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FRV *Scotia*

Cruise 1999S

REPORT

8-22 December 1999

Personnel

M Heath	(In charge)
G Slesser	
J Dunn	
J Hunter	
F Brown	
M Burns	
N E Olsen	Visitor (Danish Fisheries Research Institute)
J Rasmussen	Aberdeen Research Consortium, Student

Project

AE11n - 15 days

Sampling gear

Hydrographic CTD; Plankton nets (ARIES and OCEAN samplers)

Area

Northwestern North Sea, Faroe Shetland Channel, and Norwegian Sea.

Objectives

1. To conduct routine hydrographic sampling at stations along the standard JONSIS, Fair Isle-Munken and Nolso-Flugga survey lines.

2. To conduct plankton sampling with the OCEAN sampler at selected stations along the Fair isle-Munken and Nolso-Flugga lines.

3. To conduct comparative tows with the OCEAN sampler and ARIES in the Faroe Shetland Channel.

4. To conduct plankton and hydrographic sampling with ARIES at stations in the Norwegian Sea.

Narrative

Scotia sailed from Aberdeen at 1100 hours on 8 December, but had to return to port the same day for repairs to a burst hydraulic hose connected with the operation of the drop keel. The ship finally left Aberdeen at 0000 hours on 9 December. After conducting instrument trials off Peterhead, the vessel made for the eastern end of the JONSIS hydrographic line. However, progress was delayed by bad weather, and CTD sampling did not start until 0630 hours on 10 December. All the JONSIS stations were completed by 1930 hours the same day, and a course was set for the start of the Fair Isle-Munken line.

Relatively good weather conditions were encountered during 11 December, and all of the Fair Isle-Munken hydrographic and plankton stations were completed by 0500 hours on 12 December. A passage was then made to the western end of the Nolso-Flugga line. All hydrographic and plankton sampling along this line was completed by 2130 hours on 14 December, some time having been lost due to bad weather conditions on 13 December.

Scotia then embarked on a sub-set of the Norwegian Sea survey stations. The aim was to complete 10 stations, beginning with a line running north from Muckle Flugga along the Greenwich meridian to 68°24'N (stations 2, 5, 9, 13, 18), and returning south approximately along longitude 4°W (stations 17, 12, 8, 4, 1). Initially, good progress north was made during 15 December with two deep tow ARIES stations being completed in relatively fine weather. However, conditions worsened during 16-17 December with only one station being completed each day. The weather forced a change of plan on the morning of 17 December, with severe northerly winds, freezing temperatures and light icing. Progress to the most northerly stations was abandoned, and the vessel headed slowly west to station 12, to await an improvement in the weather. There being no improvement by 0800 hours on 18 December, station 12 was also abandoned, and the vessel turned to run south with the wind towards station 8. Some damage to the CTD hanger door was sustained during this period.

Conditions were still marginal for deploying ARIES on reaching station 8 at 0030 hours on 19 December, but a deep tow to 3,050 m was accomplished. In gradually improving weather conditions, the vessel proceeded south to complete the Norwegian Sea survey stations, and some additional stations at the northern end of the Faroe-Shetland Channel, before making a passage to Aberdeen. The vessel arrived off Aberdeen at 0930 hours on 22 December and docked shortly after.

Results

General

The vessel was successfully able to exploit the few breaks in the weather to achieve all of the hydrographic and plankton sampling objectives in the North Sea and Faroe-Shetland Channel. Sampling in the Norwegian Sea was severely hampered by the adverse weather conditions, but the disappointing loss of stations was compensated by the high quality of the data obtained at the remaining sites.

The cruise track and sampling locations are shown in Figure 1.

Equipment performance

The ships CTD system performed extremely well until almost the end of the Nolso-Flugga survey line. This was an contrast too all preceding cruises on the vessel, where leaking

terminations to the conducting cable had led to repeated failures o f the system. This time, the failure appeared not to have been in the cable, but elsewhere in the system. The hydrographic sampling was completed with a reserve CTD system.

The ARIES system produced 100% data and sample return throughout the cruise, collecting 1,032 plankton net samples and 910 water samples with 50-75 m depth resolution, as well as CTD and Optical Plankton Counter data. The long range acoustic telemetry system for monitoring the depth of the ARIES also performed extremely well to depths of 3,100 m in even the worst weather conditions.

The OCEAN sampler was deployed on two occasions for comparison with results obtained by ARIES. The system performed well, although there are some engineering modifications required to the water sampling unit. Overall, the OCEAN sampler seems too light for controlled deployment to 1,000 m depths in the poor weather conditions typically encountered during this cruise.

The nutrient autoanalyser system installed in one of the container laboratories was found to be inoperative and could not be used during the cruise. As a result, most of the water samples collected for nutrient analysis will be returned to the Laboratory in Aberdeen for processing.

Data logged by the central database system on the ship were interrogated routinely during the cruise to monitor progress and changes in weather conditions. The software developed to perform this was functional, and some additional utilities were developed. An example of the output from the database is shown in Figure 2.

Hydrographic monitoring

Uncalibrated temperature and salinity data from the JONSIS, Fair Isle-Munken and Nolso-Flugga sections are shown in Figures 3-5. The data are typical for the time of year and show no particularly unusual features.

All water samples collected for salinity analysis were processed during the cruise, and calibrations for the CTD system both on the profiling conducting cable and on ARIES were derived.

Faroe-Shetland Channel plankton monitoring

Calanus finmarchicus were, as usual, abundant in the cold bottom waters of the Faroe-Shetland Channel. Calibrations were applied to the Optical Plankton Counter data to derive quantitative estimates of the concentration of Calanus in approximately 25 m depth intervals. A qualitative assessment of the vertical distribution of abundance from the ARIES net samples confirmed the quantitative results from the Optical Plankton Counter. The mean abundance below the isopycnal surface separating the bottom waters from the upper layers was similar to previous years along both the monitoring sections (Figs 6 and 7). Specimens of *Calanus* were sorted from freshly collected ARIES samples at each station and frozen in liquid nitrogen for transfer to Denmark for lipid analysis.

