INSTITUTE OF MARINE RESEARCH
BERGEN, NORWAY

CRUISE REPORT

CRUISE NUMBER:	JH1999210
VESSEL:	R/V "JOHAN HJORT"
DEPARTURE:	Bergen, Norway on June 15, 1999
ARRIVAL:	Bergen, Norway on July 9, 1999
PORT OF CALL:	Tromsø, Norway on June 30, 1999

PARTICIPANTS:

Name	Affiliation	Responsibility
Francisco Rey	Institute of Marine Research, Bergen	Chief scientist
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Erling Molvær	Institute of Marine Research, Bergen	Instrument operator
Marianne Holm	Institute of Marine Research, Bergen	Salmon investigations
Helge Sagen	Institute of Marine Research, Bergen	Current meters (to June 30)
Reidar Pettersen	Institute of Marine Research, Bergen	Technician Zooplankton
Fred Menzia	NOAA-PMEL , USA	CFC

SCIENTIFIC OBJECTIVES

The cruise had several major objectives:

1) To carry out hydrographical and chemical investigations, including chlorofluorcarbons (CFC) and transient tracers, at selected stations in the Norwegian and Greenland Seas as part of a routine co-operative observation program between IMR and NOAA`s Pacific Marine Environmental Laboratory, Seattle, USA.

2) To carry out hydrographical, chemical and biological oceanographical observations at the standard Norwegian sections Gimsøy -NW, Fugløya-Bjørnøya and Bjørnøya -W as part of IMR`s own monitoring activities

3) To carry out physical, chemical and biological investigations in the Greenland Sea and northern Norwegian Sea in connection with the research project "Mixed layer dynamics, nutrient supply and primary production in the Nordic Seas". The project is supported by a grant from the Norwegian Research Council and is part of IMR´s research program "Mare Cognitum".

4) To collect water biological and sediment samples for the determination of diverse radionuclides in the northern Norwegian Sea (IMR), including monitoring activities at the site of a sunken Russian submarine.

5) To map the distribution of Atlantic salmon in the northern Norwegian Sea as well as to get a rough overview of the distribution of herring and other pelagic species. Emphasis was also given to the collection of diseased herring in the investigated area (IMR).

6) To recover and redeploy current meters rigs at Tromsøflaket as part of the European Program VEINS (IMR).

CRUISE TRACK

Figure 1 shows the cruise track and the positions of the oceanographic stations where sampling was carried out. Figure 2 shows the positions of the fishing stations.

NARRATIVE

The vessel left Bergen on June 15 at 1900 h and after bunkering fuel we sailed northwards along the ship lane inside the fjords in order to have relatively calm weather while we worked on mounting and testing our laboratory equipment. On the morning of the 16th and after rounding Stadt at about 62°12`N, one of the westernmost point of the Norwegian coastline, we sailed into the Vanylvsfjorden just on the northern side of Stadt, in order to carry out a check of our sampling equipment. This task was successfully accomplished and we set again a northwards course towards the first oceanographic station (Gimsøy 1) at 68° 24.6`N and 14° 04`E. On our way there we did two trawl stations just south of the Lofoten Islands in order to check the presence of salmon and herring. On the morning of the 18th of June we started the Gimsøy -NW section, a fixed oceanographic section from IMR that it is covered several times a year. On this particular cruise we extended the section further NW until 74° 05`N and 04° 20`W close to the middle of the Greenland Sea. During the first days of covering the section the work went quite slow due to a strong gale with winds up to 45-50 knots. Fortunately this bad weather lasted only a few days. After that the work went quite smoothly and after schedule. Unfortunately, after taken the first deep station we discovered that the CTD was showing salinities about 0.02 PSU lower than we had expected. Since we did not have a spare conductivity sensor onboard (all of them had been sent to the SeaBird factory for calibration and their return was delayed) we decided anyway to continue the cruise taking extra salinity samples for calibration. Since we were aware of the difficulties in carrying out oceanographic work with only one CTD package we had beforehand arranged to get a spare one on our call of port at Tromsø at the end of June.

After finishing the northwesternmost station (St. 490) on the 23rd of June in the morning, we set course almost directly west in order to try to reach the ice edge at 74° 30`N, the latitude of our next section. This was done with the help of ice charts provided to us by the Norwegian Meteorological Institute. We reached the ice edge on the 24th of June at mid-morning at longitude 15° 24 `W. The weather conditions were pretty good so we were able to take the station quite close to the ice edge, which was very well packed. From the ice edge we sailed eastwards along 74° 30`N towards Bjørnøya (Bear Island) where we arrived early in the morning on the 29th of June. One of the cruise's objectives was to take up and redeploy two currentmeters rigs on the Tromsøflaket at about 72° N and 19°40`E. Since the weather forecast, when we were at Bjørnøya, was quite good for the next days we decided to carry out this work first instead of going north towards the Svalbard Bank as planned. Unfortunately only one of the rigs was successfully recovered and redeployed. The other one was apparently lost. From the rig position we went directly to Tromsø where we

arrived on the afternoon of the 30th of June. The plan was to have only a short stop at Tromsø but due to a delay in the transport of spare parts for our Mocness net from Bergen, we had to wait until the next day. We left Tromsø again on July 1st at 0800 h and set course northwards to the first station of the Fugløya-Bjørnøya section (70° 30`N; 20° 00`E) where we arrived in the early afternoon. The section was worked out without problems and finished at Bjørnøya close to midnight on the 2nd of July.

From Bjørnøya we sailed again northwards to the southernmost part of Spitsbergen in order to cover a section from the Svalbard Bank and southwestwards along the Storfjordrenna. We finished this work on July 4th in the morning and started our way home. First we took water and sediment samples at the place of the sunken Russian submarine "Konsommolets" and thereafter we worked out a south-west section covering the deepest parts of the Lofoten and Norwegian Sea Basins. We finished this work on the afternoon of July 7th and set immediately course to Bergen where we arrived on July 9th at mid-noon just according to our schedule.

SAMPLING METHODOLOGY

HYDROGRAPHY

The hydrographic work was carried out with two independent CTD-water sampling packages from SeaBird Inc. with data being collected both during up- and downcast. The first package consisted of a SBE 911plus CTD with a 12 position SBE 32 Caroussel (CTD-12) equipped with 10 litres Niskin bottles and was used preferentially for deep water work. The other package consisted of a SBE 19 Seacat with a 24 position SBE 32 Caroussel (CTD-24) equipped with 23 pcs. 2.5 litres Niskin water samplers and was used for shallow water work. In the remaining place of the 24 positions Caroussel, a Biospherical QSP-200L irradiance meter was mounted. A SeaTech fluorometer was also attached to the system. Both the irradiance meter and the fluorometer were coupled to the SBE 19 for powering and data transmission. At all stations water samples were collected from the deepest sampling level and all sampling depths below 1000 meter for calibration of the conductivity sensors of the SBE 911+ CTD package. For calibration of the SBE19 package salinity samples were taken only at the deepest sampling depth.

CHEMISTRY

• Oxygen

Oxygen concentration was measured using the Winkler method with visual determination of the titration end-point. Titration was done on whole samples (about 120 ml) transferred to 250 ml Erlenmeyer flasks and using a 1 ml automatic burette (Metrohm Dosimat 665) with a dispensing precision of 0.001 ml. Calibration of the thiosulfate solution (about 0.1 N) was done on each run. The reproducibility of the method estimated as the standard deviation of ten replicates drawn from one 10 litre Niskin bottle was about 0.010 ml l^{-1} at an oxygen concentration of about 7 ml l^{-1}. Sampling procedures, reagents preparation and analyses were done following WOCE recommendations as stated in Culberson (1991). Conversion of volumetric to weight concentrations was done as recommended by WOCE using potential temperatures.

• Nutrients

Seawater samples for the analysis of for nitrate, nitrite, phosphate and silicic acid were collected just after the sampling for trace gases and oxygen. After rinsing three times, samples were drawn into 15 ml high-density polyethylene test tubes with pressure caps and kept dark and refrigerated at 4 %C without preservative. All samples were analysed within 48 hours after sampling. Tests done for effects of the delay in analysis showed variations for all nutrients not significantly different to the precision obtained for each parameter.

The nutrient analyses were performed using a system build up by the following items:

- Pump system from Ismatec, Switzerland.
- Reaction units of own fabrication
- Autosampling , detection and computing units from SANplus Segmented Flow Analyzer, Skalar Analytical B.V., The Netherlands.

The methods used were adaptations of standard methods (Strickland and Parsons, 1972) slightly modified to the autoanalyzer system (Føyn et al., 1981). The precision for the different analyses (ten samples drawn from the same Niskin sampler) at full scale was less than 0.2% for nitrite, nitrate and silicic acid and less than 1 % for phosphate. The reproducibility of the analyses during the whole cruise, tested by analysing a laboratory prepared control solution and deep water samples from an early station and carried out during each run, was less than 1% for nitrite, nitrate and silicic acid and less than 2% for phosphate.

