larvae on the Norwegian shelf. The 200 m isobath is also shown.

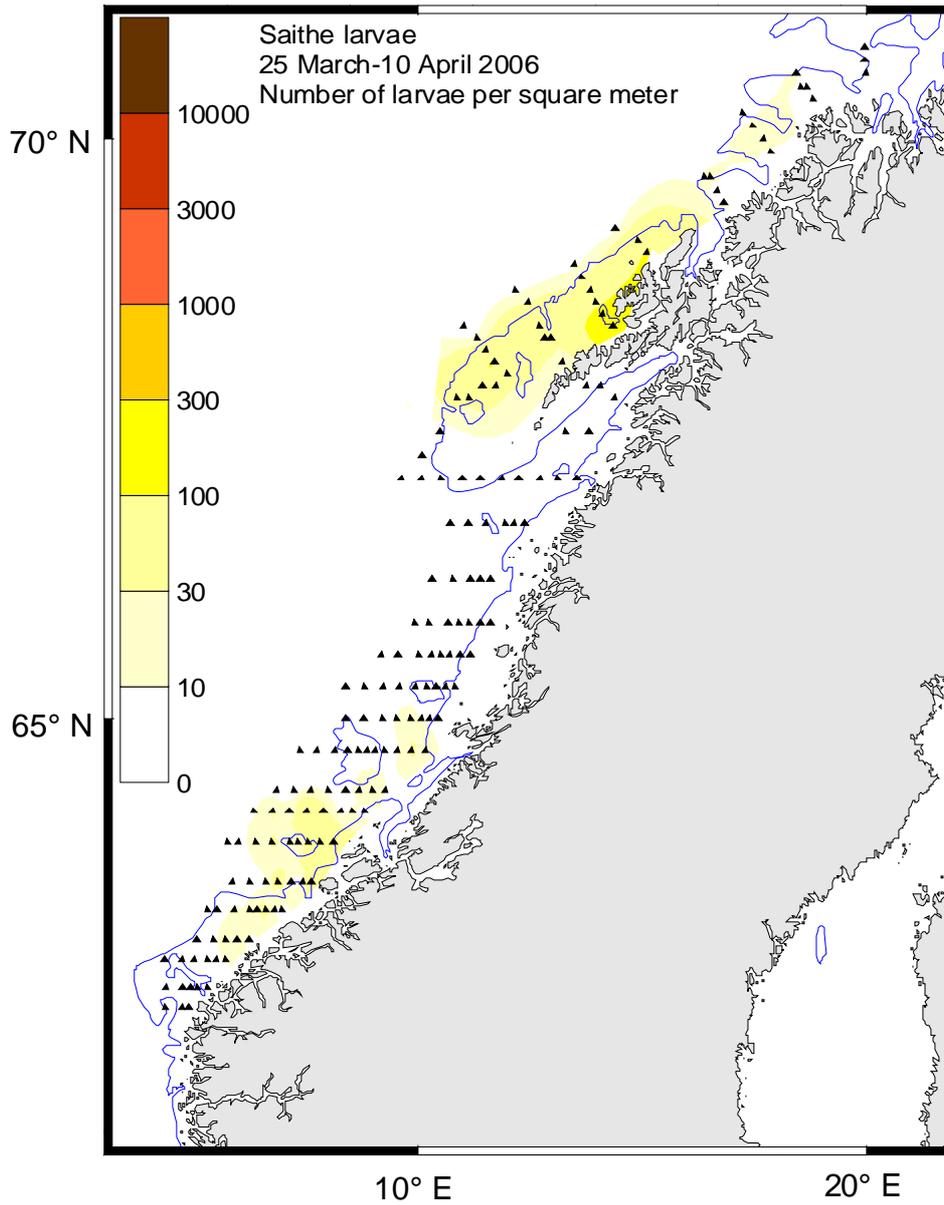


Figure 4. Concentration of saithe larvae found on each station on the Norwegian shelf.

