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FRV *Scotia*

Cruise 1609S

REPORT

2-16 December 2009

Loading: Aberdeen, 27 November 2009
Unloading: Aberdeen, 16 December 2009

Personnel

J Dunn (SIC)
N Collie
K Cook
J Hunter
D Lichtman
N Morrison
J Rasmussen
S Robinson

Project: AE11r - 15 days

Sampling gear: Hydrographic CTD; Plankton nets (ARIES) (Ocean)

Fishing gear: None

Area: North Sea-Faeroe Shetland Channel.

Objective

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

2. To conduct plankton and hydrographic sampling with ARIES in the Faroe Shetland Channel.

Narrative

Staff joined the Scotia at 0900hrs, but sailing was delayed until 100hrs due to the late arrival of a ferry. Scotia made passage to a deep-water position in the Moray Firth where all equipment was successfully tested before the vessel set away at 1700hrs for the eastern end of the Jonsis line.

This position was reached by 0200hrs on Thursday 3 December; however, the southeasterly swell and winds in excess of 60knts forced the vessel to dodge. At 0730, the decision was taken for the vessel to seek shelter in the Orkney Islands. Scotia left shelter, made passage to the western end of the Jonsis line, and attempted to deploy the CTD, but strong tides and winds made this impossible. The vessel dodged in the area until slack water when the station was started at 0150 on Friday 4 December.

Steady progress was made along the line of stations using an Ocean sampler and CTD at every station, and the line was completed by 1945 on Friday 4 December.

Scotia made passage for the end of the of the Fair Isle /Munken line, but in deteriorating weather conditions and with a very bad forecast, the ship diverted up the west side of Shetland to attempt to start the Flugga /Nolso line. However, the wind and sea state forced the vessel to seek shelter overnight in St Magnus bay on 5 December.

Scotia left St Magnus bay AT 0700hrs on 6 December to land a member of the scientific crew at Scalloway. The vessel sustained light damage coming along side at Scalloway and it was decided to berth the vessel for 24 hours to allow the ship's engineers to repair the damage.

Scotia made passage north on 7 December at 0900hrs to commence the Nolso-Flugga line from the eastern end, however very strong winds and heavy swell, forced the vessel to seek shelter in the lee of Unst. The weather had moderated sufficiently by 2200 hrs to allow the first station NOL 1 to be completed.

Reasonable progress was made along the line towards Faeroe with nine stations completed and NOL 4 being completed by 1845 on 8 December, but wind and sea state had increased again, forcing Scotia to dodge. Overnight the wind did drop slightly by 0400 but with a big swell running it was not possible to resume work. ARIES was launched at NOL 5 in heavy swell but on recovery, the main sampling net was discovered to have been ripped off, so the station had to be repeated. The heavy swell forced Scotia to dodge again, and it was decided to make passage to the east for NOL 9 and try to do the last three stations on the line in lower swell conditions. These were completed by 0700hrs on 10 December, the vessel then returned along the line to NOL 8. The remaining stations were completed by 8.35 on Friday 11 December and Scotia made passage to FIM 6 to take advantage of the good sea and wind conditions. On completion of the station, it was discovered that all three sampling nets had been ripped off possibly by the swell, so the station was repeated.

Scotia proceeded along the FIM line towards Faeroe and the western end of the line was completed by 1235 on Saturday 12 December, when the vessel turned and made her way back to FIM 5, which was completed by 2359 hrs. Scotia worked well in good weather and sea state, and completed the FIM line by 0745 hrs on Sunday 13 December. The vessel then made passage to the northern end of the east coast line.

The first station was completed at 0715 and over the next two days the CTD and Ocean sampler were deployed at all stations, with the final one being completed by 0400hrs on Tuesday 15 December.

Scotia made for an area of shelter to allow the main deck hatch to be opened, for equipment pack up and cages to be filled.

The vessel made its way to Aberdeen docking at 0003 on Wednesday 16 December.

Results

The first part of the survey was significantly disrupted by extremely poor weather; but steady progress was made in the second half of the cruise with calmer weather.

1. The JONSIS standard section in the northern North Sea was surveyed completely, including an extra station at the eastern end and Ocean sampler tows at each station.