Norwegian Sea survey

The objective of the Norwegian Sea survey was to continue the process of mapping the overwintering distribution of *Calanus*. This task was started in 1996, and during this cruise the aim was to cover the deepest area in the centre of the Norwegian Sea which had not previously

been visited. Access to the central Norwegian Sea was restricted by severe weather, but four stations deeper than 2,500 m were sampled. The maximum depth attained by ARIES was 3,050 m. *Calanus* were caught at least to 2,000 m depth. Taken together with the data collected in 1998, the results show that, integrated over the whole water column, overwintering *Calanus* are most abundant along the eastern margin of the Norwegian Sea and become less abundant in the deep central region (Fig. 8). Specimens of *Calanus* were sorted from freshly collected ARIES samples at each station and frozen in liquid nitrogen for transfer to Denmark for lipid analysis.

M R Heath
6 January 2000

Seen in draft: D Hodge, OIC

Table 1. JONSIS line stations

Name	Latitude	Longitude	Depth	Hydrographic station no	Plankton station nos
JO 1	59°17.00'N	02°14.00'W	75 m	500	
JO 1A	59°17.00'N	02°5.00'W	90 m	499	
JO 2	59°17.00'N	01°56.00'W	100 m	498	
JO 3	59°17.00'N	01°48.00'W	80 m	497	
JO 4	59°17.00'N	01°40.00'W	90 m	496	
JO 5	59°17.00'N	01°30.00'W	95 m	495	
JO 6	59°17.00'N	01°20.00'W	110 m	494	
JO 6A	59°17.00'N	01°10.00'W	120 m	493	
JO 7	59°17.00'N	01°0.00'W	125 m	492	
JO 8	59°17.00'N	00°40.00'W	120 m	491	
JO 9	59°17.00'N	00°20.00'W	140 m	490	
JO10	59°17.00'N	00°0.00'W	135 m	489	

Table 2. Fair Isle - Munken line stations

Name	Latitude	Longitude	Depth	Hydrographic station no	Plankton station nos
FIM-01	60°10.00'N	03°44.00'W	150 m	501	
SEFOS-1	60°13.00'N	03°51.50'W	170 m	502	
FIM-02	60°16.00'N	03°59.00'W	200 m	503	
SEFOS-2	60°18.00'N	04°04.50'W	330 m	504	
FIM-03	60°20.25'N	04°09.00'W	390 m	505	
FIM-04	60°25.00'N	04°19.00'W	655 m	506	
FIM-05	60°29.00'N	04°26.00'W	995 m	507	163-165
FIM-06	60°35.00'N	04°45.00'W	1,090 m	608	166-169
FIM-6a	60°38.00'N	04°54.00'W	1,030 m	509	170-172
FIM-07	60°43.00'N	05°06.00'W	915 m	510	
FIM-08	60°47.00'N	05°16.00'W	830 m	511	
FIM-09	60°51.00'N	05°29.00'W	600 m	512	
FIM-10	61°02.00'N	05°57.00'W	280 m	513	
FIM-11	61°12.00'N	06°22.00'W	240 m	514	

Table 3. Nolso - Flugga line stations

Name	Latitude	Longitude	Depth	Hydrographic station no	Plankton station nos
NOL-01	60°56.00'N	01°00.00'W	110 m	530	
SEFOS-3	60°58.70'N	01°17.70'W	125 m	529	
SEFOS-4	61°01.40'N	01°35.40'W	155 m	528	
NOL-02	61°04.00'N	01°53.00'W	270 m	527	
SEFOS-5	61°06.00'N	02°01.50'W	440 m	526	
NOL-03	61°08.00'N	02°10.00'W	550 m	525	
SEFOS-6	61°09.30'N	02°17.50'W	630 m	524	
NOL-3a	61°11.00'N	02°25.00'W	730 m	523	
NOL-04	61°14.00'N	02°40.00'W	1,080 m	522	186-188
NOL-05	61°21.00'N	03°10.00'W	1,370 m	521	183-185
NOL-06	61°28.00'N	03°42.00'W	1,235 m	520	176-179
NOL-07	61°35.00'N	04°15.00'W	990 m	519	173-175
NOL-08	61°42.00'N	04°51.00'W	235 m	518	
NOL-09	61°49.00'N	05°21.00'W	180 m	517	
NOL-10	61°54.00'N	05°45.00'W	290 m	516	
NOL-11	62°00.00'N	06°12.00'W	125 m	515	

Table 4. Norwegian Sea stations

Number	Latitude	Longitude	Depth	Hydrographic station no	Plankton station nos
NS-2	62°30.00'N	0°00.00'E	1,101 m		186-188
NS-4	63°36.00'N	3°35.91'W	2,914 m		201-203
NS-5	63°36.00'N	0°00.00'E	2,207 m		189-191
NS-8	65°12.00'N	3°48.87'W	3,224 m		198-200
NS-9	65°12.00'N	0°00.00'E	2,928 m		192-194
NS-13	66°48.00'N	0°00.00'E	3,369 m		195-197
NS-4a	63°00.00'N	5°00.00'W	2,200 m		204-206
NS-4b	63°03.00'N	3°17.96'W	2,100 m		207-209
NS-4c	63°03.00'N	1°38.96'W	1,900 m		210-212
NS-4d	62°15.00'N	1°30.00'W	1,400 m		213-215

Figure 1. Cruise track and sampling locations, Scotia 19/99 (8-22 December 1999)

