Shortlist Masterplan Wind. Fish eggs and larvae in the southern North Sea: May 2010 cruise

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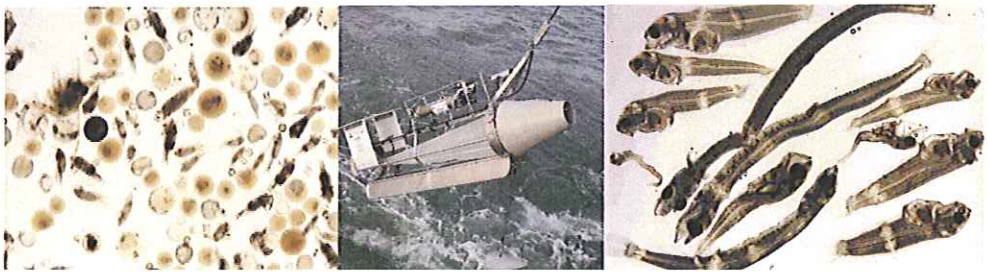
Report number C063/10



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Summary

During the second cruise we managed to sample 95 of the 96 planned stations within 5 24-hour days. During the week we experienced good weather and were able to gain high speeds between the sampling positions. It will probably not be possible to sample the station grid (almost) entirely within this time frame under bad weather conditions, or on board of another vessel with lower maximum speed.

Some technical problems were experienced during this first and second cruise, but these were solved before the second cruise and on board. It took a lot of time to set up the whole system on the 'MS Arca'. It is therefore advisable to conduct the next 10 cruises on either 'MS Arca' or 'RV Tridens', since it will again take a lot of time to get the system up and running properly on a new vessel.

We sorted out all samples on board for larvae. A few samples did not contain any fish larvae but most samples did, varying in numbers from a few to approximately 100. On board, eggs were sorted out in the first 73 samples and quality control for larval sorting was carried out in 61 samples. Contrary to the previous cruise, none of the egg samples were analysed (i.e. image analysis for species identifications and measurements) on board.

1 Introduction

1.1 Problem definition

Human activity in the North Sea is widespread. Fishing is ever present, shipping to and from the large seaports is increasing, and the network of drilling platforms and windmill farms is growing. Such activities result in a noticeable increase in unnatural disturbances of the marine environment, with undoubted consequences for the environment.

Knowledge about the spatial distribution and seasonal patterns in the appearance of the eggs and larvae of marine fish species can be used to determine to what extent the distribution of fish eggs and larvae overlaps with that of potential disturbances, and how detrimental activities may be mitigated. The available knowledge about the spatial and temporal distribution of eggs and larval fish in the North Sea is very limited. There is some information available regarding a number of commercial species, but for rare and non-commercial species, information is outdated or nonexistent (Teal et al. 2009).

Year-round monitoring of fish eggs and larvae on the Dutch Continental Shelf (NCP) will provide valuable information on the spatial and temporal distribution of the various species.

1.2 Background

Within the framework of the "Appropriate Assessment Dutch offshore wind farms", the effect of piling noise on the southern North Sea population of herring, sole, and plaice larvae was simulated (Prins et al. 2009). For this, an existing larval transport model (Bolle et al. 2005, 2009) was expanded with crude assumptions on larval mortality caused by pile driving. The model results were then - based on "expert-judgment" - extrapolated to other fish species and older life stages in an attempt to assess the effect of offshore piling on the prey availability for birds and marine mammals in (near-shore) Natura 2000 areas (Bos et al. 2009). This assessment, unfortunately, involved a large number of uncertainties related to knowledge gaps. Two of these knowledge gaps will be addressed in the research programme "Shortlist Masterplan Monitoring Wind Farms".

Firstly, little is known about mortality rates caused by the sound of pile driving or at what distance from the source mortality occurs. This knowledge gap is addressed in the project proposal "The effect of piling noise on the survival of fish larvae – pilot experiments" (Bolle et al. 2010).

