CRUISE REPORT

North Sea Ecosystem Cruise

RV "Johan Hjort" 9 April – 5 May 2015

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1. Summary

The North Sea Ecosystem spring cruise is a multi-purpose survey, covering hydrography, chemistry, phytoplankton and zooplankton as well as fish eggs and fish larvae (IMR project 14385 and 14387). The survey area of the North Sea Ecosystem cruise 2015 was extended eastward to include both northern North Sea and the Skagerrak. Pre-selected stations along standard transects were sampled for hydrography (CTD), chemistry (nutrients and chlorophyll) and plankton (including fish larvae and eggs). Two 24-hour process stations were undertaken east of Shetland (60ºN; 0.5ºW) and northeast of Aberdeen (Fladen ground, 58°N-0.6°W), to investigate the vertical and diel distribution of fish eggs and larvae and their potential predators and prey. In addition, water for analyses of radioactive contamination were sampled in Skagerrak (IMR project 14379-01). This cruise also included sampling for two projects within the Norwegian Taxonomy Initiative, on copepods (COPCLAD) and hydrozoa (HYPNO). Sampling for Hydrozoa was conducted by a guest from University of Bergen (Bergen Museum).

Cruise dates:	09.04.2015 – 05.05.2015
Cruise name:	JH2015204, North Sea Ecosystem Cruise
Vessel:	RV "Johan Hjort"
Master:	John Gerhard Aasen (09.-24.04)/Tommy Steffensen (24.04-05.05)
Area:	North Sea/Skagerrak (57-60.8ºN, 2.2ºW- 8.6ºE)
Ports of Call:	Lerwick, Shetland 11.04.15 Kristiansand, Norway, 22.-24.04.15 (crew change)

Projects:

- Climate and plankton in the North Sea and Skagerrak (IMR 14385),
- Early life history dynamics of North Sea fishes (IMR 14387).
- Monitoring of radioactivity in Norwegian waters (IMR 14379-01)
- Inventory of marine Copepoda and Cladocera (Crustacea) in Norway (COPCLAD; IMR 14534)
- Hydrozoan pelagic diversity in Norway (HYPNO, UiB)

2. Introduction

The North Sea Ecosystem spring cruise has been run since 2010 by the Institute of Marine Research (IMR) as a multi-purpose survey. The cruise covered hydrography, chemistry, phytoplankton and zooplankton as well as fish eggs and fish larvae for the IMR projects "Monitoring of climate and plankton in the North Sea Skagerrak", and "Early life history dynamics of North Sea Fishes". The cruise also included monitoring of radioactive contamination, and sampling for two projects within the Norwegian Taxonomy Initiative, on hydrozoa (HYPNO) and copepods (COPCLAD). The survey area of the North Sea Ecosystem cruise 2015 included both northern North Sea and the Skagerrak

The objectives of the North Sea Ecosystem Cruise 2015 were:

1) To sample pre-selected stations along standard transects for physical, chemical and biological parameters in the Northern North Sea and Skagerrak.
2) To map the abundance, distribution and species composition of phytoplankton, zooplankton, and early life stages of fish (eggs and larvae).
3) To undertake two process studies (northwestern North Sea and Skagerrak) to investigate the spatial, vertical and diel distribution of fish eggs and larvae and their potential predators and prey.
4) To monitor radioactive contamination in Skagerrak
5) To collect species of pelagic Hydrozoa

2.1 Monitoring of plankton, biogeochemistry and hydrography in the North Sea and Skagerrak (IMR 14385)

The aim of the IMR monitoring project «Climate and plankton in the North Sea and Skagerrak« is, 1) to collect and analyze biological, chemical, and physical data to characterize and understand the causes of variability in the North Sea and Skagerrak at the seasonal, and inter annual scales, and 2) to provide multidisciplinary data sets that can be used to establish relationships among the biological, chemical, and physical variability. The monitoring activity includes one regional coverage per year (the spring survey in April/May) in addition to sampling along two standard transects 4-12 times a year (Utsira-StartPoint and Torungen-Hirtshals).

The spring survey on plankton and hydrography in the North Sea - Skagerrak has been carried out by the institute of Marine Research since 2006. From 2006 to 2014, the survey was undertaken as a combination of two cruises running in parallel: "The Environmental cruise" (Miljøtoktet on RV / GM Dannevig) in the Skagerrak, and the North Sea plankton survey (usually on RV/ Johan Hjort) in the northern North Sea. In 2010, sampling of fish eggs and fish larvae was included in the sampling program, and the survey was renamed to "The North Sea Ecosystem Cruise". In 2015, the former two spring surveys were combined into one single cruise, and the *2015 North Sea Ecosystem Cruise* covered both the northern North Sea and the Skagerrak.

2.2 Early life history dynamics of North Sea fishes (IMR 14387)

The IMR project "Early life history dynamics of North Sea fishes" aims to determine the distribution and abundance of fish eggs and larvae in the northeastern North Sea, and to link studies on the early life history of fish with zooplankton. The survey provides depth integrated distribution of fish eggs and larvae that can be related to the zooplankton and physical oceanographic data from the standard sections in the northern North Sea. In addition, studies are undertaken to investigate the vertical and diel distribution of fish eggs and larvae and their potential predators and prey.

2.3 Monitoring of radioactivity in Norwegian waters (IMR 14379-01)

Water samples are collected by IMR once a year from Skagerrak, for analyses of radioactive contamination (cesium-137). This project contributes to the national monitoring program "Radioactivity in the Marine Environment (RAME)" which is coordinated by the Norwegian Radiation Protection Authority.

2.4 Inventory of marine Copepoda and Cladocera (Crustacea) in Norway (COPCLAD, IMR 14534)

Collection of zooplankton samples were made as part of the project COPCLAD (Inventory of marine Copepoda and Cladocera in Norway, 2015-2017). The project is funded by the Norwegian Taxonomy Initiative (NTI) and aims to perform an inventory of marine planktonic copepods and water fleas in the Norwegian EEC and the Arctic Ocean.

2.5 Hydrozoan pelagic diversity in Norway (HYPNO)

Samples of gelatinous zooplankton were collected as part of the NTI project "HYPNO" (Hydrozoan pelagic diversity in Norway). The project studies the species composition of pelagic Hydrozoa in several environments along the Norwegian coast, with photographic documentation and DNA barcoding of 16S and COI sequences of the encountered species.

3. Materials and Methods

3.1 Participation

Personnel participating in the cruise are listed (along with dates and their primary responsibilities) in Table 1. A crew change was undertaken on the 24th April in Kristiansand

Table 1: *Cruise participants*

Name	Role	Research group	Dates	
Richard Nash	Cruise leader, Fish larvae	Bunnfisk 421	09.04	- 22.04
Hannes Höffle	Fish larvae	Bunnfisk 421	09.04	- 22.04
Eli Gustad	Plankton	Plankton 434	09.04	- 22.04
Lena Omli	Plankton	Plankton 434	09.04	- 22.04
Jan Henrik Simonsen	Phytoplankton	Plankton 434	09.04	- 22.04
Jan Erik Nygaard	Instrument	Elektr. instrument. 620	09.04	- 05.05
Jarle Kristiansen	Instrument	Elektr. Instrument. 620	09.04	- 05.05
Magnus Johannessen	Cruise leader, Plankton	Plankton 434	24.04	- 05.05
Mona Ring Kleiven	Phytoplankton	Plankton 434	24.04	- 05.05
Jon Rønning	Plankton	Plankton 434	24.04	- 05.05
Aino Hosia	Gelatinous zoopl.	Guest (UiB)	24.04	- 05.05

Table 2. *Sampling equipment*

Equipment	Samples
CTD with water bottle rosette	Hydrography, Chemistry, Phytoplankton
Algae net (10µm)	Phytoplankton
WP2 (25 m^2, 180 µm)	Zooplankton
WP3 (1m^2, 1000 µm)	Gelatinous zooplankton
MOCNESS (1m^2, 180 µm)	Zooplankton
Gulf VII (40 cm diameter, 280 µm)	Fish larvae
PUP (5 cm, 65 µm) fitted on Gulf	Prey items for fish larvae
Multinet MAXI (0.5 m^2, 390 µm)	Fish larvae

3.2 Narrative

The cruise program was undertaken according to Table 3. Map of the cruise track and stations are presented in Figure 1. Sampling was undertaken over a 24h basis.

The vessel left Bergen at 10 UTC on 9th April 2015, and headed north to the first station on the transect Feie-Shetland which was undertaken at 60.75ºN; 4.6ºE at 17:50 UTC. Due to heavy sea conditions the sampling program was reduced. No quantitative MOCNESS samples were obtained from this transect due to malfunction of the MOCNESS.

11-12 April a call was made in Lerwick (Shetland) due to a gale.

13th April : The Shetland process station : was shortened due to time contraints and poor weather conditions.

17th April : South central Process Station (58°N-0.6°W) was minimized due to time constraints and weather conditions.

18-22nd April: Sampling along transects: from Aberdeen to Hanstholm, several short transects along western Denmark, and two transects in the western Skagerrak (Table 3)

On the 22-24 April a call was made in Kristiansand for crew change (Table 1)

On 29th -30th April, the Utsira-Start Point transect was sampled for the 2nd time on this cruise. The last station was completed on 30th April at 21:00 UTC whereupon the vessel headed for Lerwick and then Bergen where it arrived on 3rd May at 06:00 UTC.

Table 3: *Cruise program with CTD station numbers*

Date	Time (UTC)	Activity	Station number
09.04.2015	10:00	**Departure Bergen**	
09.04.2015	17:50	Transect "Feie-Shetland"	268-290
11.04.2015		**Call in Lerwick, Shetland**	
13.04.2015	02:10	Shetland Process Station (60°N; 0.5°W)	291-294
14.04.2015	06:40	Transect " StartPoint - Utsira" (west-east direction)	295-326
16.04.2015	06.45	Transect " Jærens Rev mot SW og W" (east-west direction)	327-336
17.04.2015	15:55	South central Process Station (58°N-0.6°W)	337-338
17.04.2015	2355	Last station on " Jærens Rev mot SW og W"	339
18.04.2015	07:50	Transect Aberdeen-Hanstholm (west-east direction)	340-369
20.04.2015	08:10	Transect Harboør	370-375
21.04.2015	17:00	Transect Huseby	376-381
21.04.2015	04:10	Transect "Lindesnes SSW" (3 southernmost stations)	382-384
21.04.2015	23:05	Transect "Hanstholm-Oksøy" (south-north direction).	385-396
22.04.2015		**Call in Kristiansand 22.-24th April.** Bunkering and crew change.	
24.04.2015		**Vessel depart Kristiansand**	
24.04.2015	22:45	Transect "Jomfruland-Koster"	397-402
25.04.2015	06:45	Transect "Väderö"	403-408
25.04.2015	17:50	Transect "Måseskär	409-416
26.04.2015	07:15	Transect "Göteborg-Fredrikshavn"	417-421
26.04.2015	16:00	Transect "Hirtshals-Torungen" (south-north direction)	422-426
27.04.2015	11:45	Transect "Lindesnes SSW" (northernmost stations)	427-429
27.04.2015	18:49	Transect "Lista mot SSW" (north-south direction)	430-435
28.04.2015	09:43	Transect "Egerøya mot SSW" (south-north direction)	436-443
29.04.2015	07:00	Transect "Utsira-StartPoint" (east –west direction)	444-475
30.04.2015	21:00	Last station completed.	
01.05.2015	08:30	MOCNESS trials completed	469
01.05.2015	10:30	**Call in Lerwick 1-2nd May**	
02.05.2015	10:20	Vessel **depart Lerwick**.	
03.05.2015	05:30	**Arrival Bergen. End of cruise**	

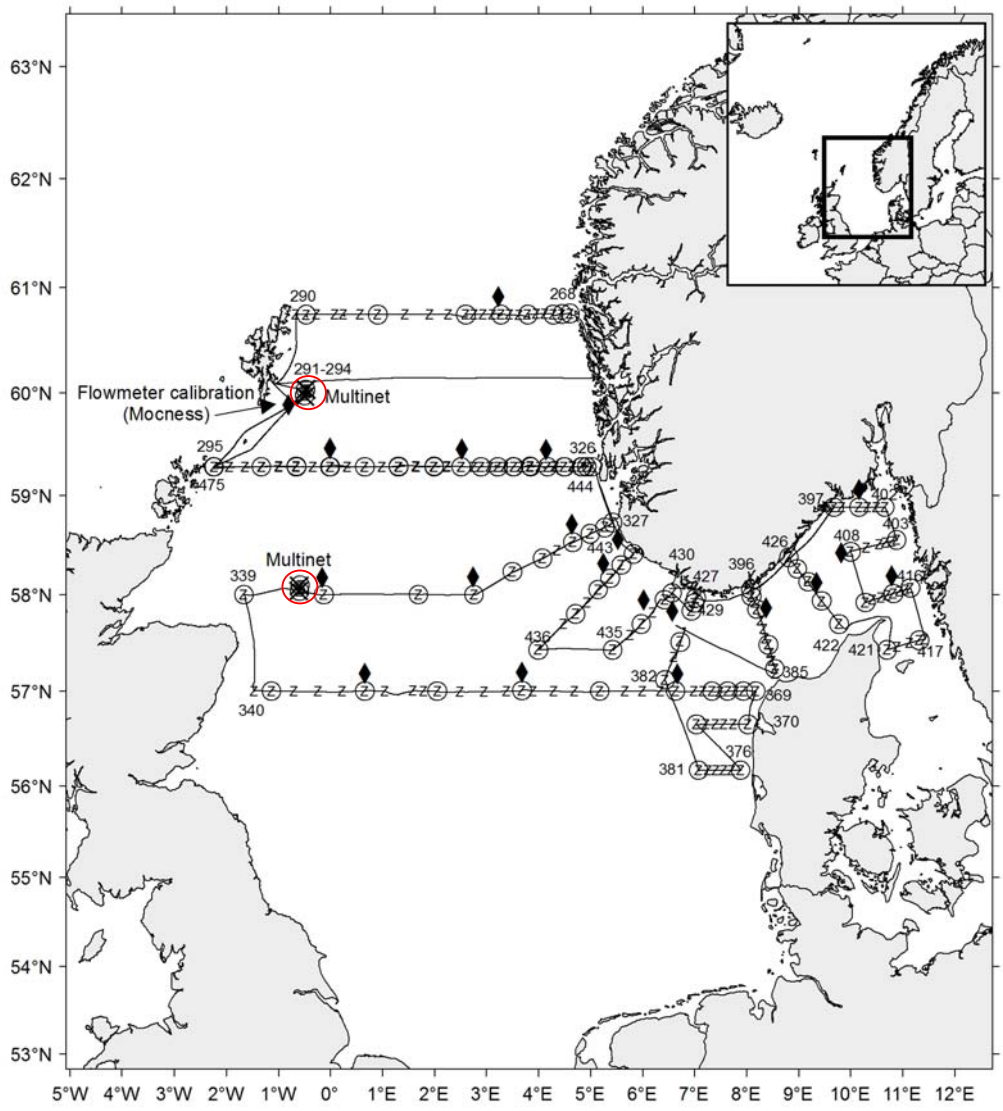

Figure 1: *RV "Johan Hjort" 09.04-05.05.2015. Cruise track with stations for CTD casts and plankton sampling. Process stations are indicated with red circles.*

3.3 Hydrography

Seawater temperature and salinity were measured at all stations with a SeaBird Electronics SBE911 CTD profiler fitted with a water bottle rosette. The Secchi disk was not used. However, as a measure of the clarity of the water, the depth when the CTD rosette sampler was no longer visible was recorded during day time, and used as a proxy for Secchi-depth.