2. Plankton and water samples were collected using CTD,ARIES and a Dual Methot net in the Faeroe Shetland Channel.

3. The east coast line was surveyed excluding the tree stations in Norwegian waters.

Throughout the cruise surface temperature, salinity and fluorescence recordings were made using a Sea-bird SBE21 Thermosalinograph and a Sea Point Fluorometer.

The water sampling room was thoroughly cleaned, and the thermosalinograph thoroughly flushed out with fresh water at the end of the cruise.

Detailed results of the hydrographic data collected during the cruise will be made available as the data is worked up and interpreted by the laboratory.

As there was no chemist or nutrient laboratory on board we stored all samples in either fridge or freezer

OPC data

Preliminary OPC analysis

Data from the optical plankton counter (OPC) obtained during ARIES deployments were investigated during the cruise.

During the cruise, problems were identified where a pattern of counts was observed across the size range of the data. This pattern seems to be replicated across stations and consisted of elevated counts in certain size bins at some depths (e.g. persistent counts of particles in size categories ~3700 um ESD for all depths, Figure 1)). One of the size ranges that appear problematic overlap the range used to quantify calanus sized particles (900-1700 µm ESD) and gave higher counts at shallower depths than previously observed. Inspection of nets from the ARIES system could not verify these elevated counts as calanus nor any other organisms in the concentrations indicated in the OPC data. While working on the FIM line, the logger was replaced, but did not seem to remove the artifact. On replacing the actual OPC unit while retaining the same logger, the artifacts did not appear any more. Hence, it appears that there was some electronic or mechanical fault in the OPC unit itself.

As a consequence, only data from 600m or deeper was used to create an integrated concentration of calanus sized particles for the 2009 data. In some cases this leads to only half the concentration of integrating for the full water column where the dubious data is included (typically occurring between 200 and 600m depth).

Abundances of equivalent spherical diameters corresponding to the copepodite stages 4 and 5 of *Calanus finmarchicus* were plotted with depth to obtain vertical profiles across the Fair Isle-Munken (FIM) and Nolso-Flugga (NOL) (Figure 2-3) transects. In previous year, OPC data was also collected on the JONSIS line, but this year, an OCEAN sampler was deployed instead, provided better resolution plankton samples, but no OPC data.

The preliminary analysis provide counts of a particular size category, but makes no distinction between species, so it is necessary to verify OPC results with a more detailed analysis of the collected plankton samples at a later stage. In addition, the problems indicated earlier shows very high counts in the shallower parts of the water column than previously observed on this cruise.

In addition to vertical profiles of OPC counts, integrated abundances of Calanus C4-C5 sized particles were also calculated and plotted for the FIM and NOL lines (Figure 4). The annual integrated abundances from 2005 to 2009 are plotted on the same scale to illustrate differences in spatial distributions.

Concentrations of Calanus C4-5 size particles were generally high on all deeper stations. The concentrations for FIM 6 and NOL 6 priority stations were similar or slightly lower to 2008, but

higher on the last priority station, NOL-5. Typically, a higher concentration is found on either the eastern or western side of the NOL line deeps, but this year there appears to be a uniformly high concentration across the line. Due to the problems identified, the data should be further inspected in detail before being used to estimate plankton abundances and the reported results should be interpreted with caution.