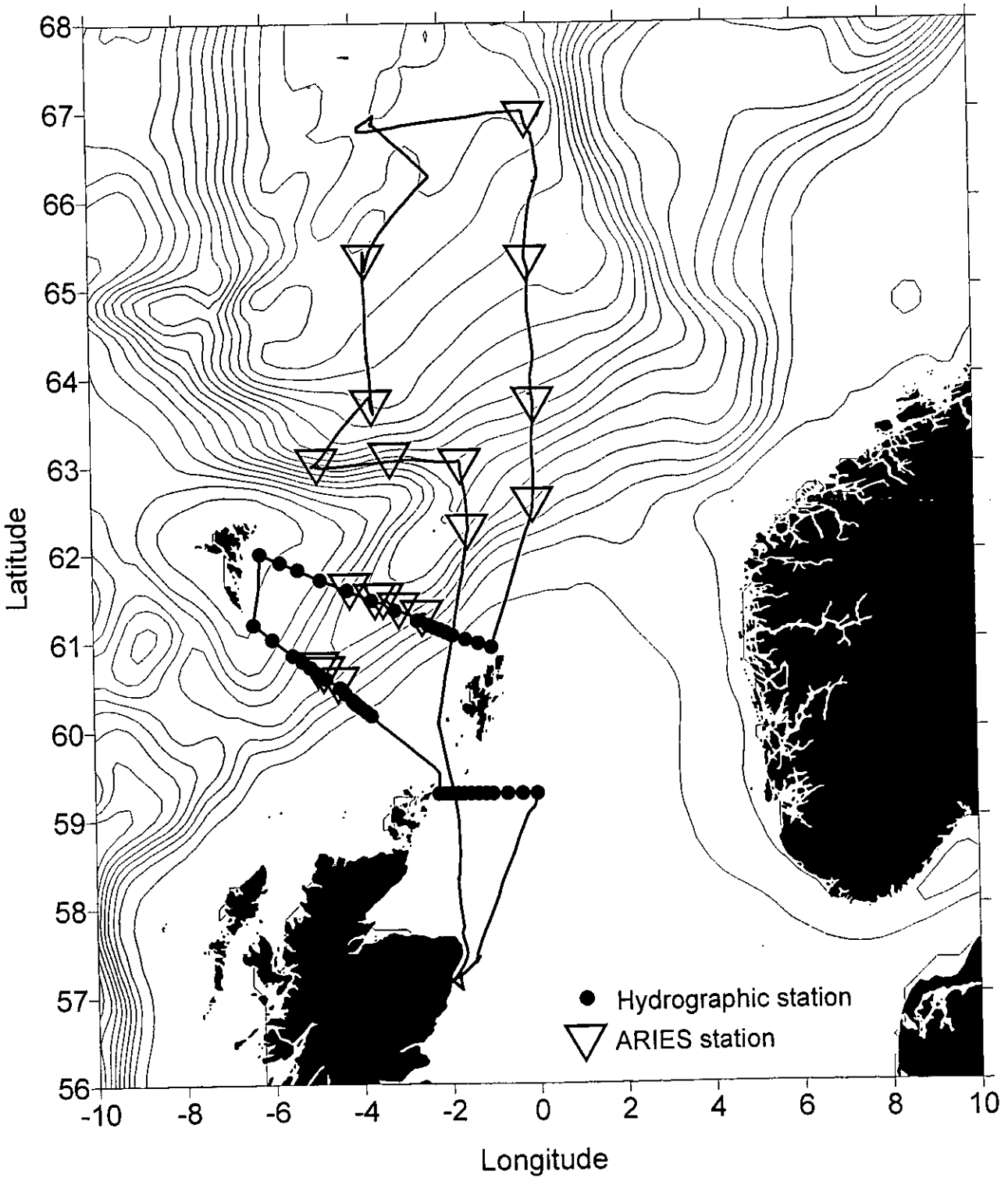


Figure 2