3.4 Biogeochemistry

Water samples for nutrient analysis (nitrate, nitrite, phosphate, silicate) were collected from all CTD stations at all depths. From each depth 20 mL aliquots of sample water were collected in clean polyethylene bottles to which was added 0.2 mL chloroform, before storage at +4°C until further analysis at the Chemistry Laboratory at Institute of Marine Research (IMR) in Bergen. Chlorophyll pigment samples (268 mL) were taken from eight depths between the surface and 100 m and collected on GF/F glassfiber filters. The filters were stored at -20 °C to be analysed for Chlorophyll- a and Phaeopigments (Chl-a, Phaeo) at the Chemistry Laboratory at IMR, Bergen. Details of analytical methods can be found at: http://www.imr.no/om_havforskningsinstituttet/fasiliteter/kjemilaboratoriet_1/kjemilaboratoriet/uorganisk_kjemi/analytiske_tjenester/nb-no

Samples for Total Nitrogen and Phosphorous (Tot NP) were collected at selected stations in the Skagerrak and along the Danish west coast (Appendix 1). Samples were obtained from the CTD water bottles at 5, 10, 20, 30 and 100 m (or deepest possible if bottom depth < 100 m). Sampling and handling of samples was carried out in accordance with the existing manuals (Hassel et al., 2013). Analyses of Tot NP was performed by the laboratory at IMR, Flødevigen

3.5 Radioactivity

Water samples for analyzes of radioactive contamination (project number 14379-01) are normally collected from 10 preselected stations in Skagerrak (Figure 2). In 2015, samples were collected from 7 of these stations (Table 4). On each station 50 liters of water from the seawater inlet (surface) were filled into 2 x 25 L plastic cans for later analyses of Cs-137 at the Chemistry Laboratory at IMR, Bergen.

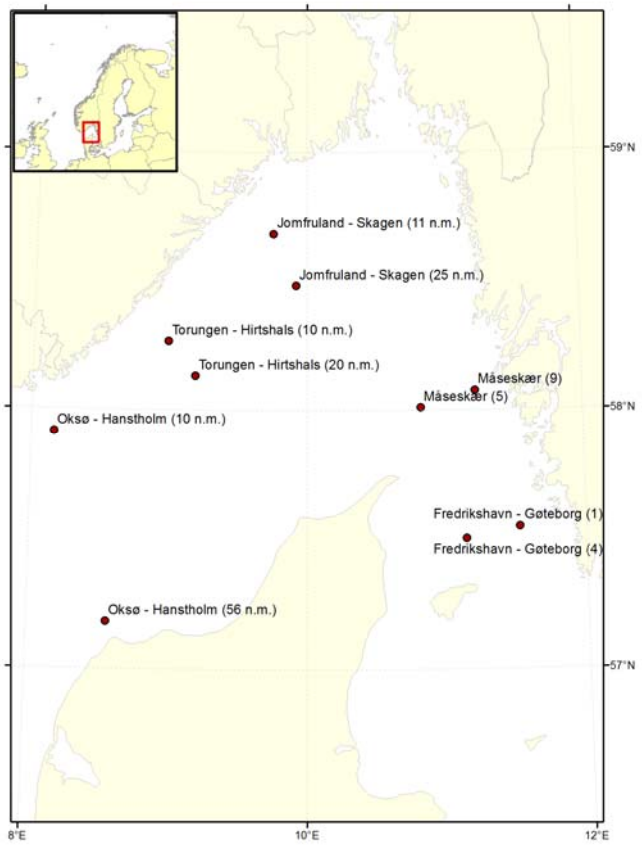

Figure 2. *Stations where seawater has been collected yearly since 2008 for analyses of Cs-137*

Table 4. *Stations where samples of seawater were collected in April 2015 for monitoring of cesium-137*

Date	Station	Latitude	Longitude	
22.04.2015	387	57,92	8,16	Oksø-Hanstholm 10 n.m
21.04.2015	396	57,18	8,57	Oksø-Hanstholm 56 n.m
27.04.2015	425	58,26	8,98	Torungen-Hirtshals 10 n.m.
26.04.2015	424	58,13	9,18	Torungen-Hirtshals 20 n.m.
26.04.2015	419	57,50	11,14	Fredrikshavn- Göteborg (4)
26.04.2015	414	58,03	10,94	Måseskär (9)
25.04.2015	410	57,95	10,43	Måseskär (5)

3.6 Phytoplankton

Samples for phytoplankton species composition and abundance were obtained from predefined stations along the transects (Appendix 1). Samples for algal cell counts were obtained from the CTD water bottles by mixing equal amounts of water (25 ml) from 5, 10,

20 and 30 m depth and fixed in Lugol. Qualitative phytoplankton samples were obtained from vertical net tows with the "Algae-net" (10 µm mesh; 0.1 m^2 opening; 30-0 m), and fixed with formalin.

3.7 Zooplankton

Zooplankton were sampled by vertical tows with WP-2 plankton nets (0.25 m^2 opening; 180 µm mesh size) from the bottom to the surface, and from 200-0 m, bottom depth permitting. Additional stratified sampling of zooplankton was carried out by MOCNESS. Oblique tows were made from 5m above bottom while releasing nets at standard depths (Table 5)

Table 5. *MOCNESS standard depth of the IMR zooplankton monitoring in the North Sea – Skagerrak*

Depth strata	MOCNESS net number
0-bottom	0
bottom-400	1
400-300	2
300-200	3
200-150	4
150-100	5
100-50	6
50-25	7
25-0	8

Large medusae and ctenophores were removed from whole samples, and the displacement volume of each species was recorded. The remaining zooplankton sample was split in two parts by a Motoda plankton splitter: one part was fixed in 4 % borax buffered formaldehyde for species identification and enumeration. The other half was used for estimation of biomass (dry weight): samples were fractionated into three fractions (180-1000µm, 1000-2000µm and >2000µm) and placed on pre-weighted aluminum trays, dried at 60°C for 24 hours and kept in a freezer until return to Bergen. From the >2000 µm size fraction euphausiids, shrimps, amphipods, fish and fish larvae were counted and their lengths measured separately before drying. In addition, Chaetognaths, *Pareuchaeta* sp. and *Calanus hyperboreus* from the >2000 µm size fraction were counted and dried separately (but sizes not measured).

Samples were not split on the transect Hanstholm-Aberdeen, due to shallow depths and small sampling volumes. Instead, two WP2-tows were made: 1/1 sample was fixed in 4% formaldehyde, and 1/1 sample was fractionated and dried for later biomass measurements.

All dry weights were determined at the IMR plankton laboratory in Bergen after the cruise.

Details on the sampling procedures are found in the IMR Plankton Manual (Hassel et al., 2013-updated version).

3.8 Zooplankton samples for genetic studies

MOCNESS net number 0 was kept open during lowering of the MOCNESS. This sample is to be considered as a non-quantitative integrated sample from the entire water column and was fixed on 96% un-denatured (i.e., drinkable) ethyl alcohol for later genetic analyses as part of the COPCLAD project. After 24 hours, the ethanol was replaced with fresh ethanol, and the sample kept in the freezer (-18°C).

3.9 Sampling of pelagic Hydrozoa (HYPNO)

Sampling of gelatinous zooplankton was made on 13 stations (Table 6) with a large plankton net (WP 3, 1000 µm mesh, 1 m^2) equipped with a large, non-filtering cod-end, and towed vertically at low speed (0.2 m/s). In addition to hydrozoa, all ctenophores from this net were identified and enumerated from the live sample.

Additional sampling for Hydrozoa was conducted opportunistically from samples taken with other gear (WP2 and MOCNESS, Table 7). In these cases, single interesting specimens (total n=14) were picked and noted as removed from the sample prior to fixation.

Table 6. *WP3 (1000 µm) samples where all hydrozoa and ctenophore were identified and counted. NB: Aglantha digitale, Obelia spp. and Dimophyes arctica colonies/eudoxids were not counted.*

Station	Date	Haul (m)	Gear
397	25-Apr-2015	38-0	WP3
422	26-Apr-2015	65-0	WP3
427	27-Apr-2015	90-0	WP3
428	27-Apr-2015	100-0	WP3
429	27-Apr-2015	100-0	WP3
430	27-Apr-2015	100-0	WP3
431	27-Apr-2015	100-0	WP3
441	28-Apr-2015	100-0	WP3
442	28-Apr-2015	100-0	WP3
443	29-May-2015	67-0	WP3
444	29-May-2015	78-0	WP3
445	29-May-2015	100-0	WP3
446	29-May-2015	92-0	WP3

Table 7. *Opportunistic sampling of Hydrozoa: Samples where only selected (interesting) specimens were picked out (see Results).*

Station	Date	Haul (m)	Gear	mesh (µm)
408	25-Apr-2015	535-401	MOC1	180
408	25-Apr-2015	399-302	MOC2	180
408	25-Apr-2015	300-203	MOC3	180
442	28-Apr-2015	150-102	MOC3	180
442	28-Apr-2015	99-52	MOC4	180
442	28-Apr-2015	99-52	MOC4	180
468	30-Apr-2015	ca 25 m	MOC2	180
468	30-Apr-2015	ca 25 m	MOC2	180
468	30-Apr-2015	ca 25 m	MOC2	180

3.10 Fish eggs and larvae

Sampling for fish eggs and larvae was undertaken at selected stations along each of the standard North Sea transects (see Figure 3) using a Gulf VII high-speed sampler (Nash *et al.* 1998) (76cm frame). The sampler was fitted with a 40 cm diameter nose cone, a General Oceanics flow meter was set off centre in the nose cone (for quantities of water filtered and a 280 µm mesh net. The sampler was towed at between 3 and 5 knots in a double oblique haul to 130m depth or to within 10m of the bottom. All fish eggs and larvae were sorted from the samples at sea, sub-sampling being undertaken where necessary, and preserved in 4% seawater and Borax buffered formalin.

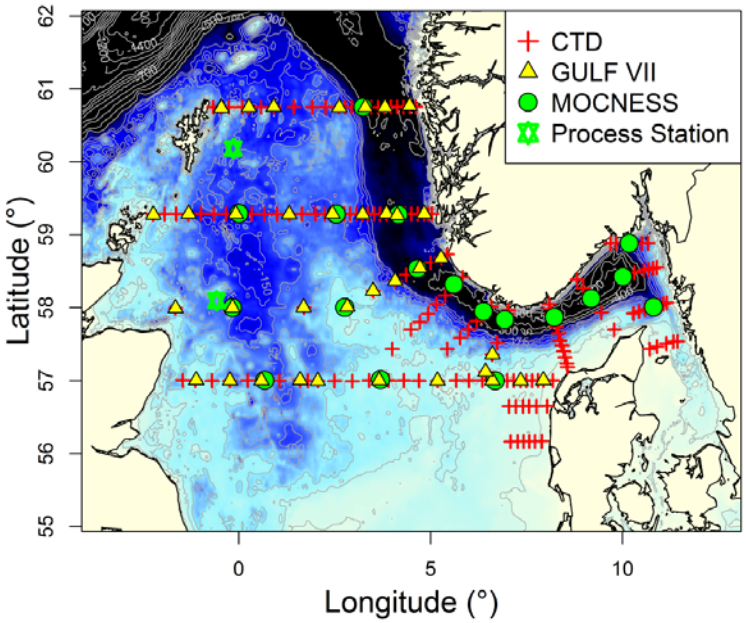

Figure 3. *Location of Gulf VII stations. CTD, MOCNESS and Process stations also shown.*

In addition a PUP sampler (5cm diameter nosecone with a General Oceanics flow meter for water volume sampled and a 65 µm mesh net was fitted to the Gulf VII to provide samples of prey items for fish larvae. These samples were preserved in 4% seawater and Borax buffered formalin.

