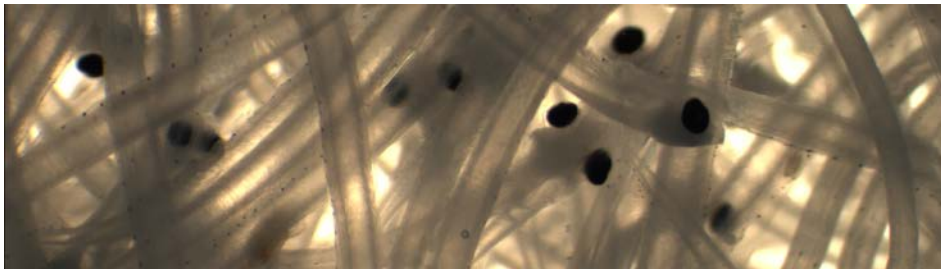
Herring larvae surveys 2012-2013: Survey reports and results

C.J.G. van Damme & C. Bakker

Report number 14.001



IMARES Wageningen UR

(IMARES - Institute for Marine Resources & Ecosystem Studies)

Client: Centrum voor Visserijonderzoek (CVO)
Haringkade 1
1976 CP IJmuiden

WOT-05-406-110-IMARES-3

Publication date: 20 March 2014

IMARES is:

- an independent, objective and authoritative institute that provides knowledge necessary for an integrated sustainable protection, exploitation and spatial use of the sea and coastal zones;
- an institute that provides knowledge necessary for an integrated sustainable protection, exploitation and spatial use of the sea and coastal zones;
- a key, proactive player in national and international marine networks (including ICES and EFARO).

P.O. Box 68
1970 AB IJmuiden
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 26
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 77
4400 AB Yerseke
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 59
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 57
1780 AB Den Helder
Phone: +31 (0)317 48 09 00
Fax: +31 (0)223 63 06 87
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 167
1790 AD Den Burg Texel
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 62
E-Mail: imares@wur.nl
www.imares.wur.nl

A_4_3_2-V13

Contents

Summary

The international herring larvae surveys (IHLS) are carried out to sample larvae of the North Sea autumn and winter spawning herring populations. The abundance of larvae is used as an index for the estimation of North Sea herring spawning stock biomass. These surveys are performed within the statutory research tasks within the framework of EZ-programs (WOT).

In the period September 2012 to January 2013 three herring larvae surveys were carried out by 'RV Tridens'. In September, the Buchan area and Central North Sea were sampled and in December and January the southern North Sea and the Eastern channel. During the second part of the September survey the weather conditions were bad and some of the planned stations could not be sampled. In December due to technical problems, 4 stations could not be sampled. In January the weather conditions were good, so almost all stations could be sampled. Despite some loss of sampled stations, over all coverage of the entire sampling area was achieved during all surveys.

In September high numbers of herring larvae, similar to 2011, were caught, but only in the Buchan area. In the Central North Sea abundances were much lower compared to September 2011. In December and January high abundances of larvae were found, higher compared to previous surveys in 2011-2012. The high number of non-yolk sac larvae and the wide spread in December suggest an early start of the spawning season. High numbers of larvae were found at almost all stations in January. This season the Spawning-Component Abundance Index (SCAI) is the highest in the time series.

An internal larvae identification workshop was held for quality assurance. The agreement in identification of all larvae is improved compared to previous workshops.

1. Introduction

Every year the international herring larvae surveys (IHLS) are carried out to sample larvae of the autumn and winter spawning herring populations in the North Sea and English Channel. The number of larvae is used as an index for the estimation of the existing North Sea herring spawning stock biomass. The produced fishery-independent estimate is used for ' tuning' of the herring stock assessment. These surveys are performed within the statutory research tasks within the framework of EZ-programs (WOT).

The international herring larvae surveys are carried out together with the German fisheries institute "Thünen Institute" in Hamburg. In the autumn larvae of herring spawning in the north western North Sea are sampled:

- 1st half of September – Orkney/Shetland by Germany (2 weeks)
- **2nd half of September – Buchan and Central North Sea by the Netherlands (2 weeks)**

In winter the larvae of the 'Channel' or 'Downs' herring are sampled:

- **2nd half of December – southern North Sea/Eastern Channel by the Netherlands (1 week)**
- 1st half of January – southern North Sea/Eastern Channel by Germany (1 week)
- **2nd half of January – southern North Sea/Eastern Channel by the Netherlands (1 week)**

The herring larvae surveys are coordinated by the ICES "Working Group for International Pelagic Surveys" (WGIPS). The database is managed by the Thünen institute. Since 2012 the survey data is also stored in the ICES egg and larval database http://www.ices.dk/marine-data/data-portals/Pages/Eggs-and-larvae.aspx and data are publicly available.

Until 2012 the numbers of herring larvae in the North Sea, based on all individual surveys, were only presented in the so-called "MLAI-index" (Multiplicative Larval Abundance Index). The MLAI index is based on the assumption that the relative proportions between the different spawning components, Shetland, Buchan, Central North Sea and the 'Downs', are fixed. However, the relative proportion of the 'Downs' component has increased in recent years. In order to include changes in relative proportions between the different spawning components a new index, the "SCAI"-index (Spawning-Component Abundance Index; Payne, 2010), has been developed. Since 2012 the "SCAI" Spawning-Component Abundance Index" is calculated.
Both the MLAI and SCAI indices are used by the ICES "Herring Assessment Working Group" (HAWG) for the assessment of the herring spawning stock biomass.

2. Objective

The provision of an index for the spawning stock biomass of the autumn and winter spawning herring populations in the North Sea and English Channel is the aim of the International Herring Larvae Surveys (IHLS). This index is used by the "Herring Assessment Working Group" (HAWG) for tuning of the herring assessment.

This report contains the results of the Dutch herring larvae surveys carried out in the spawning season 2012-2013.

3. Materials and Methods

3.1 Gear

The sampling of the herring larvae was performed with a "High Speed Plankton Sampler Gulf VII" (Figure 3.1) (referred to as 'torpedo' in the remainder of the report) with a plankton net with mesh size 280 µm (Nash *et al*. 1998). A small Scripps depressor (25 kg) was attached to the plankton sampler. The amount of water filtered during each haul was measured using a Valeport electronic flowmeter mounted inside the nosecone (Model 001; http://www.valeport.co.uk/Portals/0/Docs/Datasheets/Valeport_Model001&002_v2a.pdf). A similar 'external' flowmeter was mounted on the frame of the sampler. The ratio of 'internal' to 'external' flowmeter revolutions provided an index of the extent of net clogging.

A Seabird 911plus CTD with a Benthos PSI 916 altimeter were mounted on the sampler frame to provide a 'real-time' graphical display (Figure 3.2) of the depth of the torpedo in the water column, its height off the seabed as well as continues measurements of the temperature and salinity throughout each deployment.

Figure 3.1. The Gulf VII plankton sampler.

3.2 Fishing method

The survey was carried out on board the 'RV Tridens'. The speed during fishing with the torpedo was 5 knots through the water. At each station a 'double oblique' haul (a V-shaped haul through the water column; Figure 3.2) was performed. This way each 10 meters of the water column are sampled 1 minute going down and going up.

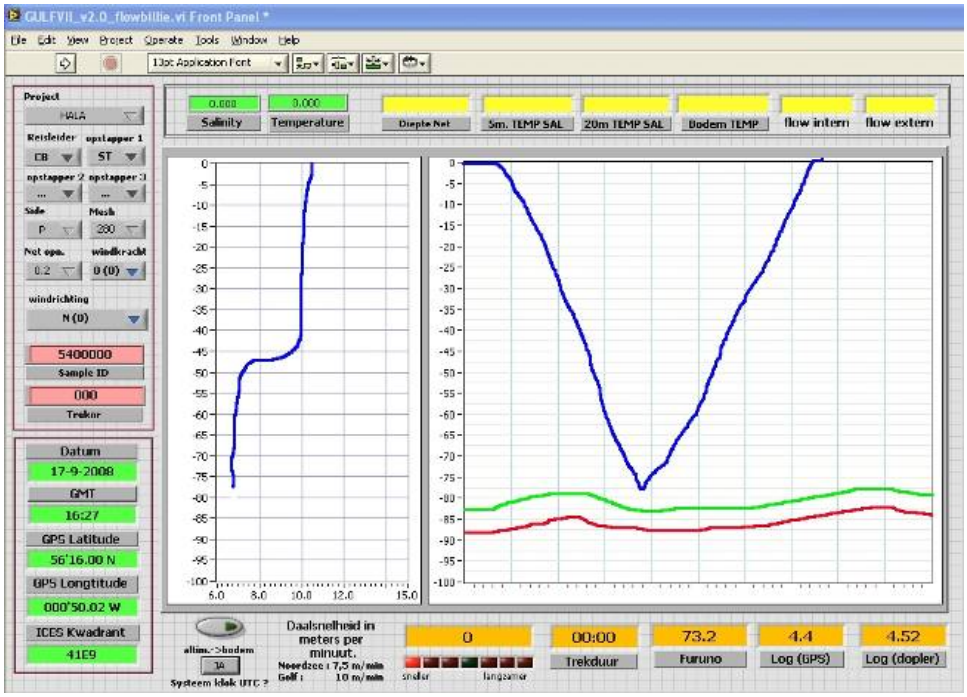


Figure 3.2. Illustration of a 'double-oblique' haul in the Labview program. In the right frame: The blue line shows the depth profile of the plankton sampler, the red line is the sea bottom depth, the green line is the 5 meter above the bottom safety line. In the left frame: The blue line shows the temperature through the water column.

The torpedo was lowered to 5 meter above the sea floor. To ensure enough water was filtered, haul duration needed to be at least 10 minutes. At shallower stations a double or triple 'double oblique' was performed without the torpedo breaking the surface of the water to ensure sufficient water was filtered.

3.3 Sampling grid

During the herring larvae surveys a standard grid is sampled. In each ICES rectangle 9 stations are sampled (0°30 N x 1°E/W; ca. 30 x 30 NM).
If at a station the sample contains over a thousand larvae, immediately within the 1/9 ICES rectangle another sample is taken. In this way a reliable estimate of the total number of larvae, which is not dominated by exceptional high catches, can be ensured.

3.4 Workup of samples

After each deployment, as soon as the torpedo was on board the vessel, the sample was taken to the laboratory on board of the vessel. The number of herring larvae in the sample is estimated, and the fresh sample is immediately fixed in 4% buffered formaldehyde (formaldehyde solutions were buffered with sodium acetate trihydrate).
Upon return after each survey, fish larvae were sorted out from the fixed sample. If the sample contains a high number of larvae, the larvae were sub-sampled using a 'Folsom' splitter (Griffiths *et al*. 1984). At least 50 clupeid larvae were identified in each sample. Clupeid larvae are identified to species by counting the number of myotomes, which are species and length specific (Ehrenbaum 1909, Russel 1976, Munk & Nielsen 2005). The species composition is used through the subsample factor to calculate the total number of herring larvae in the whole sample. All or at least 100 clupeid larvae were measured in each sample.
All data is entered into Billie turf and after standard data checking procedures uploaded to the IMARES FRISBE database.

For quality assurance an internal IMARES clupeid larvae identification workshop is held before the analyses of the survey samples.

