

**TOKTRAPPORT / SURVEY REPORT****Capelin migration and spawning dynamics in 2002**

By Aril Slotte

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**Introduction**

During 4 March to 6 April R/V *Michael Sars* was used to survey the Norwegian coast from Møre to Kirkenes. One purpose was to sample Norwegian spring spawning herring at the spawning grounds; this was carried out during 4-10 March, but data from this period is not presented in this report. The main purpose of the cruise was to study the migration and spawning dynamics of capelin off the Finnmark district. This was carried out from, 10 March to 6 April. The present report describes the data collected during this period, gives some preliminary results and further plans for analyses and use of the data.

**Material and Methods***Acoustic data*

Acoustic data with capelin as key species were collected during the period 10 March to 6 April 2002 with R/V *Michael Sars* off the Finnmark district in northern Norway. An acoustical survey covering historical important capelin spawning grounds (Fig. 1) was repeated four times during the study period. Data were collected at three different frequencies: 18khz, 38khz and 129khz. The data were scrutinized into capelin, groundfish (cod, saithe and

haddock grouped together, other fish and plankton. Acoustic data were also collected from an acoustic boy to study possible vessel avoidance.

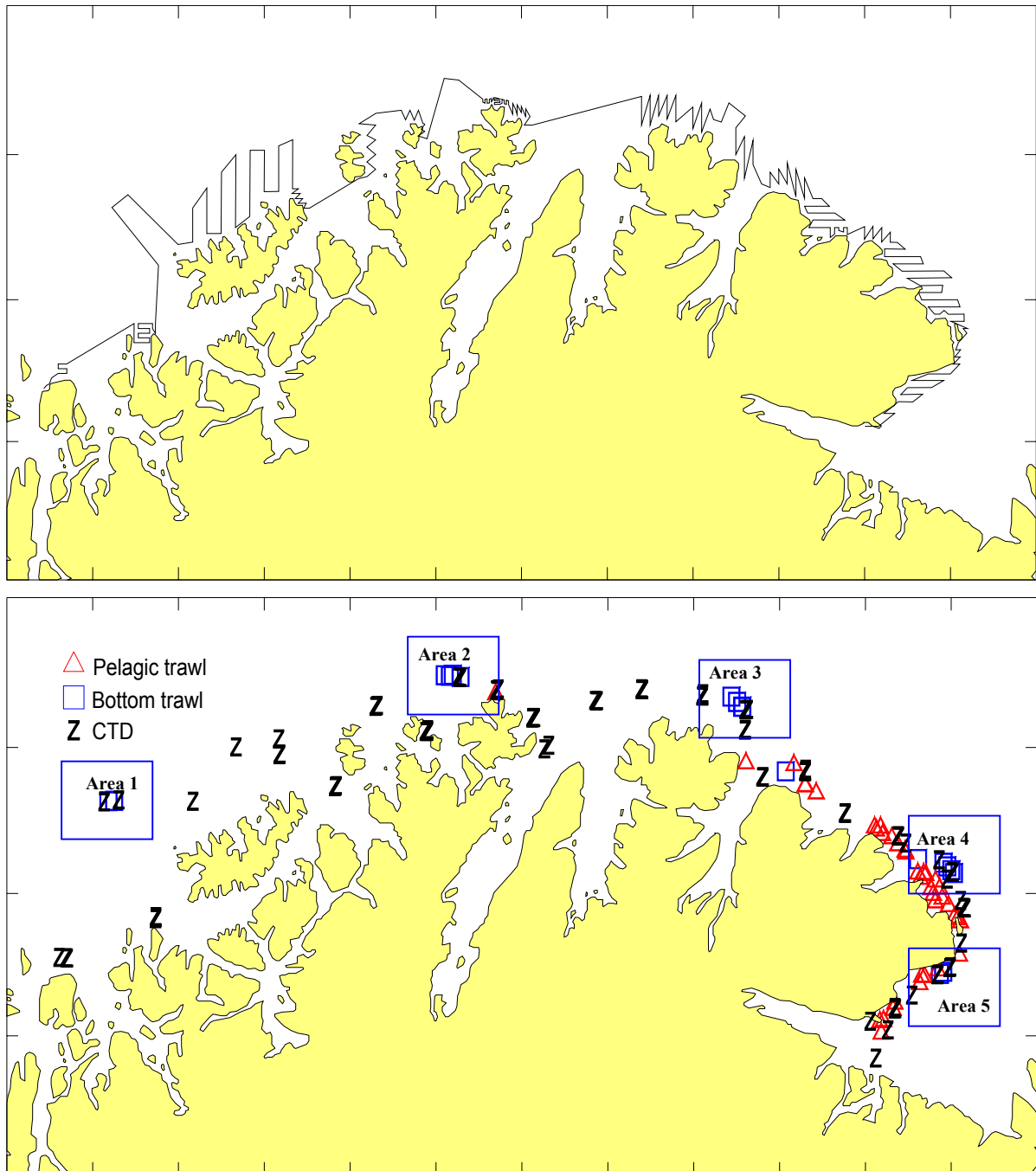


Fig.1. The survey track of R/V Michael Sars that was repeated four times during 10 March to 6 April 2002 (upper) and stations taken (Symbols: Z = CTD, blue rectangles = bottom trawls haul, red triangles = pelagic

trawl hauls) during the surveys (bottom). Bottom trawl hauls, with biological measures and stomach sampling of cod, saithe and haddock, were taken in 5 destined areas (Area 1-5) outlined in blue.

### *Environmental, trawl and biological data*

CTD-stations with data on temperature and salinity from 5 different areas from west to east were also repeated during each survey (Fig. 1). Bottom trawling was carried out in 5 different areas (Areas 1-5) from west to east, also repeated during each survey, whereas pelagic trawl hauls for capelin were carried out according to acoustic registrations (Fig. 1). The bottom trawl areas were outside the actual spawning grounds. Thus, it was expected that the ground fish in these areas would feed upon pre-spawning capelin migrating into the spawning grounds and spent capelin leaving the spawning grounds.