3.11 Process station

The northern process station (off Shetland, see Figure 3) was sampled using a combination of acoustics (5 x 5NM grid with transects spaced at 1NM), 3 Gulf VII and PUP net samples, and two Multinet tows. The layout for the process station is shown in Figure 4. The Multinet was a standard Hydrobios 'MAXI' (0.5 m^2) with 390µm mesh net, soft cod-ends and towed horizontally in a single oblique tow from depth to the surface at 3 knots.

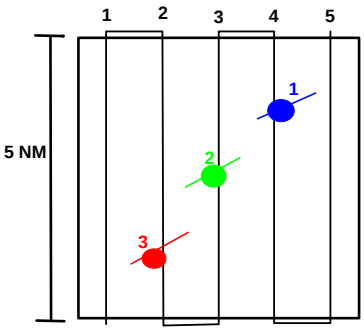

Figure 4. *Survey area layout for process studies. Lines 1-5 are acoustic transects, circles (1-3) with lines denote CTD stations plus Gulf VII high-speed plankton sampling (stations 1-3) and Multinet stations (1 and 3 only).*

The southern process station (see Figure 3) was reduced to one acoustic grid and two Multinet samples (see Figure 4) due to time and weather constraints. As with all standard samples, a CTD cast was taken prior to each net haul thus the CTD number and the net haul retain the same station number.

Table 8. *Summary of samples (No) from transects and process stations*

	Date	**CTD**	**Nutrients (N, P)**	**Tot NP**	**Chl*a***	**Mixed algal sample**	**Phytopl. net 10µm**	**WP-2 180µm**	**MOCNESS 180 µm**	**WP3 1000 µm**	**Gulf VII (+PUP)**	**Water (radioactivity)**	**Multinet**
Feie-Shetland	09.04-11.04	23	23	0	23	6	4	6	1	3	7	0	0
Utsira-StartPoint 1	14.04-16.04	32	32	0	32	9	6	16	3	3	9	0	0
Jærens Rev mot SW og W	16.04-17.04	10	10	0	10	8	5	7	3	2	8	0	0
Hanstholm-Aberdeen	18.04-20.04	30	30	8	30	14	6	7	3	4	10	0	0
Harboør	20.04-21.04	6	6	6	6	4	2	2	0	0	0	0	0
Huseby	21.04	6	6	6	6	4	2	2	0	0	0	0	0
Lindesnes SSW	21.04	3	3	0	3	3	0	2	0	1	3	0	0
Hanstholm-Oksøy	21.04-22.04	12	12	12	12	6	2	3	1	0	0	2	0
Jomfruland-Koster	24.04-25.04	6	6	6	6	4	2	3	1	0	0	0	0
Väderö	25.04	6	6	6	6	4	2	2	1	0	0	0	0
Måseskär	25.04-26.04	8	8	8	8	4	3	3	1	0	0	2	0
Göteborg-Fredrikshavn	26.04	4	4	6	4	4	1	3	0	0	0	1	0
Hirtshals-Torungen	26.04-27.04	4	4	0	4	4	0	4	1	1	0	2	0
Lindesnes SSW	27.04	3	3	0	3	3	1	2	1	0	0	0	0
Lista mot SSW	27.04-28.04	6	6	0	6	4	1	4	1	0	0	0	0
Egersøya mot SSW	28.04-29.04	8	8	0	8	11	1	5	1	1	0	0	0
Utsira-StartPoint 2	29.04-30.04	32	32	0	32	9	8	16	3	2	0	0	0
Process station													
Shetland	13.04-14.04	4	0	0	0	0	0	2	0	0	3	0	2
South Central	17.04	4	0	0	0	0	0	0	0	0	0	0	2
	SUM	**207**	**199**	**58**	**199**	**101**	**46**	**89**	**21**	**17**	**40**	**7**	**4**

4. Results and Discussion

4.1 Hydrography

The hydrographic coverage of the survey area provides information on the main characteristics of the water masses in the northern North Sea and in the Skagerrak. The surface salinity was relatively low in the entire Skagerrak during the last part of April 2015 (Figure 3, upper panel). This is probably caused by enhanced Baltic outflow through the Kattegat where the regional scale wind pattern forces low salinity waters westward when turning North-Jutland (Grenen). The surface circulation in the Skagerrak is normally anti-clockwise, where saltier water enters north of Jutland from the North Sea. In addition, we see a westward displacement of the Norwegian Coastal Current north of Lista, and a cold, low salinity area west of Jæren (at about 4.5°E,58°N) due to a large anticyclonic (anti-clockwise) eddy, introducing local upwelling.

The temperatures were relatively low related to the Coastal Current off the Norwegian west-coast, while the Atlantic waters in the northwestern North Sea and the Skagerrak surface waters are higher (Figure 3, lower panel). Related to the long-term average for the 1981-2010 period, the water masses in the northern North Sea (along the entire Utsira-W transect) were about 1°C colder in April 2015 (not shown).

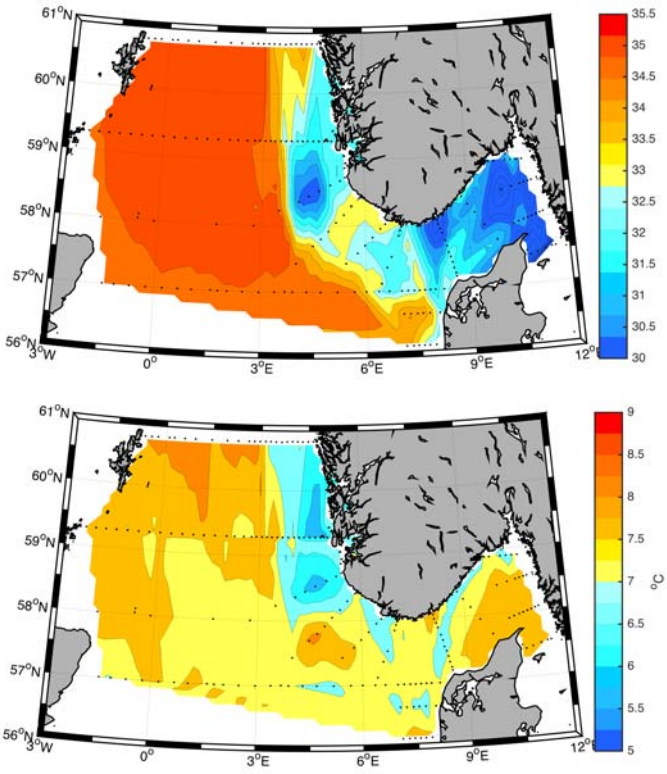

Figure 5: *Salinity (upper panel) and temperature (lower panel, in °C) at 5m depth based on the hydrographic stations (marked with black dots) taken between 9/4 and 29/4 2015.*

4.2 Biogeochemistry

Surface concentrations of dissolved inorganic nutrients (0-7 m range) shows elevated concentrations in the north-eastern part of the North Sea surrounding Shetland (Figure 6), which is the area with the lowest recorded concentrations of both surface Chl-*a* detected by satellite (Figure 7) and the calculated, integrated concentrations of Chl-*a* from direct measurements (Figure 8). The lowest surface concentrations of DIN were found in the south-eastern part of the North Sea extending into most of Skagerrak (Figure 6). Regional phosphate concentrations were low in surface waters in the south central and eastern part of the North Sea and the entire Skagerrak. Surface silicate concentrations were at a minimum in the south-eastern part of the North Sea but only in a limited region of the eastern part of Skagerrak (Figure 6).

Rate estimates of net primary productivity (new production), based on cellular incorporation of nitrate (NO_3) by phytoplankton in the photic zone (NPP_{NO3}), matched integrated Chl-*a* in the northern part of the North Sea and in Skagerrak (Figure 8). Dissolved phosphate in surface waters and within the productive nitracline (NO_3 conc. < 9.5 uM) were above the P:N Redfield relationship of 0.0625 (equivalent to molar N:P=16), with the exception of samples from the south-eastern part of the North Sea (Figure 9A) where remaining phytoplankton appeared to have access to more DIN than PO4. Dissolved SiO4 remained low relative to both DIN and PO4 in the entire region (Figures 9B, C). At SiO4 concentrations less than 2.5 uM however, the Si:N-ratio was higher than 1 (Figure 9C) suggesting that relatively more DIN than Si was incorporated by phytoplankton in the low-nutrient euphotic zone.

Measured phytoplankton stocks, calculated from measured integrated Chl-a, were plotted as a function of expected phytoplankton biomass, calculated from integrated NPP (Figure 10). The red line in figure 10 shows the 1:1 relationship, where the measured phytoplankton stocks are matching the biomass calculated from NPP. Measured stocks higher than the 1:1 line (the mid stations on the Utsira transect) are in theory impossible or that NPP-NO3 is underestimating phytoplankton biomass. This can only happen if other sources than new NO3 from the annual vertical mixing are utilized for cellular growth (e.g. external, horizontal transfer of NO3 or internal, regenerated use of ammonium). Most stations however, were below the 1:1 line (Figure 10) suggesting that a significant part of phytoplankton growth was lost from the euphotic zone, due to sedimentation and zooplankton grazing.

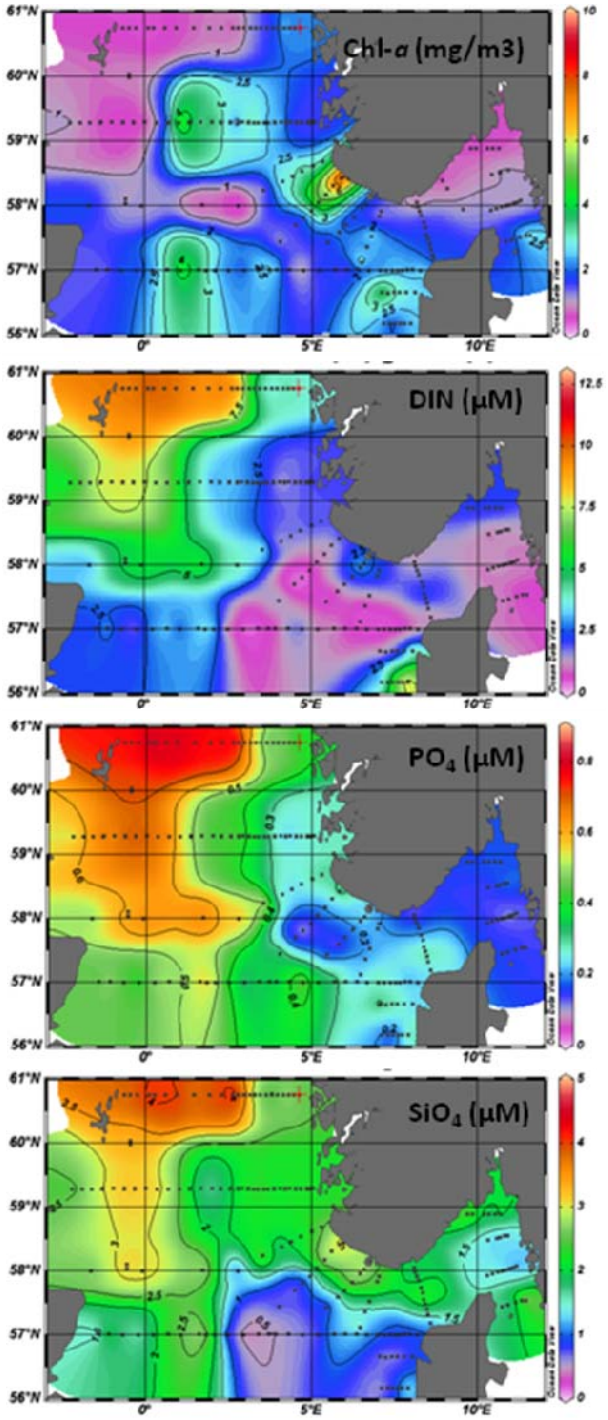

Figure 6: *Surface concentrations of chlorophyll-a (Chl-a), combined (Nitrate+Nitrite), Dissolved Inorganic Nitrogen (DIN), Phosphate (PO4) and Silicate (SiO4) from samples collected between 0-7 m depth during the Ecosystem cruise in the North Sea and Skagerrak region, April 9 – May 5, 2015.*

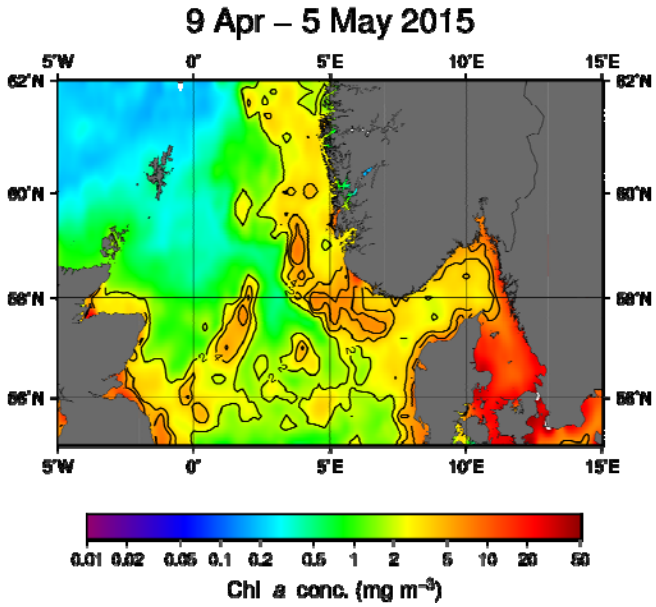

Figure 7: *Surface chlorophyll-a (Chl-a) concentrations as detected by MODIS during the Ecosystem cruises in the North Sea and Skagerrak region, April 9 – May 5, 2015.*