John Dunn
Jens Rasmussen

17 December 2009

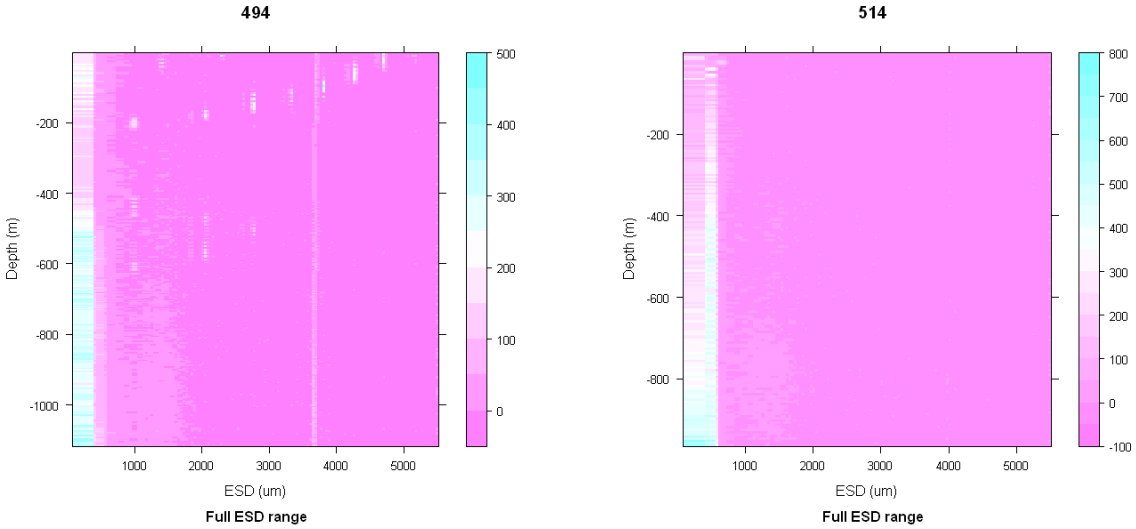


Figure 1: Demonstrating problems identified with the OPC unit. In the plot of haul 494, concentration of particles with depth across the size range analyzed show isolated high counts can be seen as a line traversing size and depth as well as a line of continuously high counts in one size bin. In haul 514 where the OPC unit had been replaced, these artifacts are no longer present.

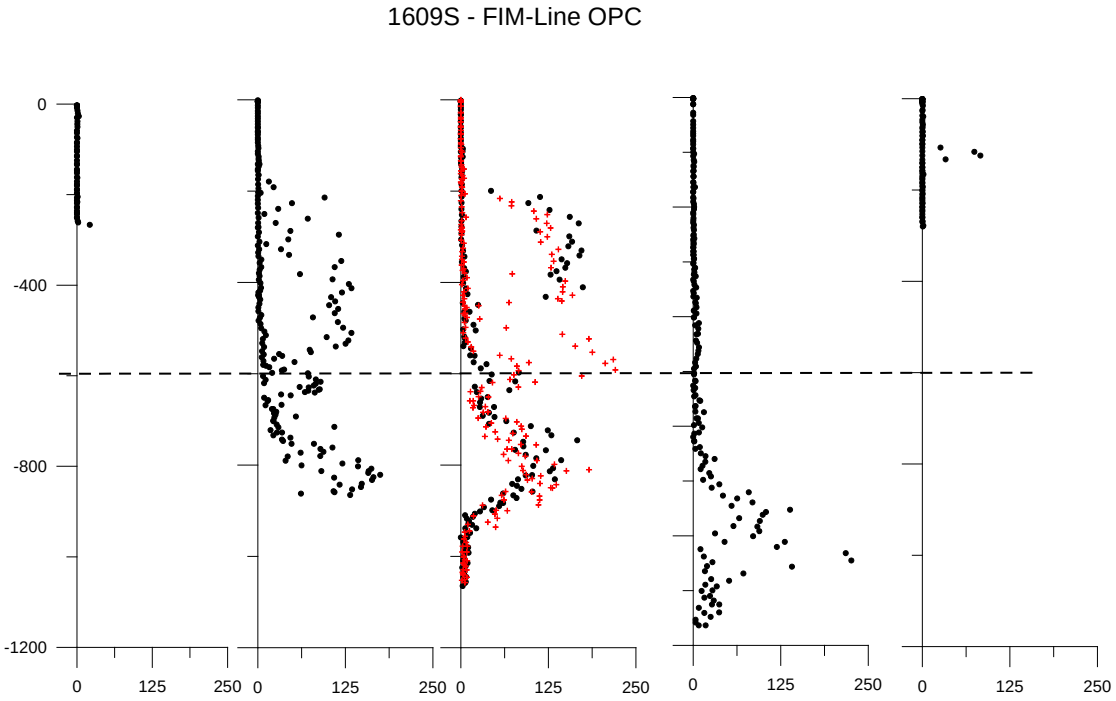


Figure 2: OPC data for the Fair-Isle Munken line stations FIM9, FIM7, FIM6, FIM5, and SEFOS-2. Red crosses on the FIM-6 plot plots a second deployment where nets failed but OPC logged data. The dotted line indicates the limit for integrated concentration of calanus sized particles.