Altogether 3283 capelin were sampled and analysed. Length and weight was measured on up to 100 individuals, whereas sex, stage of maturity (subjective scale from 1-8), stomach fullness (subjective scale from 1-5), stomach content (two categories: capelin eggs, other individuals) and age was measured on up to 50 individuals (Table 1). Similarly cod, haddock and saithe were sampled at the bottom trawl stations. Here the length was measured from the entire catch or a sub-sample, whereas weight, stage of maturity and sex was investigated stratified by up to 5 fish in each 5 cm length groups. Stomachs from bottom trawl stations were also sampled by up to 5 stomachs in each 5 cm length group. Totally, stomachs of 641 cod, 420 haddock and 270 were sampled for diet studies. All the trawl data and biological measures have been punched with IMR's system Regfisk and stored in the database. The stomachs were frozen individually in plastic bags and collected in bigger bags for each station and specie. Each stomach was marked with numbers corresponding to individual data (length, weight, sex and maturity).

*Table 1. Overview of the number of trawl stations sampled and number of samples taken during the R/V Michael Sars survey 10 March to 6 April 2002. N-length measured indicates the number of fish length measured in addition to the full samples (length, weight, sex, maturity stage and stomach content).*

Species	N-stations	N-stomachs	N-length measured	N-total
<i>Capelin</i>	35	3283	391	3674
<i>Cod</i>	16	641	588	1229
<i>Haddock</i>	16	420	422	842
<i>Saithe</i>	11	270	227	497

## **Preliminary results, planned studies and suggested authors**

### *1) Migration dynamics of Barents Sea capelin at the spawning grounds: a case study*

By Aril Slotte and Harald Gjørseter

Barents Sea capelin generally spawns in March-April along the Finnmark district off northern Norway. In some years the capelin arrives the coast in two distinct groups, first in the east and then in the west based on the autumn and wintering distribution in the Barents Sea. Prior to the spawning migration, in the autumn 2001 and winter 2002, the stock was distributed with one western and another more eastern group. Thus, it was expected to arrive in two groups as in some previous years.

Based on this information the acoustical survey, which covered the presumed spawning area off the western and eastern spawning groups, was repeated four times during the 10 March to 6 April 2002. The objective was to get a better understanding of possible influencing factors to historic variations in spawning ground utilisation following the migration dynamics of these two groups at the spawning grounds in great detail with special emphasis on possible differences in age, size condition as well as timing of arrival and spawning.