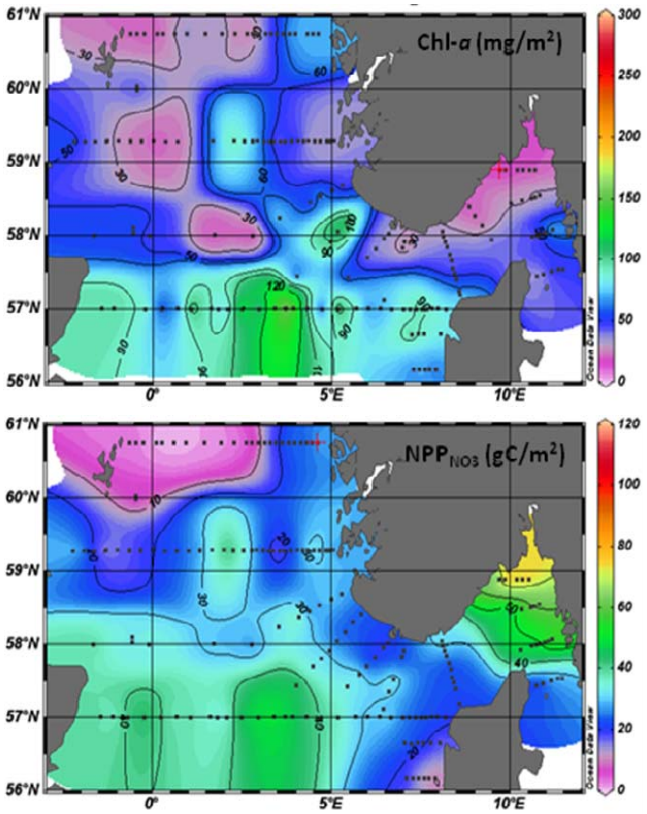

Figure 8: *Integrated values of Chlorophyll-a (Chl-a) calculated from pigment samples collected during the Ecosystem cruises in the North Sea and Skagerrak region, April 9 – May 5, 2015. New primary production (lower panel) was calculated from the observed loss of nitrate (NPP_{NO3}) in the photic surface waters and by using a Redfield C:N-ratio of 16.*

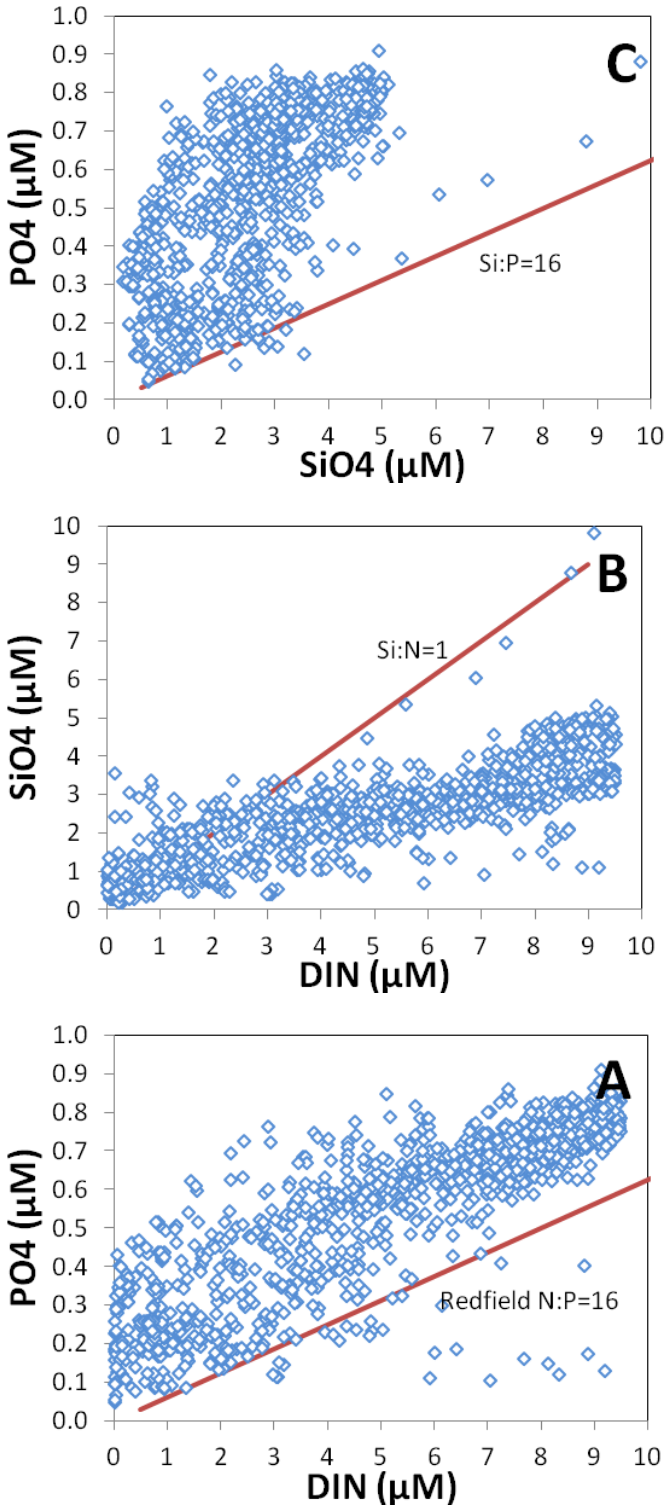

Figure 9: *Dissolved inorganic nutrients measured within the nitracline (NO3 conc. < 9.5 uM) from the Ecosystem cruises (April 9 – May 5, 2015) in the North Sea and Skagerrak region. Phosphate (A) and silicate (B) was plotted as a function of dissolved, combined nitrogen (DIN= NO2+NO3), and phosphate (C) was plotted as a function of silicate. The red bars shows the Redfield N:P relationship and other molar relationships (N:Si, Si:P), that are assumed necessary for a balanced cellular synthesis and growth in phytoplankton.*

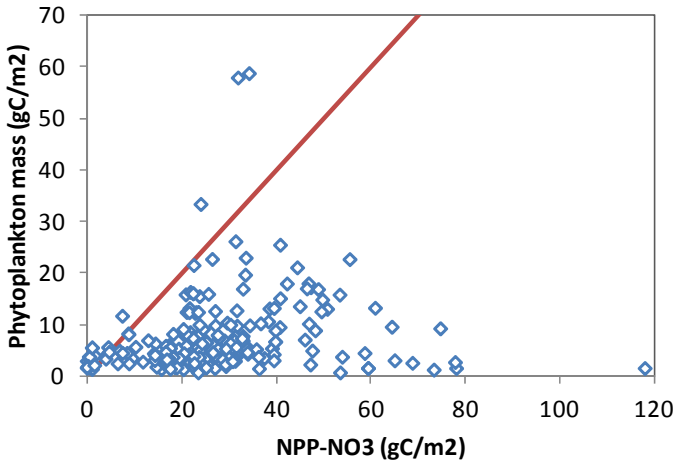

Figure 10: *Depth integrated phytoplankton standing stocks as a function of new production (NPP). Phytoplankton biomass (g C m^{-2}) was calculated from measured Chl-a and by assuming a C:Chl-ratio of 100, and NPP-NO3 (g C m^{-2}) was estimated from the observed net loss of NO3 in surface waters and assuming a Redfield cellular C:N-ratio of 16. The red line shows the theoretical, maximum boundary for phytoplankton stocks, calculated from NPP and without loss due to sedimenting cells and zooplankton grazing.*

4.3 Radioactivity

The Baltic Sea is the largest source of radioactive contamination to Norwegian waters today. The reason for this is that land areas around the Baltic Sea received significant amounts of fallout from the Chernobyl accident. Run-off from these contaminated areas is transported with ocean currents from the Baltic Sea to Norwegian waters. In order to monitor the supply of cesium-137 (Cs-137) from the Baltic Sea to Norwegian waters, samples of seawater have been collected yearly since 2008 from the 10 stations shown in Figure 2.

The samples collected in 2015 have not yet been analysed. Results from 2008 to 2014 are shown in Figure 11. The highest activity concentrations of Cs-137 are, as expected, found at the stations nearest the outlet of the Baltic Sea. The data indicate a general decreasing time trend, but this is not evident at all stations. Yearly variations are due to variations in precipitation and run-off from land and oceanographic processes, among other things. The lowest levels are found at the station at the Oksø-Hanstholm section, near Hanstholm. This is as expected as seawater at this station has characteristics more like the North Sea.

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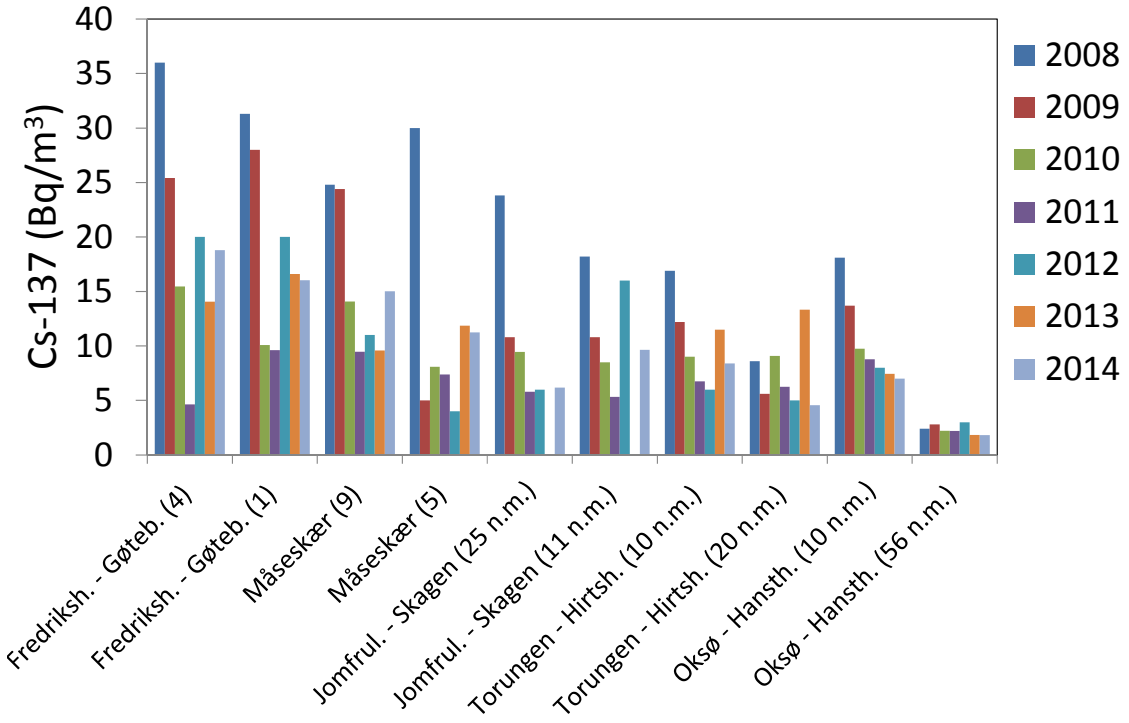


***Figure 11**. Activity concentrations of cesium-137 (Cs-137) (Bq/m^3) in samples of seawater collected yearly in the period 2008 – 2014 at the stations shown in Figure 2.*

4.4 Phytoplankton

Phytoplankton samples from the CTD water bottles were analyzed onboard during the cruise, for cell numbers at genera and where possible species level. Phytoplankton counts are often skewed due the presence of localized blooms, and median values for phytoplankton numbers may therefore better represent the typical pattern. Figure 12a shows the median distribution of key genera along the Torungen-Hirtshals transect while Figure 12b shows the species number and composition for April 2015.

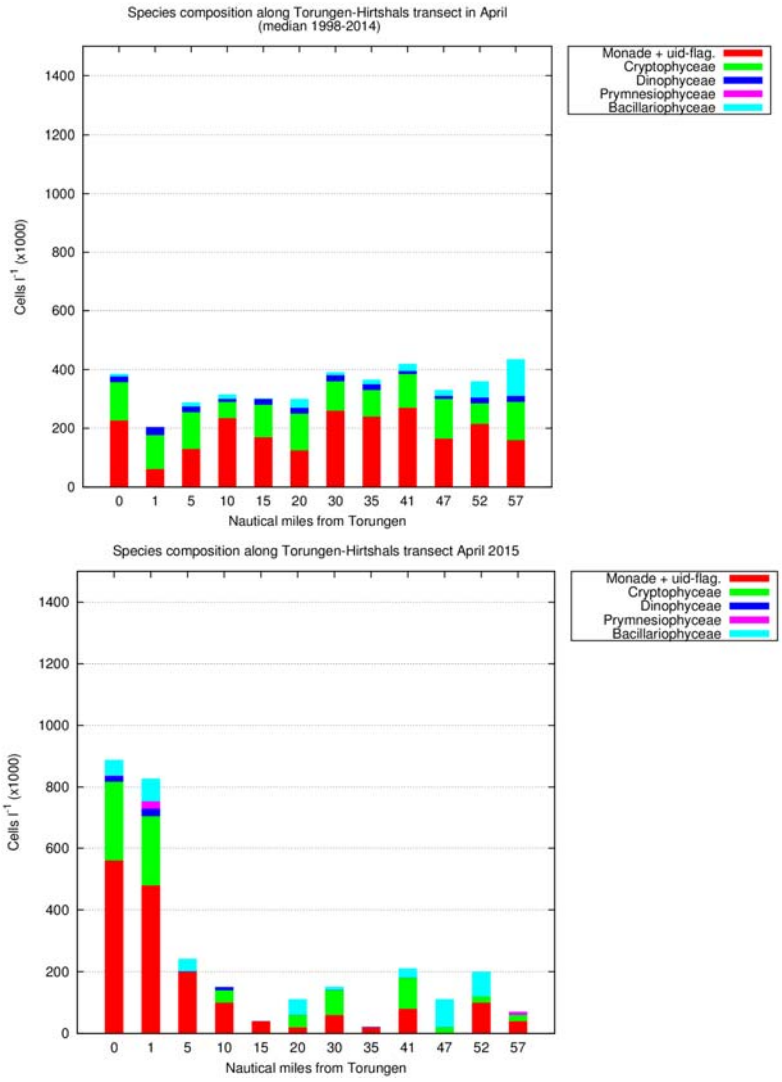


Figure 12 a) *Phytoplankton Genera composition for the Torungen-Hirtshals transect for April in the period 1998-2014.* ***b)*** *Mean phytoplankton genera composition for Torungen-Hirtshals transect in April 2015.*

Increased phytoplankton numbers of unidentified flagellate and Cryptophyceae were observed close to the Norwegian coast. Along the rest of the transect there was a reduction in total phytoplankton counts, particularly in the unidentified flagellate category. Dinoflagellate were

absent in much of the transect and Cryptophyte numbers were also reduced, though diatom numbers were slightly above usual values.