3.5 Calculation of the larvae numbers

The total number of herring larvae in the sample were counted and abundances were calculated using the below formulae (Smith & Richardson 1977). The numbers below a square metre of sea surface at each station were calculated as:

$$n/m^2 = \frac{larvae\ per\ sample\ (n) * bottom\ depth\ (m)}{volume\ \ filtered\ (m^3)}$$

The volume filtered is obtained from the formula:

$$Volume\ \ filtered\ \ = \frac{area\ of\ \ mouth\ opening\ (m^2) * efficiency\ \ factor * flowmeter\ revolutions}{flowmeter\ calibration\ constant}$$

$$Raising\ Factor = \frac{total\ n\ caught}{total\ measured}$$

$$Calibration\ Factor = \frac{flowmeter\ calibration * bottom\ depth}{flowmeter\ revolutions * pi * \left(\frac{aperture}{2}\right)^2 * efficiency\ \ factor}$$

$$n/m^2_{Year,10*10\ rectangle} = grouped\ LFD * raising\ \ factor * calibration\ \ factor$$

The number of eggs and larvae per m^2 were plotted per station per month. Temperature and salinity were plotted per month using the kriging method in Golden Software Surfer v8.01.

4. Results

4.1 September survey

Date, time and harbours

From (harbour)	Date	Time (UTC)	To (harbour)	Date	Time (UTC)
Scheveningen	17-09-2012	09:00	Aberdeen	21-09-2012	16:00
Aberdeen	24-09-2012	04:00	Scheveningen	28-09-2012	07:00

Crew Kees Bakker (cruise leader)
Ineke Pennock (week 38)
Corrina Hinrichs (week 39)

Volunteers Jeike van de Poel
Carmen Embregts

Guests Björn Illing (University Hamburg, Germany)

Extra sampling
For our colleagues from Hamburg University we did a pelagic trawl haul to collect spawning herring for the fertilization of herring eggs. We also used the SB32 water sampler to collect water samples. Attached to this was a microzooplankton net. Both the water and microzooplankton samples were collected for condition and diet studies of the herring larvae.

Deviations from the planned sampling grid
During week 38 positions of some stations were slightly moved for nautical reasons, thus the sampling position of these stations was off the centre of the 1/9 ICES rectangle (Figure 4.1a). In week 39 a storm from the Northeast occurred on the North Sea. As a result, 20 of the planned stations could not be sampled (Figure 4.1b).

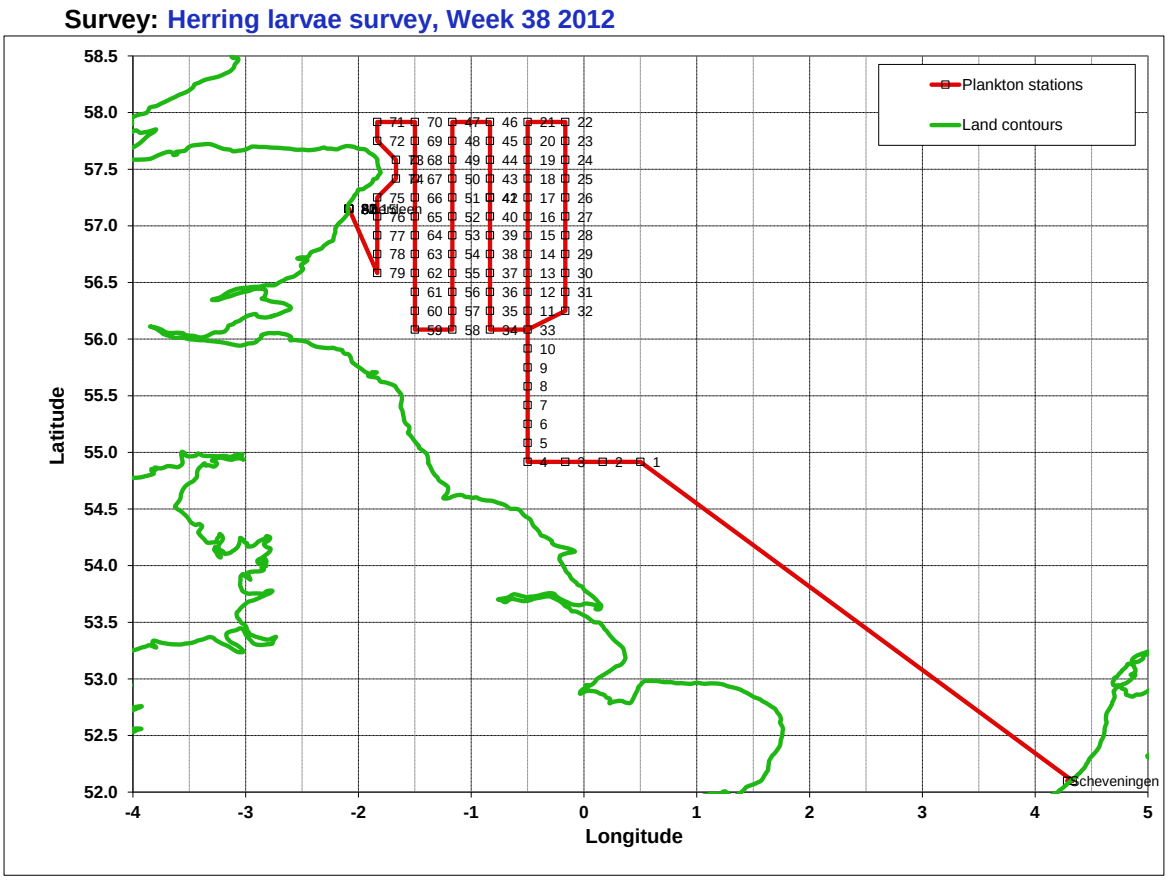


Figure 4.1a. Stations sampled in week 38 2012.

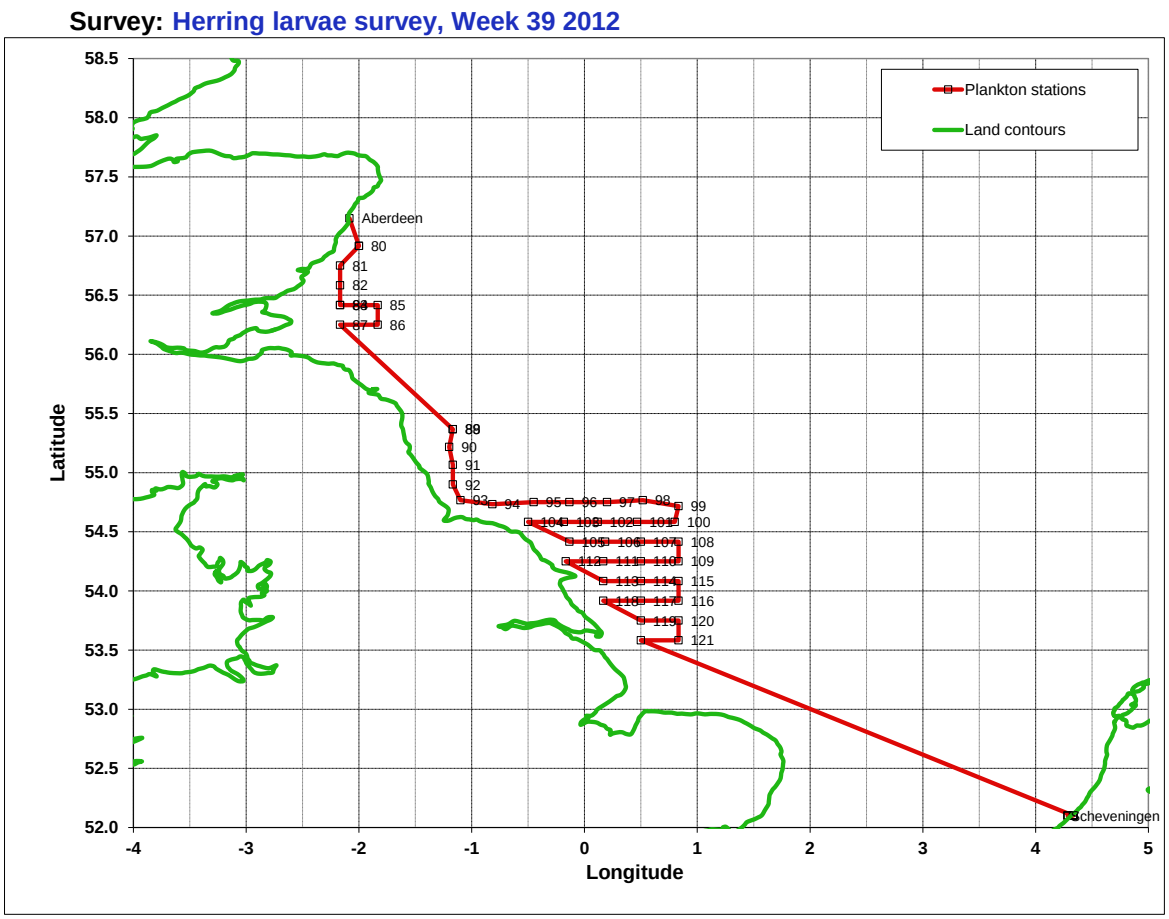


Figure 4.1b. Stations sampled in week 39 2012.

Damage to sampling equipment

No damage to the sampling equipment occurred during this survey. Twice a new connection had to be made between the torpedo and winch cable. This was due to leakage of sea water in the cable of the starboard winch. The portside winch could not be used, probably because the new slip rings on the winch were not installed correctly.

Survey

Week 38

Departed from Scheveningen harbour on Monday 17 September 9:00 (UTC). After 17 hours of steaming we reached the first station on 18 September 1:28 (UTC). During the first week 4 water and microzooplankton samples were collected. It was also planned to carry out a pelagic trawl haul this week but no herring schools were seen on the acoustics, hence this was moved to the second week.
Friday early in the morning the last of the planned stations for week 38 was sampled and it was decided to continue with planned stations for week 39. Due to technical problems the first week sampling was ended on Friday afternoon and we steamed to Aberdeen harbour for the weekend. We arrived 18:00 (UTC) in Aberdeen.

Week 39

Despite the bad weather forecast we left Aberdeen Monday 24th at 5:00 (UTC). Because of the approaching storm the Aberdeen harbour would be closed for an unknown time period. We left Aberdeen and were able to sample 8 plankton stations before the storm arrived. During the storm from Monday 15:00 (UTC) till Tuesday 14:00 (UTC) we were anchored in the Firth of Forth. Because of the storm it

was decided to not sample the stations between 56.15N and 55.22N. Numbers of herring larvae were very low in 2011. Instead we focused on the more southern stations were higher numbers of larvae were expected. However, these southern samples contained low numbers of herring, maybe because of the storm.
On 26 September 14:00 (UTC) a pelagic trawl haul was performed. After 5 hours we retrieved a catch of 35 tonnes, mostly mackerel. But the catch contained enough spawning herring to fertilise eggs.
On Thursday the last plankton station was sampled at 12:31 (UTC). After a steam of 160 nautical miles we arrived in Scheveningen Friday morning 7:00 (UTC).