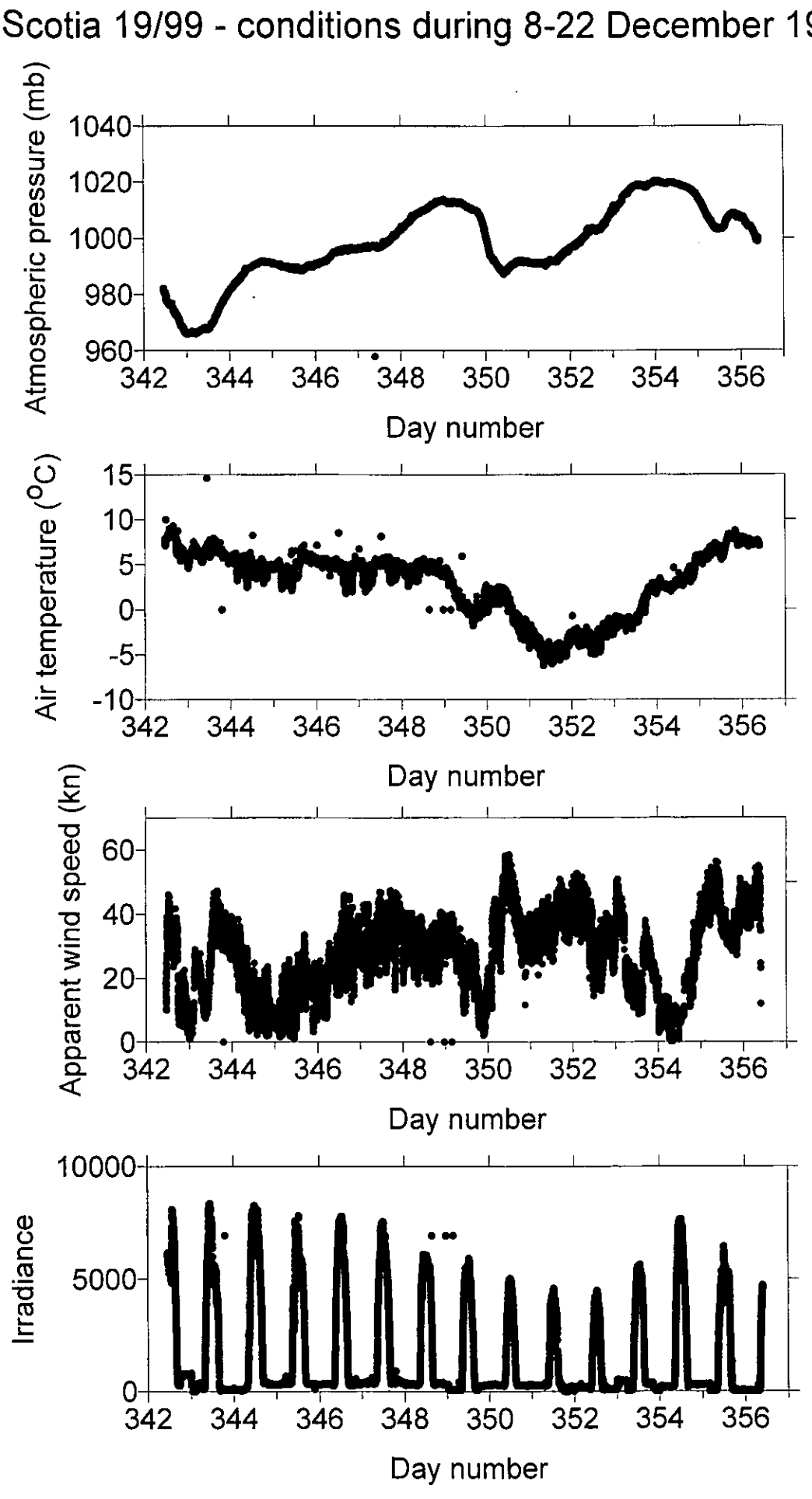
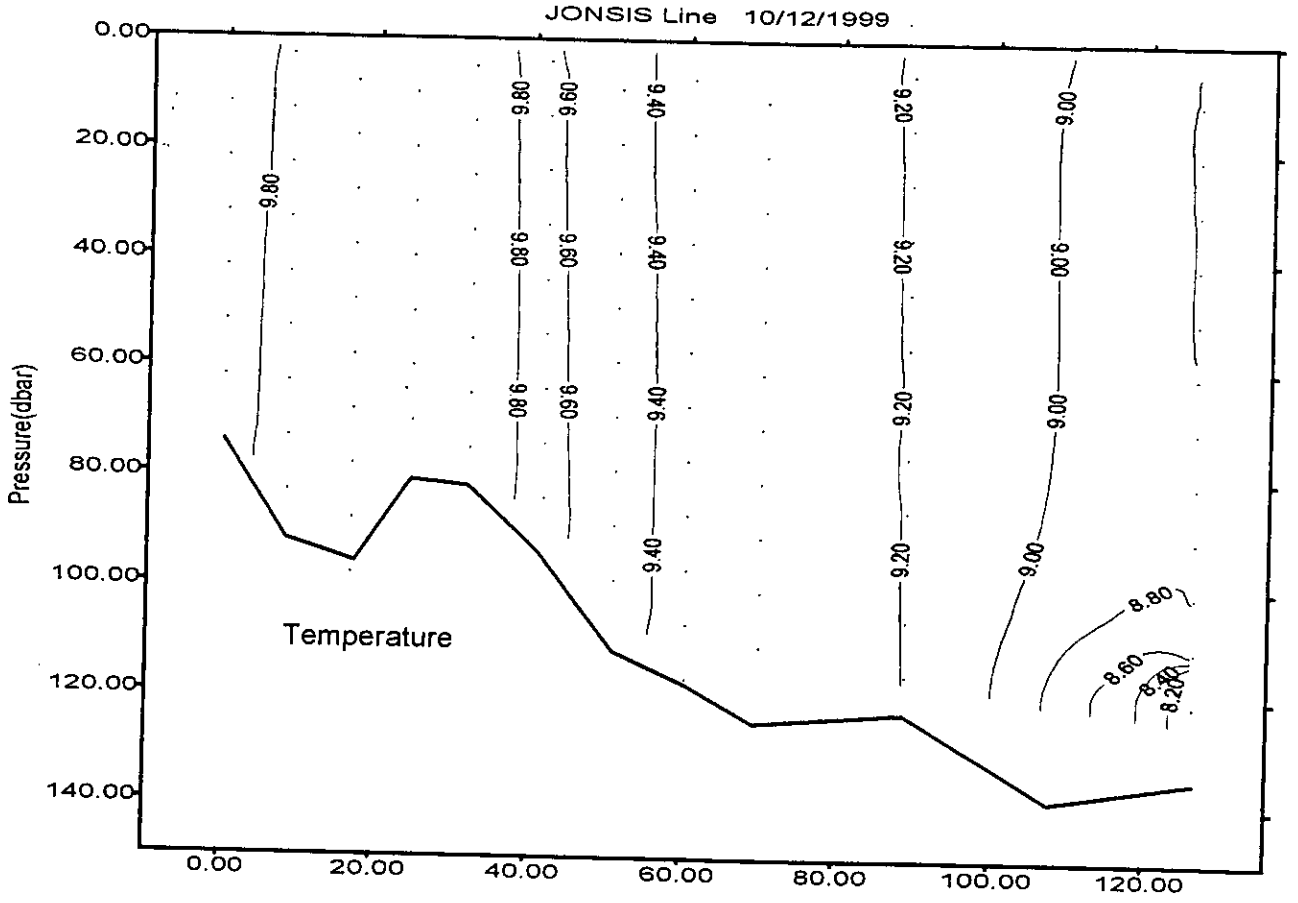