- **Chlorofluorocarbons. CFC-11, CFC-12, CFC-113, CH3CCL3, and CCl4** (Fred Menzia)

Sample Collection

All samples were collected using 10 litres water sampling bottles. Aliquots of seawater were transferred to 100 cm^{-3} precision ground-glass syringes for the CFC analysis. All the 12 bottles in use remained on the frame in the water sampling room between stations. None of them showed a CFC contamination problem during the cruise.

Equipment and Technique

Chlorofluorocarbons CFC-11, CFC-12, CFC-113, CH3CCl3 and CCl4 were measured at most stations. The analytical technique is described in Wallace et. al. (1994) and more completely in Happell et. al. (1996). Trapping was achieved using a length of 1/8 in. o.d. ss tubing packed with Porapak N cooled to -20 °C. Subsequent desorption was done by electrically heating the trap to 125 °C and injecting the contents of the trap onto a megabore DB-624 precolumn and column housed in a Varian ECD-GC. Water samples for analysis were drawn first from the bottles and then stored under clean seawater. The analysis was usually completed within 12 hours of the samples coming on board. Air samples were run periodically from an air intake high up on the foremast. Air was pumped from this location through a length of Dekoron tubing.

Calibration

Calibration curves used for determining CFC concentrations in air and water samples are generated by injections of known volumes of standard gas. The calibration curves spanned the range of CFC levels in the air and water analyses. The standard was contained in a Scott Aculife cylinder as recommended in WHPO 91-1. The gas standard was prepared and calibrated at Brookhaven National Laboratory using methods described in Happell and Wallace (in press).

- **Transient tracers** (Fred Menzia)

Samples for Helium and Tritium were collected following closely the recommendations given by WOCE (Bullister, 1991; Jenkins et al., 1991). All samples will be analysed ashore.

Radiochemistry (Lars Føyn and Hilde E. Heldal)

During the cruise water, biological and sediment samples were taken for measurement of different radioactive isotopes (Cs-134, Cs-137, Tc-99, Pu-239, 240, Pu-238, Sr-90 and I-129) in order to study the transport and accumulation of these in the foodweb in the Nordic Seas. The sampling was carried out with different gears as water bottles, underwater pumps,

continuous filtration from the ship's water intake, sediment grabs (Smøgen boxcorer), plankton nets and pelagic trawl.

BIOLOGY

• **Water sampling.** Samples for biological analyses were obtained from the Niskin bottles on the caroussels

• **Biomass (BIOM)**

• **Chlorophyll**

Samples for chlorophyll analyses were collected in 263 ml plastic bottles and filtered through glassfiber type F filters. The filters were immediately frozen and kept for analyses ashore. In the laboratory the pigments will be extracted during overnitgh with 90% acetone at 4°C and in the dark. Thereafter the extracts are centrifuged at 500 *g* and measured fluorometrically with a Turner Designs AU-10 filter fluorometer both before and after the addition of 5% v/v hydrochloric acid. The fluorometer is calibrated against commercial chlorophyll *a* (Sigma Inc.).

• **Particulate organic carbon and nitrogen.**

Samples were collected in 529 ml plastic bottles and filtered through pre-combusted glassfiber filters of type F. The filters were frozen immediately after filtration and will be analysed in the laboratory ashore using a Carlo Erba model 106 Elemental analyser.

• **Particulate biogenic silica.**

Water samples were collected in 529 ml plastic bottles and filtered through polycarbonate filters with 0.6 &m pore size. The filters were then immediately frozen and will be analysed ashore.

• **Phytoplankton taxonomy**

Samples for quantitative analysis of phytoplankton were drawn from the Niskin bottles into 100 ml brown glass bottles and 1 ml 20 % formaldehyde was added for conservation.

• **Primary productivity**

• **Radioactive carbon uptake (14C)**

Uptake of radioactive carbon by phytoplankton was done in a P vs. E incubator equipped with a metal halide daylight lamp (OSRAM HQI-T 400/DH) providing 16 different irradiances from 0 to about 700 μmol m^{-2} s^{-1} by means of neutral filters. The incubator was cooled with subsurface seawater from the ship's water intake. Samples aliquots from a 500 ml sample collected in a dark glass bottle were used to rinse the 25 ml incubation glass bottles. These had previously been thoroughly washed with diluted hydrochloric acid and rinsed three times with distilled water. To the remaining water sample 40 μCi $Na_2H^{14}CO_3$ was added. After thorough mixing 20 ml of radioactive sample were dispensed on each of the 16 incubation bottles and placed immediately in the incubator. A 200 µl aliquot, in triplicate, was also dispensed into 1 ml of phenethylamine in order to determine the actual activity in the sample. Incubation time lasted about 2 hours. After incubation the samples were immediately filtered through GF/F glassfiber filters and frozen for later analysis ashore. This scheme was applied to samples from three or four depths, usually above and below the pycnocline, from selected stations. Commercially available radioactive carbon was used (DuPont NEN Sodium bicarbonate NEC-086S, 20 µCi)

• *In situ* phytoplankton photosynthesis

In situ phytoplankton photosynthetic rate was estimated by means of a PNF-300 Profiling Natural Fluorometer (Biospherical Instruments Inc., USA) . In addition the instrument records depth profiles of irradiance, natural fluorescence, cholorophyll concentration and temperature. Profiles were usually acquired to a depth of 75 meters at the same time as the *in situ* incubations for primary productivity. A FRRF fluorometer from Chelsea Instruments Ltd. (Fasttracka) was also deployed simultaneously with the PNF-300 in order to obtain rapid, real-time *in situ* measurements of the photosynthetic characteristics of phytoplankton.

• Zooplankton

Samples for zooplankton biomass and species composition were obtained by vertical tows at selected depth intervals by means of a 56 cm opening WP-2 plankton net with a 180 μm mesh size. The samples were split into two, one part being preserved with formaldehyde for later determination of species composition. The other part was passed through three different meshsize nets, 2000, 1000 and 180 μm, and the fractions collected into pre-weighted aluminium containers, dried at 60 °C and then frozen, for later determination of dried weight ashore. The same procedure was applied to the samples collected with the MOCNESS net, which was obliquely towed at two knots through the water column from about 700 meters depth or close to the bottom and up to the surface. At some stations vertical hauls with a Multinet equipped with 5 nets of 180 μm mesh size were carried out from 900 meters to the surface collecting samples at 5 different layers.

UNDERWAY MEASUREMENTS

Chlorophyll *in vivo* fluorescence (WebStar Mini fluorometer), temperature and salinity (SBE 21 Thermosalinograph, Seabird Inc.) were continuously monitored on water from the ship's water intake at 5 meters depth. The Thermosalinograph was calibrated against temperature and salinity records of the SeaBird 911 CTD when this was at the subsurface just prior to the initiation of the downcast. The position of the CTD at this time was about 2-3 meters distance from the water intake of the Thermosalinograph.

FISHERIES (Marianne Holm)

For identification of the fish species registered by the echosounders (BEI system) and for sampling of Atlantic salmon, a pelagic trawl, Åkra trawl with Thyborøn doors was used. The trawl has a vertical opening of 20-25 m. In order to sample salmon, which is thought to feed in the upper water layers, the trawl was operated in surface position (0-25m) with the aid of 4 large floats on the wings and, in addition to the regular floats, one fenderfloat at the midpoint of the upper panel. The towing time was 30 minutes.

An experimental drifnet for salmon consisting of a total of 38 nets of 6 different mesh sizes was used in areas where herring was absent. The net series consisted of netpanels of mesh sizes of 36, 48, 52, 57 and 65 mm (knot to knot). The drift net was launched from the trawl stern and left it to drift attached to the vessel for at least 4 hours. Total time for setting and hauling was about one hour.

SUMMARY OF STATION WORK

Table 1 shows an overview of the work carried out at each oceanographic station. Table 2 shows an overview of the fishing stations and the main catches obtained at them.

PRELIMINARY RESULTS

Fig.3 shows the vertical distribution of potential temperature, salinity and sigma-theta along the Gimsøy-NW section. On the eastern end of the section the coastal waters of the Norwegian Coastal Current are easily identified above the narrow continental shelf by salinities below 35 and as low as 32.5. Starting from the continental slope and northweswards the Atlantic waters are identified by salinities above 35 and temperatures above 2° C, extending down to 500-600 meters. Further west and below 100 meter depth, a transition zone from Atlantic to proper Greenland Sea water (> 34.9 PSU, temperature above 0 ° C), the Arctic Front was also observed. The westernmost part of the section was characterised by water masses with salinities below 34.9 PSU and temperatures below 0°C, representing Greenland Sea water. In the central Greenland Sea part of the section, no indication of winter mixing deeper than about 1500 meters was observed. The upper 100 meters along the whole section was influenced by the warming up of the upper layers resulting in higher temperatures and stratified waters as shown in the sigma-theta distribution. The stratification was, as expected, more pronounced in the eastern end of the section due to the presence of low salinity waters from the Norwegian Coastal Current.