The chlorophyll concentration obtained from the MODIS satellite (Figure 7) indicates a slight increase near the Danish end of the transect. However, this may not be indicative of increased phytoplankton cell numbers as satellite retrievals are known to over-estimate chlorophyll in coastal waters, in comparison to that measured directly, where other organic compounds from river runoff and sediment re-suspension give a spurious signal.

The MODIS satellite data set was sampled to extract all of the pixels within 0.05 degrees radius of all the surface ship chlorophyll measurements obtained on the ecosystem cruises. The results are shown in Figure 13. There is a bias at low chlorophyll concentrations where the satellite over estimates the chlorophyll concentration. This is known to occur in coastal water regions for the reasons just given. At chlorophyll concentrations above about 1.5 mg m^{-3} the correlation between satellite and ship observations improves. There is some confidence then that the satellite chlorophyll of Figure 7 accurately represents the true surface chlorophyll concentration, a proxy for surface phytoplankton biomass, especially away from the coast.

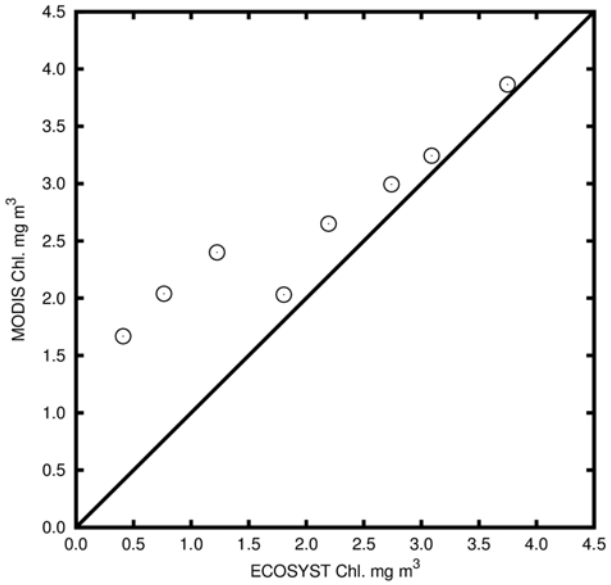


Figure 13: *MODIS satellite data vs measured Chlorophyll a (mg m^{-3}) .*

4.5 Zooplankton

Depth integrated zooplankton biomass (g dry weight/m^2) is presented as total biomass (>180µm, Figure 14a) and as three different size fractions (Figure 15 a-c). The highest biomass values were registered in the eastern area, above the Norwegian Trench (8.7-9.3 g/m^2, Figure 14 a). The average zooplankton biomass for the whole survey area was 3,9 g m^{-2} which is below the long term average (2005-2014). The biomass was below average in most of the investigated are, apart from stations near the coast of Denmark and Scotland (Figure 14 b).

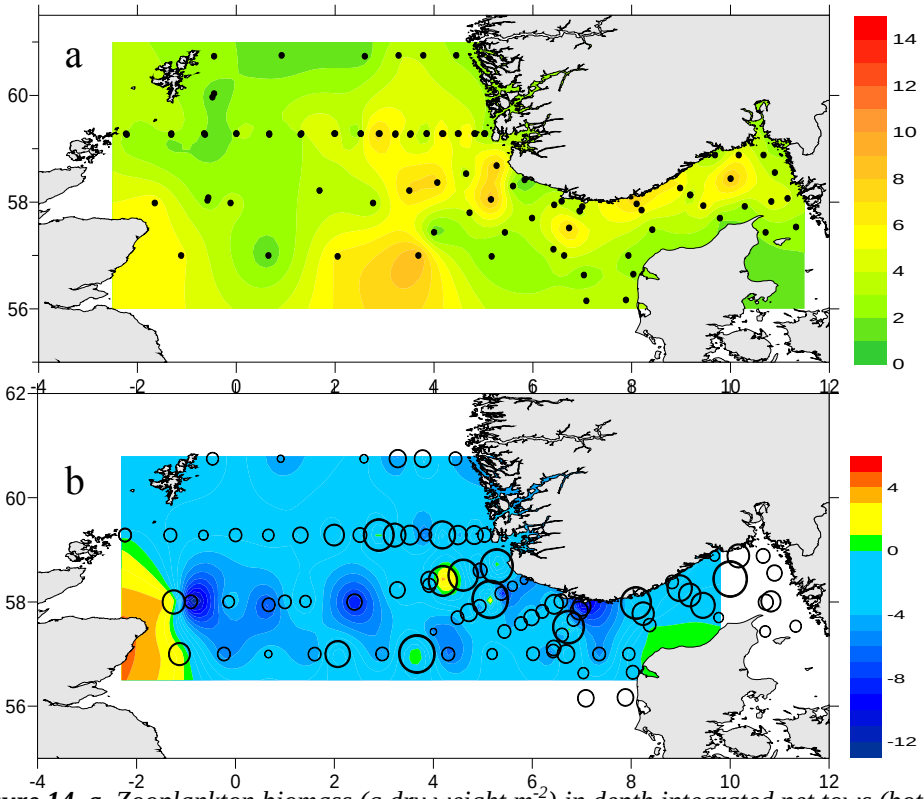


Figure 14. a*. Zooplankton biomass (g dry weight m^{-2}) in depth integrated net tows (bottom – surface, WP2, 180 µm).* ***b.*** *Zooplankton biomass anomalies. Anomalies from long term average 2005-2014. Circles indicate biomass in 2015 (same values as in Figure 12a)*

The 180-1000 µm size fraction (Figure 15 a) contains small sized copepods (*Oithona* sp, *Pseudocalanus* spp), juvenile stages of large copepods (*Calanus*) and benthic larvae. However, this fraction may also contain phytoplankton, especially along the Hanstholm-Aberdeen transect (Figure 7). The highest biomass of this smallest fraction was observed in the southwest. In contrast, the 1000-2000 µ size fraction, which is dominated by *Calanus* spp, was mainly distributed along the Norwegian Trench (Figure 15b). Similarly, the largest size fraction > 2000 µm was found in the deeper areas over the Norwegian trench. (Figure 15d). This fraction contains large sized copepods (*Calanus hyperboreus, Paraeuchaeta norvegica)*, amphipods, decapod shrimps, chaetognaths and gelatinous zooplankton (Figure 16).

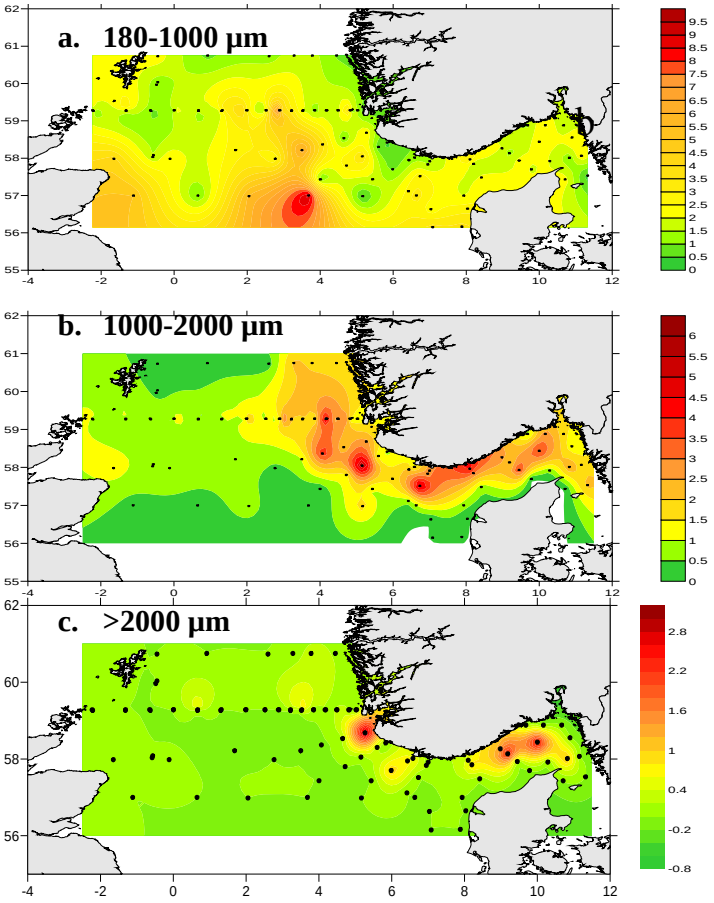
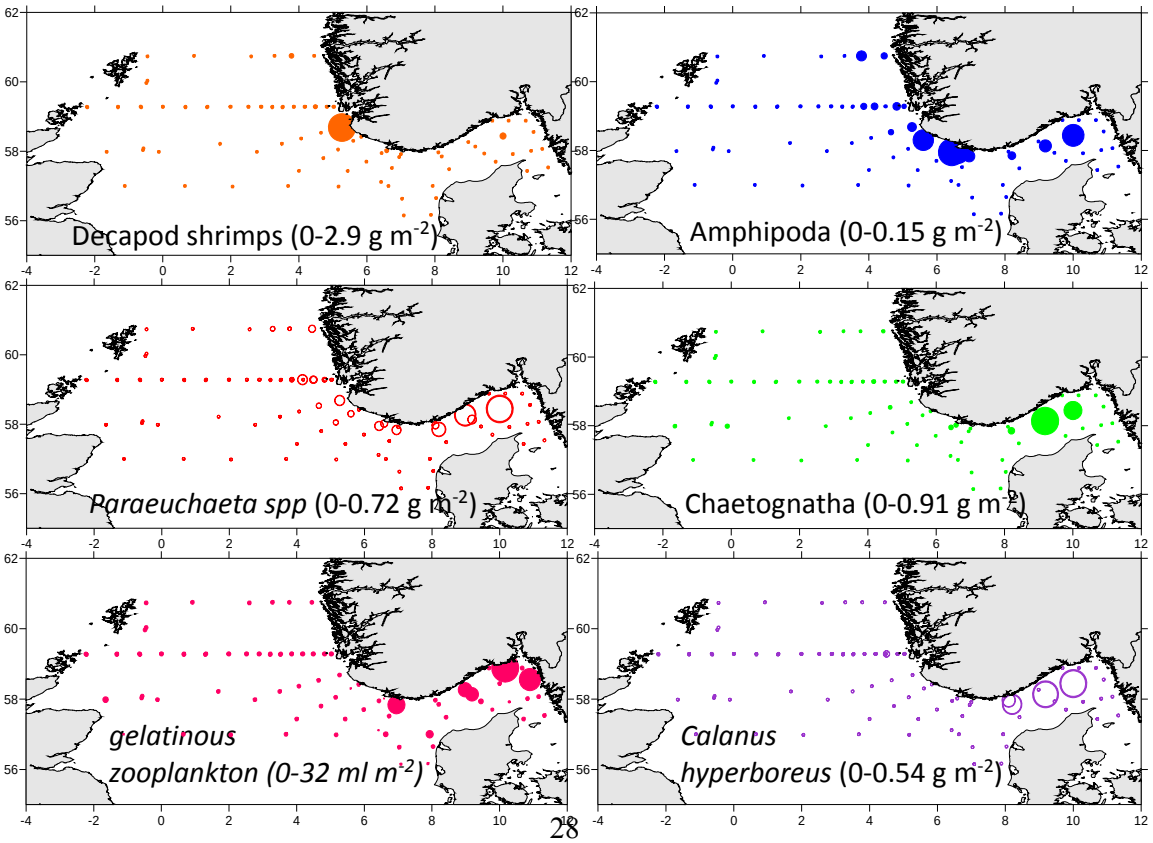


Figure 15. *(left) Zooplankton biomass (g dryweight m-2) in depth integrated net tows (bottom – surface, WP2, 180 µm). Biomass in a) Size fraction 180-1000 µm, b) Size fraction 1000-2000 µm, c) Size fraction >2000 µm.*

Figure 16. (below). *Biomass of selected groups of zooplankton in the > 2000 µm fraction (in WP2 net tows, 180 µm, bottom-surface)*



4.6 Pelagic Hydrozoa (HYPNO)

DNA samples for pelagic Hydrozoa were collected from 49 individuals representing ~22 species

Opportunistic sampling: 14 specimens (Table 9) were removed from WP2 and MOCNESS samples (from the half that was later fixed in formalin). NB: This is NOT a complete list of gelatinous species in the sample.