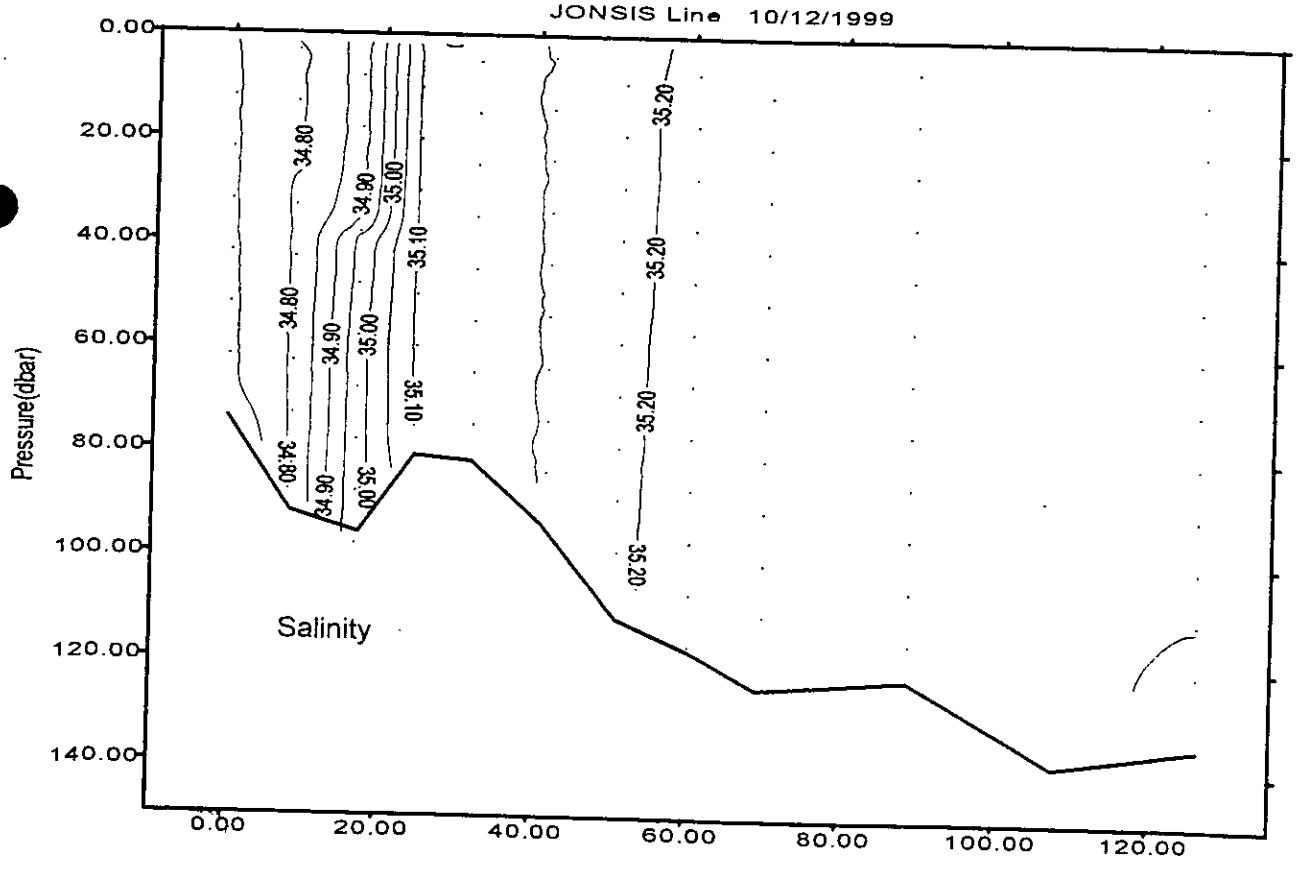
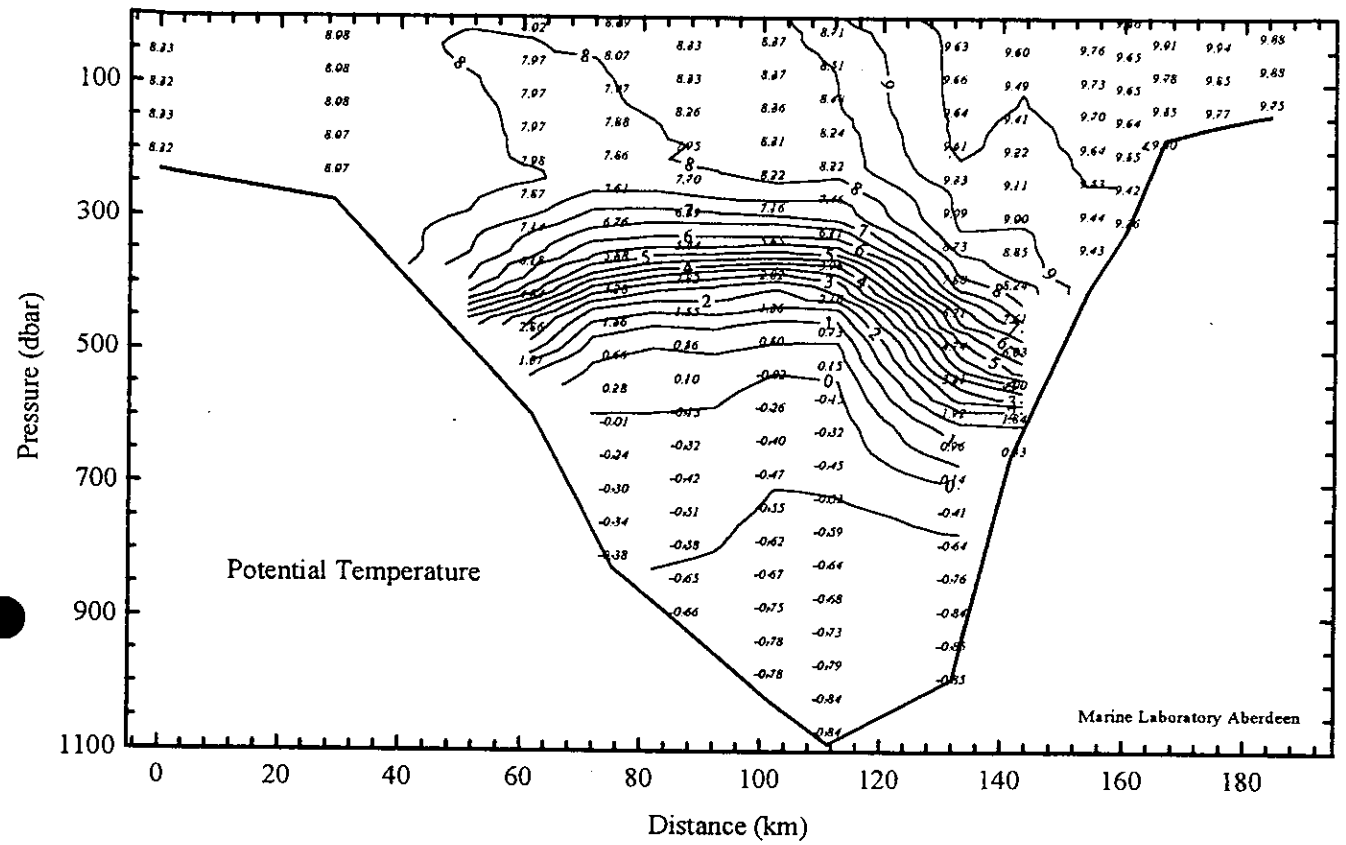