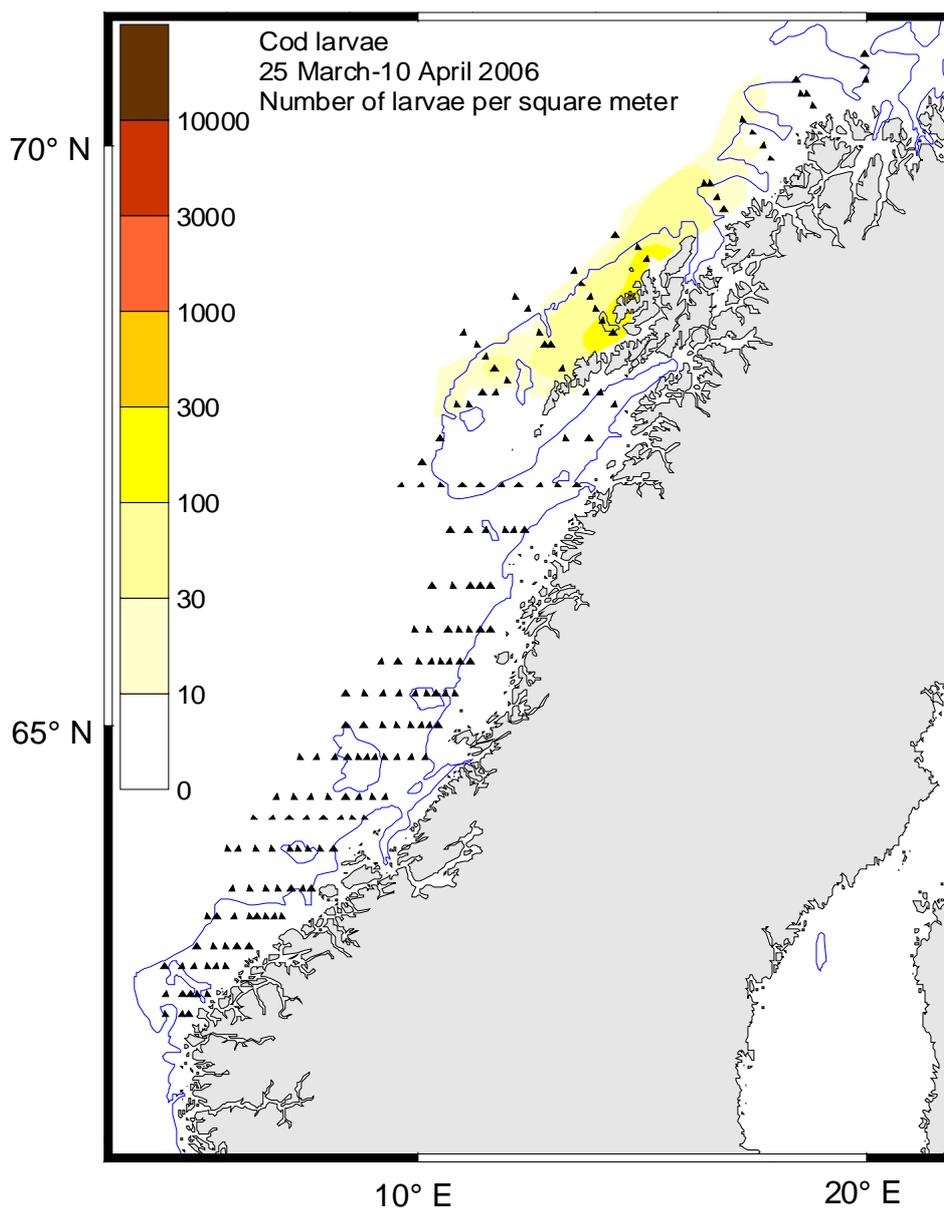


Figure 5. Concentration of cod larvae found on each station on the Norwegian shelf.