Sample-id's
2012.5400151 t/m 2012.5400271

Samples and data
We sampled 121 stations with a Gulf VII plankton torpedo with a CTD mounted on top. At each station a double oblique haul was performed and minimum sampling time was 10 minutes.
One pelagic trawl haul was performed and at 5 stations water and microzooplankton samples were collected.

Remarks for the next surveys
A video connection exists between the plankton lab and the bridge. The computer in the plankton lab receives the live feed from the torpedo. The video feed from the plankton lab to the bridge is of vital importance for the winch controller on the bridge to see the position of the torpedo in the water column. At the start of this survey the video connection was not working. The reason for this failure was found just prior to the arrival at the first plankton station. The cable in the acoustics lab as well as the RS323 connection of the ES60 were broken together with the. An emergency repair was conducted for this survey, but it is very important that the cable is replaced before the survey in December.

Numbers of herring larvae
High numbers of herring larvae were found in the centre of the northern part of the Buchan area, which was comparable to the numbers caught in 2011 (Figure 4.2). In the central North Sea larvae were only caught at a few stations. Numbers were much lower compared to 2011.
Bottom temperature much more variable in the sampling area (Figure 4.3). Temperature varied between 11.2 and 14.7°C, and was in general higher compared to 2011. In 2011 the temperature range was between 10.1 and 14.2°C.
Bottom salinity was not very variable in September 2012 (Figure 4.4) and comparable to 2011. The 35 ‰ isocline is at the same position as in 2011.

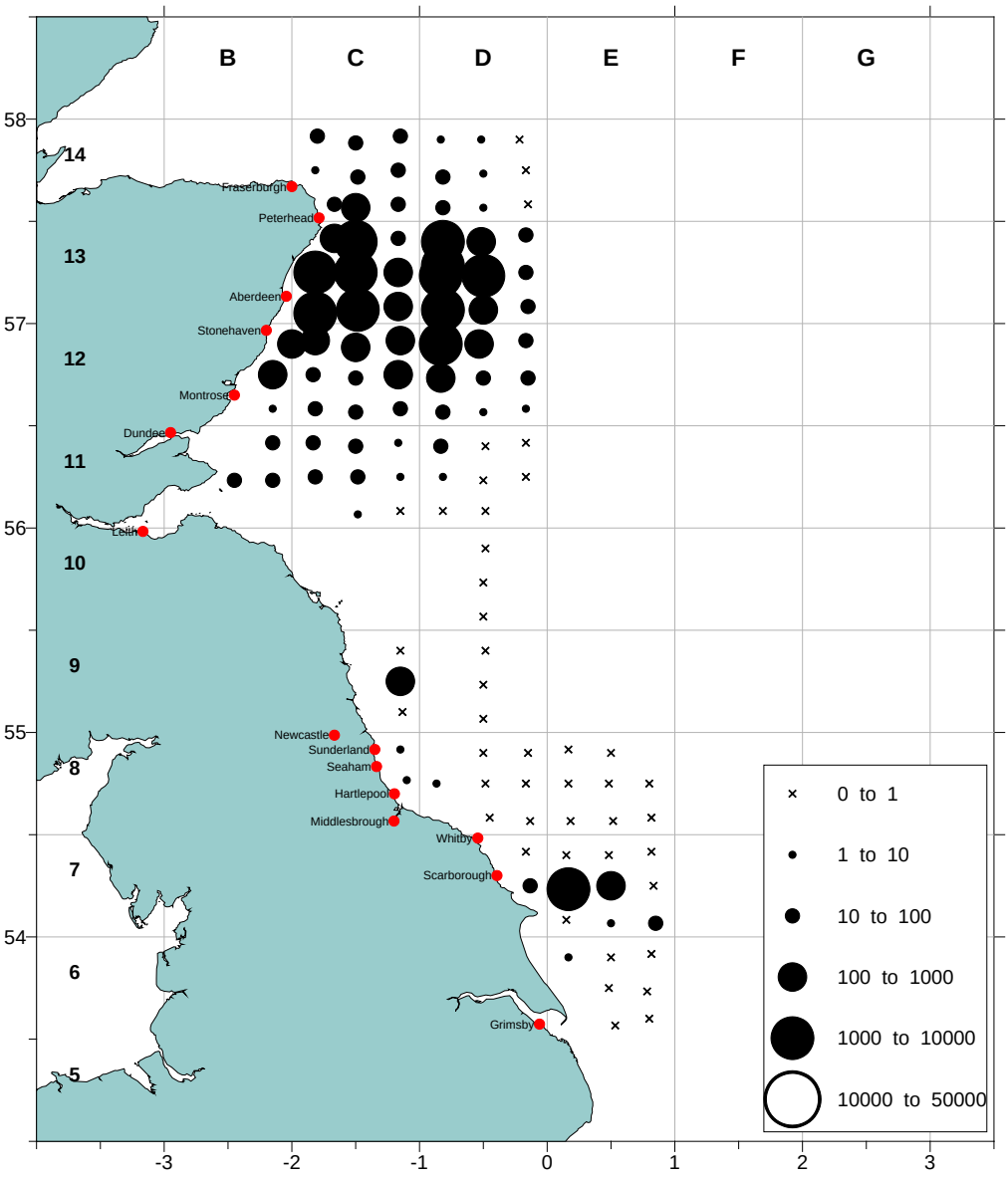


Figure 4.2. Numbers of larvae per m^2 caught during the September 2012 survey.

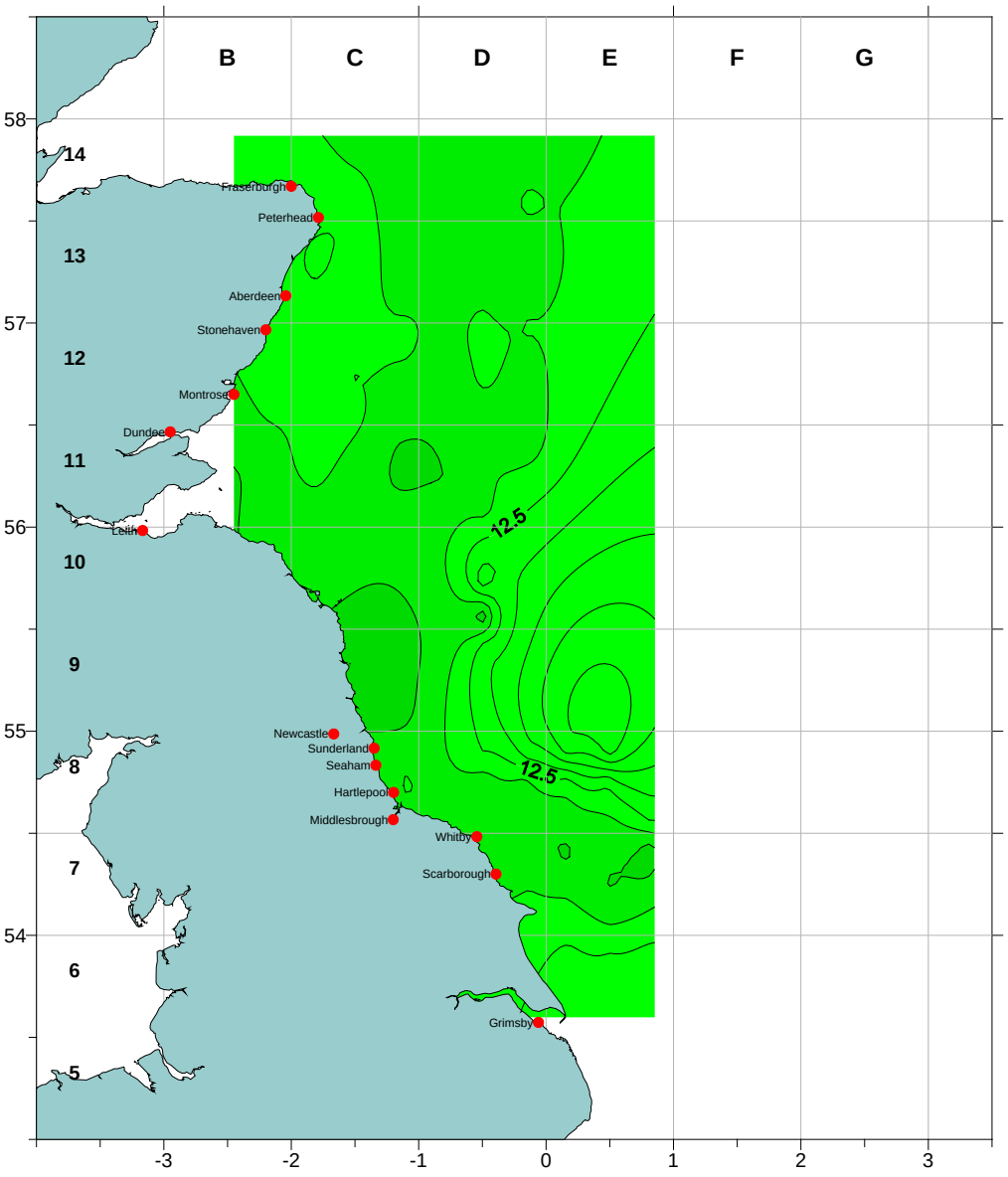


Figure 4.3. Bottom temperature during the September 2012 survey.