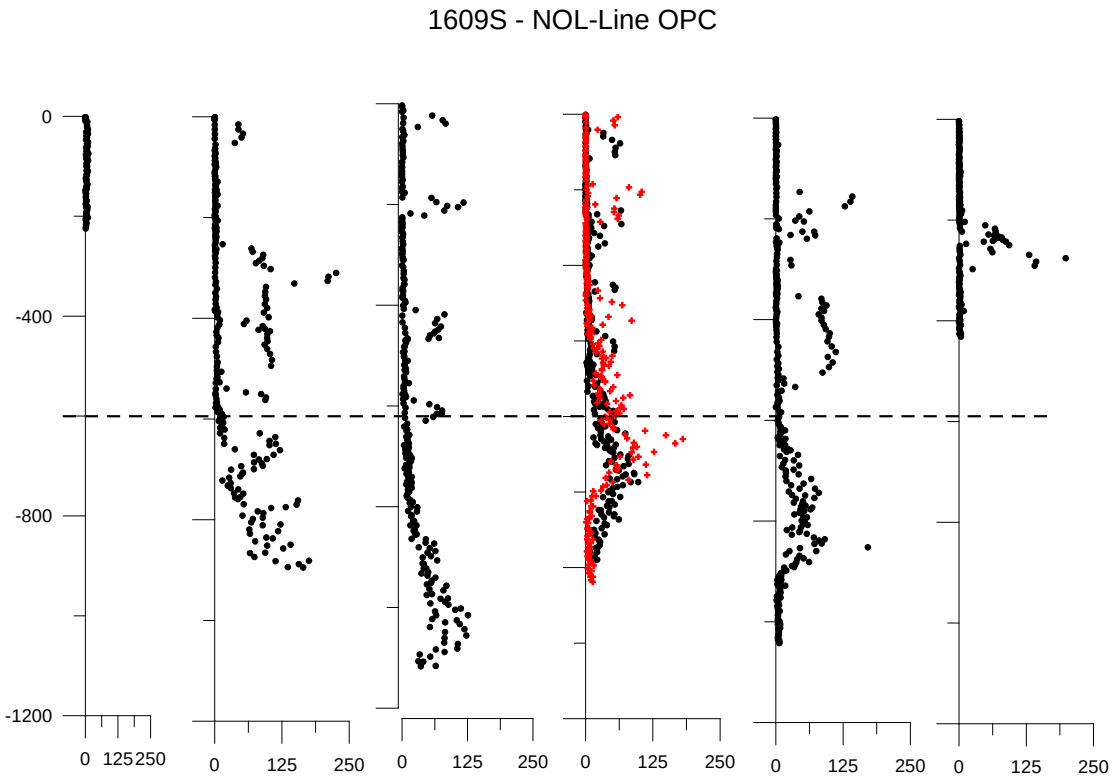
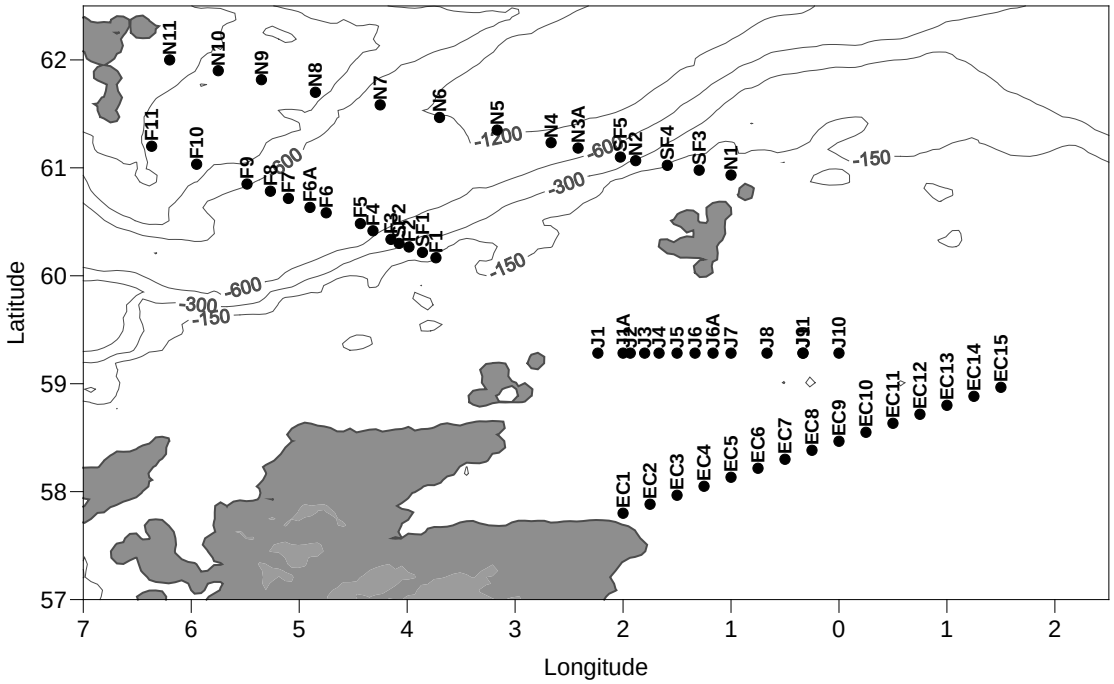
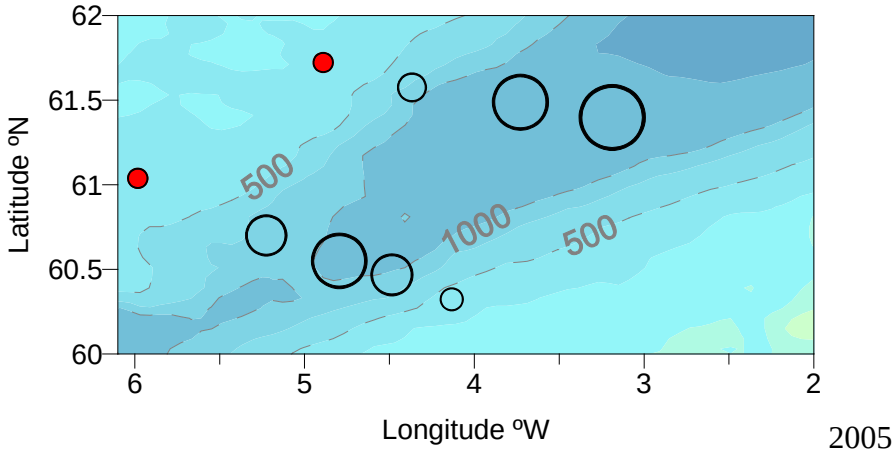