Fig.4 shows the vertical distribution of potential temperature, salinity and sigma-theta along the 74° 30`N section (Bjørnøya-W section). On the western part of the section the influence of the ice associated with the East Greenland Current is easily observed by the low salinities in the upper 100 meters, as low as 32. No indications of winter mixing deeper than 1500 meters was observed in the central part of the Greenland Sea. However, a core of cold waters (below - 1°C) was observed at about 200-300 meters. From the central Greenland Sea, salinities increased eastwards across the Arctic Front to values above 35 proper of the northflowing Atlantic water. This watermass extended down to about 500 meters. On the easternmost part of the section the salinities decreased again to just below 35 indicating mixing with the Polar waters from the Svalbard Bank. Along the whole section, stratification was present in the upper 50 meters, being most pronounced close to the ice edge due to the influence of the melt water.

Fig.5 shows the vertical distribution of potential temperature, salinity and sigma-theta along the Fugløya-Bjørnøya section. The upper 200 meters on the southern part of the section are dominated by coastal waters from the Norwegian Coastal Current, while the rest of the section was completely dominated by Atlantic waters with salinities above 35, with the exception of a narrow area shallower than 150 meters on the Bjørnøya side of the section.

Fig.6 shows the vertical distribution of potential temperature, salinity and sigma-theta along the Storfjordrenna section south of Spitsbergen. The most conspicuous feature of this section is the presence of a heavy cold water mass with high salinities spreading along the bottom from the Svalbard Bank westwards and into the West Spitsbergen Current. This water mass has been earlier described as one of the most heavier in the Nordic Seas and is the product of the entrance of waters of Atlantic origin into the Storfjordrenna that gets cooled during winter at the same time as its salinity increases further by brine rejection during sea ice formation

The biological conditions encountered at the three main sections are described by the results from the continuous sampling with the Thermosalinograph and fluorometer together with the nutrient concentrations from the upper sampling depth at the oceanographic stations, usually from 4 to 6 meters. Fig. 7 shows the results from the Gimsøy -NW section. In the Norwegian coastal waters with salinities below 35, nitrate concentrations were very low concentrations while there was still some silicate left and low chlorophyll *in vivo* fluorescence values. This indicates that the spring bloom was over and had been dominated by non-diatom species. In the part of the section

dominated by Atlantic waters with salinities above 35, chlorophyll *in vivo* fluorescence were relatively low and variable while nitrate concentrations fluctuated between 3 and 4 µM and silicate was around 2 µM. Onboard observations of zooplankton catches indicate that zooplankton biomass was high in this area and could explain the low phytoplankton biomass presence of a mixed phytoplankton population. Close to the Arctic Front but still in Atlantic waters, at station 484, a bloom of phytoplankton was observed by the high chlorophyll *in vivo* fluorescence values. On the Greenland Sea side of the front and towards the end of the section silicate decreased to concentrations below 1 µM while nitrate increased to concentrations above 6 µM. At the same time chlorophyll *in vivo* fluorescence was relatively low and variable. This picture suggests that a strong diatom bloom had already taken place in this area. Almost at the end of the section another phytoplankton bloom was observed.

Fig. 8 shows the results from the Bjørnøya -W section. Close to the ice edge, all three parameters were low indicating that the spring bloom was already over. Immediately after the transition from the melt waters to the Greenland Sea proper a huge bloom was observed with very low concentrations of both nutrients. The central Greenland Sea itself, characterised by extremely constant salinities showed variable chlorophyll *in vivo* fluorescence values, low silicate concentrations and high nitrate concentrations. This suggests again that a strong diatom bloom had taken place in this area. At the Arctic Front (st.502) silicate increased radically as we reached the West Spitsbergen Current dominated by Atlantic waters. Nitrate was still high and chlorophyll *in vivo* fluorescence low and variable with a few peaks. This pattern continued all the way until we reached Bjørnøya and can be charactherisee as a bloom in development. Again, relatively high zooplankton biomass observed onboard indicates that the phytoplankton biomass was controlled by grazing. At the last station of the transect, the closest one to Bjørnøya nitrate concentrations decreased rapidly as well as chlorophyll *in vivo* fluorescence increased. Since silicate mantained the relatively high concentrations we assume that the phytoplankton at this place was dominated by non-diatoms species.

Fig. 9 shows the results from the section Fugløya - Bjørnøya. On the coastal waters of the Norwegian Coastal Current (<34.5 PSU) all three parameters were low, especially nitrate that was almost completely depleted. This suggests that the spring bloom of phytoplankton had already taken place. The rest of the section was characterised by relatively higher nutrient concentrations and chlorophyll *in vivo* fluorescence, suggesting that there still was some phytoplankton activity.

The catches at the different fishing stations are shown in Table 2. Although surface temperatures were > 7°C at most of the trawl sites, except for those in the Greenland Sea, no post-smolts were captured on the Gimsøy transect at the start of the cruise. Only salmon that had already been one winter season at sea and possibly were on their way back to their home rivers to spawn were caught in this region. On the southwards transect at the end of the cruise, post-smolts, probably migrating northwards were caught at about 68° N. This distribution is in accordance with the assumed salmon migration pattern.

Lumpsuckers were caugth in most of the trawl hauls. One large catch of capelin (2.9 metric tonnes) was obtained in the West Spitsbergen Current. In the cold waters of the Greenland Sea and at the ice edge, large individuals (15-30 mm in length) of the amphipod *Parathemisto libellula* were captured in the trawl. Diseased herring were observed on many of the catches and samples were taken for further analysis ashore.

In general, the trawl catches were small, except for a few larger ones of capelin and herring. The fact that the cruise was conducted earlier in the summer than in previous years, accounts for the observed difference in the distribution of the fish species. Regarding salmon that had already been one winter in the sea, these were probably concentrated in the coastal and Atlantic waters before their spawning migration back to their natal rivers. At the end of the cruise a total of 21 post.smolt were captured at two consecutive stations around 68°N indicating the northward limit of the post-smolt migrations at this time of the feeding season.