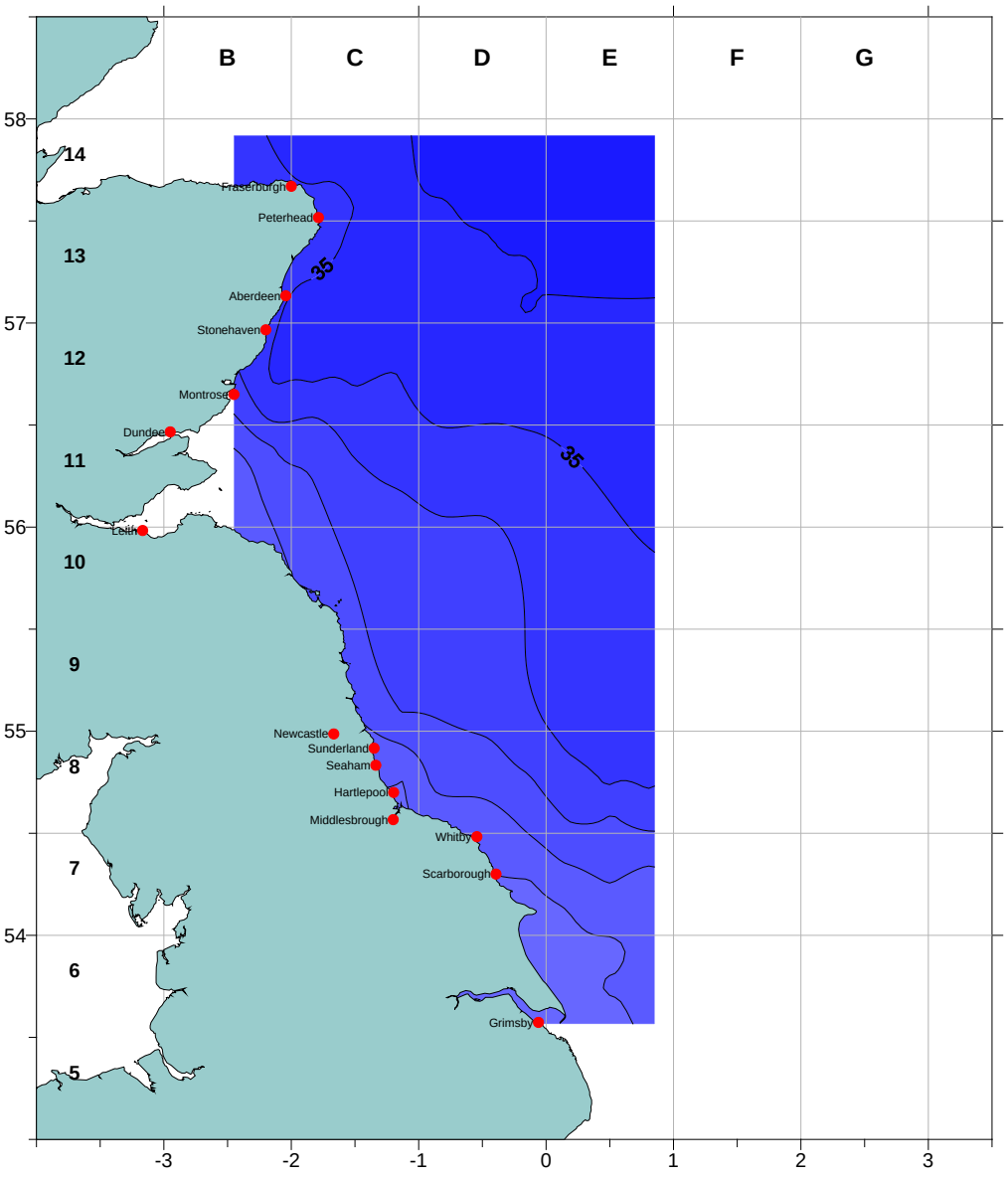


Figure 4.4. Bottom salinity during the September 2012 survey.

4.2 December survey

Date, time and harbours

From (harbour)	Date	Time (UTC)	To (harbour)	Date	Time (UTC)
Scheveningen	17-12-2012	12:30	Scheveningen	20-12-2012	20:00

Crew Kees Bakker (cruise leader)
André Dijkman-Dulkes
Kees Groeneveld

Guests Franziska Bils (University Hamburg, Germany)
Jan Göbel (University Hamburg, Germany)

Extra sampling

For our colleagues from Hamburg University also used the SB32 water sampler to collect water samples. Attached to this was a microzooplankton net. Both the water and microzooplankton samples were collected for condition and diet studies of the herring larvae.
Due to on-going renovations of the fish winch it was not possible to carry out a pelagic trawl haul to collect spawning herring for the fertilization of herring eggs during this survey.

Kees Groeneveld participated in the survey for an experiment to monitor survival of sole in salt water tanks on a moving vessel.

Deviations from the planned sampling grid

Because of technical problems and bad weather conditions 5 planned stations could not be sampled (Figure 4.5). Positions of some stations were slightly moved for nautical reasons, thus the sampling position of these stations was off the centre of the 1/9 ICES rectangle.

Survey: Herring larvae survey, Week 51 2010

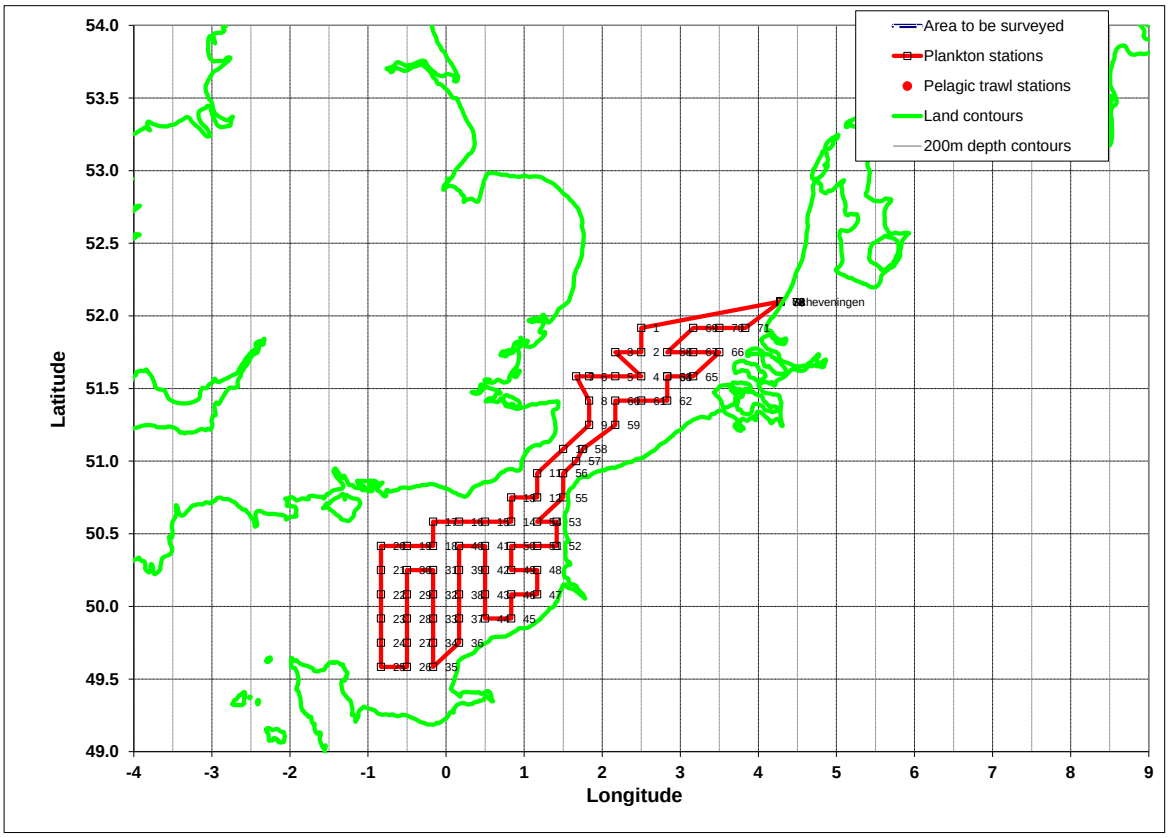


Figure 4.5. Stations sampled in December 2012.

Damage to sampling equipment

No damage occurred to the torpedo during this survey. The microzooplankton net of our German colleagues was lost due to the bad weather circumstances.

Survey

During the testing of the sampling equipment, just prior to the start of this survey, it was discovered that the echo sounder ES-60 was not functioning. This echo sounder is of vital importance to the larvae survey since it is the feed of the bottom depth for the plankton sampling. It appeared that the video splitter of the ES-60 had disappeared. Just before leaving the harbour material was bought to solve this problem. Five hours after leaving the harbour the problem was solved and the plankton sampling could start.

On Monday 17 December Tridens left Scheveningen harbour at 12:30 (UTC). Due to the repairs of the ES-60 the first 4 planned stations could not be sampled. The first plankton station was sampled at 18:18 (UTC). On Thursday at 15:50 (UTC) the last plankton station was sampled.

Sample-id's

2012.5400301 t/m 2012.5400374

Samples and data

We sampled 74 stations with a Gulf VII plankton torpedo with a CTD mounted on top. One haul was invalid, because part of the sample was lost while washing it from the codend into a jar for fixation. At each station a double oblique haul was performed and minimum sampling time was 10 minutes.

Remarks for the next survey

Just prior to the start of the survey it became clear that the echo sounder (ES-60) did not function. The echo sounder is necessary to see the seafloor during the haul in order to lower the plankton sampler 5m above the seafloor. The reason for the malfunctioning appeared to be the disappearance of the video splitter. Before the start of the survey materials were bought to repair this. It took four hours to repair and the loss of 4 plankton stations before things were functioning again.

Numbers of herring larvae

December is the start of the spawning season of the 'Downs' herring. The numbers of larvae are high (Figure 4.6), higher compared to December 2011. The larvae are much more spread out over the area and are also found on the northern stations. This suggests spawning started much earlier this year and the start of hatching is missed. Highest abundances of herring larvae were found directly north of the Seine Bay and in the eastern Channel, at the known spawning hotspot. Many herring larvae both with and without yolk sac were caught. The high numbers of non-yolk sack larvae also show the early start of spawning and hatching in 2012.

The bottom temperature in the channel and the southern North Sea were only slightly lower in December 2012 compared to December 2011 (Figure 4.7). The temperature varied from 7.7 to 11.7°C, in 2011 the temperature varied between 7.9 and 12.4°C. The bottom salinity was comparable to 2011 (Figure 4.8).

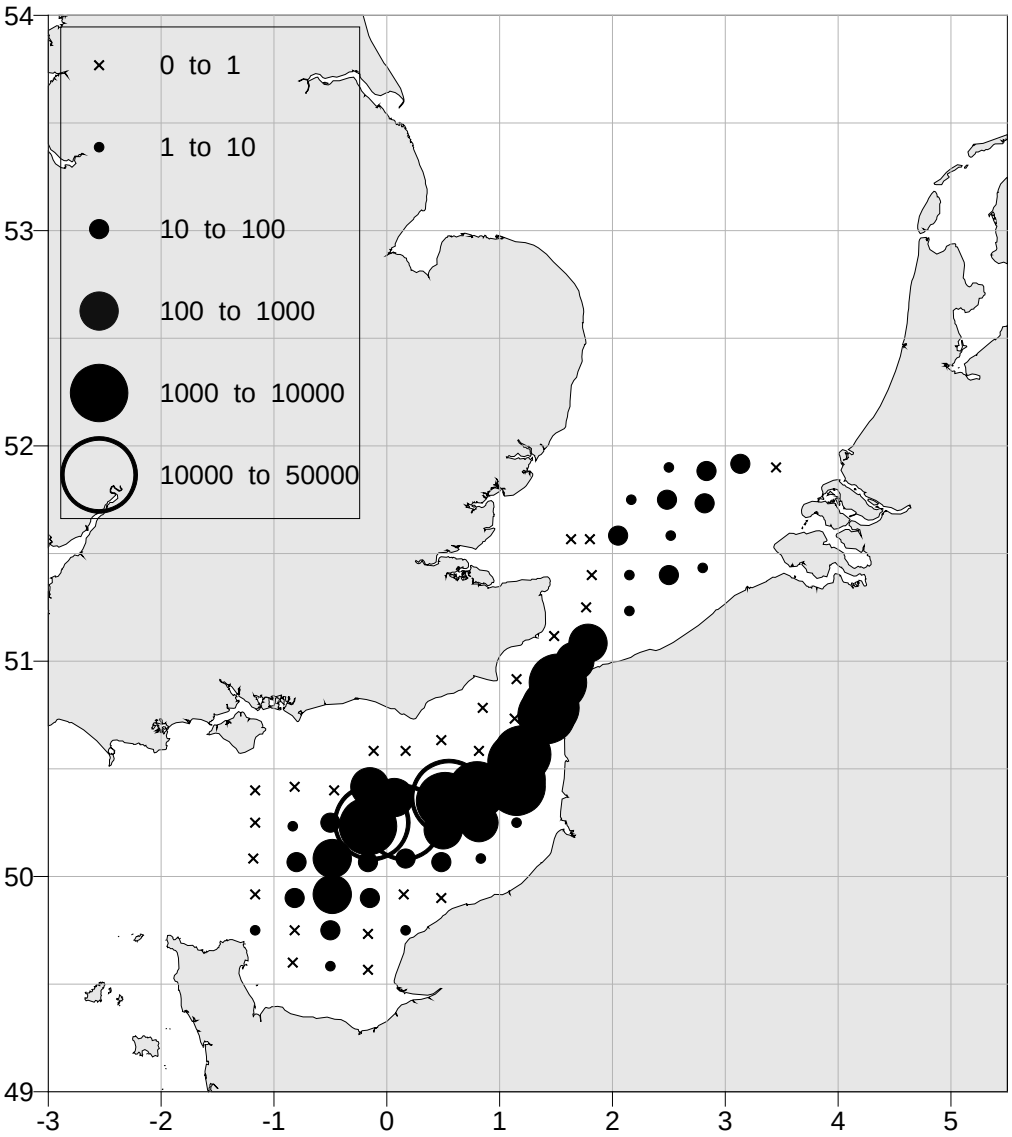


Figure 4.6. Numbers of larvae per m^2 caught during the December 2012 survey.