Figure 3: OPC data for NOL line stations NOL8, NOL7, NOL6, NOL5, NOL4, and SEFOS-5. Red dots indicate a second OPC deployment on NOL5 where nets failed. The dotted lines is the limit for vertical integration of Calanus sized particles that was applied.

Station List for 1609S





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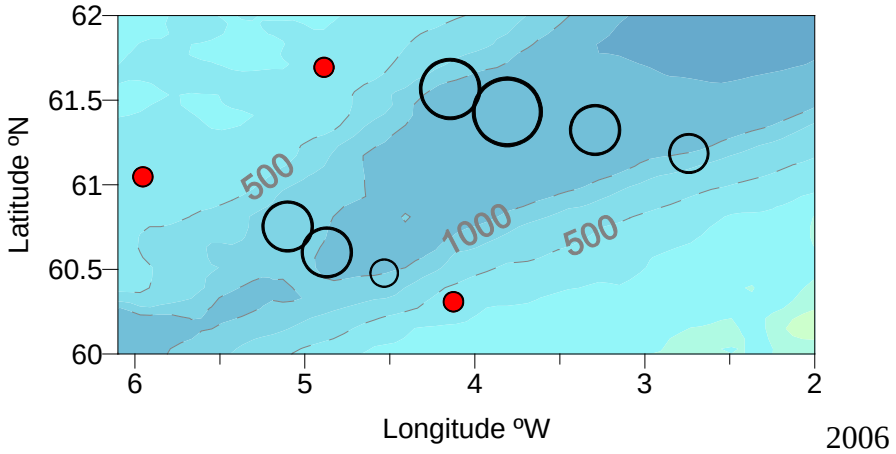