Results from the four acoustic surveys as well as data from the fishery demonstrate that the capelin did not follow the presumed migration routes this year; it seemed to arrive only in the east. However, during the study period the total capelin abundance at the spawning grounds increased and at the same time there was a westward movement of the stock (Fig. 2). The biological data indicate that the capelin developed from a ripe stage in the first two surveys to spawning and spent stages in the next to surveys. Possible environmental or other reasons to the observed migrations dynamics in 2002 will be analysed and discussed in this study.

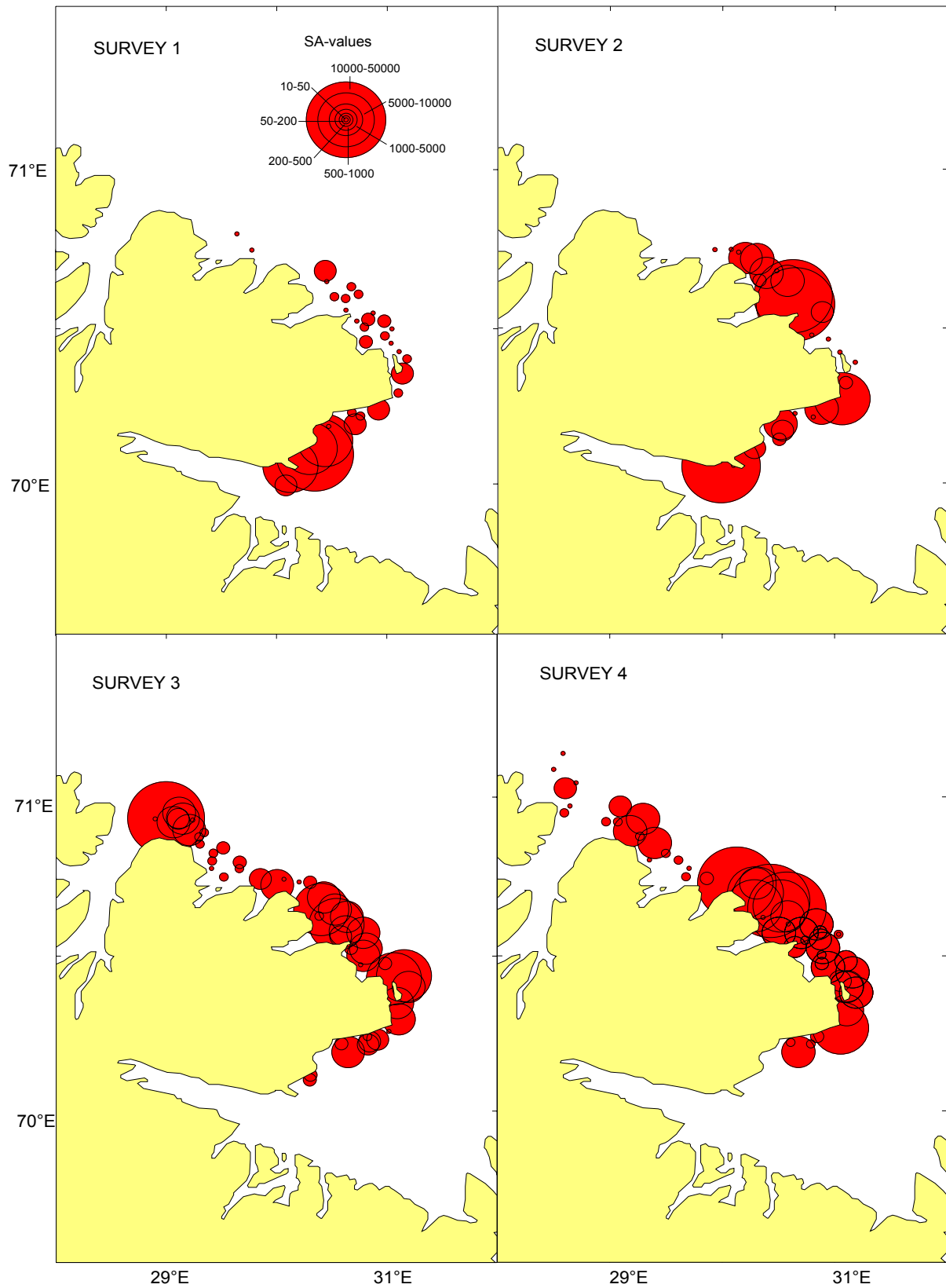


Fig. 2. Distribution and acoustic density (SA) of capelin recorded with R/V Michael Sars during 10 March to 6 April 2002. Capelin was not observed acoustically during surveying west of 28°E (see tracks Fig. 1).