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Bergen, September 22, 1999

Francisco Rey
Chief Scientist

Table 1. Overview of the oceanographic stations

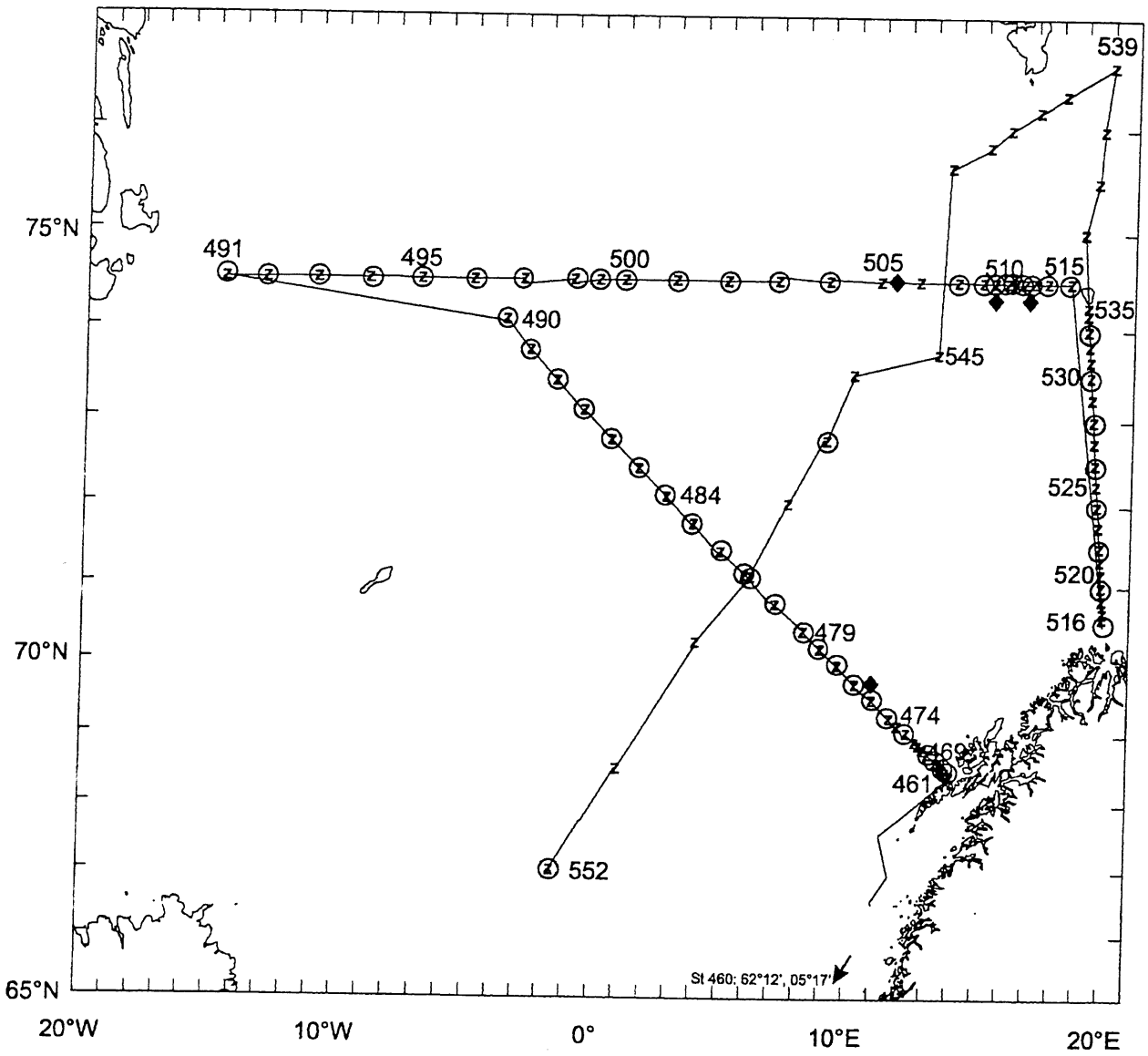
STN NBR	MONTH	DAY	TIME	LATITUDE			LONGITUDE			ECCHO DEPTH	CTD-12 Cast 1	CTD-12 Cast 2	WP-2	MOCNESS	MULTINET	RADIOCHEMISTRY			COMMENTS
																GRAB	PUMP	FILTRATION	
461	6	18	5	68	24.6	N	14	4.0	E	47	6-35								
462	6	18	5	68	25.8	N	14	0.9	E	110	4-101		X						Gimsøy 1
463	6	18	6	68	28.6	N	13	53.0	E	186	4-178						X		Gimsøy 2
464	6	18	7	68	30.8	N	13	46.4	E	138	4-129		X						Gimsøy 3
465	6	18	8	68	32.8	N	13	41.1	E	106	4-99								Gimsøy 4
466	6	18	8	68	34.9	N	13	35.5	E	133	3-129		X						Gimsøy 5
467	6	18	9	68	37.0	N	13	29.1	E	118	5-112								Gimsøy 6
468	6	18	12	68	44.0	N	13	10.1	E	112	7-103		X					X	Gimsøy 7
469	6	18	14	68	47.0	N	12	58.3	E	179	5-177								Gimsøy 8
470	6	18	16	68	51.0	N	12	48.2	E	660	4-654								Gimsøy 9
471	6	18	18	68	54.0	N	12	38.2	E	1350	10-1330						X		Gimsøy 10
472	6	18	20	69	2.1	N	12	17.4	E	2640	496-2600	7-401	X X						Gimsøy 11
473	6	19	4	69	7.9	N	11	56.8	E	2890	8-2831								Gimsøy 12
474	6	19	8	69	14.1	N	11	37.2	E	2929	11-2881								Gimsøy 13
475	6	19	13	69	28.9	N	10	56.8	E	2952	10-2901		X X						Gimsøy 14
476	6	19	20	69	42.0	N	10	16.0	E	2932	500-2881	8-404	X	X					Gimsøy 15
477	6	20	2	69	56.7	N	9	35.0	E	2873	11-2809		X X						Gimsøy 16
478	6	20	9	70	10.0	N	8	52.9	E	2888	9-2852		X						Gimsøy 17
479	6	20	14	70	24.0	N	8	12.1	E	2922	502-2875	6-402	X					X	Gimsøy 18
480	6	20	23	70	45.1	N	7	4.5	E	3023	11-2979		X			X	X		Gimsøy 19
481	6	21	4	71	5.2	N	6	0.1	E	3075	10-3002		X						
482	6	21	9	71	25.0	N	4	54.6	E	2868	501-2746	5-401	X						
483	6	21	14	71	45.0	N	3	50.0	E	3040	10-3003		X						
484	6	21	20	72	5.0	N	2	45.3	E	2412	9-2353		X						
485	6	22	0	72	25.1	N	1	39.9	E	2980	501-2953	6-404	X						
486	6	22	7	72	45.0	N	0	35.4	E	2748	9-2702		X						
487	6	22	11	73	5.0	N	1	29.9	W	2807	11-2728		X					X	
488	6	22	17	73	25.0	N	2	25.0	W	2901	500-2843	1-401	X				X		
489	6	22	22	73	45.0	N	3	19.9	W	3000	12-2952		X						
490	6	23	3	74	4.9	N	4	19.8	W	3479	11-3407		X			X			
491	6	24	7	74	30.2	N	15	23.5	W	267	4-251		X			X	X	X	
492	6	24	14	74	30.0	N	13	0.1	W	2394	8-2376		X						
493	6	24	19	74	30.0	N	11	0.1	W	3053	499-3003	3-401	X		X				
494	6	25	2	74	30.0	N	9	0.1	W	3227	9-3176		X						
495	6	25	8	74	30.0	N	7	0.5	W	3381	600-3331	9-502	X						
496	6	25	15	74	30.0	N	5	0.3	W	3489	10-3452		X						
497	6	25	20	74	29.9	N	5	0.0	W	3577	799-3553	11-602	X						
498	6	26	2	74	30.0	N	1	0.0	W	3286	10-3254		X				X	X	

STN	MONTH	DAY	TIME	LATITUDE			LONGITUDE			ECCHO	CTD-12	CTD-12	WP-2	MOCNESS	MULTINET	RADIOCHEMISTRY			COMMENTS
NBR										DEPTH	Cast 1	Cast 2				GRAB	PUMP	FILTRATION	
499	6	26	7	74	29.9	N	0	0.2	E	3725	1000-3682	11-759	X				X	X	
500	6	26	13	74	30.1	N	1	0.2	E	3755	11-3702		X						
501	6	26	19	74	30.1	N	3	0.2	E	3320	601-3263	10-501	X		X		X		
502	6	27	1	74	29.9	N	5	0.2	E	3170	10-3002		X					X	
503	6	27	6	74	30.0	N	7	0.2	E	2440	499-2402	5-401	X				X	X	Bjørnøya-W 13
504	6	27	17	74	30.1	N	9	0.5	E	2562	10-2531		X						Bjørnøya-W 12
505	6	27	21	74	30.0	N	11	0.1	E	2390	502-2333	4-402	X				X	X	Bjørnøya-W 11
506	6	28	2	74	30.0	N	12	30.0	E	2283	9-2233		X						Bjørnøya-W 10
507	6	28	6	74	30.0	N	13	59.8	E	2106	500-2051	6-402	X				X		Bjørnøya-W 9
508	6	28	12	74	30.0	N	15	0.0	E	1739	11-1703		X						Bjørnøya-W 8
509	6	28	15	74	30.0	N	15	30.0	E	1340	11-1304		X		X				Bjørnøya-W 7
510	6	28	18	74	29.9	N	16	0.0	E	912	9-892		X				X		Bjørnøya-W 6
511	6	28	21	74	30.0	N	16	30.2	E	254	7-245		X						Bjørnøya-W 5
512	6	28	22	74	29.8	N	16	40.0	E	193	8-180		X				X		Bjørnøya-W 4
513	6	28	23	74	30.0	N	16	59.8	E	181	5-172		X		X				Bjørnøya-W 3
514	6	29	1	74	29.9	N	17	35.1	E	129	6-122		X						Bjørnøya-W 2
515	6	29	2	74	29.9	N	18	29.7	E	64	7-59		X				X		Bjørnøya-W 1
516	7	1	12	70	30.1	N	20	0.2	E	146	6-136		X				X	X	Fug.-Bjørn. 1
517	7	1	14	70	40.0	N	19	57.9	E	154	5-147								Fug.-Bjørn. 2
518	7	1	16	70	50.0	N	19	55.8	E	180	4-171								Fug.-Bjørn. 3
519	7	1	18	71	0.0	N	19	53.9	E	187	6-180		X X						Fug.-Bjørn. 4
520	7	1	19	71	10.1	N	19	51.8	E	208	4-202								Fug.-Bjørn. 5
521	7	1	21	71	20.0	N	19	50.3	E	210	4-201								Fug.-Bjørn. 6
522	7	1	22	71	30.0	N	19	47.9	E	236	5-228		X X				X	X	Fug.-Bjørn. 7
523	7	2	0	71	45.0	N	19	43.9	E	265	5-254								Fug.-Bjørn. 8
524	7	2	3	72	0.0	N	19	41.0	E	309	5-303		X X						Fug.-Bjørn. 9
525	7	2	5	72	14.9	N	19	36.7	E	325	4-315								Fug.-Bjørn. 10
526	7	2	7	72	30.0	N	19	33.7	E	387	3-375		X X				X		Fug.-Bjørn. 11
527	7	2	9	72	45.0	N	19	30.9	E	397	3-390								Fug.-Bjørn. 12
528	7	2	10	73	0.0	N	19	27.9	E	412	4-402		X X					X	Fug.-Bjørn. 13
529	7	2	14	73	15.0	N	19	24.1	E	449	4-444								Fug.-Bjørn. 14
530	7	2	15	73	29.9	N	19	20.1	E	480	4-466		X X				X		Fug.-Bjørn. 15
531	7	2	17	73	40.0	N	19	17.8	E	348	5-340								Fug.-Bjørn. 16
532	7	2	18	73	50.0	N	19	15.9	E	235	6-225								Fug.-Bjørn. 17
533	7	2	20	74	0.0	N	19	12.9	E	136	6-128		X						Fug.-Bjørn. 18
534	7	2	21	74	9.9	N	19	10.6	E	71	7-65								Fug.-Bjørn. 19
535	7	2	22	74	15.0	N	19	9.8	E	58	5-52						X	X	Fug.-Bjørn. 20
536	7	3	2	75	0.0	N	19	0.1	E	64	5-56						X		
537	7	3	5	75	30.0	N	19	30.3	E	86	5-80						X		
538	7	3	9	76	0.1	N	19	39.6	E	121	6-117					X		X	