Secondly, extrapolating the results of the modelling study to other species is hampered by the limited knowledge of the spatial and temporal distribution of fish eggs and larvae. Based on the results of the modelling study, a mitigating measure was installed: limitation of pile driving to summer and autumn (i.e. the period in which herring, sole, and plaice larvae are absent). However, in this period eggs and larvae of other fish species may be present on the NCP (e.g. whiting). It is therefore extremely important to map the spatial and temporal distribution of eggs and larvae for all fish species on the NCP. Existing knowledge has been collated in Teal et al. (2009). The present offer is for gathering new information by means of a year-round ichthyoplankton survey, which, unlike all previous ichthyoplankton surveys, will not focus on the spawning period of specific, commercially important species.

2 Aim of the project

The purpose of this project is to monitor the spatial distribution and seasonal patterns in the appearance of fish eggs and larvae on the NCP. To this end, a year-round survey will be carried out during which ichthyoplankton samples will be taken from the entire NCP and from the adjacent area south and west of the NCP.

3 Methods

3.1 Gear

The sampling of the fish eggs and larvae is carried out with a "High Speed Plankton Sampler Gulf VII" (Figure 3.1) with a plankton net with mesh size 280 µm. If clogging of the net occurs due to large amounts of phytoplankton the complete net is changed for one with a 500 µm mesh size. A small skrips-depressor of 25 kg is attached to the torpedo. The amount of water filtered during each haul is measured using an internal Valeport electronic flowmeter. On the frame an external flowmeter is also mounted, to check for blowing of the net due to large amounts of phyto- and microzooplankton in the water.

On top of the torpedo a Seabird 911plus CTD with a Benthos PSI 916 altimeter is mounted to monitor live view the depth of the torpedo in the water column and the bottom under the torpedo. The CTD also measures temperature and salinity.

Figure 3.1. Gulf VII plankton torpedo.

3.2 Fishing method

This survey is carried out on board the 'MS Arca' and the 'RV Tridens'. The speed during fishing with the plankton torpedo is 5 knots through the water. At each station a 'double oblique' haul is performed (Figure 3.2). To ensure that enough water is filtered, haul duration should be at least 10 minutes. At stations with low depth a double or multiple 'double oblique' is performed without the torpedo breaking the surface of the water.

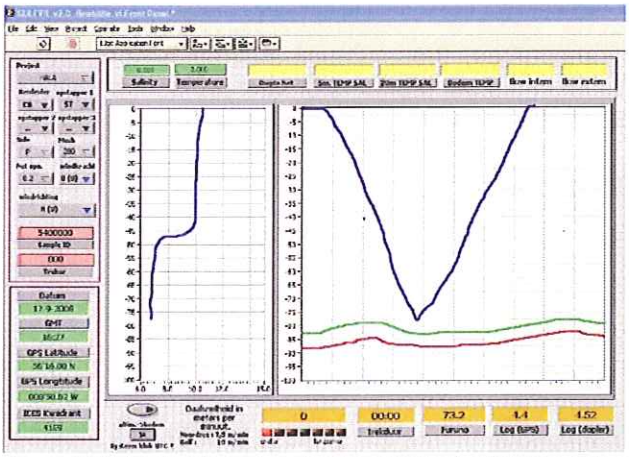

Figure 3.2. Illustration of a double oblique haul in the Labview program. The blue line in the right figure shows the depth profile of the torpedo.

3.3 Sampling grid

A sampling grid consisting of 3 stations per ICES rectangle is sampled (Figure 3.3). During the first survey the original sampling grid was fine-tuned based on nautical grounds (shipping lanes, sandbanks etc.). In principle this grid (Figure 3.3) will be sampled on all the next cruises, although a discussion is ongoing to reduce the time at sea and hence the sampling grid.

