Cruise Report
Cruise no. 2008 823, part 2

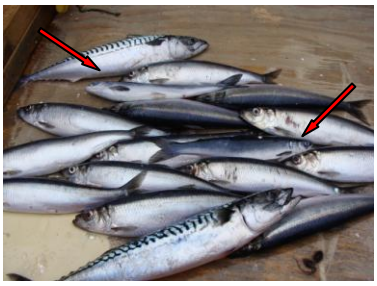
Ecosystem Survey & Whale Observations in Southeast Greenland Sea and Northern Norwegian Sea

Part 2, 26 July – 09 August, 2008

Including SALSEA-Merge cruise # 3


The M/S "EROS"


Concentration on herring sampling


Two post smolts "hiding" between herring and mackerel in a catch


A big catch

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INTRODUCTION

The cruise was a joint effort, merging a pelagic ecosystem survey, concentrating on salmon, herring and mackerel and observation of whales.

The aims were:

1. Investigate the distribution and feeding ecology of salmon post-smolts during their first year at sea in what is anticipated to be the northernmost part of the post smolt summer feeding areas in the Northeastern Norwegian and Southwestern Groenland Seas. Provide samples of post smolts for genetic, pathologic and physiological analyses.
2. Investigate macro plankton distribution in the northern areas, i.e. the food items available for the young salmon and other pelagic species
3. Survey of the distribution of herring in the Northeastern Norwegian and Southwestern Groenland Seas and the northerly range of mackerel distribution.
4. Observation of the distribution of whale species along the cruise track.
5. Experiments with sssessing the TS values of several large whale species by multibeam sonar.
6. Release of three Argo drifting buoys for the university of

The Ecosystem surveys are part of the IMR research programmes, and have been carried through regularly in July since 2002. The whale observations are made bi-annually in these areas. The salmon investigation was the third part of a series of cruises started in 2008 within the joint EU project SALSEA-Merge: Advancing understanding of Atlantic Salmon at Sea: Merging Genetics and Ecology to resolve Stock-specific Migration and Distribution patterns. Because SALSEA is a new project AT the IMR, it is present below in somewhat greater detail than the other projects involved.

Rationale for the salmon investigations

Despite management measures taken over the past two decades, the stocks of Atlantic salmon have been declining. The specific reasons for the decline are as yet unknown, but an increasing proportion of the salmon are believed to die at sea during their oceanic feeding migration Salmon populations may migrate to different marine zones, whose environmental conditions may vary. To date it has been difficult to sample and identify the origin of sufficient numbers of wild salmon at sea to enable this vital question to be addressed. The greatest challenge in salmon conservation is to gain insight into the spatial and ecological use of the marine environment by different regional and river stocks,

Aim of SALSEA

The SALSEA-Merge project (a joint project under the EU FP7 2008-2010) is aimed at providing the basis for advancing our understanding of oceanic-scale, ecological and ecosystem processes. Such knowledge is lacking for salmon, and is fundamental to the future sustainable management of this species. Through a partnership of 9 European nations the programme will deliver innovation in the areas of: genetic stock identification techniques, new genetic marker

development, fine scale estimates of growth, the use of novel high seas pelagic trawling technology and individual stock linked estimates of food and feeding patterns. In addition, the use of the three-dimensional Regional Ocean Modelling System, merging hydrography, oceanographic, genetic and ecological data, will deliver novel stock specific migration and distribution models. The project provides the basis for a comprehensive investigation into the problems facing salmon at sea. It may also act as a model for understanding the factors affecting survival of other marine species.

AREA SURVEYED

The area targeted area (**Fig. 1**) covers the south east Greenland and the northeast Norwegian Seas. This area is a.o. believed to cover the northernmost range of the post smolt (young salmon in their first feeding season at sea after leaving their home rivers). It covers also the northernmost range of the mackerel, and parts of the area is a transition and feeding area for several whale species.