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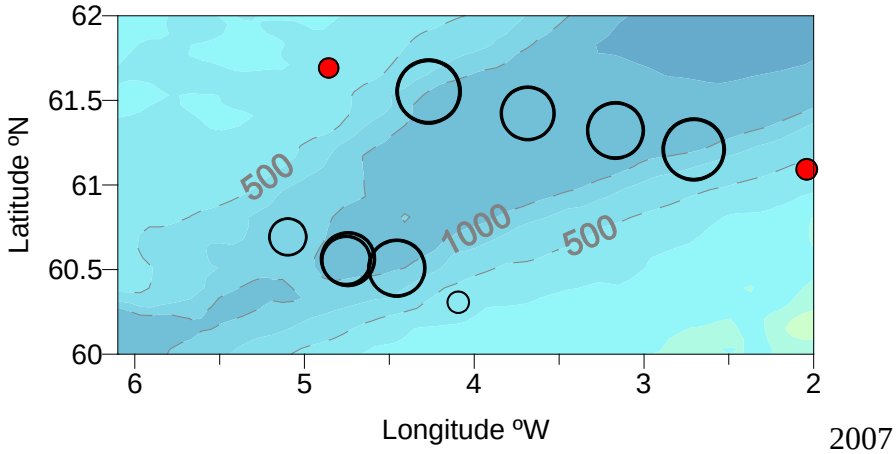
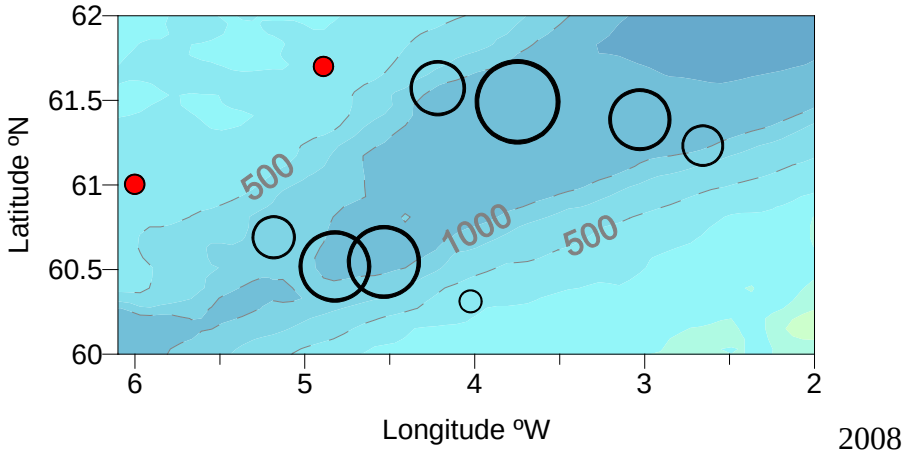


2007



2008

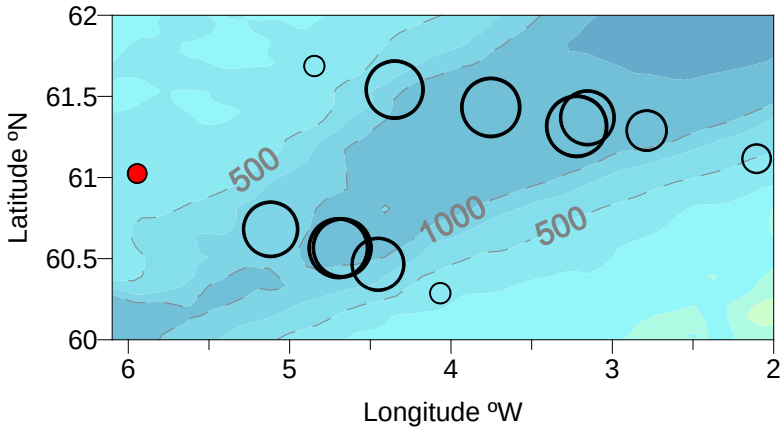


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Figure 4: Integrated OPC counts for FIM and NOL Lines. Note for 2009, only OPC counts deeper than 600m has been integrated to provide an estimate of concentration.