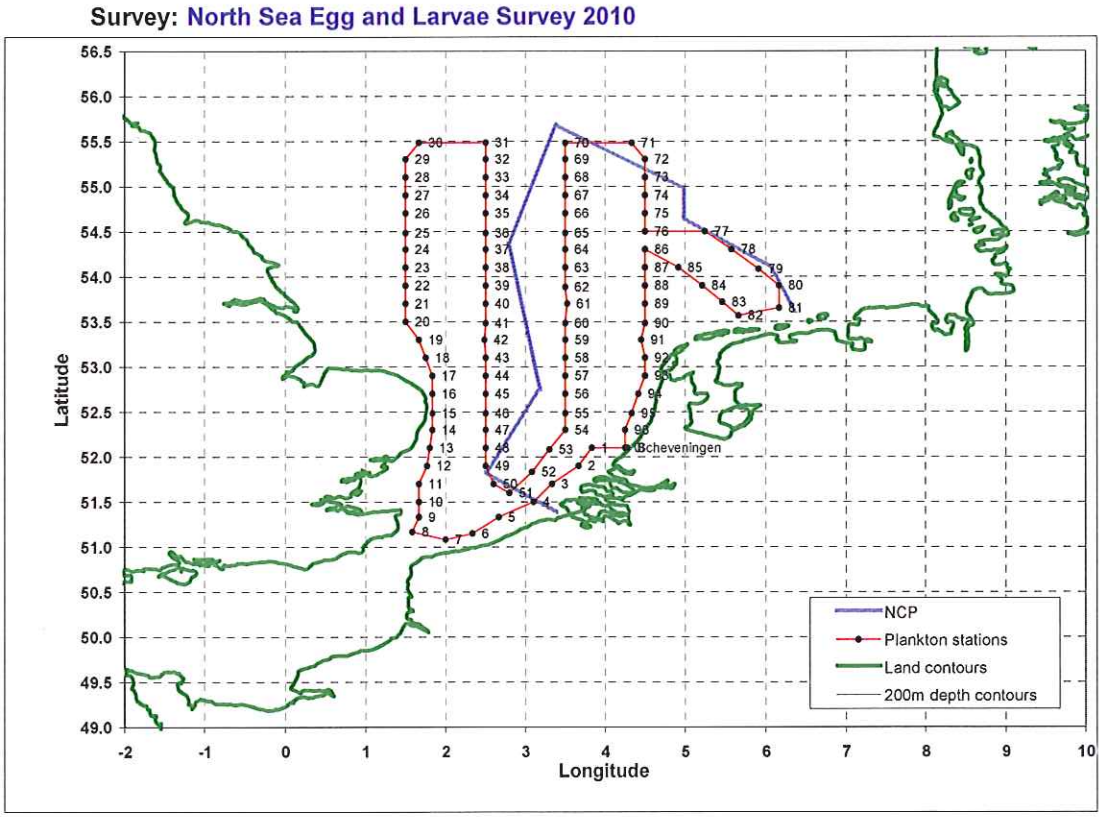

Figure 3.3. Sampling grid.

3.4 Workup of the samples on board

As soon as the torpedo is back on board the vessel, the sample (Figure 3.4) is brought to the lab facility on board of the vessel. All fish larvae are sorted out from the fresh sample (Figure 3.5) and put on 4% buffered formaldehyde. The remainder of the plankton is also fixated in 4% formaldehyde, but in a separate container.

Figure 3.4. The cod-end with the plankton sample.

Figure 3.5. Larvae from a plankton sample

After at least 24 hours of fixation, the fish eggs are separated from the other plankton using the 'spray method'. If the non-ichthyoplankton volume is very small and the sample contains many jellyfish (Ctenophora), it may be quicker to pick these out by hand.

If time permits the eggs will also be photographed and identified to species using image analysis.

3.5 Workup of the samples in the lab

As soon as possible upon return to the lab, the larvae samples are sent to the Polish Fisheries institute (Sea Fisheries Institute, ul. Kazimierza Królewicza 4-E, 71-550 Szczecin, Poland) for species identification and measurements.

It is impossible to sort out and analyse the eggs of all samples on board. This work will be continued in the lab. The analyses of the egg samples (species identification, stage identification, size measurements) is done using image analysis (Figure 3.6). If the sample contains hundreds of eggs, all eggs will be separated from the remaining plankton. Then the eggs will be sub-sampled using a 'Folsom' splitter. At least 100 eggs will be identified and measured in each sample.