MATERIAL AND METHODS

Cruise tracks with trawl, hydrographic, and plankton netting stations are shown in **Fig. 1**.
Acoustic data were recorded with the ER60 software. Frequencies at 18, 38,70 ,120 and 200 kHz were logged. Only data at 38 kHz was examined using the (Large Scale Survey System) LSSS. The target species were herring, mackerel and blue whiting.

All transducers were mounted on a drop keel which was lowered 1, 5 m below the bottom of the ship in order to avoid interference from air bubbles. The total range from sea surface to the transducers was around 7, 5 m.

Biological samples of salmon and other fish were obtained with a special trawl designed to be towed at the surface covering 0 - 10 m depth, width 60 m. To sample zooplankton a macro plankton trawl was used for sampling larger species and fish larvae, while a WP2 plankton net was used to sample small zooplankton.

All species caught were registered according to the IMR sampling protocol (number of fish, length, weight, total weight). Samples of herring scales and mackerel otoliths were taken for age determinations. Sex and stomach fullness of herring and mackerel were registered and stomachs of herring and mackerel were preserved for later analyses of content.

The salmon post-smolts were photographed, measured, weighted, sexed, scale loss was estimated, number of lice counted and stored, and visual inspection of cataracts, external tags, finclip for internal tags, deteriorated fins/escapee, scars etc. Following samples and recordings were taken (and stored if applicable) on every fish: scale sample, pectoral fin for DNA sample, disease sample (gill filament, pyloric caeca, spleen, kidney on three places), ISA disease sample

(gill filament and kidney), Isotope sample (liver, dorsal muscle, adipose fin, heart, tip of caudal fin), lipid sample (dorsal muscle), stomach sample, otolith sample. The carcass was labelled and stored.

The biological sampling was time consuming and it took about 10-15 min to sample each fish by three people on board, and on a occasions with large catches (more than 10 salmon) a reduced sampling scheme was applied, and in two cases the fish was frozen after only the length, weight, picture, scale loss, lice count, DNA sample, and presence of cataracts was recorded.

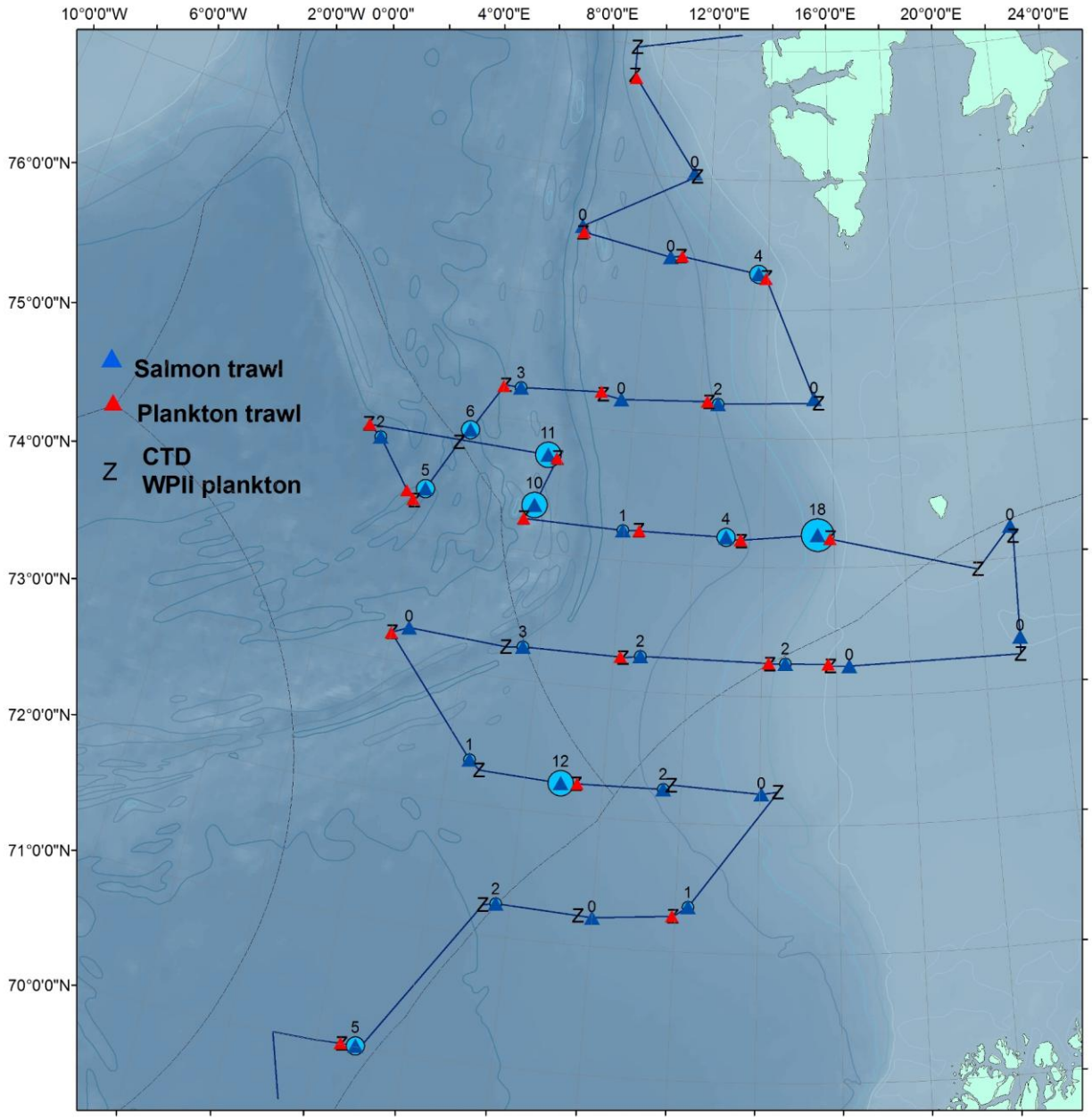
Other species like mackerel and herring were measured, weighted, sexed, otoliths were removed for age reading, and the stomach was removed for dietary analysis (of the first 10 fish sampled for each species).