STN	MONTH	DAY	TIME	LATITUDE			LONGITUDE			ECCHO	CTD-12	CTD-12	WP-2	MOCNESS	MULTINET	RADIOCHEMISTRY			COMMENTS
NBR										DEPTH	Cast 1	Cast 2				GRAB	PUMP	FILTRATION	
539	7	3	12	76	35.0	N	19	59.8	E	205	5-201								
540	7	3	17	76	19.0	N	18	9.8	E	246	6-241					X	X	X	
541	7	3	21	76	10.1	N	17	6.6	E	278	10-271						X		
542	7	3	23	76	0.0	N	15	59.9	E	365	5-351								
543	7	4	1	75	50.0	N	15	9.9	E	374	3-361								
544	7	4	5	75	38.1	N	13	39.7	E	960	10-940					X	X		
545	7	4	17	73	43.5	N	13	16.2	E	1680	10-1654						X		
546	7	5	2	73	30.0	N	10	0.0	E	2260	9-2203					X	X		Konsommolet
547	7	5	9	72	45.0	N	8	59.7	E	2332	501-2276	5-402	X		X				
548	7	5	18	72	0.0	N	7	29.8	E	2714	12-2654								
549	7	6	4	71	5.0	N	6	0.1	E	3069	501-3002	5-401	X						
550	7	6	11	70	15.0	N	4	0.1	E	3190	601-3103	9-501						X	
551	7	7	2	68	30.0	N	0	59.9	E	2838	501-2777	5-402				X	X	X	
552	7	7	15	27	0.0	N	1	29.8	W	3414	799-3362	9-601	X					X	
																X	X	X	

Table 2. Overview of the fishing stations with number of the most important species at each station. Larval fish and amphipods are given in kilogrammes.

FISHING STNNBR	LATITUDE N	LONGITUDE E; W	Salmon numbers	Herrring numbers	Herring 0-group, kg	Mackerel numbers	Saithe 0-group, kg	Haddock 0-group, kg	Capelin numbers	Lumpsucker numbers	Gonatus numbers	Other fish numbers	Amphipods kg
284	66.5	11.11	3	0	0	1951	17.4	0	0	29	0	0	0
285	67.51	11.23	0	1	0	0	5.03	0	0	3	0	34	0
286	68.62	13.46	3	19	0	0	1	0	0	2	0	1	0
287	68.74	13.15	0	5	0.51	0	10.59	0	0	4	0	1	0
288	68.79	12.95	0	1	0	0	4.35	0.01	0	4	0	2	0
289	68.84	12.82	0	43	0	0	10.56	0	0	1	0	1	0
290	68.99	12.23	0	375	0	0	0.39	0	0	17	0	6	0
291	69.12	11.92	1	81	0	0	9.94	0	0	22	0	2	0
292	69.24	11.61	1	7	0	0	2.56	0	0	9	0	0	0
293	69.65	10.35	0	11	1	0	0	0	0	7	2	0	0
294	70.18	8.87	3	3	0	0	2.48	0	0	31	0	1	0
295	70.78	6.95	0	11	0.03	0	0.47	0	0	12	400	0	0
296	71.73	3.77	0	0	0	0	0.01	0	0	1	414	0	0
297	72.41	1.63	0	73	0	0	0	0	0	9	1939	0	0
298	73.08	-0.58	0	0	0	0	0	0	0	0	723	1	0.72
299	74.05	-3.84	0	0	0	0	0	0	4	0	5	7	5.4
300	74.5	-14.59	0	0	0	0	0	0	0	0	0	15	0.81
301	74.48	-1.09	0	0	0	0	0	0	0	0	6	2	1.73
302	74.52	7.05	0	66	0	0	0	0	0	0	0	0	0
303	74.52	14.01	0	0	0	0	0	0	133855	13	4960	0	0
304	74.49	16.47	0	0	0	0	0.01	0	28287	13	0	0	0
305	70.69	19.97	0	1406	16	0	0.01	0	1	3	0	0	0
306	70.85	19.94	0	232	0	0	0	0.01	7	16	23	1	0
307	71.19	19.84	0	3109	0	0	9.68	0	0	7	0	0	0
308	71.77	19.72	0	28429	0	0	0.16	0	0	5	28	0	0
309	73.02	19.49	0	2	0	0	1.23	0	15912	18	3	0	0
310	73.47	9.99	0	134	0	0	0	0	1	4	143	1	0
311	72.76	8.87	0	584	1	0	0.03	0	1	13	13	0	0
312	71.99	7.48	0	112	0.54	0	0.28	0.01	0	8	283	0	0
313	71.04	5.99	0	27	1	0	2.09	0.15	0	7	557	0	0
314	70.21	3.99	0	7	1.08	0	0.03	0.15	1	1	39	0	0
315	68.49	0.95	13	2	0	6	0	0	0	3	0	0	0
316	67.74	-0.3	8	0	0	7	0	0	0	3	0	0	0
317	66.98	-1.43	0	1	0	2	0	0	0	2	3	6	0
TOTALS			32	34741	21.16	1966	78.28	0.32	178069	267	9541	81	8.66



15 June - 9 July 1999

Cruise no 1999210

Z CTD st.no 460-552

"Johan Hjort"

Ⓩ CTD and PLANKTON st. (WP II-net)

◆ Multinet or Mocness st.

Standard section Fugløya-Bjørnøya st.no 516-535

Gimsøy NW st.no 461-479

Figure 1. Cruise track and oceanographic stations locations for R/V "Johan Hjort" cruise JH1999210, 15 June- 9 July 1999.

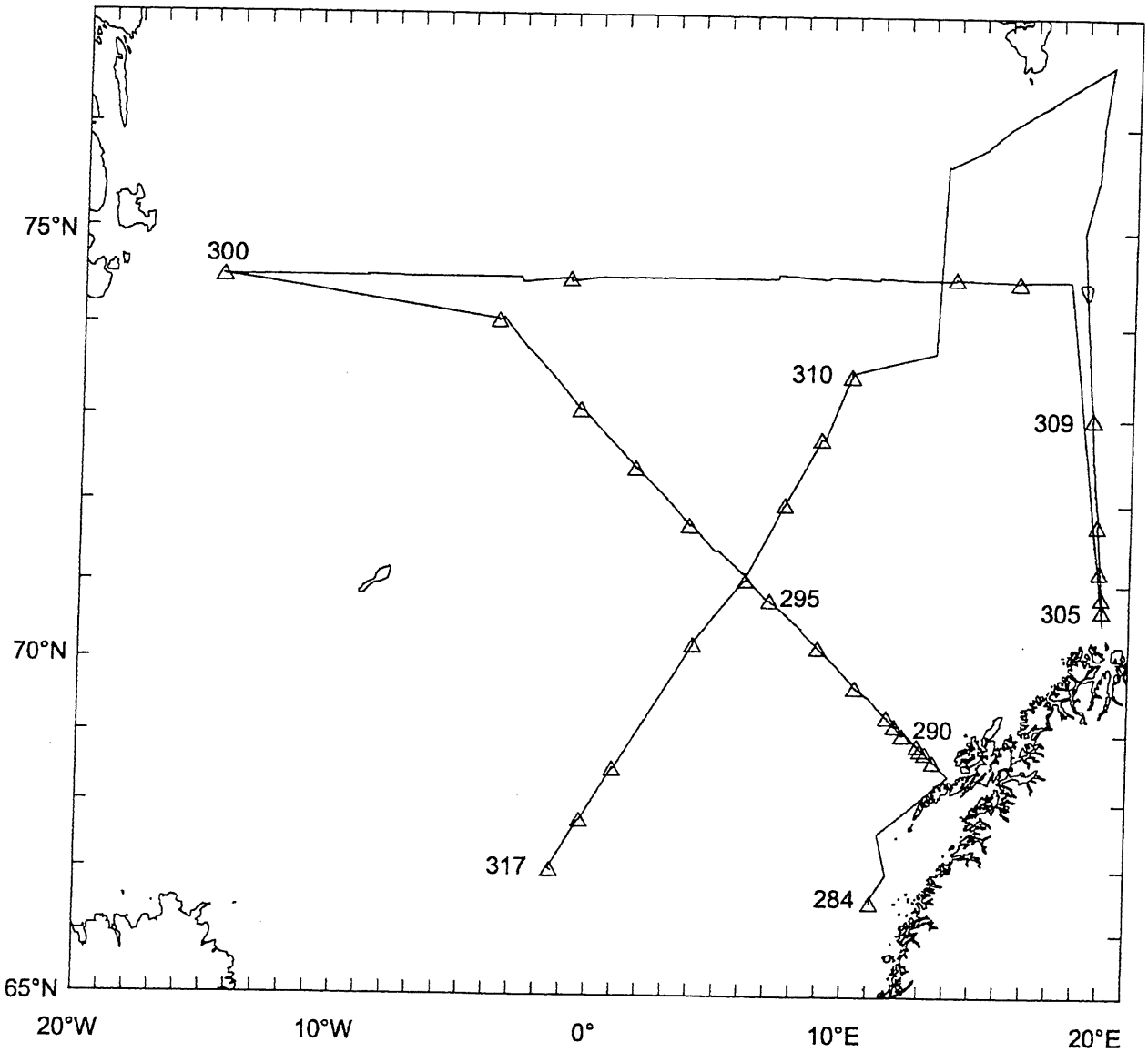


Figure 2. Cruise track and fishing stations locations for R/V "Johan Hjort" cruise JH1999210, 15 June- 9 July 1999.