Table 9. *Specimens of gelatinous zooplankton sorted out from zooplankton samples by the HYPNO project*

st	date	Depth range (m)	gear	mesh (µm)	species	no.
408	25-Apr-2015	535-401	MOC1	180	*Tima bairdi*	1
408	25-Apr-2015	399-302	MOC2	180	*Dimophyes arctica* pg an	1
408	25-Apr-2015	300-203	MOC3	180	*Nanomia* sp. Stem	1
442	28-Apr-2015	150-102	MOC3	180	*Bythotiara murrayi*	1
442	28-Apr-2015	99-52	MOC4	180	*Nanomia* sp. Nectophores	3
442	28-Apr-2015	99-52	MOC4	180	*Nanomia* sp. Nectophores	2
468	30-Apr-2015	ca 25 m	MOC2	180	*Cyanea* sp. Juvenile (2.5 cm)	1
468	30-Apr-2015	ca 25 m	MOC2	180	*Mitrocomella polydiademata*	1
468	30-Apr-2015	ca 25 m	MOC2	180	*Leuckartiara octona*	1

4.7 Fish eggs- and larvae

Fish eggs and larvae occurred all over the northern North Sea, however, the highest densities tended to be in the north and west toward Shetland (Figure 17).

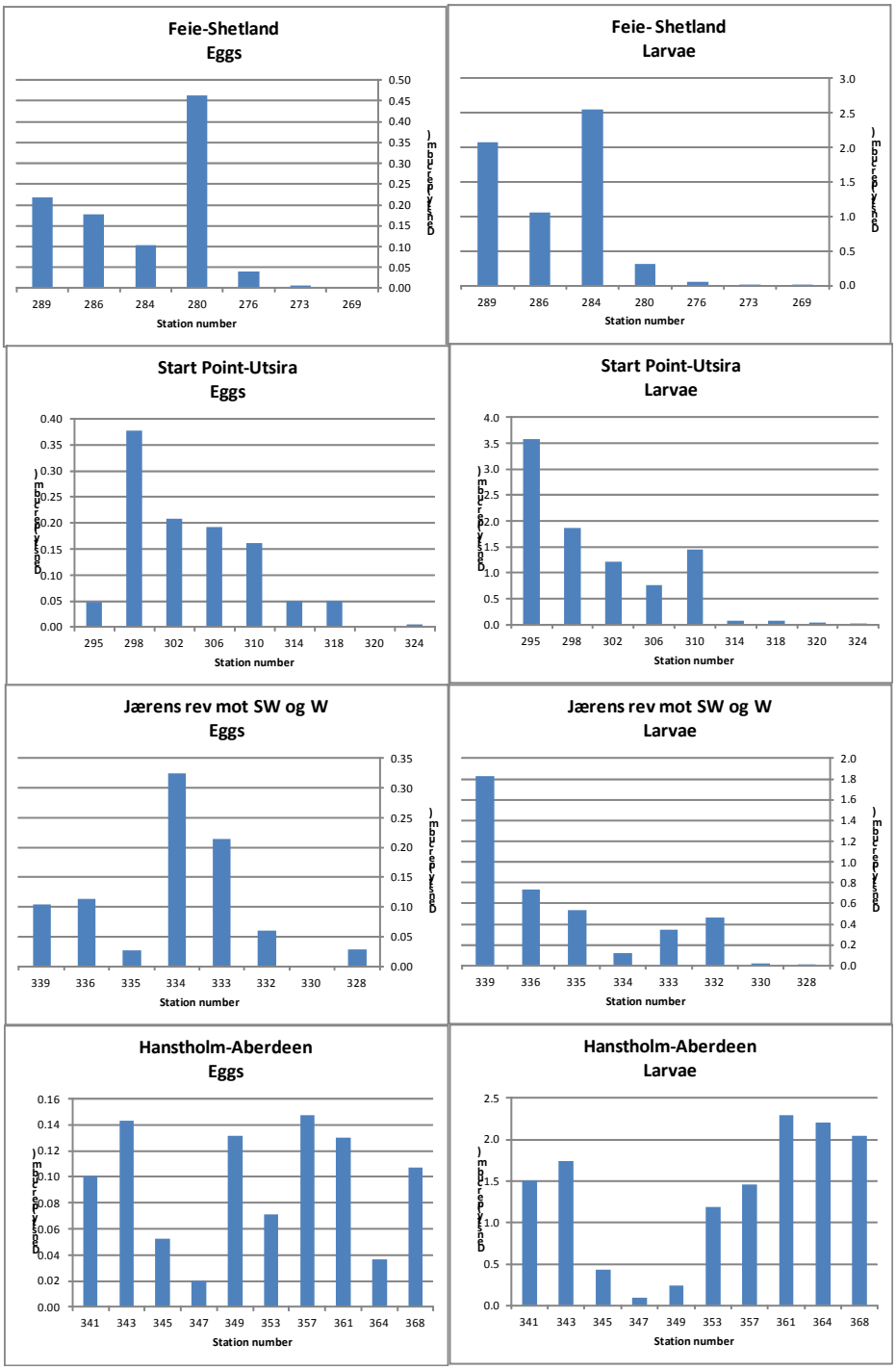


Figure 17. *Densities of fish eggs and larvae caught on the standard transects across the northern North Sea using a Gulf VII high speed plankton sampler. Stations are arranged from west to east as left to right. See Figure 18 for spatial locations.*

In general gadoid larvae predominated in the northwestern part and flatfish larvae tended to dominate the shallower southeastern part of the survey area (Figure 18). Very few larvae occurred over the deep water of the Norwegian trench.

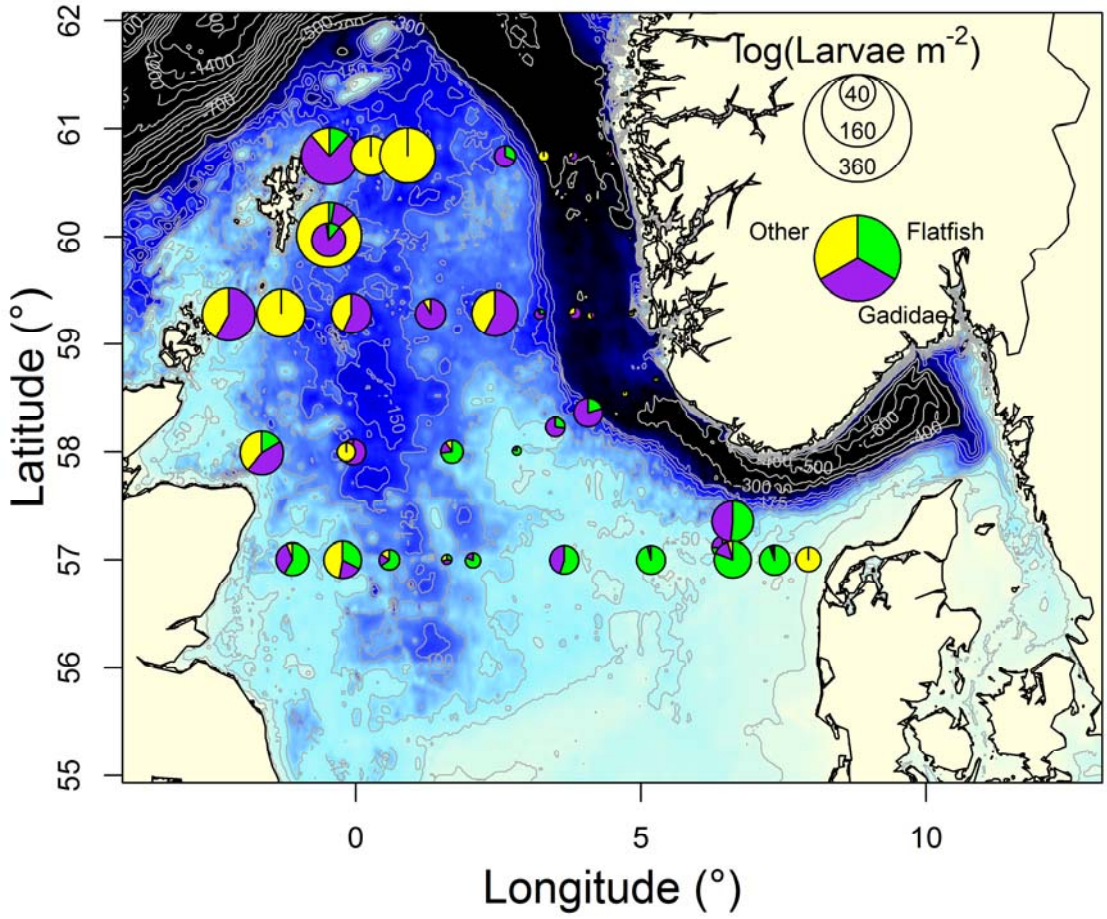


Figure 18. *Distribution of larvae caught with the Gulf VII high speed plankton sampler.*

4.8 Process studies

The acoustics data are not immediately available. The Gulf VII samples indicate similar composition and densities of larvae as seen on the transects to the north and south (see Figure 17). In this area the larvae consisted mainly of gadoids and non-flatfishes.

There were higher densities of eggs in the northern station with both stations indicating variation through the water column (Figure 19). There were similar densities of larvae at both the northern and southern station. In general the densities of larvae tended to be higher in the water column later in the day. The larvae data, especially will be identified to species.

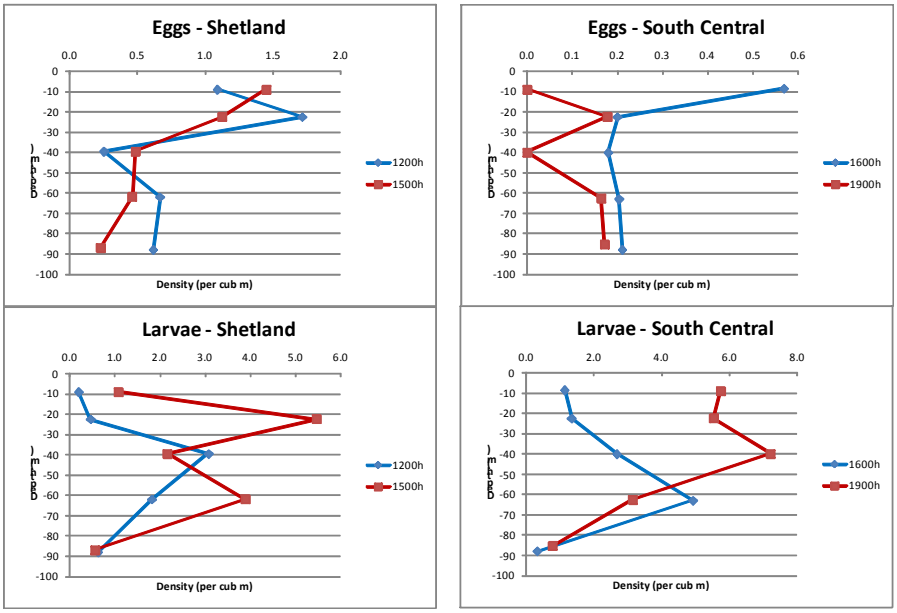


Figure 19. *Vertical distribution of eggs and larvae at the Shetland (1200 and 1500h UTC) and South Central (1600 and 1900h UTC) process stations. Densities are given in numbers* m^{-3}.

5 Acknowledgements

We greatly appreciate and thank the masters and crew onboard RV "Johan Hjort" for outstanding collaboration and practical assistance at the North Sea Ecosystem cruise 9 April – 5 May 2015. We are indebted to all the participants of the North Sea Ecosystem Cruise 2015 for their valuable work during collecting and processing of samples.

6 References

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Nash, R.D.M., Dickey-Collas, M. & Milligan, S.P. 1998. Descriptions of the Gulf VII/PRO-NET and MAFF/Guildline unencased high-speed plankton samplers. Journal of Plankton Research 20: 1915-1926.

MOCNESS: Multiple Opening Closing Net with Environmental Sensors

Multinet (MAXI)

Gulf VII High-speed sampler with PUP net

NORDSJØEN OG SKAGERRAK										**FEIE - SHETLAND**						**April/May 2015**								
Tid:		23.3																						
Kommentar	155 nm, 23 CTD stasjoner, 6 planktonstasjoner m håv, 1 stasjon MOC,																							
Nr.	**POSISJON**							**Distanse**	**Antatt**	**Skriv**	**PRØVETAKING**													
	Grad	**Min**		**Grad**	**Min**	**Desimalgrader**				**inn**	**VANNPRØVER**					**DYREPLANKTONPRØVER**								
	N			**E/W**		**N**	**E/W**	**n.m.**	**dyp**	**CTD stasjon**	**CTD**	**N.salt**	**Oksygen**	**Klorofy**	**Pl.plankt.**	**WP2-Håv**	**MOC**	**Algehåv**	**Secci-dyp**	**WP3**	**Gulf VII**			
1	60	45	E	4	37	60.750	4.617		175	268	x	x		x					x	x				
2	60	45	E	4	27	60.750	4.450	4.88	375	269	x	x		x	30-0*	bunn-0/200-0		~~30-0***~~	x	x	**X**			
3	60	45	E	4	17	60.750	4.283	4.88	315	270	x	x		x					x	x				
4	60	45	E	4	7	60.750	4.117	4.88	315	271	x	x		x					x					
5	60	45	E	3	57	60.750	3.950	4.88	315	272	x	x		x					x					
6	60	45	E	3	47	60.750	3.783	4.88	325	273	x	x		x	30-0*	bunn-0/200-0		~~30-0***~~	x		**X**			
7	60	45	E	3	37	60.750	3.617	4.88	315	274	x	x		x					x					
8	60	45	E	3	27	60.750	3.450	4.88	325	275	x	x		x					x					
9	60	45	E	3	17	60.750	3.283	4.88	330	276	x	x		x	30-0*	bunn-0/200-0	**x**	30-0***	x		**X**			
10	60	45	E	3	7	60.750	3.117	4.88	240	277	x	x		x					x					
11	60	45	E	2	56	60.750	2.933	5.37	170	278	x	x		x					x					
12	60	45	E	2	46	60.750	2.767	4.88	125	279	x	x		x					x					
13	60	45	E	2	36	60.750	2.600	4.88	125	280	x	x		x	30-0*	bunn-0		30-0***	x		**X**			
14	60	45	E	2	16	60.750	2.267	9.77	125	281	x	x		x					x					
15	60	45	E	1	55	60.750	1.917	10.25	125	282	x	x		x					x					
16	60	45	E	1	26	60.750	1.433	14.16	150	283	x	x		x					x					
17	60	45	E	0	55	60.750	0.917	15.14	155	284	x	x		x	30-0*	bunn-0		30-0***	x		**X**			
18	60	45	E	0	35	60.750	0.583	9.77	145	285	x	x		x					x					
19	60	45	E	0	15	60.750	0.250	9.77	135	286	x	x		x					x		**X**			
20	60	45	E	0	5	60.750	0.083	4.88	120	287	x	x		x					x					
21	60	45	W	0	16	60.750	-0.267	10.25	115	288	x	x		x					x					
22	60	45	W	0	28	60.750	-0.467	5.86	140	289	x	x		x	30-0*	bunn-0		30-0***	x		**X**			
23	60	45	W	0	40	60.750	-0.667	5.86	100	290	x	x		x					x					
								154.78																