Hydrographic data (temperature, depth, and conductivity/salinity) were collected at every station with a CTD (SAIV sonde) cast down to 500 m depth, and a termosalinograph recording temperature, salinity and conductivity at 5m depth every second along the cruise track. Water samples were taken from each station (except from two CTD stations taken in relation to whale observations), with 5 litre Niskin water bottles mounted on the CTD wire, for analysis of nutrients and chlorophyll. The water samples were taken at 10, 30, 50 and 100 meter depth. Nutrient samples were preserved with chloroform, stored in the fridge and will be analysed at IMR, Bergen. Water samples for chlorophyll analysis was filtered onboard, stored in the freezer and will be analysed at IMR.
Meso-zooplankton were sampled at every station with an egg net, diameter 160 cm and 375µ mesh size, from 50 meter to the surface. The samples were preserved in formaldehyde and will be analysed at IMR. Macro-zooplankton were collected at selected stations with a macro-plankton trawl towed in the surface water. The samples were taxonomically analysed, each taxonomic group weighted and counted, and individuals were length measured. The plankton samples are quantitative.

Whale observation
The whale observation task was less extensive on this second cruise leg, with only two observers on board. When the weather conditions permitted it, the observations were recorded simultaneously from two positions on the bridge during the transport stretches from one trawl station to another. Species, number of animals, distance, lat. & long. coordinates, and comments were logged. In addition, for the purpose of experiments with Target Strength measurements of the targeted whale species, angles relative to the boat were measured.

RESULTS
The weather was excellent and the survey coverage was according to the survey plans although the tracks where altered slightly from original plan due to observations made along the track. The instrumentation functioned as planned, except for minor breaks in the termosalinograph logging due to malfunction of the windows programme.
In July-early August, at the latitudes surveyed, the sun stays above the horizon during the whole diurnal cycle.

Figure 1 Cruise track with "salmon" trawl and macro plankton trawl tows, CTD casts and plankton net stations. Number of salmon captured per 2 h trawl tow indicated with light blue circles and numbers



FISH
Altogether 31 surface trawl tows were made.