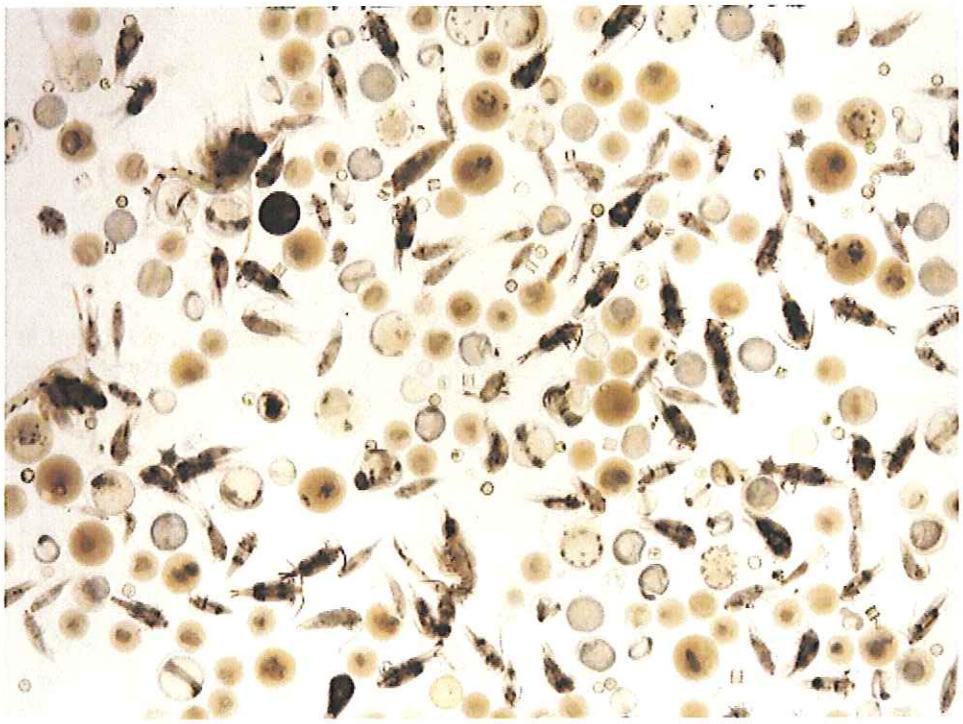

Figure 3.6. Eggs in a plankton sample.

For quality assurance sorting of the samples is checked. After the survey, 5 samples of each plankton-team (with different total amounts of plankton) are checked to see if larvae and eggs are properly sorted. If >5% of the total number of larvae or eggs is found in the check, then all samples of this team will be checked and catch numbers will be adjusted.

3.6 Calculation of the number of larvae and eggs

The total number of larvae and eggs in the water are calculated using the below formulae:

The numbers per square metre at each station can be 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:

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

4 Results

Date and time

From (harbour)	Date	Time (UTC)	To (harbour)	Date	Time (UTC)
Scheveningen	24-05-2010	6:00	Scheveningen	29-05-2010	7:00

Scientific crew

Kees Bakker (cruise leader)
Loes Bolle
Ruben Hoek
Betty van Os-Koomen
Mardik Leopold (birds and mammals)
Rob van Bemmelen (birds and mammals)
Peter de Boer (RWS)
Marcel de Vries (RWS)

Deviations from the sampling grid

All stations, except station 76 and 86, have been sampled according to the sampling grid presented in Figure 3.3. To compensate for the delay experienced on Thursday, the sampling grid was slightly adjusted; Station 76 was moved towards the east by 10' and station 86 was skipped (Figure 3.7).