Scotia 19/99 - conditions during 8-22 December 1999
Atmospheric pressure (mb)
1040
1020
1000
980
960
342
344
346
348
350
352
354
356
Day number
Air temperature (°C)
15
10
5
0
-5
-10
342
344
346
348
350
352
354
356
Day number
Apparent wind speed (kn)
60
40
20
0
342
344
346
348
350
352
354
356
Day number
Irradiance
10000
5000
0
342
344
346
348
350
352
354
356
Day number

Figure 3. Uncalibrated temperature and salinity data along the JONSIS monitoring section in the North Sea.







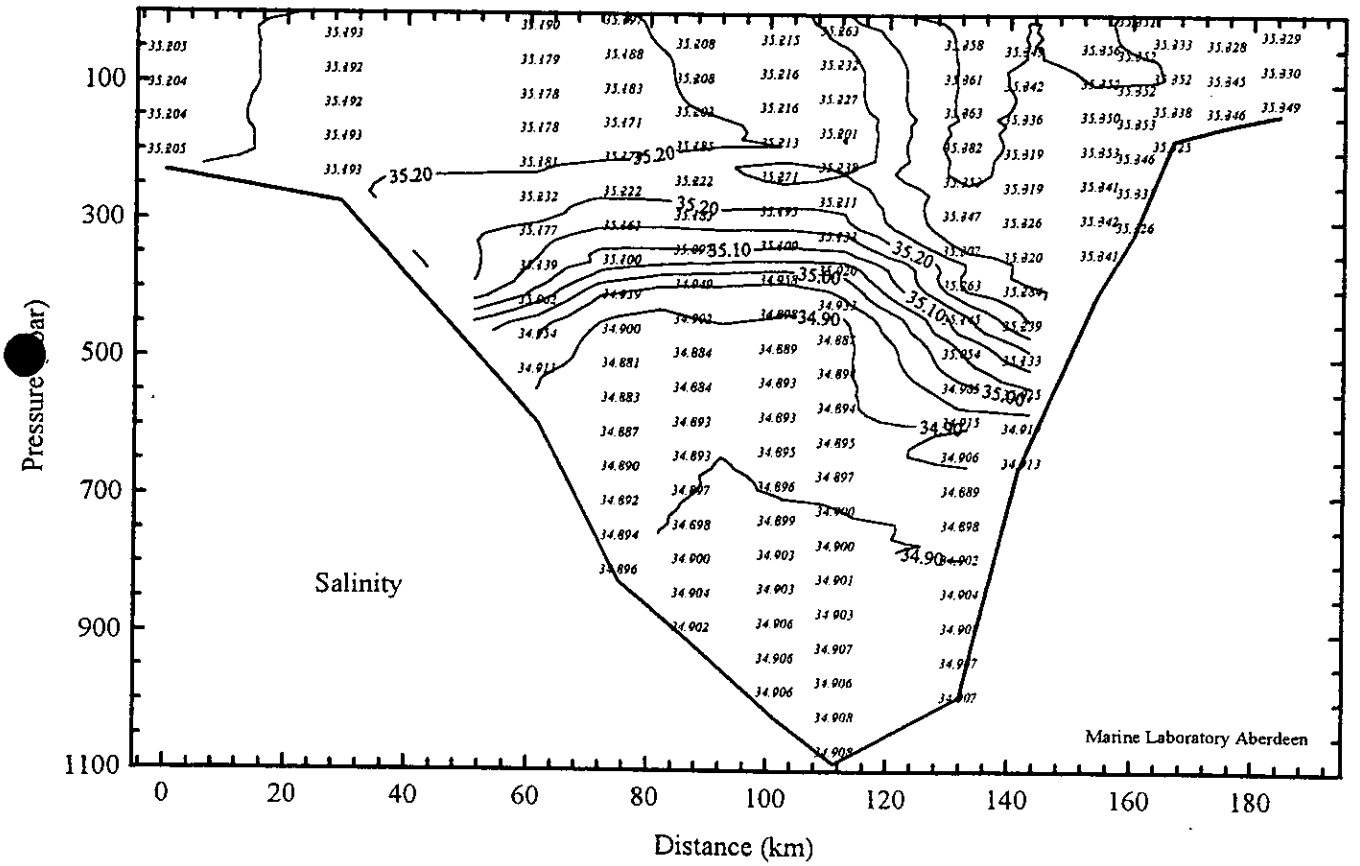


Figure 4. Uncalibrated temperature and salinity data along the Fair Isle - Munken monitoring section in the Faroe-Shetland Channel.