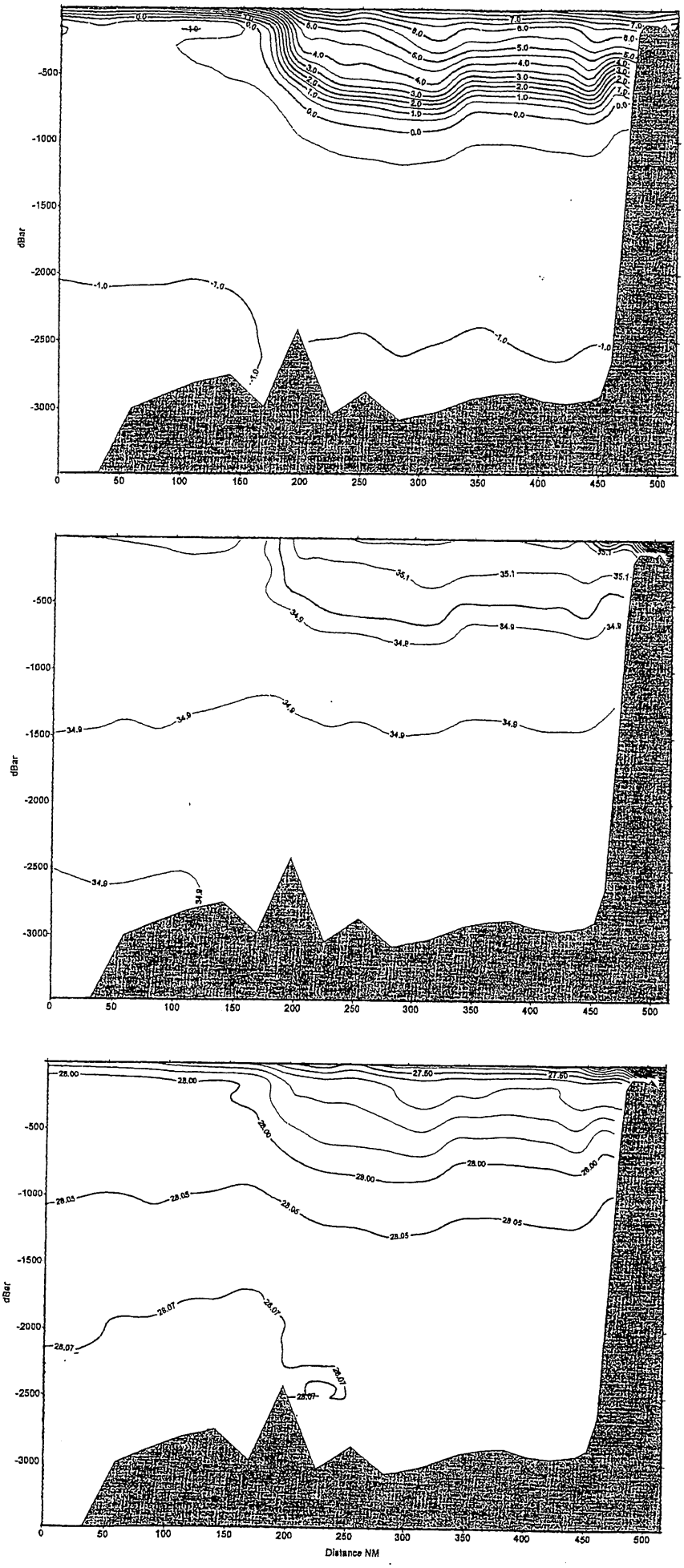


Figure 3. Vertical distribution of potential temperature (upper panel), salinity (middle panel) and sigma-theta (lower panel) at section Gimsøy - NW (St.461 to 490, from rigth to left)

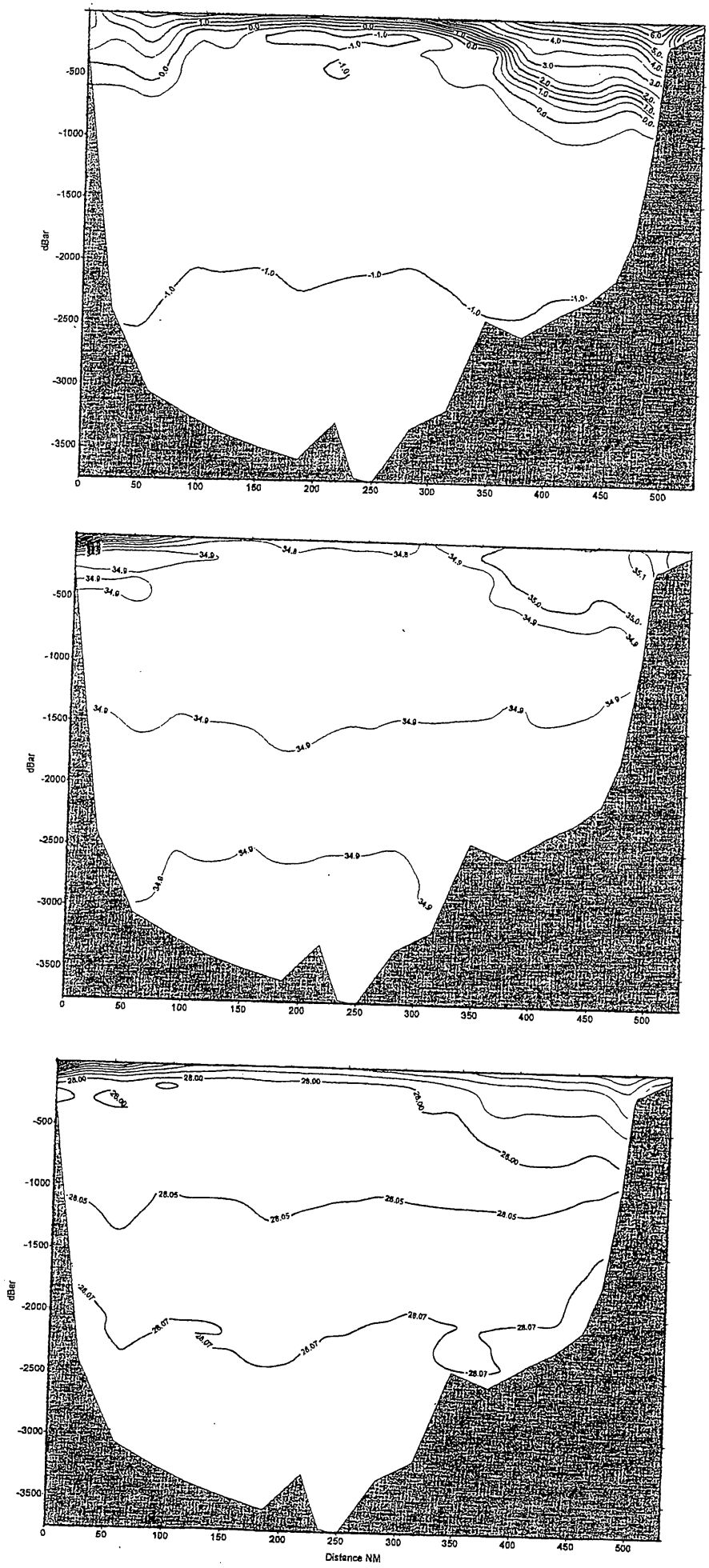


Figure 4. Vertical distribution of potential temperature (upper panel), salinity (middle panel) and sigma-theta (lower panel) at section Bjørnøya - W (St.491 to 515, from left to rigth)