Salmon
These areas have not been surveyed systematically for post smolts before, and especially the westerly distribution of these fish is unknown. Although not numerous, salmon post-smolts were caught in almost every haul, on average 3 posts smolts per 2 h tow with three tows containing more than 10 salmon. In total 88 salmon were caught most of them post-smolts (mean length 24,8 cm and 143 g) that had left the rivers in the spring. 6 adult salmon were also caught, 5 of them fish that had passed one winter at sea (1SW salmon, mean length 50,2 cm) and one 2SW (98 cm) female kelt (a salmon that has re-entered the sea after spawning).

Figure 2. Post smolts without scales in a catch where important numbers of lumpfish had been present

None of the captured salmon were carrying tags or were fin-clipped.
Most of the post smolts had lost most of the scales during towing (**Fig. 2**). All fish were screened for lice but because of the loss of most of the scales, few lice were detected on the fish. The fish were examined for signs of skin damages due to lice infestation and the ratio was 57/ 88 or 65 %. However, these damages were mostly 1 out of a scale of 4. The larger salmon suffered less scale loss and consequently the number of lice per fish was higher (range 4-36). Only one of the adults had so many lice and so important skin leisures that it could be considered as dramatic, especially as many of the lice were in sub adult stages.

This year's observations will form an excellent basis for setting up a revised cruiseplan for 2009, the second sampling year within the SALSEA-merge project.

Mackerel
Mackerel were caught in 77% of the tows but never in large quantities. The mean length was 37 (30 – 45 cm range) cm and mean weight was 482g .

Norwegian spring spawning herring
Herring were found in 90% of the tows but only in the eastern areas in larger quantities. The mean length and weight were 30,2 cm and 236 g, respectively. In some tows in the shelf area herring larvae were found in large quantites meshed in the mid part of the trawl.

Other species
Capelin were found in the northernmost tows.
Lumpfish were caught in 83% of the tows.
Pipefish were frequently captured, but not in great numbers.
A few squid (Todarodes) were captured during the late night hauls.
Gadoid, sandeel and herring larvae were observed in the tows between the 1000-2000 m depth isoline

BIOLOGICAL AND HYDROGRAPHICAL OBSERVATIONS
22 macro plankton trawl tows, 31 WP2 plankton net stations and 33 CTD stations. Temperature and salinity in 6 m depth were logged from day 3 (76°N) onwards along the track.