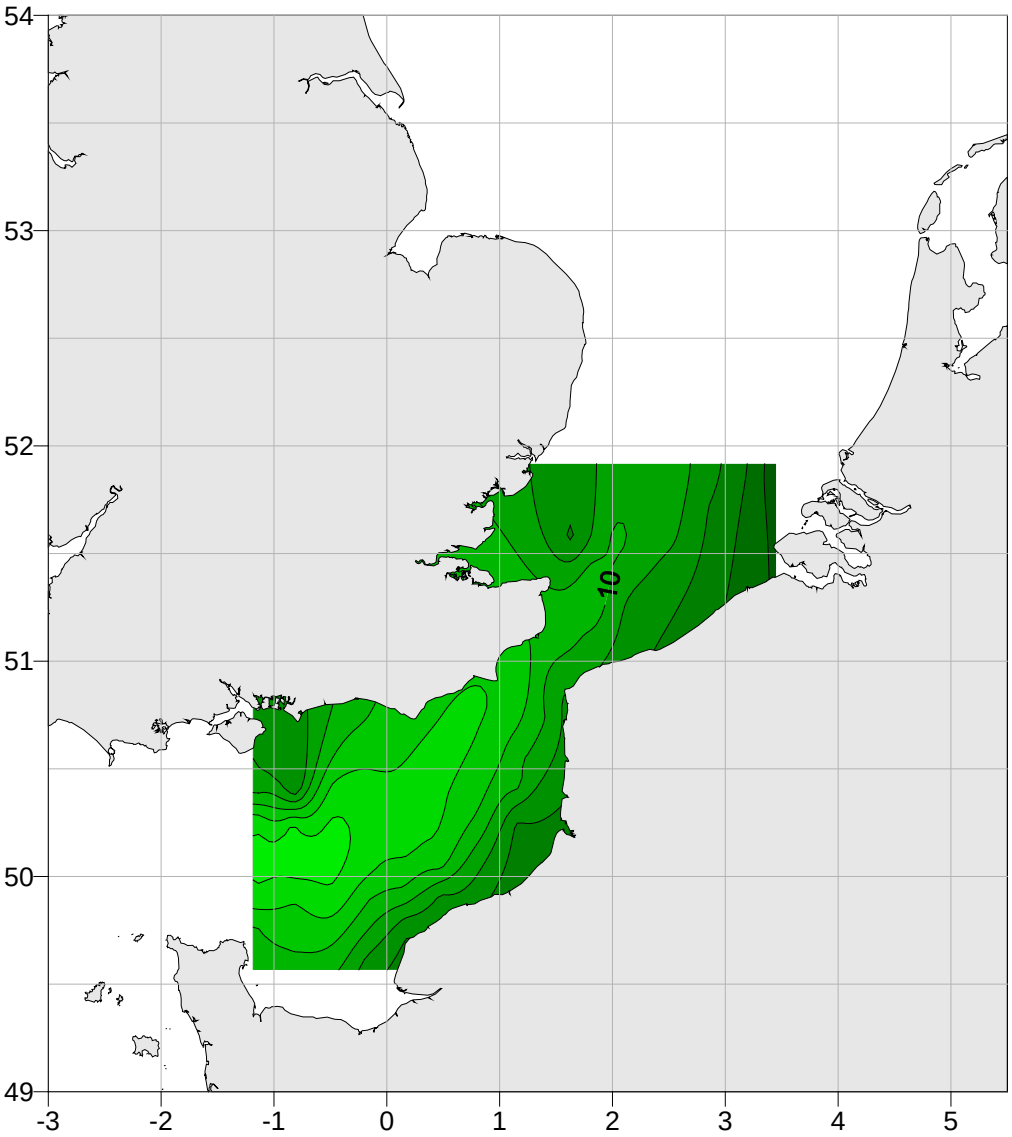


Figure 4.7. Bottom temperature during the December 2012 survey.

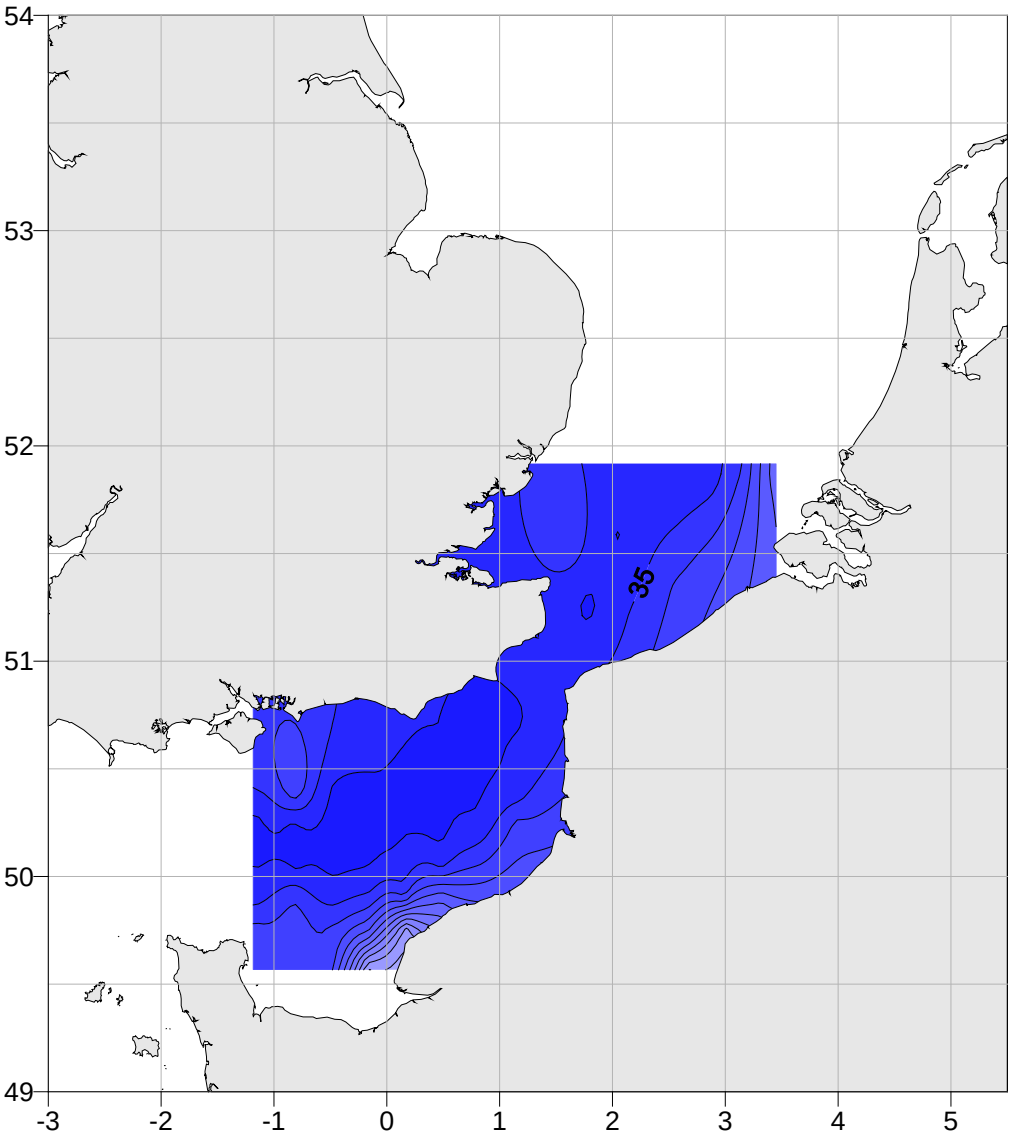


Figure 4.8. Bottom salinity during the December 2012 survey.

4.3 January survey

Date, time and harbours

From (harbour)	Date	Time (UTC)	To (harbour)	Date	Time (UTC)
Scheveningen	14-01-2013	12:30	Scheveningen	18-01-2013	09:00

Crew Kees Bakker (cruise leader)
Andre Dijkman-Dulkes

Guests Franziska Bils (Universiteit Hamburg)
Björn Illing (Universiteit Hamburg)

Deviations from the planned sampling grid

Of the 91 planned stations, 89 were sampled during the January survey (Figure 4.9). Given the predicted adverse weather conditions later in the week, is was decided at the start of the survey to change the route. It was decided to first sample the stations in the Strait of Dover and the Channel where highest numbers of larvae were expected. However, the predicted bad weather conditions did not appear and it was still possible to also sample most of the stations in the north of the sampling area.
Positions of some stations were slightly moved for nautical reasons, thus the sampling position of these stations was off the centre of the 1/9 ICES rectangle.