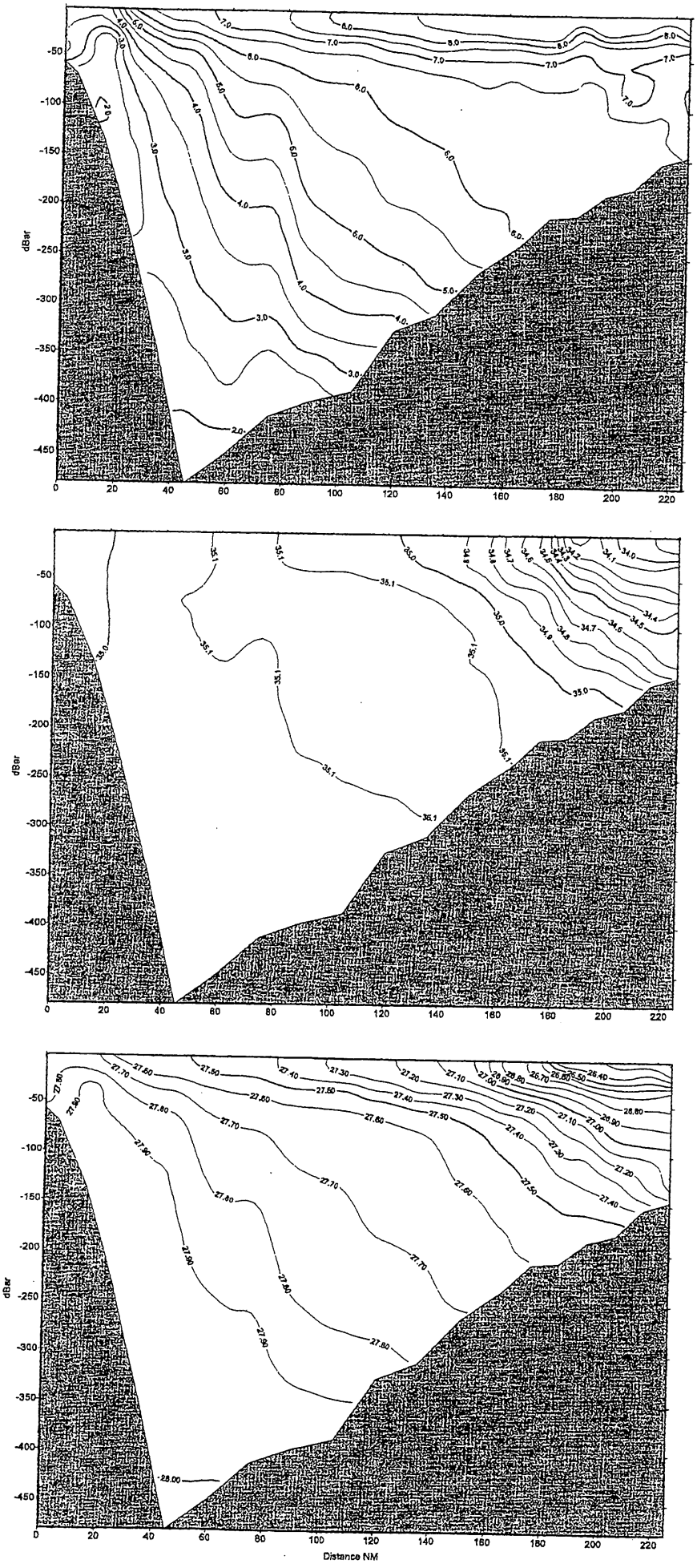


Figure 5. Vertical distribution of potential temperature (upper panel), salinity (middle panel) and sigma-theta (lower panel) at section Fugløya - Bjørnøya (St.461 to 490, from rigth to left)

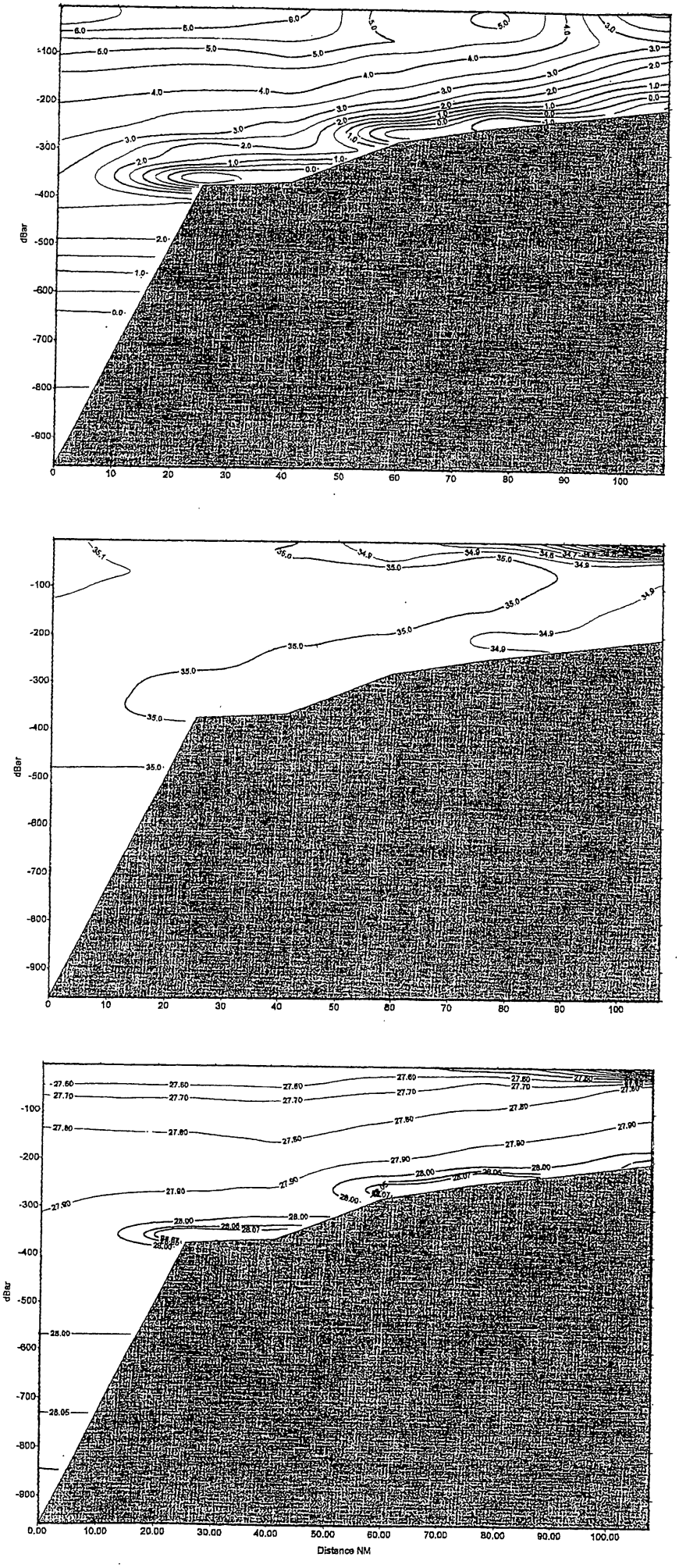


Figure 6. Vertical distribution of potential temperature (upper panel), salinity (middle panel) and sigma-theta (lower panel) at section along Storfjordrenna (St.539 to 544, from rigth to left)

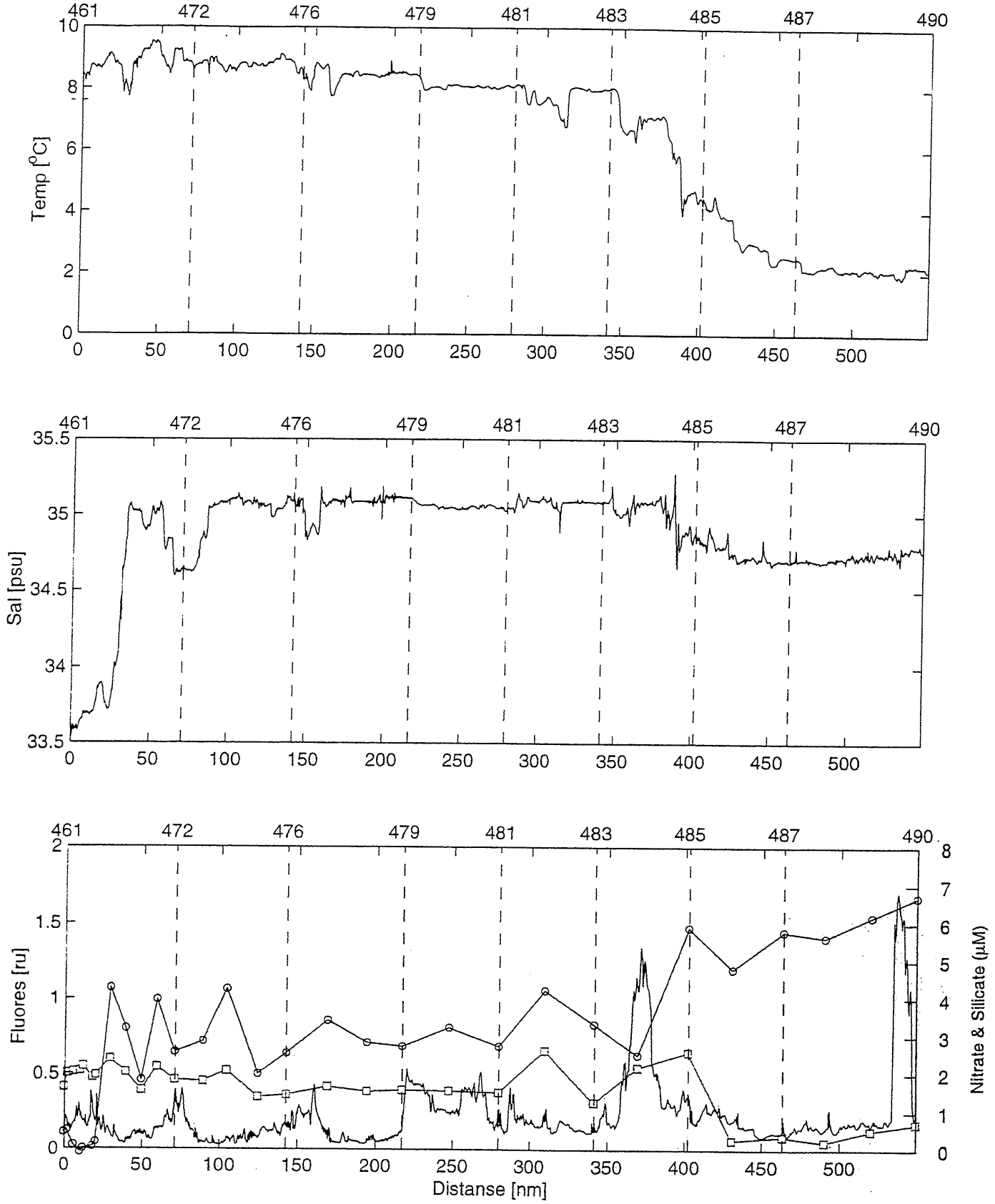


Figure 7. Continuous observations at 5 meter depth of temperature (upper panel), salinity (middle panel) and chlorophyll *in vivo* fluorescence (lower panel) at section Gimsøy - NW. Also nitrate (circles) and silicate (squares) concentrations at stations points (lower panel)