NORDSJØEN OG SKAGERRAK **UTSIRA MOT W** **April/May 2015**

Fartøy:

Tid: ####

Kommenta 223 nm, 32 CTD stasjoner, 16 planktonstasjoner med håv, 3 MOC

Legend: artsopparbeiding på zooplankton (orange); Planktonstasjon med håvtrekk er markert med gult (yellow)

Nr.	POSISJON Grad N	Min N	E/W	Grad	Min	Desimalgrader N	Desimalgrader E/W	istanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksyger	Klorofy	Pl.plankt.:	PLANKTONPRØVER WP2-Håv	MOC	Algehåv	Secci-dyp	WP3	Gulf VII
1	59	17	E	5	2	59.283	5.033		80	326	x	x		x	30-0*	bunn-0		~~30-0***~~	x	x	
2	59	17	E	4	56	59.283	4.933	3.06	140	325	x	x		x					x	x	
3	59	17	E	4	50	59.283	4.833	3.06	150	324	x	x		x		bunn-0			x	x	X
4	59	17	E	4	40	59.283	4.667	5.10	270	323	x	x		x					x		
5	59	17	E	4	30	59.283	4.500	5.10	255	322	x	x		x	30-0*	bunn-0/200-0		~~30-0***~~	x		
6	59	17	E	4	20	59.283	4.333	5.10	260	321	x	x		x					x		
7	59	17	E	4	11	59.283	4.183	4.59	280	320	x	x		x		bunn-0/200-0	x	30-0***	x		x
8	59	17	E	4	2	59.283	4.033	4.59	280	319	x	x		x					x		
9	59	17	E	3	51	59.283	3.850	5.62	270	318	x	x		x	30-0*	bunn-0/200-0		30-0***	x		X
10	59	17	E	3	41	59.283	3.683	5.10	250	317	x	x		x					x		
11	59	17	E	3	32	59.283	3.533	4.59	220	316	x	x		x		bunn-0			x		
12	59	17	E	3	22	59.283	3.367	5.10	160	315	x	x		x					x		
13	59	17	E	3	13	59.283	3.217	4.59	140	314	x	x		x	30-0*	bunn-0		30-0***	x		x
14	59	17	E	3	4	59.283	3.067	4.59	130	313	x	x		x					x		
15	59	17	E	2	54	59.283	2.900	5.10	105	312	x	x		x		bunn-0			x		
16	59	17	E	2	45	59.283	2.750	4.59	115	311	x	x		x					x		
17	59	17	E	2	31	59.283	2.517	7.15	130	310	x	x		x	30-0*	bunn-0	x	30-0***	x		X
18	59	17	E	2	15	59.283	2.250	8.17	125	309	x	x		x					x		
19	59	17	E	2	0	59.283	2.000	7.66	120	308	x	x		x		bunn-0			x		
20	59	17	E	1	39	59.283	1.650	10.72	115	307	x	x		x					x		
21	59	17	E	1	19	59.283	1.317	10.21	110	306	x	x		x	30-0*	bunn-0		30-0***	x		X
22	59	17	E	1	0	59.283	1.000	9.70	110	305	x	x		x					x		
23	59	17	E	0	40	59.283	0.667	10.21	135	304	x	x		x		bunn-0			x		
24	59	17	E	0	20	59.283	0.333	10.21	135	303	x	x		x					x		
25	59	17	E	0	0	59.283	0.000	10.21	130	302	x	x		x	30-0*	bunn-0	x	30-0***	x		X
26	59	17	W	0	20	59.283	-0.333	10.21	135	301	x	x		x					x		
27	59	17	W	0	39	59.283	-0.650	9.70	125	300	x	x		x		bunn-0			x		
28	59	17	W	0	59	59.283	-0.983	10.21	125	299	x	x		x					x		
29	59	17	W	1	19	59.283	-1.317	10.21	110	298	x	x		x	30-0*	bunn-0		~~30-0***~~	x		X
30	59	17	W	1	38	59.283	-1.633	9.70	90	297	x	x		x					x		
31	59	17	W	1	56	59.283	-1.933	9.19	95	296	x	x		x					x		
32	59	17	W	2	14	59.283	-2.233	9.19	70	295	x	x		x	30-0*	bunn-0			x		X
								222.56													

* Planteplankton kvantitative prøver: blandingsprøve fra 0-30 m

***Planteplankton "kvalitative prøver": 20 um håv, 30-0 m

NORDSJØEN OG SKAGERRAK						**HANSTHOLMEN - ABERDEEN**					**April/May 2015**												
Dyp:											artsopparbeiding på zooplankton												
Tid:		46.20																					
Kommentar	308 nm, 26 CTD stasjoner, 13 planktonstasjoner med håv, 3 MOC																						
Nr.	**POSISJON**							**Distanse**	**Antatt**	**Skriv**	**PRØVETAKING**												
	Grad N	**Min**		**Grad E/W**	**Min**	**Desimalgrader N**	**E/W**	**n.m.**	**dyp**	**inn CTD stasjon**	**VANNPRØVER**						**PLANKTONPRØVER**						
											CTD	**N.salt**	**Oksygen**	**Klorofyl**	**Tot NP**	**Pl.plankt.**	**WP2-Håv**	**MOC**	**Algehåv**	**Secci-dyp**	**WP3**	**Gulf VII**	
1a	57	0	E	8	11	57.000				369	x	x		x	x	30-0*				x	x		
1b	57	0	E	7	57	57.000	7.950		25	**368**	x	x		x	x	30-0*	2 st bunn-0**		30-0***	x	x	**x**	
2a	57	0	E	7	48	57.000				**367**	x	x		x	x	30-0*				x			
2b	57	0	E	7	39	57.000	7.650	9.80	20	**366**	x	x		x	x	30-0*				x	x		
3a	57	0	E	7	30	57.000				365	x	x		x	x	30-0*				x			
3b	57	0	E	7	21	57.000	7.350	9.80	37	**364**	x	x		x	x	30-0*				x	x	**x**	
4a	57	0	E	7	10	57.000				363	x	x		x	x	30-0*				x			
4b	57	0	E	7	0	57.000	7.000	11.43	32	**362**	x	x		x	x	30-0*				x			
5	57	0	E	6	41	57.000	6.683	10.34	55	**361**	x	x		x	x	30-0*	2 st bunn-0	**x**	30-0***	x		**x**	
6	57	0	E	6	21	57.000	6.350	10.89	55	**360**	x	x		x	x					x			
7	57	0	E	6	0	57.000	6.000	11.43	50	359	x	x		x	x					x			
8	57	0	E	5	40	57.000	5.667	10.89	50	**358**	x	x		x	x					x			
9	57	0	E	5	11	57.000	5.183	15.79	55	357	x	x		x	x	30-0*	2 st bunn-0		30-0***	x		**x**	
10	57	0	E	4	42	57.000	4.700	15.79	60	**356**	x	x		x	x					x			
11	57	0	E	4	18	57.000	4.300	13.06	60	**355**	x	x		x	x					x			
12	57	0	E	3	54	57.000	3.900	13.06	60	**354**	x	x		x	x					x			
13	57	0	E	3	40	57.000	3.667	7.62	65	353	x	x		x	x	30-0*	2 st bunn-0	**x**	30-0***	x		**x**	
14	57	0	E	3	24	57.000	3.400	8.71	65	**352**	x	x		x	x					x			
15	57	0	E	2	58	57.000	2.967	14.15	65	351	x	x		x	x					x			
16	57	0	E	2	30	57.000	2.500	15.24	70	**350**	x	x		x	x					x			
17	57	0	E	2	4	57.000	2.067	14.15	90	**349**	x	x		x	x	30-0*	2 st bunn-0		30-0***	x		**x**	
18	57	0	E	1	48	57.000	1.800	8.71	90	**348**	x	x		x	x					x			
19	57	0	E	1	36	57.000	1.600	6.53	95	347	x	x		x	x					x		**x**	
20	57	0	E	1	8	57.000	1.133	15.24	85	**346**	x	x		x	x					x			
21	57	0	E	0	40	57.000	0.667	15.24	90	345	x	x		x	x	30-0*	2 st bunn-0	**x**	30-0***	x		**x**	
22	57	0	E	0	14	57.000	0.233	14.15	80	**344**	x	x		x	x					x			
23	57	0	W	0	14	57.000	-0.233	15.24	75	**343**	x	x		x	x					x		**x**	
24	57	0	W	0	42	57.000	-0.700	15.24	65	**342**	x	x		x	x					x			
25	57	0	W	1	8	57.000	-1.133	14.15	65	341	x	x		x	x	30-0*	2 st bunn-0		30-0***	x		**x**	
26	57	0	W	1	28	57.000	-1.467	10.89	65	**340**	x	x		x	x					x			
								308					**Tot NP**	Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m									
													* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m										
													** Dyreplankton: To replikate WP2-håver bunn-0m: en til biomasse og en til fiksering										
													***Planteplankton "kvantitative prøver": 20 um håv, 30-0 m										
										30	30	30	0	30	30	14							

JÆRENS REV MOT SW OG W

April/May 2015

Dyp:

Tid: 35.7

Kommentar: 238 nm, 10 CTD stasjoner, 10 planktonstasjoner med håv, 3 MOC

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksygen	Klorofyl	Pl.plankt.	PLANKTONPRØVER WP2-Håv	MOC	Algehåv	Secci-dyp	WP3	Gulf VII
1	58	44	E	5 26	58.733	5.433			327	x								x	x	
2	58	41	E	5 17	58.683	5.283	5.55	234	328	x	x		x	30-0*	0-bunn		~~0-30 m~~	x	x	**X**
							4.61													
4	58	37	E	5 0	58.617	5.000	5.09	248	329	x	x		x					x	~~x~~	
							4.62													
6	58	32	E	4 41	58.533	4.683	6.47	270	330	x	x		x	30-0*	0-bunn	**x**	~~0-30 m~~	x		**x**
							6.02													
8	58	27	E	4 22	58.450	4.367	5.11	286	331	x	x		x					x		
							4.64													
10	58	22	E	4 5	58.367	4.083	5.59	162	332	x	x		x	30-0*	0-bunn		0-30 m	x		**X**
							4.31													
							5.59													
							4.65													
14	58	14	E	3 30	58.233	3.500	5.63	101	333	x	x		x	30-0*	0-bunn		0-30 m	x		**x**
							5.17													
							5.15													
							11.65													
18	58	0	E	2 46	58.000	2.767	6.88	63	334	x	x		x	30-0*	0-bunn	**x**	0-30 m	x		**X**
							7.41													
							6.88													
							10.06													
22	58	0	E	1 42	58.000	1.700	9.53	91	335	x	x		x	30-0*	0-bunn		0-30 m	x		**X**
							10.59													
							10.06													
							14.83													
26	58	0	W	0 6	58.000	-0.100	21.71	124	336	x	x		x	30-0*	0-bunn	**x**	0-30 m	x		**X**
							9.53													
							14.83													
							12.71													
30	58	0	W	1 40	58.000	-1.667	12.71	105	339	x	x		x	30-0*	0-bunn		0-30 m	x		**x**
							237.61													

EGERØYA MOT SW — April/May 2015

Dyp:
Tid: ca 12 timer
Kommentar: 83 nm, 8 CTD, 8 håv, 1 MOC

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksygen	Klorofyl	Pl.plankt.	PLANKTONPRØVER WP2-Håv	MOC	Algehåv	Secci-dyp	WP3	Gulf VII
1	58	25	E 5	50	58.417	5.833		70		x	x		x		0-bunn			x	x	X
							5.42													
3	58	18	E 5	36	58.300	5.600	4.74	332		x	x		x	30-0*	0-200/0-bunn	x	0-30 m	x	x	X
							5.09													
5	58	10	E 5	23	58.167	5.383	5.44	296		x	x		x					x	x	
							5.44													
7	58	3	E 5	9	58.050	5.150	4.76	191		x	x		x		0-bunn			x		X
							5.11													
9	57	55	E 4	56	57.917	4.933	5.46	100		x	x		x					x		
							4.78													
11	57	48	E 4	43	57.800	4.717	5.12	95		x	x		x		0-bunn			x		X
							5.21													
13	57	42	E 4	29	57.700	4.483	4.39	73		x	x		x					x		
							9.49													
15	57	26	E 4	0	57.433	4.000	12.81	69		x	x		x		0-bunn			x		X
							83													