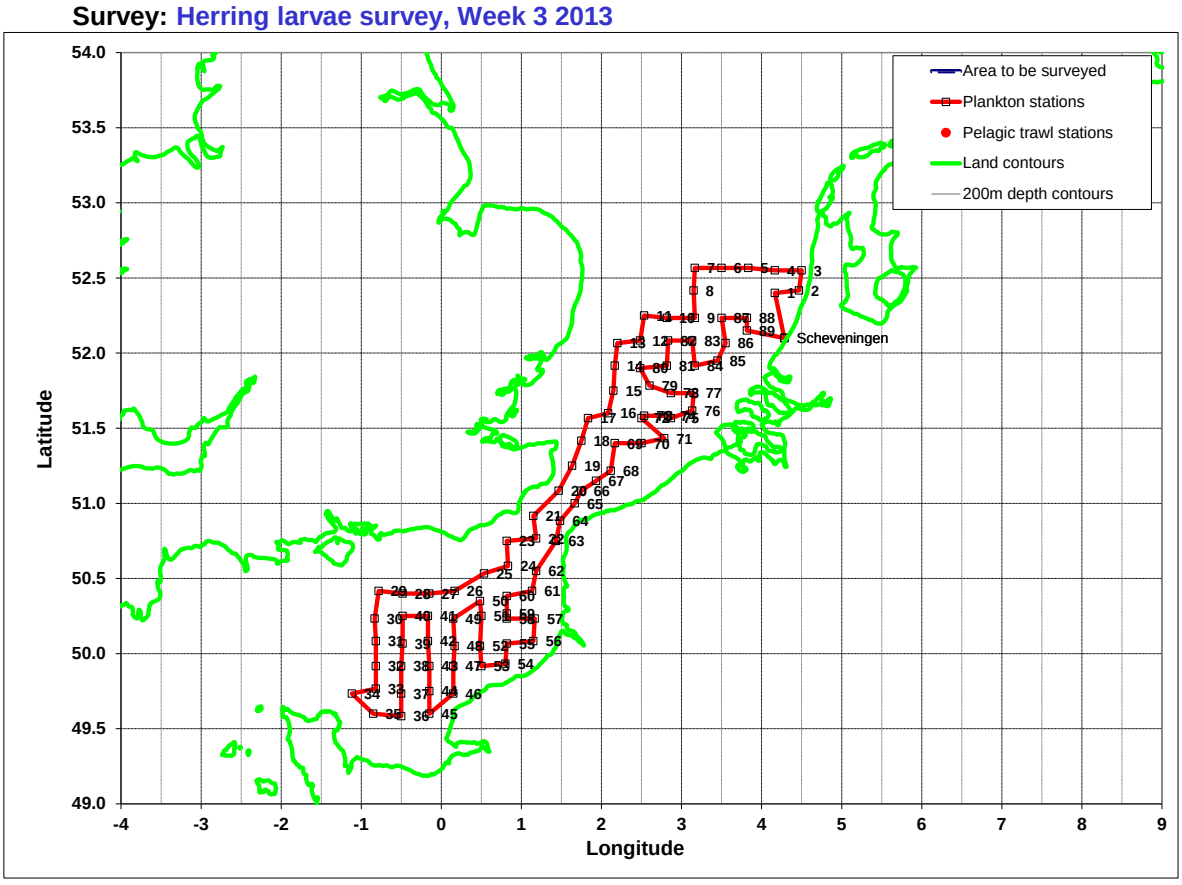


Figure 4.9. Stations sampled in January 2013.

Damage to sampling equipment
During the survey no damage was sustained to the sampling equipment.

Survey
On Monday 14 January 2013 12:30 (UTC) RV Tridens departed from the port of Scheveningen. After one hour steaming the first station was sampled at 13:45 (UTC). On 18 January at 00:15 (UTC) we sampled the last station.
For population research phyto- and zooplankton samples were collected at some stations and herring larvae were sorted out for feeding and DNA analyses.

Sample-id's
2013.5400001 t/m 2013.5400089

Samples and data
We sampled 89 stations with a Gulf VII plankton torpedo with a CTD mounted on top. At each station a double oblique haul was performed and minimum sampling time was 10 minutes.

Remarks
The slip rings sets of both torpedo winches which were replaced in January 2012 are performing well, since no malfunctions occurred this survey.
During 2013 the ships navigation routes in the Channel, Strait of Dover and Southern North Sea will be renewed. This will have consequences for the location of some of our sampling stations which will need to be taken into account when planning the December 2013 survey.

Numbers of herring larvae
Except for 3 stations herring larvae were found at all stations throughout the sampling area in January 2013. High abundances of herring larvae were found throughout the sampling area (Figure 4.10), and numbers were higher compared to 2012. Larvae both with and without yolk sac were caught in January, but numbers of yolk-sac larvae were low.
The bottom temperature and salinity in January 2013 were the similar to 2012 (Figure 4.11 & 4.12). The bottom temperature varied from 6.7 to 10.8°C in January 2013 and from 6.0 to 11.0°C in 2012.

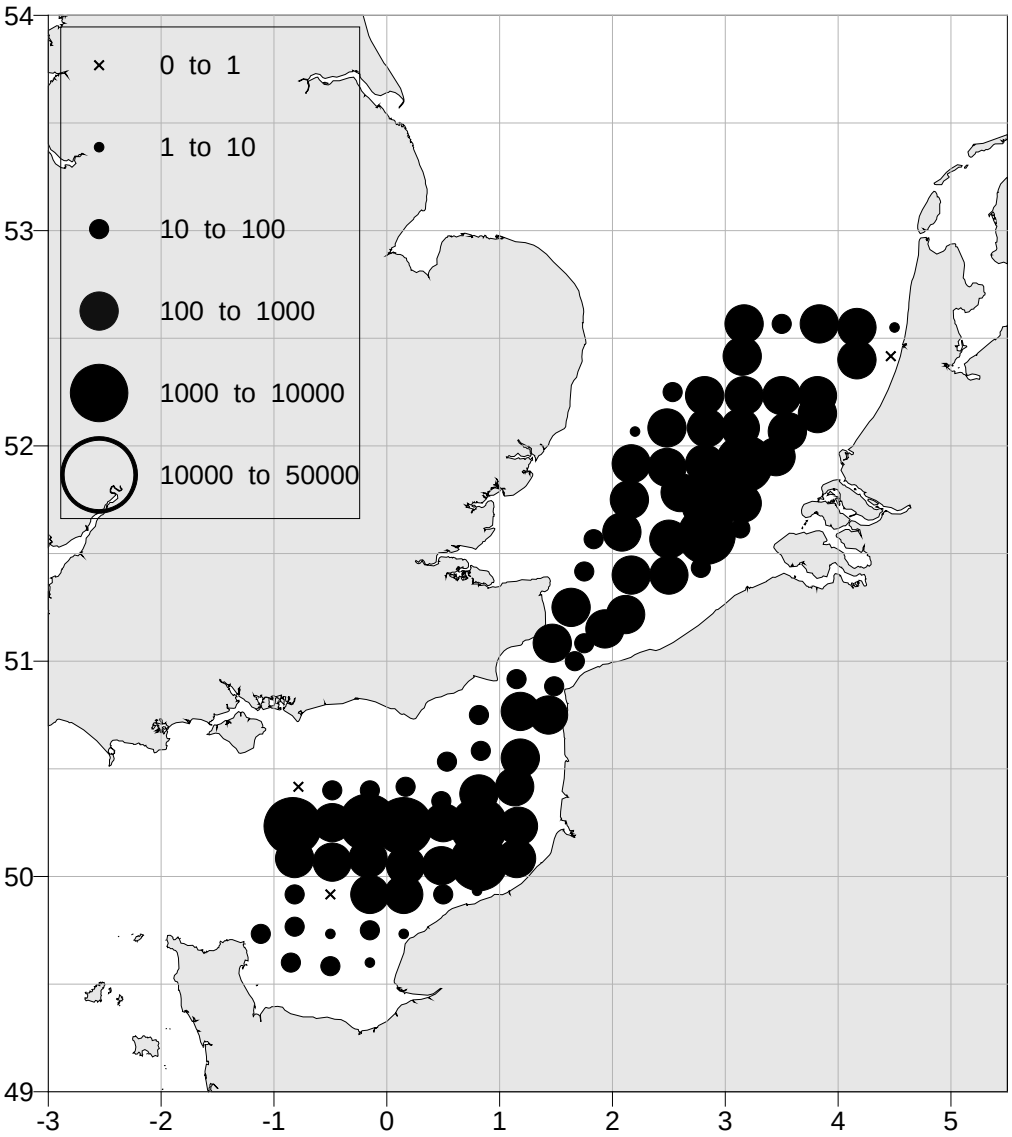


Figure 4.10. Numbers of larvae per m^2 caught during the January 2013 survey.

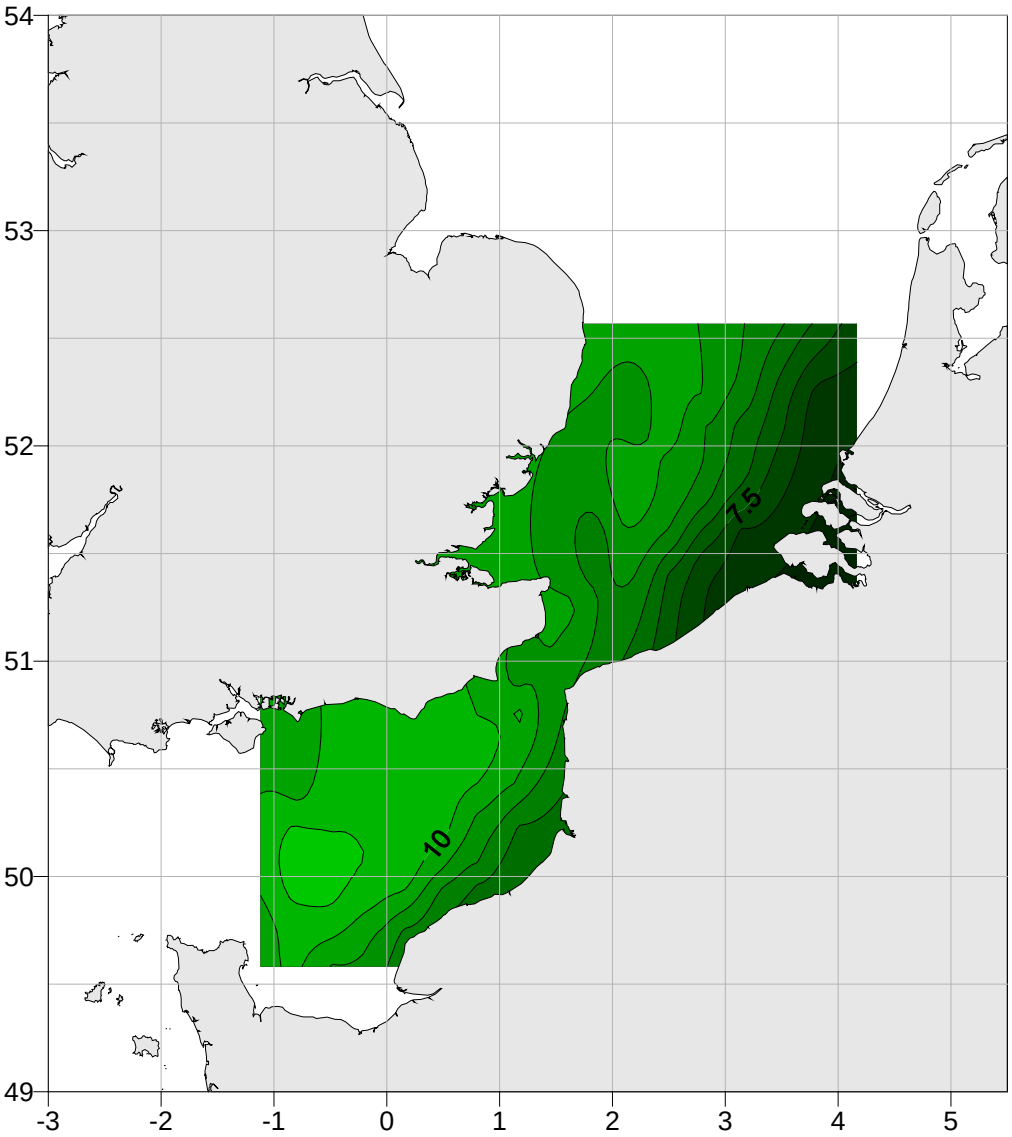


Figure 4.11. Bottom temperature during the January 2013 survey.