Table 1. Total number of CTD, water samples and plankton samples collected
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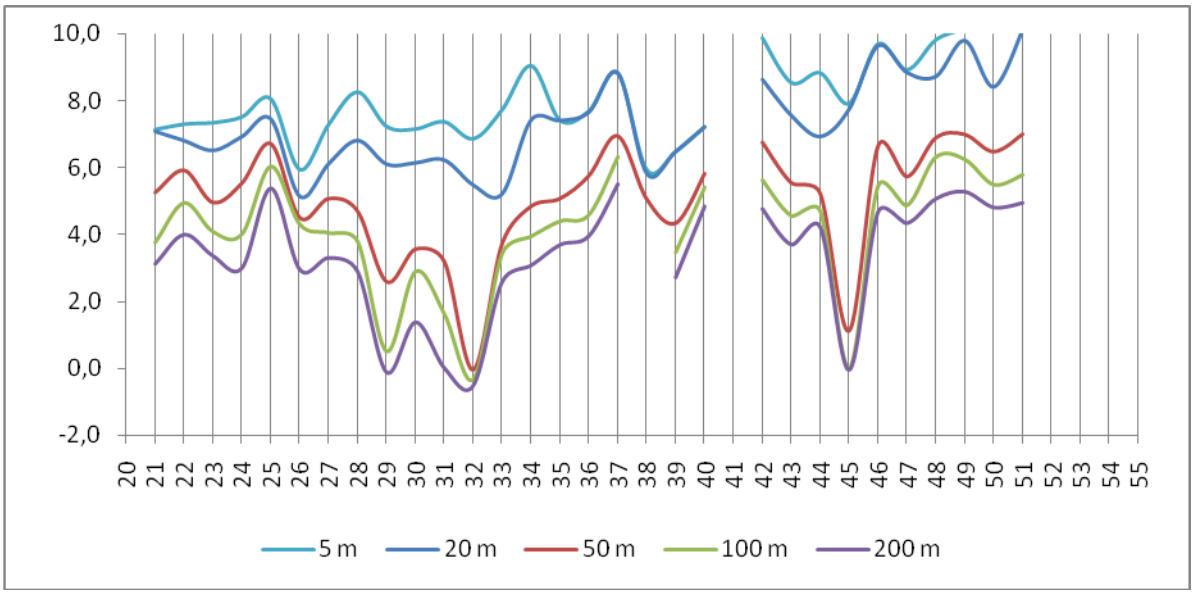
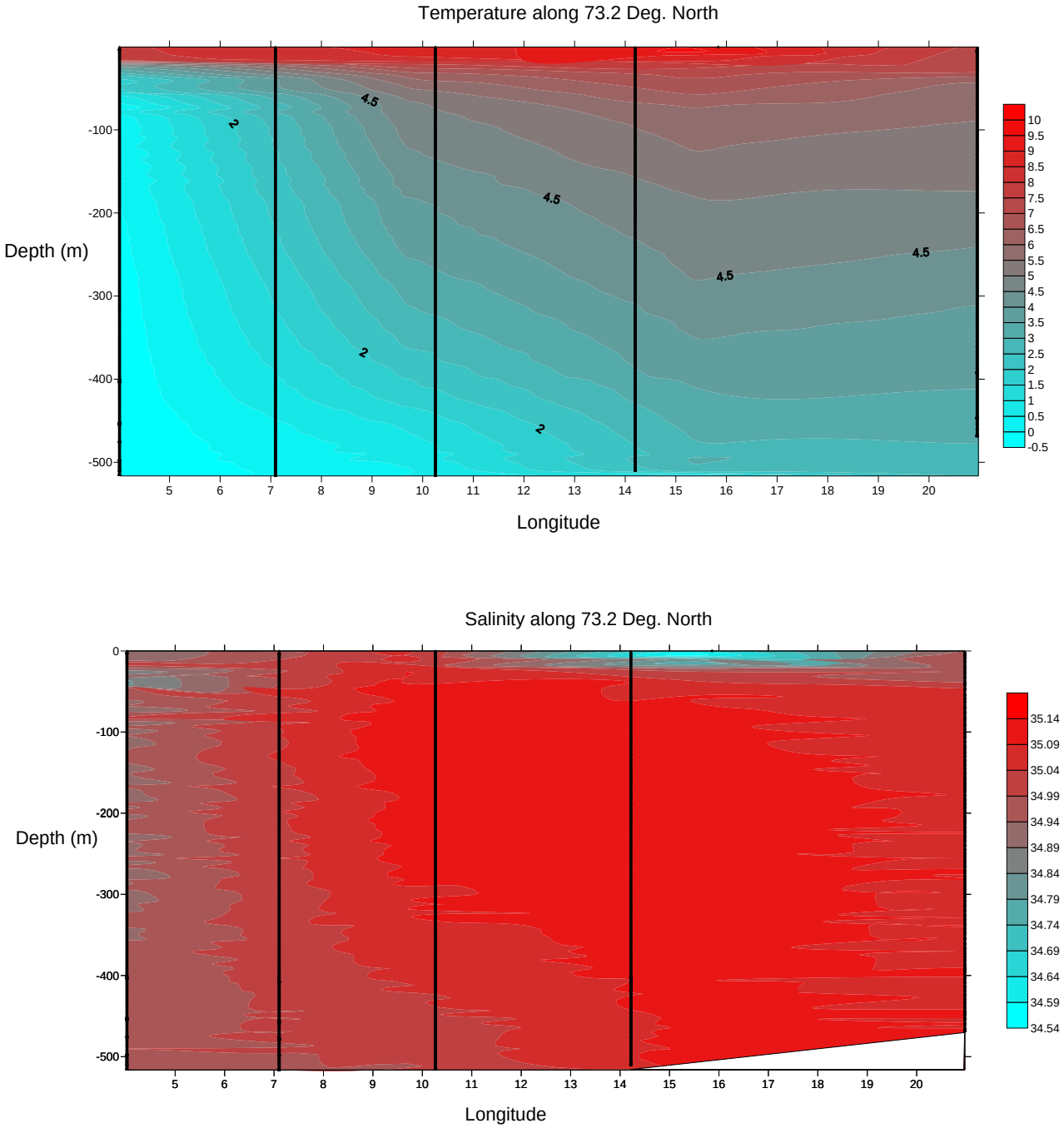
Sample type	Number of sampling stations
CTD	33
Chlorophyll	31
Nutrients	31
Egg net	31
Krill trawl	22