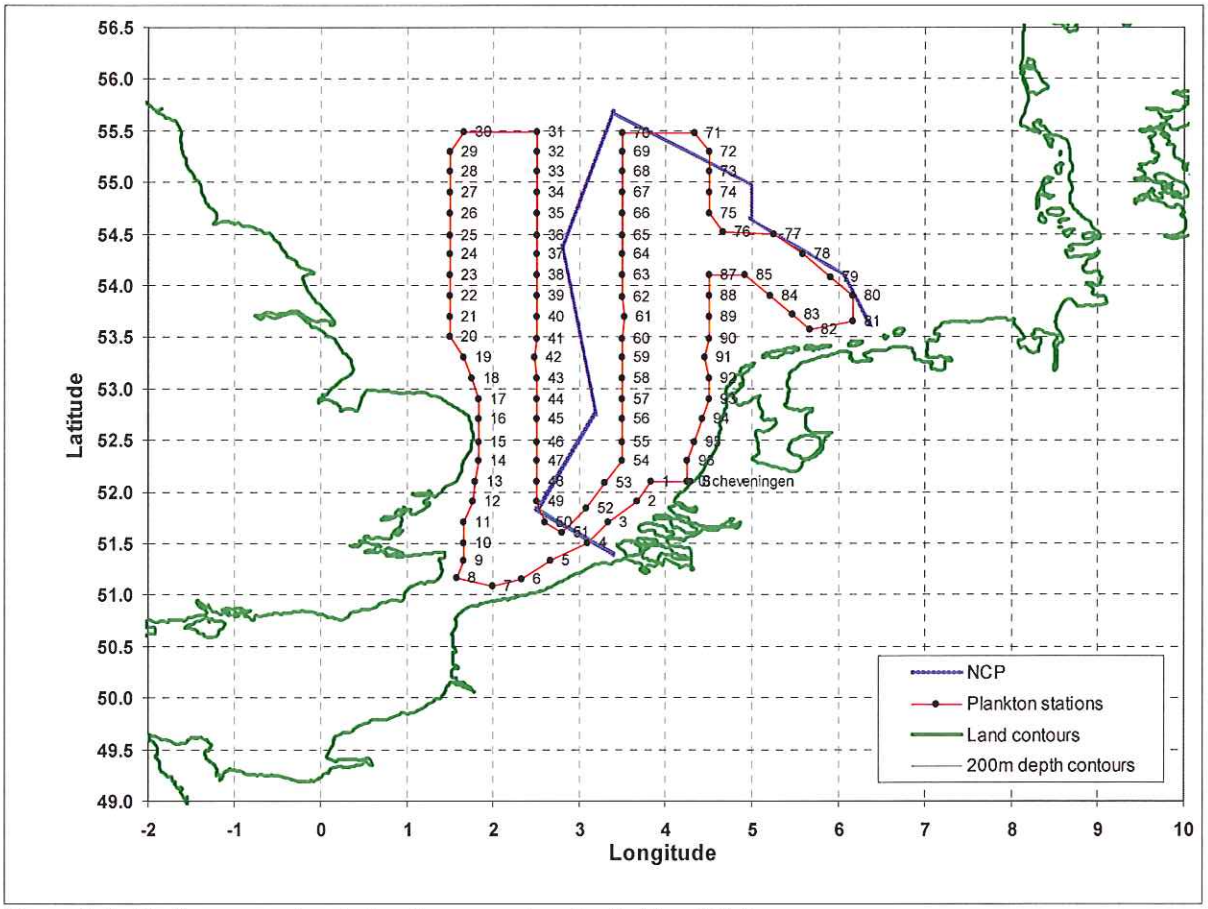

Figure 3.7. Stations samples during the second cruise in May 2010.

Damage to sampling equipment

In the week prior to the survey, all damage to the winch and cables, which had occurred during the first cruise, was repaired. The system was adapted to prevent similar disorders in the future: an additional cable for the earth was established between the winch and the deck unit.

The control of the winch malfunctioned during the first 24 hours, probably due to water leakage. This only affected the ease of controlling the speed of ascent/descent of the torpedo. The control was repaired on Tuesday.

Early Thursday morning (03.00) we lost the data signals from the torpedo, because the connection between the cable and the torpedo was damaged. It was repaired by 06.00. This connection is the weakest point between the torpedo and the deck unit and damage, due to wear and the great forces on the system, is inevitably encountered once in a while. Delay caused by damage to this connection could be limited if a second winch would be available. We might be able to borrow a winch from Rijkswaterstaat for the next cruises on the 'MS Arca'. This possibility will be explored. Two winches are available on the 'RV Tridens'.

Damage to the connection between the torpedo and the cable occurred again on Friday night at 24.00. This time the connection was repaired without waiting for the resin to harden out. We took this risk to limit the delay (to 25 min) and the connection held for the remainder of the stations.