*2) Factors influencing the size and density of Barents Sea capelin schools during the spawning season.*

By Aril Slotte and Harald Gjøsæter

The acoustical surveying of Barents Sea capelin during the spawning season 2002 along the Finnmark district off northern Norway demonstrated large variations in school sizes and density. Based on biological sampling of a variety of schools including a total of 3283 capelin from 35 trawl stations, we plan to explore whether the composition of length, condition, sex and stage of maturity can explain any of the observed variations in aggregation behaviour.

*3) Egg cannibalism in Barents Sea capelin*

By Aril Slotte and Harald Gjøsæter

During the spawning season 2002 Barents Sea capelin was observed to feed heavily on their eggs. A total of 1780 capelin from 35 trawl stations were sampled for stomach fullness on a the following subjective scale: (1) No content (2) Some content, often visible after cutting in the stomach, (3) Stomach is half full, (4) Stomach is full but not stretched and (5) stomach is full and stretched. 35.7 % of the investigated individuals had stomach contents, all of which had eaten only capelin eggs often mixed with gravel. However the egg cannibalism differed with stage of maturity and sex. In maturity stages 5 (ripe), 6 (spawning) and 7(spent) the percentage of individuals having eaten eggs were respectively 3.1, 0.8 and 64.4% for females and 19.9, 28.9 and 62.6% for males. The degree of stomach fullness also increased from maturity stages 5-6 and it was higher in males than in females. The males are larger then the females, but the frequency of individuals with cannibalism did not differ with body length in either females or males. The possible reasons to this significant egg cannibalism will be discussed from life history perspective.

#### *4) Reactions of Barents Sea capelin to vessel noise during the spawning season*

By Harald Gjørseter, Nils Olav Handegard and Aril Slotte

Experiments of possible vessel avoidance were made using an acoustic buoy developed at the Institute of Marine Research during the acoustic survey on Barents Sea capelin at the spawning grounds off northern Norway 2002. The buoy was anchored at shallow sites with capelin below its transducer. The echo sounder in the buoy made continuous recordings while the research vessel sailed towards the buoy, eventually to pass it at a close distance. The echograms from the buoy echo sounder were continuously sent by radio to the vessel during the passing, so possible effects on capelin behaviour could be studied directly. The results from thorough analyses of the backscattering data of these avoidance experiments indicate small or insignificant reactions to vessel noise.

#### *5) Diet of cod, haddock and saithe related to the capelin spawning migration 2002*

By Frøydis Rist and Aril Slotte

Student Frøydis Rist will in her Cand, scient thesis combine the data collected on acoustic density and biology on capelin in from studies 1) and 2) with the biological data collected on cod, haddock and saithe in 5 different areas (Area 1-5 in Fig. 1). Clearly, the most important part of this thesis will be to analyse the diets of these ground fish related to the capelin migration. She has finished the stomach content analyses in the lab, in accordance with standard methods at the IMR, but with emphasize on capelin. The exceptions from normal standards are that capelin found in stomachs has been measured for length (nearest half cm), weight (wet weight, mg), sex and maturity (pre- or post-spawners) whenever this is possible. The study has four objectives:

- A) To compare the diet between areas with and without capelin spawning; From the acoustic distribution (Fig. 2) it appears that there was little capelin in Area 1 and 2, Area 3 was an intermediate area, whereas capelin were present in Area 4 and 5 during

the entire study period. Also describe the effect that the occurrence capelin may have on diet and discuss the importance for growth of the predators.

- B) Describe how the diet may change over time within an area as the capelin arrives and the abundance may increase with spawning and decrease after spawning. Hereunder, investigate whether the diet may change as the composition of capelin, with regard to size, condition, stage of maturity and sex, may vary. In addition investigate whether the diet may change as the capelin may be available as both live and dead individuals.
- C) Describe inter-specific differences in diet. Cod, saithe and haddock are quite different species. The main question is whether all species chose to feed upon capelin when this is present in large quantities.
- D) Describe intra-specific differences. Does size matter? What is the minimum length of fish that preys on capelin? Are large fish more selective towards larger prey? These are questions we seek to answer in the study.

### **Acknowledgements**

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