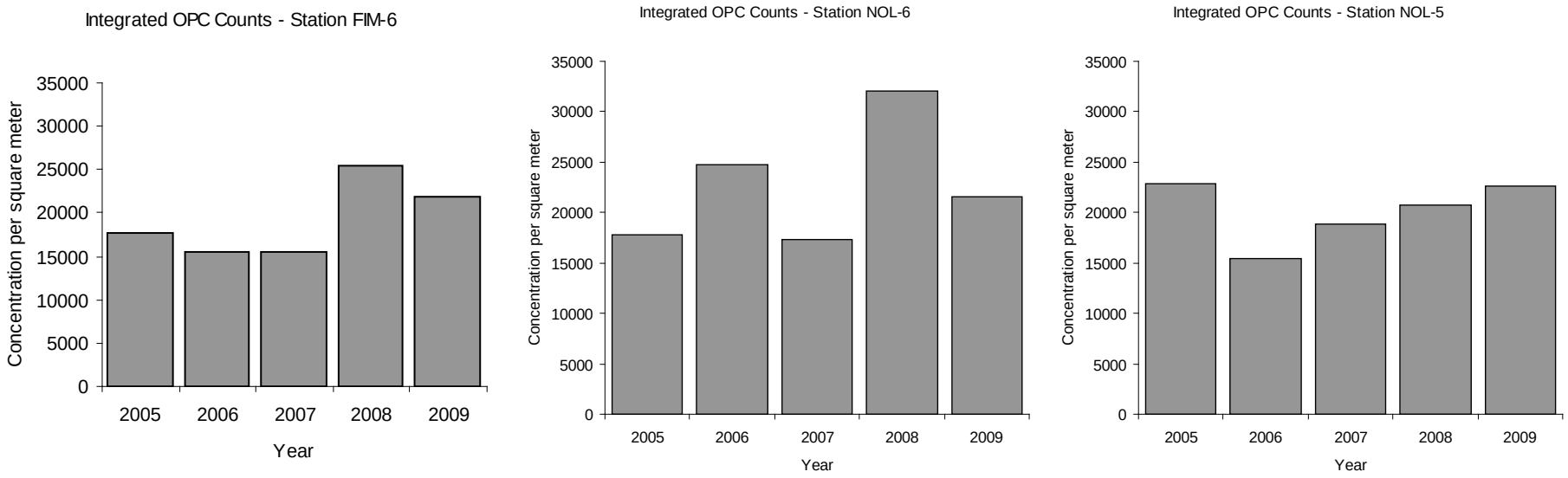

Figure 5: Integrated abundances on priority stations between 2005 and 2009.

Table 1

JONSIS Line Stations

Name	Latitude	Longitude	Depth	Spacing
JO 1	59°17.00'N	02°14.00'W	75 m	
JO 1A	59°17.00'N	02°5.00'W	90 m	8.5 km
JO 2	59°7.00'N	01°56.00'W	100 m	8.5 km
JO 3	59°17.00'N	01°48.00'W	80 m	7.6 km
JO 4	59°17.00'N	01°40.00'W	90 m	7.6 km
JO 5	59°17.00'N	01°30.00'W	95 m	9.5 km
JO 6	59°17.00'N	01°20.00'W	110 m	9.5 km
JO 6A	59°17.00'N	01°10.00'W	120 m	9.5 km
JO 7	59°17.00'N	01°0.00'W	125 m	9.5 km
JO 8	59°17.00'N	00°40.00'W	120 m	18.9 km
JO 9	59°17.00'N	00°20.00'W	140 m	18.9 km
JO10	59°17.00'N	00°0.00'W	135 m	18.9 km