LISTA MOT SW — April/May 2015

Dyp:
Tid: ca 8 timer
Kommentar: 51 nm, 5 CTD, 6 håvstasjoner, 1 MOC

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksygen	Klorofyl	Pl.plankt.	PLANKTONPRØVER WP2-Håv	MOC	Algehåv	Secci-dyp	WP3	Gulf VII
1	58	1	E 6	35	58.017	6.583		340		x	x		x		0-200/0-bunn			x	x	X
2	57	57	E 6	26	57.950	6.433	6.22	330		x	x		x	30-0*	0-200/0-bunn	x	0-30 m	x	x	
							5.46	300												
4	57	49	E 6	12	57.817	6.200	5.46	280		x	x		x					x	x	X
							4.38	250												
6	57	42	E 5	59	57.700	5.983	5.47	150		x	x		x		0-bunn			x		
							4.79	136												
8	57	35	E 5	46	57.583	5.767	5.13	100		x	x		x					x		X
							4.80	90												
10	57	26	E 5	26	57.433	5.433	9.21	79		x	x		x		0-bunn			x		X
							51													

LINDESNES MOT SSW — April/May 2015

Dyp:
Tid: ca 9,5 timer
Kommentar: 55 nm, 6 CTD, 6 håvstasjoner, 1 MOC

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksygen	Klorofyl	Pl.plankt.	PLANKTONPRØVER WP2-Håv	MOC	Algehåv	Secci-dyp	WP3	Gulf VII
1	57	58	E 7	2	57.967	7.033		25	427	x								x	x	
2	57	55	E 7	0	57.917	7.000	3.18	376	428	x	x		x		0-200/0-bunn			x	x	X
3	57	50	E 6	57	57.833	6.950	5.25	390	429	x	x		x	30-0*	0-200/0-bunn	x	0-30 m	x	x	
							5.25	340												
5	57	40	E 6	50	57.667	6.833	5.43	200		x	x		x					x		X
							4.31	300												
7	57	31	E 6	44	57.517	6.733	5.25	160	384	x	x		x		0-bunn			x		
							4.54	110												
9	57	22	E 6	36	57.367	6.600	5.44	100	383	x	x		x					x		X
							6.21	75												
11	57	7	E 6	26	57.117	6.433	9.76	50	382	x	x		x		0-bunn			x		X
							9.57	50												
							15.78	50												
							80													

Planktonstasjon med håvtrekk er markert med gult

NORDSJØEN OG SKAGERRAK — TORUNGEN - HIRTSHALS — Apr.15

Snittet kjøres på GM Dannevig i samme periode. Derfor tas kun et utvalg stasjoner.

Dyp:
Tid: Februar, april, juni-juli, november-desember
Kommentar: Primært ovennevnte måneder, men ellers så ofte som mulig.

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksygen	Klorofyl	Tot NP	Pl.plankt.	PLANKTONPRØVER MOC	WP2-Håv	Algehåv	Secci-dyp	Radioaktivitet	
1	58	24	E 8	46	58.400	8.767		110													Æredypet
2	58	23	E 8	49	58.383	8.817	1.86	90		x			x				bunn-0				1 n.m
3	58	20	E 8	53	58.333	8.883	3.66	250													5 n.m
4	58	16	E 8	59	58.267	8.983	5.09	400		x			x				bunn-0			x	10 n.m
5	58	12	E 9	5	58.200	9.083	5.09	410													15 n.m
6	58	8	E 9	11	58.133	9.183	5.10	640		x			x			x	bunn-0, 200-0**			x	20 n.m
7	58	0	E 9	21	58.000	9.350	4.79	440													30 n.m
8	57	56	E 9	27	57.933	9.450	5.11	175		x			x				bunn-0				35 n.m
9	57	51	E 9	34	57.850	9.567	6.23	80													41 n.m
10	57	48	E 9	40	57.800	9.667	4.38	35													47 n.m
11	57	42	E 9	47	57.700	9.783	7.06	65		x			x				bunn-0				52 n.m
12	57	38	E 9	52	57.633	9.867	4.81	25													57 n.m

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m

* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol

Dyreplankton: To WP2-håver: a) **bunn-0 (har første prioritet!) og b) 200-0m

***Planteplankton "kvantitative prøver": 20 um håv, 30-0 m

NORDSJØEN OG SKAGERRAK — OKSØ - HANSTHOLMEN — 2015

Dyp:
Tid: Februar, april, juni-juli, november-desember
Kommentar: Primært ovennevnte måneder, men ellers så ofte som mulig.

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	PLANKTONPRØVER Pl.plankt.*	MOC	WP2-Håv	Algehåv	Secci-dyp	Radioaktivitet
1	58	3	E 8	5	58.050	8.083		100	385	x	x	x	x	x	0-30			30-0	x	
2	57	59	E 8	6	57.983	8.100	4.03	450	386	x	x	x	x	x	0-30		bunn-0		x	
3	57	55	E 8	10	57.917	8.167	4.53	480	387	x	x	x	x	x					x	x
4	57	51	E 8	12	57.850	8.200	4.14	520	388	x	x	x	x	x	0-30	x	bunn-0, 200-0**		x	
5	57	44	E 8	17	57.733	8.283	7.49	400	389	x	x	x	x	x					x	
6	57	39	E 8	20	57.650	8.333	5.25	210	390	x	x	x	x	x	0-30				x	
7	57	33	E 8	22	57.550	8.367	6.09	120	391	x	x	x	x	x					x	
8	57	29	E 8	25	57.483	8.417	4.31	75	392	x	x	x	x	x	0-30		bunn-0		x	
9	57	24	E 8	28	57.400	8.467	5.25	40	393	x	x	x	x	x					x	
10	57	19	E 8	30	57.317	8.500	5.11	25	394	x	x	x	x	x					x	
11	57	14	E 8	33	57.233	8.550	5.25	25	395	x	x	x	x	x	0-30			30-0	x	
12	57	11	E 8	34	57.183	8.567			396	x	x	x	x	x					x	x

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m
* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol
**Dyreplankton: To WP2-håver (bunn-0 og 200-0m)

SKAGERAK — JOMFRULAND - SKAGEN — Tas ikke i 2015!

Dyp:
Tid: En gang hver måned.
Kommentar:

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	PLANKTONPRØVER Pl.plankt.	MOC	WP2-Håv	Algehåv	Secci-dyp	Radioaktivitet
3	58	41	E 9	45	58.683	9.750		400		x										x
5	58	29	E 9	55	58.483	9.917		500		x										x

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m

SKAGERAK — JOMFRULAND - KOSTER

Dyp:
Tid:
Kommentar:

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	Pl.plankt.	PLANKTONPRØVER MOC	WP2-Håv	Algehåv	Secci-dyp
1	58	53	E 9	41	58.883	9.683				x	x		x	x	0-30		bunn-0	30-0	x
2	58	53	E 9	50	58.883	9.833	4.65			x	x		x	x					x
3	58	53	E 10	10	58.883	10.167	10.33			x	x		x	x	0-30	x	bunn-0		x
4	58	53	E 10	20	58.883	10.333	5.16			x	x		x	x					x
5	58	53	E 10	30	58.883	10.500	5.16			x	x		x	x	0-30				x
6	58	53	E 10	40	58.883	10.667	5.16			x	x		x	x	0-30		bunn-0	30-0	x

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m
* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol

SKAGERAK — VÄDERØ

Dyp:
Tid:
Kommentar:

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	Pl.plankt.	PLANKTONPRØVER MOC	WP2-Håv	Algehåv	Secci-dyp
3	58	33.2	E 10	53.7	58.553	10.895	1.99	80		x	x		x	x	30-0		bunn-0	0-30	x
4	58	32.5	E 10	48.0	58.542	10.800	3.05	105		x	x		x	x					x
5	58	31.6	E 10	40.7	58.527	10.678	3.91	135		x	x		x	x	30-0				x
6	58	30.7	E 10	33.3	58.512	10.555	3.97	185		x	x		x	x					x
7	58	28.8	E 10	18.4	58.480	10.307	8.01	360		x	x		x	x	30-0				x
8	58	26.4	E 10	0.0	58.440	10.000	9.91	560		x	x		x	x	30-0	x	bunn-0	0-30	x

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m
* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol

SKAGERAK — MÅSESKJÆR

posisjoner stemmer ikke m Miljøtokt?

Dyp:
Tid:
Kommentar:

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING: VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	Pl.plankt.	PLANKTONPRØVER: MOC	WP2-Håv	Algehåv	Secci-dyp	Radioaktivitet
2	58	4.6	E 11	13.2	58.077	11.220	1.92	55		x	x		x	x	0-30		bunn-0	30-0	x	
3	58	4.0	E 11	9.3	58.067	11.155	2.15	110		x	x		x	x					x	
4	58	3.1	E 11	3.8	58.052	11.063	3.04	125		x	x		x	x	0-30				x	
5	58	1.9	E 10	56.6	58.032	10.943	3.99	100		x	x		x	x					x	x
6	58	0.7	E 10	49.4	58.012	10.823	4.00	210		x	x		x	x	0-30	x	bunn-0		x	
7	57	59.5	E 10	42.2	57.992	10.703	4.00	190		x	x		x	x					x	
8	57	58.3	E 10	35.0	57.972	10.583	4.00	145		x	x		x	x	0-30				x	
9	57	56.8	E 10	25.9	57.947	10.432	5.05	110		x	x		x	x					x	x
10	57	55.3	E 10	16.8	57.922	10.280	5.06	90		x	x		x	x	0-30		bunn-0	30-0	x	

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m

* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol

KATTEGAT — GØTEBORG - FREDRIKSHAVN

Dyp:
Tid:
Kommentar:

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING: VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	Pl.plankt.	PLANKTONPRØVER: MOC	WP2-Håv	Algehåv	Secci-dyp	Radioaktivitet
1	57	33.0	E 11	31.5	57.550	11.525		80		x	x		x	x	0-30		bunn-0	0-30	x	x
2	57	32.3	E 11	26.0	57.538	11.433	3.03	55		x	x		x	x					x	
3	57	32.0	E 11	19.5	57.533	11.325	3.50	45		x	x		x	x	0-30		bunn-0		x	
4	57	30.3	E 11	8.5	57.505	11.142	6.14	45		x	x		x	x					x	x
5	57	27.9	E 10	54.0	57.465	10.900	8.15	45		x	x		x	x	0-30				x	
6	57	26.0	E 10	42.5	57.433	10.708	6.47	30		x	x		x	x	0-30		bunn-0	0-30	x	

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m

* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol

NORDSJØEN — HARBOØR

Dyp:
Tid:
Kommentar:

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	Pl.plankt.	PLANKTONPRØVER MOC	WP2-Håv	Algehåv	Secci-dyp
1	56	39	E	8	2			30	370	x	x		x	x	0-30		bunn-0**	0-30	x
2	56	39	E	7	46			35	371	x	x		x	x					x
3	56	39	E	7	34			35	372	x	x		x	x	0-30				x
4	56	39	E	7	24			35	373	x	x		x	x					x
5	56	39	E	7	13			40	374	x	x		x	x	0-30				x
6	56	39	E	7	2			40	375	x	x		x	x	0-30		bunn-0**	0-30	x

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m
* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol
** Dyreplankton: To replikate WP2-håver bunn-0m: en til biomasse og en til fiksering

NORDSJØEN — HUSEBY KLIT

Dyp:
Tid:
Kommentar:

Nr.	POSISJON Grad N	Min N	Grad E/W	Min E/W	Desimalgrader N	Desimalgrader E/W	Distanse n.m.	Antatt dyp	Skriv inn CTD stasjon	PRØVETAKING VANNPRØVER CTD	N.salt	Oksyger	Klorofyll	Tot NP	Pl.plankt.	PLANKTONPRØVER MOC	WP2-Håv	Algehåv	Secci-dyp
1	56	10	E	7	54			30	381	x	x		x	x	0-30		bunn-0**	0-30	x
2	56	10	E	7	43			35	380	x	x		x	x					x
3	56	10	E	7	34			35	379	x	x		x	x	0-30				x
4	56	10	E	7	25			30	378	x	x		x	x					x
5	56	10	E	7	16			35	377	x	x		x	x	0-30				x
6	56	10	E	7	5			35	376	x	x		x	x	0-30		bunn-0**	0-30	x

Tot NP Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m
* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol
** Dyreplankton: To replikate WP2-håver bunn-0m: en til biomasse og en til fiksering

NORDSJØEN								**KNUDE DYB**															
Dyp:																							
Tid:																							
Kommentar:																							
		POSISJON										**PRØVETAKING**											
	Nr.	**Grad N**	**Min**	**Grad E/W**		**Min**	**Desimalgrader N**	**Desimalgrader E/W**	**Distanse n.m.**	**Antatt dyp**	**Skriv inn CTD stasjon**	**VANNPRØVER**						**PLANKTONPRØVER**					
												CTD	**N.salt**	**Oksygen**	**Klorofyll**	**Tot NP**	**Pl.plankt.**	**MOC**	**WP2-Håv**	**Algehåv**	**Secci-dyp**		
	1	55	19	E	8	14				35		x	x		x	x	0-30		bunn-0**	0-30	x		
	2	55	19	E	8	0				35		x	x		x	x					x		
	3	55	19	E	7	50				30		x	x		x	x	0-30				x		
	4	55	19	E	7	40				30		x	x		x	x					x		
	5	55	19	E	7	30				25		x	x		x	x	0-30				x		
	6	55	19	E	7	20				25		x	x		x	x					x		
	7	55	19	E	7	10				25		x	x		x	x	0-30				x		
	8	55	19	E	7	0				20		x	x		x	x	0-30		bunn-0**	0-30	x		
																Tot NP	Fra alle dyp 5-30 m + største dyp hvis bunndyp< 100m/ eller 100 m hvis bunndyp>100m						
																	* Planteplankton: "kvantitative prøver": blandingsprøve fra 0-30 m. Fikseres på brun flaske m Lugol						
																	** Dyreplankton: To replikate WP2-håver bunn-0m: en til biomasse og en til fiksering						