Daily report

Monday 24-05-2010
'MS Arca' left Scheveningen harbour on Monday at 8:00 (ship time). At 09:00 we carried out the calibration of the flow-meters. The configuration of the flow-meters has not been changed since the previous survey, so these calibration values can be used for the previous survey as well. The first station was sampled at 10:27. Eleven hauls in total were done on the first day. The first 6 hauls contained large amounts of phytoplankton, almost clogging the net. However comparison of the internal and external flow-meter values showed that these hauls are valid. All hauls were done with the 500µm net. Using a smaller mesh size (280 µm) during this cruise is impossible, because of the large amounts of phytoplankton.
The control of the winch was not functioning as smoothly as it should. This was fixed on Tuesday morning.

Tuesday 25-05-2010
The last hauls yesterday and the first hauls today contained many Ctenophora. Hauls 18 - 28 contained very small amounts of plankton (total volume) and very few larvae. Note: this does not necessarily indicate low numbers of fish eggs. Hauls 29-31 were still small in volume but contained more phytoplankton. A total of 20 hauls was done. At 10.30 (ship time) we started sorting eggs in the first sample, i.e. after a 24 hour fixation period. A total of 7 samples were sorted on Tuesday. All these samples contained large amounts (±500 to >1000) of eggs.

Wednesday 26-05-2010
Today, stations 32-52 were sampled. Most samples were small in volume and contained few larvae. Exceptions were stations 49-52 (i.e. the stations closer to the Dutch coast). These samples contained large volumes of phytoplankton and substantial numbers of larvae. Samples 8-30 were sorted out for eggs. Due to the large amount of jellyfish and small amount of copepods, samples 8-14, 16-20 and 22-29 were sorted out entirely in stead of using the spray method (the spray method does not work well for samples with many jellyfish). All samples that have been sorted out entirely for eggs were simultaneously double-checked for sorting out of larvae.

Thursday 27-05-2010
Stations 53-70 were sampled on Thursday. Samples 53-56 contained large amounts of phytoplankton, although the volume decreased from station 53 to 56. Samples 57-60 were small in volume but still contained a large proportion phytoplankton. The stations further north contained very little phytoplankton. The numbers of larvae were relatively high on the southern stations (±25-100) and decreased on the stations further north to 0 larvae on stations 69-70. Samples 31-49 were sorted out for eggs. Samples 32-49, which were small in volume and often

contained many Ctenophora, were sorted out entirely (in stead of or after using the spray method). All samples that have been sorted out entirely for eggs were simultaneously double-checked for sorting out of larvae.
At 03.00 we lost the data signals from the torpedo, because the connection between the cable and the torpedo was damaged. It was repaired by 06.00.

Friday 28-05-2010
Stations 71-90 were sampled on Friday. Station 86 was dropped to compensate for the delay which occurred on Thursday. Again, phytoplankton contents increased with decreasing distance to the coast. Samples 50-73 were sorted out for eggs. Samples 50, 52-73 were sorted out entirely.
At midnight the data signals from the torpedo were lost again. This time the connection was repaired without waiting for the resin to harden out, limiting the delay to 25 min.

Saturday 29-05-2010
Stations 91-96 were sampled on Saturday. The last station was sampled at 07.26 (ship time), i.e. the same time as on the last survey. The samples were sorted out for larvae. No samples were sorted out for eggs because of the required minimum fixation period of 24 hours.
The 'MS Arca' moored in Scheveningen harbour, after unloading the samples and other materials, at approximately 09.00 (ship time).

Sample-id's

2010.5000101 t/m 2010.5000196

Samples and data

We sampled 95 stations with a Gulf VII plankton torpedo with a CTD mounted on top. One station (86) was sacrificed to compensate for the delay experienced on Thursday. At each station a double oblique haul was performed and minimum sampling time was 10 minutes.

Preliminary results

All samples were sorted for larvae on board. Numbers of larvae varied from 0 to approximately 100. Eleven samples contained 0 larvae (stations 20, 31, 33-36, 40-41, 44, 69-70). On board, the first 73 samples were sorted for eggs and all these samples contained eggs, varying from approximately 50 to well over 1000 eggs. Furthermore, 61 samples were double-checked for larvae, while sorting out the eggs.