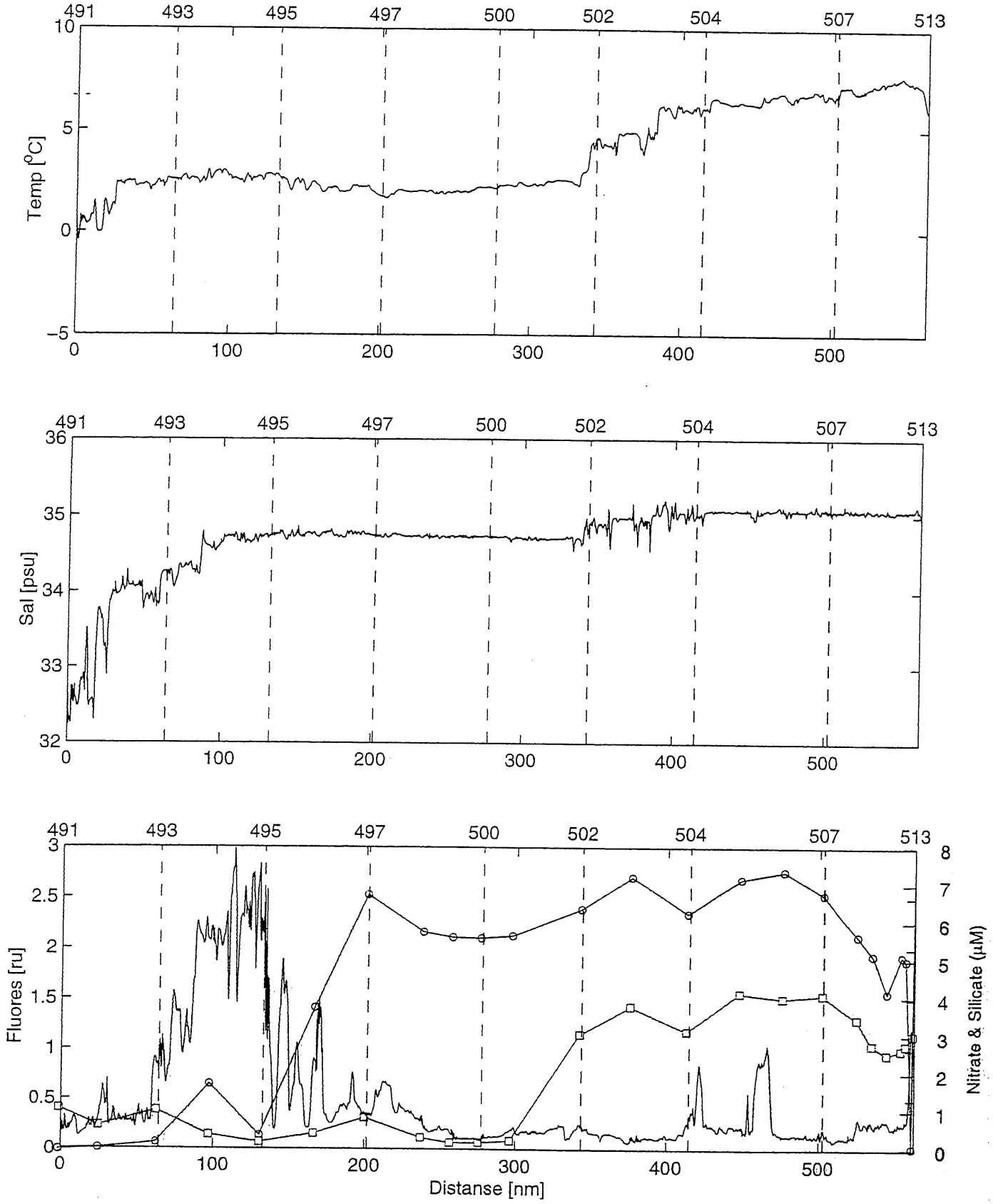


Figure 8. Continuous observations at 5 meter depth of temperature (upper panel), salinity (middle panel) and chlorophyll *in vivo* fluorescence (lower panel) at section Bjørnøya - W . Also nitrate (circles) and silicate (squares) concentrations at stations points (lower panel)

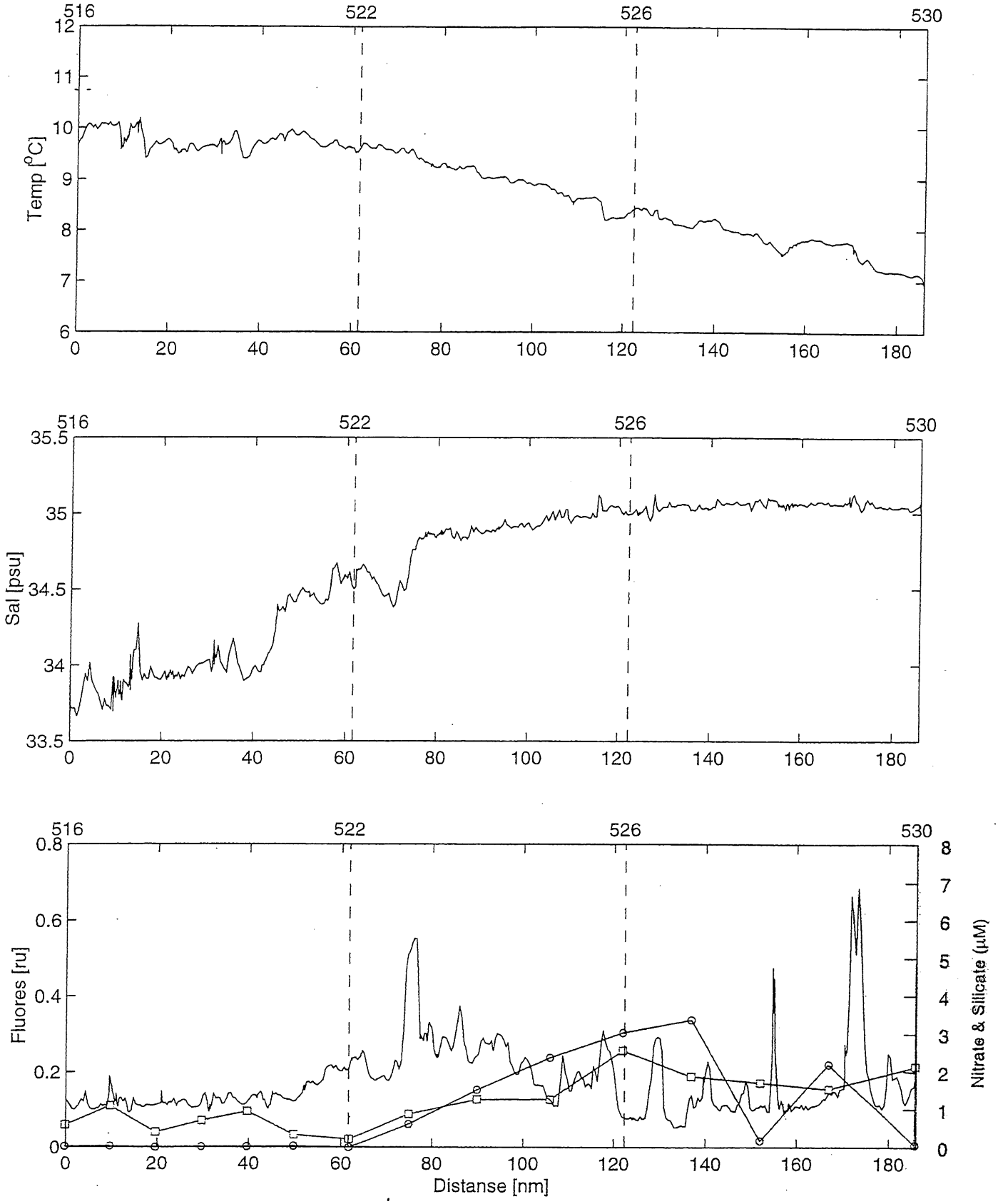


Figure 9 Continuous observations at 5 meter depth of temperature (upper panel), salinity (middle panel) and chlorophyll *in vivo* fluorescence (lower panel) at section Fugløya - Bjørnøya. Also nitrate (circles) and silicate (squares) concentrations at stations points (lower panel)