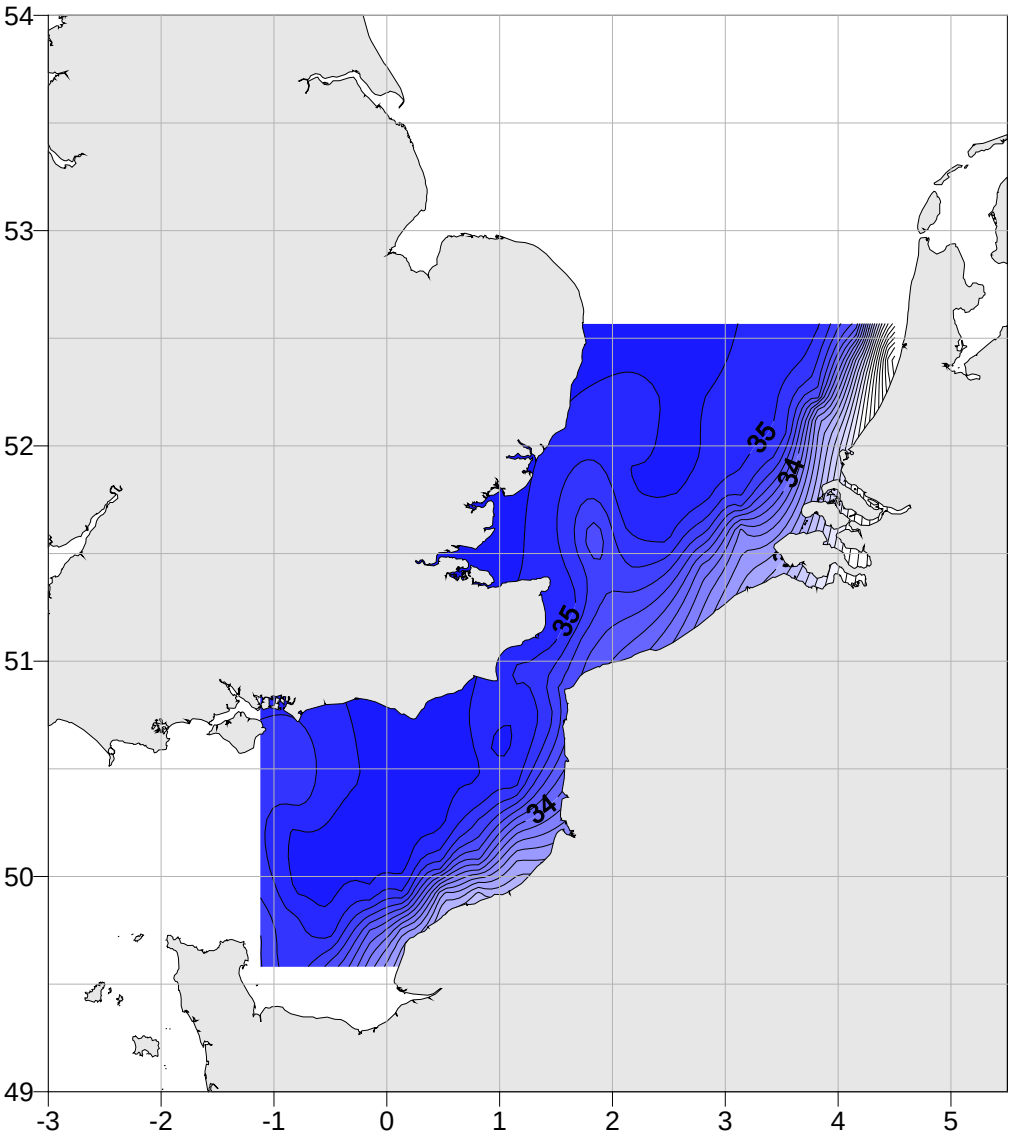


Figure 4.12. Bottom salinity during the January 2013 survey.

5. Conclusions

In 2012 the abundances of herring larvae caught in the Buchan area were similar in number and placement to those found in September 2011. In the Central North Sea on the other hand, larvae were only found at a few stations and numbers in this area were much lower compared to the previous year. Bottom temperature was more variable and generally higher in 2012, while salinity was the same as the previous survey in 2011.
The winter spawning 'Downs' herring component had a good spawning season. Abundances in both December 2012 and January 2013 were higher compared to the winter in 2011-2012. The high number of non-yolk sack larvae and the spread of the larvae at the northern stations in December suggests spawning and hatching were early this winter. Larvae were found at almost all stations in high numbers in January. The IBTS-MIK survey in February showed that herring were still spawning half of February and small newly hatched larvae were still caught in the MIK samples. This suggests that the herring spawning season in the English Channel and Southern North Sea did not only start earlier in 2012, but was also prolonged. Despite the changes seen in spawning, the temperature and salinity in December 2012 and January 2013 were the same as in the previous winter season.

The 2013 SCAI index is the highest in the time series (Figure 5.1; ICES 2013)

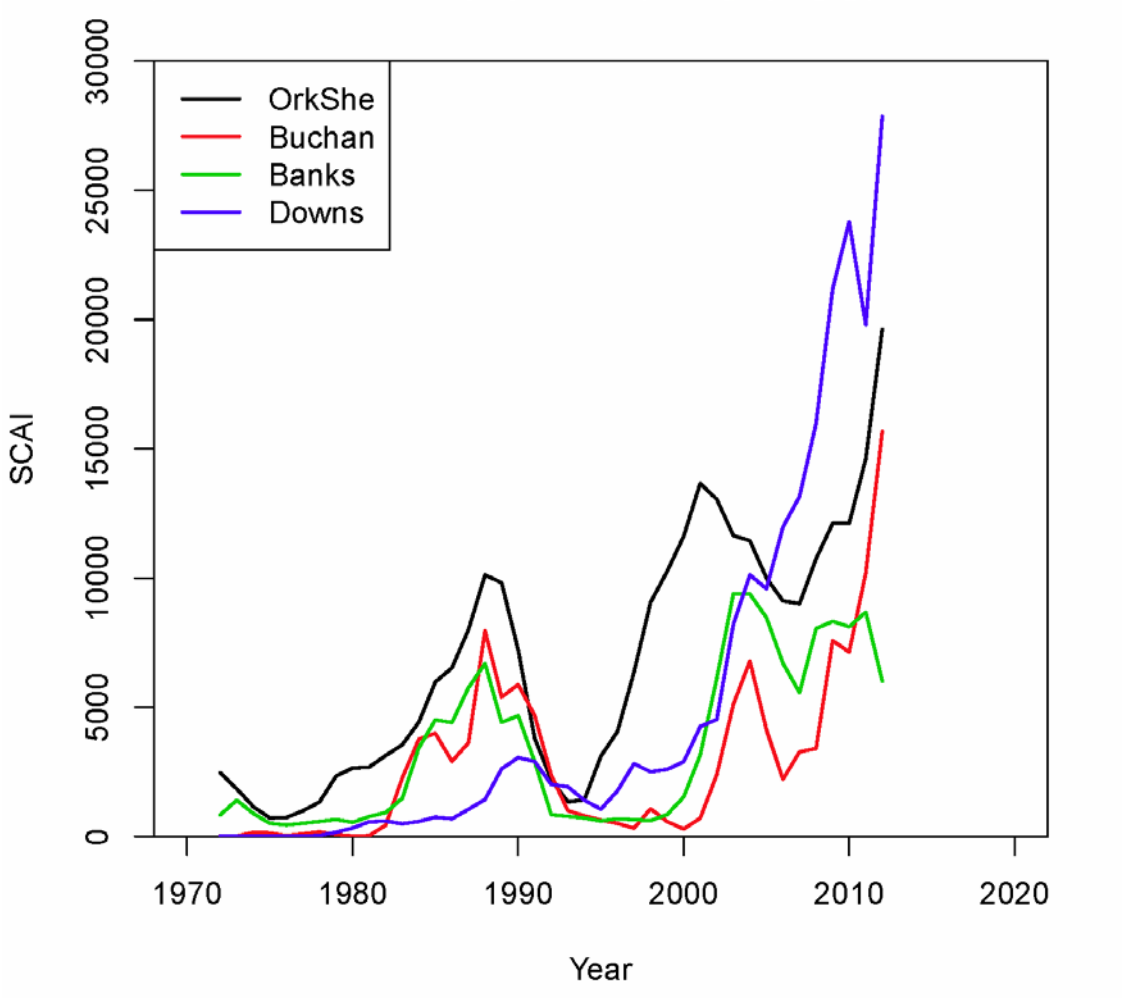


Figure 5.1. The time series of the SCAI index.

6. Quality Assurance

6.1 Check on the identification of the larvae

Following the protocols for the IMARES standard plankton surveys identification was checked (Damme *et al*. 2012).

On 28 September 2012 an internal workshop was organized for the quality control of the identification of the clupeid larvae. During the workshop 30 larvae were identified by all participants. The larvae were taken from the various herring larvae surveys in 2011 and 2012 and the MIK samples from 2012. The larvae were divided among the three plankton dissecting microscopes and every participant changed from one microscope to the other, thus possible differences between the microscopes did not influence the results of the workshop. Of each larva myotomes from the head to the anus and myotomes from the head to the tail are counted. On the basis of the number of myotomes the species of the larvae is determined and finally is the length of all the larvae measured. It is also considered whether a yolk sac was present or not.

Participants	**Expertise**
André Dijkman-Dulkes	Expert
Betty van Os-Koomen	Expert
Cindy van Damme	Intermediate
Ineke Pennock	Expert
Ruben Hoek	Expert

Results

Tables 6.1 to 6.3 give the overview of the results of the species identification of all larvae (Table 6.1), the larvae from the herring larvae survey samples (Table 6.2) and the larvae from the MIK-samples (Table 6.3). The original identification is the identification in the sample, hence not a validated identification. On the basis of the determination of all participants and the original determination, a modal species is determined, shown in table A is the numbers per species which each participant based on the modal species should have determined. In table B is the quantity per species which actually was determined is shown. Numbers in table A and B are not always the same, because larvae are damaged during the workshop and not every participant is able to identify each larvae. The total columns at the end of table A and B are shown for information for the overall estimations of over-/underestimation and agreement. Table C shows the over-or underestimation for each participant and finally table D shows the agreement in identification by species. No validated larvae were available for this workshop so the results only show the agreement and differences among the participants, including the original identification.

Table 6.1. Species identification of all larvae.