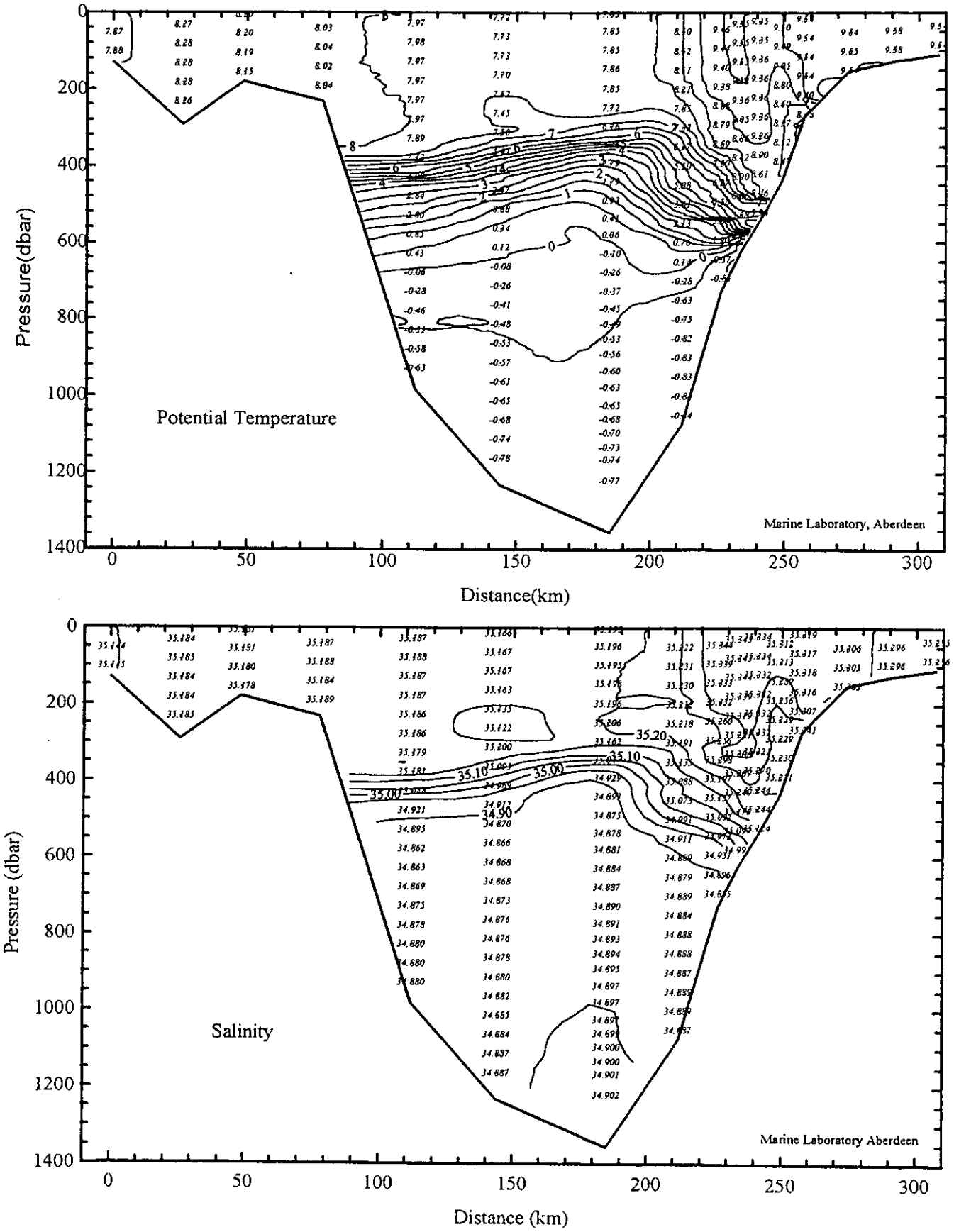


Figure 5. Uncalibrated temperature and salinity data along the Nolso-Flugga monitoring section in the Faroe-Shetland Channel.

Figure 6. Mean concentration (number/m^3) of *Calanus finmarchicus* in the surface (open bars) and bottom waters (solid bars) along the Fair Isle - Munken section in 1999 (Winter 99/00), compared to previous years. Numbers next to each bar indicated the number of 1 min Optical Plankton Counter samples in each case.