During the first cruise, eggs were identified on board. This was not done during the second cruise as we had 1 crew member less and because the image analysis equipment was in use in the laboratory.

Overview of results to date (1 June 2010).

	cruise 1 (April)	cruise 2 (May)
Hauls	96	95
CTD profiles	96	95
Plankton samples	95	95
Larvae sorted out	95	95
QA larvae sorting	95	73
Eggs sorted out	96	73
QA egg sorting	15	10
Images	81	0
Egg identifications and measurements	55	0
Larvae identifications and measurements	0	0

5 Recommendations for the next cruises

1) We strongly recommend to employ either the 'MS Arca' or the 'RV Tridens' for this survey. The 'MS Zirfaea' is not good alternative because of the limited speed of this vessel. Furthermore, we have setup the system on the 'MS Arca'. This took three full days of preparation before the first cruise, and more work during and after the first cruise, to get the complete system up and running properly. We would therefore like to advise to use either the 'MS Arca' or the 'RV Tridens' (which has the same setup operational and an experienced crew).

2) During the first cruise with the 'MS Arca' (May 2010), we were able to sample the whole station grid between Monday morning (08.00) and Saturday morning (09.00). During the second cruise (June 2010) we were able to sample 95 of the 96 stations within the same time period. The weather conditions were good on both cruises. If the weather conditions are less favourable, it will not be possible to sample the whole grid on board the 'MS Arca' within this time period, which means that either the time at sea will be increased or the number of stations will be reduced.

3) We need to reach a definite agreement on (1) the estimated arrival time if no delays occur, and (2) the latest acceptable arrival time if delays occur. These restraints need to be quantified for both vessels (Arca and Tridens). The approach "sample until all stations are done" is not a workable approach in practice.

4) The uncertainty about the sampling grid, which arose shortly before and lasted until the very last moment before onset of the second cruise, was confusing for everybody involved. It is necessary to establish clarity about the sampling grid well before the third cruise (i.e. before 7 June).

5) On 19 May the possibility was raised to carry out the third cruise on board of the 'RV Tridens' in stead of the 'MS Arca'. This too is an issue which needs to be clarified well before the third cruise (i.e. before 7 June), because it will require adaptations in the preparations (e.g. permits, crew members). Furthermore, as far as we know, negotiations about the available time at sea in the case of the Tridens still have to take place.

6) We strongly recommend that one of the IMARES scientists acts as cruise leader. Confusion about this issue occurred during the second cruise. IMARES has the responsibility for the survey, not only with regard to the how the samples are worked up, but also with regard to the priority of the stations. It is therefore necessary that IMARES supplies the cruise leaders.

7) At present it is unclear if the RWS surveyors will join the cruises on board of the 'RV Tridens'. If they won't join the Tridens cruises then this will have consequences for the budget.

8) The overall cooperation with the crew of the 'MS Arca' and the 'RWS surveyors' was very pleasant. It would greatly facilitate the next cruises if the built-up expertise among the 'RWS surveyors' is used on the following cruises. We would therefore like to advise that the 'RWS surveyors', who joined the survey during the first or second cruise, are scheduled for the next cruises.

6 Quality Assurance

6.1 Check on the sorting of the samples

All participants in the survey are required to use the 'spray' technique on two samples with know numbers of eggs before going to sea.

For quality assurance sorting of the samples is checked. After the survey, 5 samples of each plankton-team (with different total amounts of plankton) are checked to see if eggs are properly sorted. If >5% of the total number of eggs is found in the check, then all samples of this team will be checked and catch numbers will be adjusted. All samples are double-checked for sorting of larvae. This is partly done on board (see section 4) and partly done in the laboratory.

6.2 ISO

IMARES utilises an ISO 9001:2000 certified quality management system (certificate number: 08602-2004-AQ-ROT-RvA). This certificate is valid until 15 March 2010. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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Justification

Rapport C063/10
Project Number: 430.250.15.01

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

Approved: Dr. Mark Dickey Collas

Signature: Mark Collas

Date: 2 June 2010

Approved: Drs. T. Bult
Head of Department Fisheries

Signature:

Date: 2 June 2010

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