Table 6.1 Larvae identification Workshop, IJmuiden, 28 September 2012
Results of all larvae

A **Species compositions using modal/actual species**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	TOTAL
Herring	1	15	15	15	15	15	15	90
Pilchard	2	5	5	5	5	5	5	30
Sprat	3	4	4	4	4	4	4	24
Sandeel	4	1	1	1	1	1	1	6
Goby	5	1	1	1	1	1	1	6
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	1	1	1	1	1	1	6
Other	8	3	3	3	3	3	3	18
Total	1-8	30	30	30	30	30	30	180

B **Species compositions as estimated per participant and whole group**

	Species	Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	TOTAL
Herring	1	15	14	13	12	14	13	81
Pilchard	2	6	4	7	5	5	5	32
Sprat	3	4	5	4	5	5	6	29
Sandeel	4	1	1	1	1	1	1	6
Goby	5	2	2	1	3	1	1	10
Roundfish	6	0	0	0	0	0	0	-
Flatfish	7	1	2	1	1	1	1	7
Other	8	1	1	2	3	3	3	13
Total	1-8	30	29	29	30	30	30	178

C **Percentage overestimation / underestimation**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	ALL
Herring	1	0%	-7%	-13%	-20%	-7%	-13%	-10%
Pilchard	2	20%	-20%	40%	0%	0%	0%	7%
Sprat	3	0%	25%	0%	25%	25%	50%	21%
Sandeel	4	0%	0%	0%	0%	0%	0%	0%
Goby	5	100%	100%	0%	200%	0%	0%	67%
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	0%	100%	0%	0%	0%	0%	17%
Unknown	8	-67%	-67%	-33%	0%	0%	0%	-28%

D **Percentage agreement in species identification per species**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	ALL
Herring	1	87%	87%	87%	80%	93%	87%	87%
Pilchard	2	80%	60%	100%	40%	80%	100%	77%
Sprat	3	100%	100%	100%	100%	100%	100%	100%
Sandeel	4	100%	100%	100%	100%	100%	100%	100%
Goby	5	100%	100%	100%	100%	100%	100%	100%
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	100%	100%	100%	100%	100%	100%	100%
Unknown	8	33%	33%	67%	100%	100%	100%	72%
Weighted mean	1-8	83.3%	80.0%	90.0%	80.0%	93.3%	93.3%	86.7%
		4	5	3	5	1	1	

Table 6.2. Species identification of larvae from the herring larvae surveys.

Table 6.2 Larvae identification Workshop, IJmuiden, 28 September 2012
Results of HELA larvae

A **Species compositions using modal/actual species**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	TOTAL
Herring	1	12	12	12	12	12	12	72
Pilchard	2	1	1	1	1	1	1	6
Sprat	3	4	4	4	4	4	4	24
Sandeel	4	1	1	1	1	1	1	6
Goby	5	1	1	1	1	1	1	6
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	1	1	1	1	1	1	6
Unknown	8	3	3	3	3	3	3	18
Total	1-8	23	23	23	23	23	23	138

B **Species compositions as estimated per participant and whole group**

	Species	Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	TOTAL
Herring	1	11	11	10	11	11	10	64
Pilchard	2	3	1	3	1	2	1	11
Sprat	3	4	4	4	4	4	6	26
Sandeel	4	1	1	1	1	1	1	6
Goby	5	2	2	1	2	1	1	9
Roundfish	6	0	0	0	0	0	0	-
Flatfish	7	1	2	1	1	1	1	7
Unknown	8	1	1	2	3	3	3	13
Total	1-8	23	22	22	23	23	23	136

C **Percentage overestimation / underestimation**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	ALL
Herring	1	-8%	-8%	-17%	-8%	-8%	-17%	-11%
Pilchard	2	200%	0%	200%	0%	100%	0%	83%
Sprat	3	0%	0%	0%	0%	0%	50%	8%
Sandeel	4	0%	0%	0%	0%	0%	0%	0%
Goby	5	100%	100%	0%	100%	0%	0%	50%
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	0%	100%	0%	0%	0%	0%	17%
Unknown	8	-67%	-67%	-33%	0%	0%	0%	-28%

D **Percentage agreement in species identification per species**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	ALL
Herring	1	83%	92%	83%	92%	92%	83%	88%
Pilchard	2	100%	100%	100%	0%	100%	100%	83%
Sprat	3	100%	100%	100%	100%	100%	100%	100%
Sandeel	4	100%	100%	100%	100%	100%	100%	100%
Goby	5	100%	100%	100%	100%	100%	100%	100%
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	100%	100%	100%	100%	100%	100%	100%
Unknown	8	33%	33%	67%	100%	100%	100%	72%
Weighted mean	1-8	82.6%	87.0%	87.0%	91.3%	95.7%	91.3%	89.1%
		6	4	4	2	1	2	

Table 6.3. Species identification of larvae from the MIK samples.

Table 6.3 Larvae identification Workshop, IJmuiden, 28 September 2012
Results of MIK larvae

A **Species compositions using modal/actual species**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	TOTAL
Herring	1	4	4	4	4	4	4	24
Pilchard	2	4	4	4	4	4	4	24
Sprat	3	-	-	-	-	-	-	-
Sandeel	4	-	-	-	-	-	-	-
Goby	5	-	-	-	-	-	-	-
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	-	-	-	-	-	-	-
Unknown	8	-	-	-	-	-	-	-
Total	1-8	8	8	8	8	8	8	48

B **Species compositions as estimated per participant and whole group**

	Species	Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	TOTAL
Herring	1	5	4	3	1	4	3	20
Pilchard	2	3	3	5	5	3	4	23
Sprat	3	0	1	0	1	1	1	4
Sandeel	4	0	0	0	0	0	0	-
Goby	5	0	0	0	1	0	0	1
Roundfish	6	0	0	0	0	0	0	-
Flatfish	7	0	0	0	0	0	0	-
Unknown	8	0	0	0	0	0	0	-
Total	1-8	8	8	8	8	8	8	48

C **Percentage overestimation / underestimation**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	ALL
Herring	1	25%	0%	-25%	-75%	0%	-25%	-17%
Pilchard	2	-25%	-25%	25%	25%	-25%	0%	-4%
Sprat	3	-	-	-	-	-	-	-
Sandeel	4	-	-	-	-	-	-	-
Goby	5	-	-	-	-	-	-	-
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	-	-	-	-	-	-	-
Unknown	8	-	-	-	-	-	-	-

D **Percentage agreement in species identification per species**

Modal or actual species		Original	Reader 1	Reader 2	Reader 3	Reader 4	Reader 6	ALL
Herring	1	100%	75%	75%	25%	100%	75%	75%
Pilchard	2	75%	50%	100%	50%	75%	100%	75%
Sprat	3	-	-	-	-	-	-	-
Sandeel	4	-	-	-	-	-	-	-
Goby	5	-	-	-	-	-	-	-
Roundfish	6	-	-	-	-	-	-	-
Flatfish	7	-	-	-	-	-	-	-
Unknown	8	-	-	-	-	-	-	-
Weighted mean	1-8	87.5%	62.5%	87.5%	37.5%	87.5%	87.5%	75.0%
		1	5	1	6	1	1	

For all larvae there is an agreement in species determination of 87.0%, higher compared to 2011 (78.0%), with an agreement of 87, 100 and 77% for herring and sprat, sardine, respectively. For all species this was an improvement to the results of 2011. During the workshop in 2011 one beginner participated, this workshop no beginners participated. Yolk sac identification of all participants was correct during this workshop.

For the larvae of the herring larvae survey samples, there is an agreement of 88% for herring, 83% for sardine and for sprat 100%. Compared to 2011 this is also improvement for all species. For the MIK-samples the agreement for herring and sardine was lower compared to the herring larvae survey samples. For both herring and sardine agreement was 75%, which was a slight increase from 71% agreement for herring in 2011, but much higher compared to 43% in 2011 for sardine. No sprat larvae were available from the MIK samples during this workshop.

This year the quality of the larvae to identify during the workshop was good. These results suggest that there is a reasonable consensus in the identification of the herring and sardine, and agreement between the identifiers is improved, but the identification of sprat is still difficult. Like previous workshop, this workshop showed that the identification of the larger larvae from the MIK samples is more difficult, in comparison to the other larvae. The MIK sample larvae are larger and less transparent than the smaller larvae from the herring larvae survey samples; it is therefore more difficult to count the myotomes.

Table 6.4 shows the relative difference in the number of counted myotomes. First the modal number of myotomes per larva is determined and then the difference per participant in myotomes relative to this mode is estimated. The average values of the participants are low, but the STDEV is high. The values are comparable to 2011.

Table 6.4. Over/underestimation of the number of myotomes.

	Myotomes from head to anus						Myotomes from head to tail				
	Reader 1	Reader 2	Reader 3	Reader 4	Reader 5		Reader 1	Reader 2	Reader 3	Reader 4	Reader 5
Mean overall	-1	-1	1	-1	1		0	0	1	0	0
STDEV overall	1.69	1.98	1.75	1.31	1.10		1.52	1.47	2.20	1.54	2.01
Mean HELA	0	-1	1	0	1		0	0	0	0	0
STDEV HELA	1.19	2.46	1.07	0.85	1.16		0.76	1.51	1.21	0.98	0.97
Mean MIK	-1	-1	2	-1	0		0	0	3	0	1
STDEV MIK	3	1	3	2	1		2.61	1.09	2.39	2.36	0.78

Table 6.5 shows the over/underestimation of the length relative to the average length. Results are comparable with 2011.

Table 6.5. Over/underestimation the larvae length measurements.

	Length				
	Reader 1	Reader 2	Reader 3	Reader 4	Reader 5
Mean overall	0	0	0	0	0
STDEV overall	0.60	0.74	0.57	0.64	0.60
Mean HELA	0	0	0	0	0
STDEV HELA	0.45	0.83	0.52	0.64	0.62
Mean MIK	0	0	0	0	0
STDEV MIK	0.90	0.49	0.58	0.49	0.49

7. ISO

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2017 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

References

Ehrenbaum E (1909) Eier und Larven von Fischen. Lipsius & Tischer, Kiel und Leipzig.

Griffiths FB, Brown GH, Reid DD, Parker RR (1984) Estimation of sample zooplankton abundance from Folsom splitter sub-samples. Journal of Plankton Research 6(5): 721-731.

ICES (2013) Report of the Herring Assessment Working Group for the area South of 62 N (HAWG). ICES CM 2013/ACOM:06.

Munk P, Nielsen JG (2005) Eggs and larvae of North Sea fishes. Biofolia, Frederiksberg.

Nash RDM, Dickey-Collas M, Milligan SP (1998) Descriptions of the Gulf VII/PRO-NET and MAFF/Guildline unencased high-speed plankton samplers. J. Plankton Res. 20(10): 1915-1926.

Payne, M. R. 2010. Mind the gaps: a state-space model for analysing the dynamics of North Sea herring spawning components. ICES Journal of Marine Science, 67: 1939-1947.

Russell FS (1976) The Eggs and Planktonic Stages of British Marine Fishes, Academic Press, London.

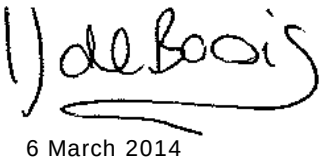
Smith PE, Richardson SL (1977) Standard techniques for pelagic fish egg and larval surveys. FAO Fisheries Technical Paper No 175.

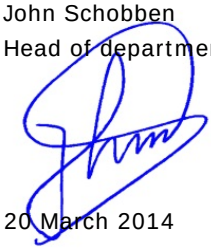
Van Damme C, Bakker K, Bolle L, De Boois I, Couperus B, Van Hal R, Heessen H, Hoek R, Fässler S (2012) Handboek bestandsopnamen en routinematige bemonsteringen op het water Versie 6, februari 2012. CVO report. Report No. CVO 12.003.

Justification

Report number : 14.001
Project number : 4301211052

The scientific quality of this report has been peer reviewed by a colleague scientist and the head of the department of IMARES.

Approved:	Ingeborg de Boois Project leader Surveys
Signature:	
Date:	6 March 2014

Approved:	John Schobben Head of department Fish
Signature:	
Date:	20 March 2014