Table 2

Fair Isle - Munken line stations

Name	Latitude	Longitude	Depth	Spacing	
FIM-01	60° 10.00' N	03° 44.00' W	150 m		CTD
SEFOS-1	60° 13.00' N	03° 51.50' W	170 m	8.9 km	CTD
FIM-02	60° 16.00' N	03° 59.00' W	200 m	8.9 km	CTD
SEFOS-2	60° 18.00' N	04° 04.50' W	330 m	6.3 km	CTD, ARIES
FIM-03	60° 20.25' N	04° 09.00' W	390 m	6.3 km	CTD
FIM-04	60° 25.00' N	04° 19.00' W	655 m	12.4 km	CTD
FIM-05	60° 29.00' N	04° 26.00' W	995 m	9.8 km	CTD,ARIES
FIM-06	60° 35.00' N	04° 45.00' W	1090 m	20.6 km	CTD, ARIES, MIKT Priority station for ARIES
FIM-6a	60° 38.00' N	04° 54.00' W	1030 m	9.9 km	CTD
FIM-07	60° 43.00' N	05° 06.00' W	915 m	14.3 km	CTD, ARIES
FIM-08	60° 47.00' N	05° 16.00' W	830 m	11.7 km	CTD
FIM-09	60° 51.00' N	05° 29.00' W	600 m	13.9 km	CTD
FIM-10	61° 02.00' N	05° 57.00' W	280 m	32.4 km	CTD, ARIES
FIM-11	61° 12.00' N	06° 22.00' W	240 m	29.1 km	CTD

Table 3

Nolso - Flugga line stations

Name	Latitude	Longitude	Depth	Spacing	
NOL-11	62° 00.00' N	06° 12.00' W	125 m		CTD
NOL-10	61° 54.00' N	05° 45.00' W	290 m	26.0 km	CTD
NOL-09	61° 49.00' N	05° 21.00' W	180 m	22.9 km	CTD
NOL-08	61° 42.00' N	04° 51.00' W	235 m	29.3 km	CTD, ARIES
NOL-07	61° 35.00' N	04° 15.00' W	990 m	34.2 km	CTD, ARIES
NOL-06	61° 28.00' N	03° 42.00' W	1235 m	31.9 km	CTD, MIKT, ARIES Priority station for ARIES
NOL-05	61° 21.00' N	03° 10.00' W	1370 m	31.2 km	CTD, ARIES Priority station for ARIES
NOL-04	61° 14.00' N	02° 40.00' W	1080 m	29.6 km	CTD, ARIES
NOL-3a	61° 11.00' N	02° 25.00' W	730 m	14.5 km	CTD
SEFOS-6	61° 09.30' N	02° 17.50' W	630 m	7.4 km	CTD
NOL-03	61° 08.00' N	02° 10.00' W	550 m	7.1 km	CTD
SEFOS-5	61° 06.00' N	02° 01.50' W	440 m	8.5 km	CTD, ARIES
NOL-02	61° 04.00' N	01° 53.00' W	270 m	8.5 km	CTD
SEFOS-4	61° 01.40' N	01° 35.40' W	155 m	16.7 km	CTD
SEFOS-3	60° 58.70' N	01° 17.70' W	125 m	16.7 km	CTD, ARIES
NOL-01	60° 56.00' N	01° 00.00' W	110 m	16.7 km	CTD

Table 4

East Coat Line

Name	Latitude	Longitude	Depth	Spacing	
EC15	59° 13.00' N	01° 30.00' E	125 m		CTD, OCEAN
EC14	58° 53.00' N	01° 15.00' E	120 m	17.0 km	CTD, OCEAN
EC13	58° 48.00' N	01° 00.00' E	120 m	17.1 km	CTD, OCEAN
EC12	58° 43.00' N	00° 45.00' E	140 m	17.1 km	CTD, OCEAN
EC11	58° 38.00' N	00° 30.00' E	140 m	17.1 km	CTD, OCEAN
EC10	58° 33.00' N	00° 15.00' E	150 m	17.2 km	CTD, OCEAN
EC09	58° 28.00' N	00° 00.00' W	140 m	17.2 km	CTD, OCEAN
EC08	58° 23.00' N	00° 15.00' W	130 m	17.2 km	CTD, OCEAN
EC07	58° 18.00' N	00° 30.00' W	120 m	17.3 km	CTD, OCEAN
EC06	58° 13.00' N	00° 45.00' W	105 m	17.3 km	CTD, OCEAN
EC05	58° 08.00' N	01° 00.00' W	115 m	17.3 km	CTD, OCEAN
EC04	58° 03.00' N	01° 15.00' W	110 m	17.3 km	CTD, OCEAN
EC03	57° 58.00' N	01° 30.00' W	95 m	17.4 km	CTD, OCEAN
EC02	57° 53.00' N	01° 45.00' W	75 m	17.4 km	CTD, OCEAN
EC01	57° 48.00' N	02° 00.00' W	185 m	17.4 km	CTD, OCEAN