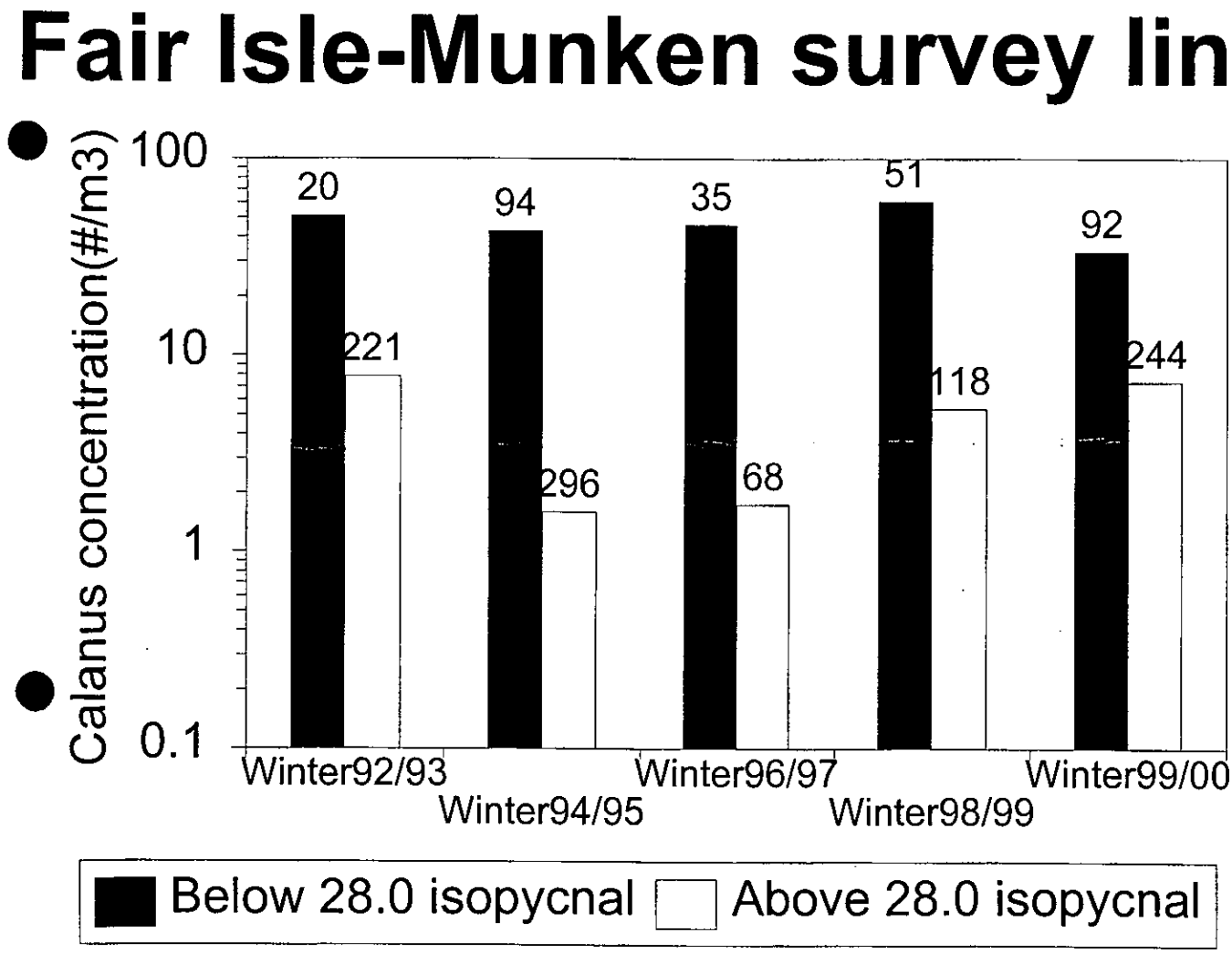


Figure 7. Mean concentration (number/m^3) of *Calanus finmarchicus* in the surface (open bars) and bottom waters (solid bars) along the Nolso - Flugga section in 1999 (Winter 99/00), compared to previous years. Numbers next to each bar indicated the number of 1 min Optical Plankton Counter samples in each case.

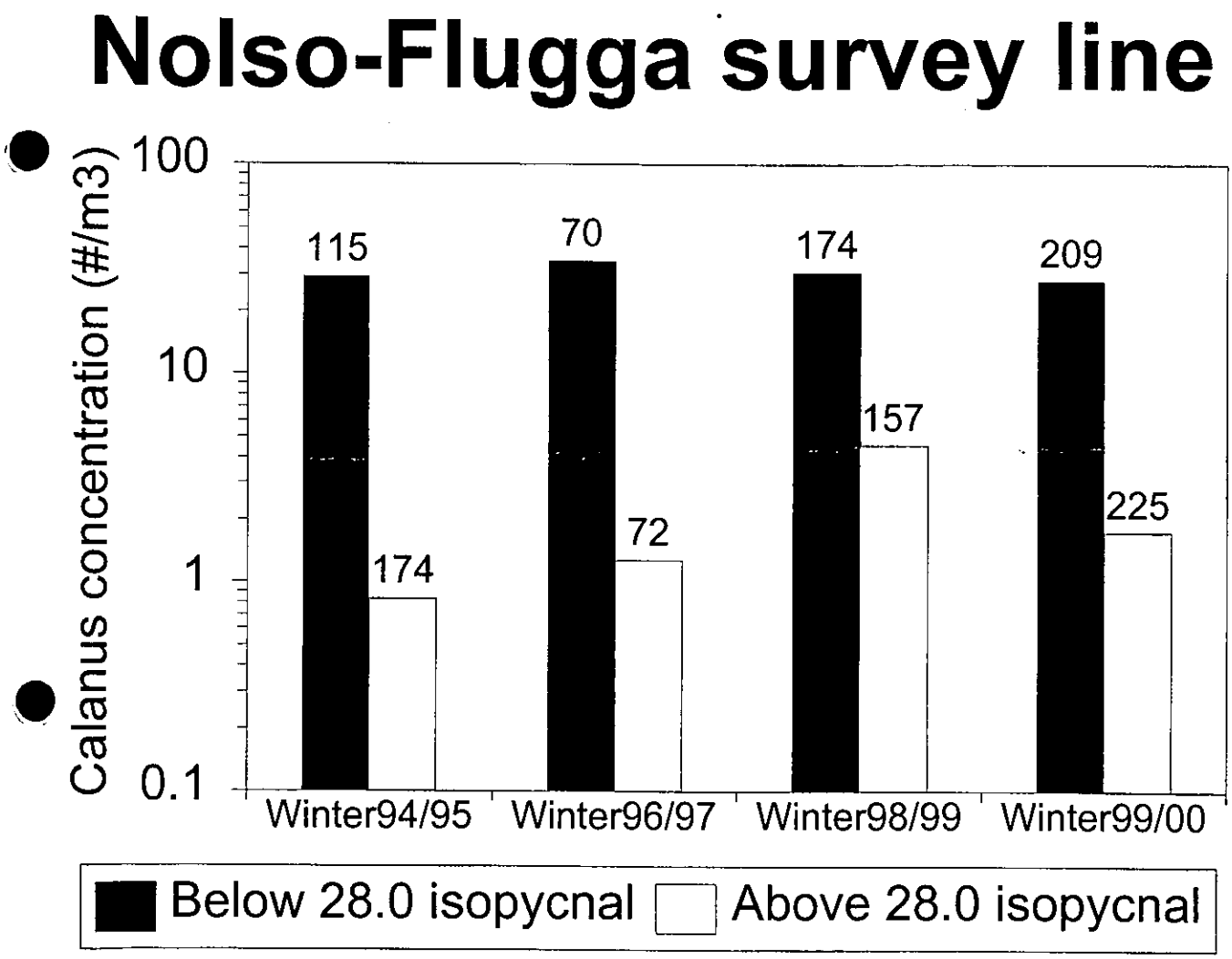


Figure 8. Abundance in the whole water column (number below one square metre of sea surface) of *Calanus* at Faroe-Shetland Channel and Norwegian Sea sampling stations in 1999, and during the equivalent survey in 1998.