Marine Environment
The temperature (°C) in 5 -200m at the stations is shown in **Fig. 3**. Calibrated temperature and salinity data from the CTD casts will be available at a later stage.



Figures 4a and b show vertical distribution of salinity and temperature along the transect at 73 °N. Decreasing temperature with depth and towards west was typical for all transects. Salinity was highest in the central parts of the transects, where Atlantic water dominated.

Figure 3. Temperature (upper panel) and salinity(lower panel) along the transect at about 73 ° N.



Zooplankton

The meso-zooplankton was not analysed onboard, and therefore the final taxonomic results are not available yet. The samples mainly consisted of *Calanus finmarchicus.* The youngest *C. finmarchicus* copepodite stages were not collected due to the mesh-size, and older stages were found in relatively high numbers throughout the sampling area. In addition, small chaetognaths, amphipods (most likely Themisto sp.), Limacina sp., and ctenophora were found. In general, very low numbers of macro-zooplankton were observed in surface water in the survey area, except from the northernmost stations. Fish larvae were the dominant macro-zooplankton observed, with highest concentrations observed in the eastern part of Atlantic water and towards the west coast of Svalbard. The fish larvae consisted mainly of cod, haddock, blue whiting, herring, red fish, and capelin. Red fish and capelin larvae were found in varying numbers throughout the survey area. At the northernmost stations west of Svalbard, relatively high numbers of *Themisto libellula* were observed. In addition, C*lione limacina*, ctenophora, *Gonatus fabricii* were observed in low numbers.

Whales

In order to enable more precise assessment of number of individuals in a flock and identification of some species resembling each other, whale observation requires very calm weather to be successful. During the second cruise leg, only a few days fulfilled those requirements, although the weather was good enough for the other investigations. However, 84 observations of marine mammals were made. It should be noted that "observation" may imply a single or a few animals or even a whole flock. Twice around the northernmost trawl tows, a jumping salmon was sighted.

Table 2 . Sightings of marine mammals and salmon

SPECIES	OBSERVATIONS, TOTAL NO.	SPECIES	OBSERVATIONS, TOTAL NO.
Minke whales	21	White beaked dolphin	19
Fin whales	21	Humpback whales	5
Sperm whales	8	Unidentified large whale	2
Sperm whale, dead	1	Unidentified dolphin	1
Killer whales	6	Salmon, jumping	2

TS measurements

Several whale species were successfully logged with the sonar for up to 30 min and the target strength values for different positions of the animal relative to the sonar will be calculated after calibration.

Acknowledgements
Due to the merging, with short notice, of several cruises with relatively disparate research aims, the cruise logistics, instrumentation and sampling schemes were complicated. The scientific personnel are thanked for high spirits and hard work during long hours. Likewise the instrument operators deserve honours for a wonderful job setting up complicated and important instrumentation en route while we were operating at sea. Lastly the crew of M/S "Eros" are thankfully acknowledged for their cooperative spirits, professionalism and forbearance with the different changes in routines when the scientific needs so required.