

Mackerel Egg Survey, March 5th – 29th, 2010

by

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Abstract

Every three years the International Council for the Exploration of the Sea (ICES) coordinates a series of mackerel and horse mackerel egg surveys covering the eastern Atlantic from Gibraltar to the north coast of Scotland between January and July. The aim of this survey programme is to assess the northeastern Atlantic mackerel and horse mackerel stock. The Marine Institute participates in this programme and covers stations in the Celtic Sea. Plankton samples were collected at 105 stations, and the eggs they contained were preserved in 4% buffered formaldehyde. Preliminary analysis shows that egg numbers were concentrated close to the shelf edge, around the 200m contour line. Four fishing hauls were made to collect mackerel and horse mackerel samples for fecundity analysis. Samples were collected to ensure maximum temporal and geographical spread.

1 Introduction

Every three years the International Council for the Exploration of the Sea (ICES) coordinates a series of mackerel, *Scomber scombrus*, and horse mackerel, *Trachurus trachurus*, egg surveys covering the eastern Atlantic from Gibraltar to the north coast of Scotland between January and July. The aim of this survey programme is to estimate the spawning stock biomass of the northeastern Atlantic mackerel and horse mackerel stock. The Marine Institute participates in this programme and in this survey covered stations in the Celtic Sea.

This was one of twelve surveys covering the Celtic Sea, west of Ireland, west of Scotland, and Faeroese waters in the coming months. Five further surveys will target the Bay of Biscay and the Cantabrian Sea. This reflects the spawning area of both mackerel and horse mackerel. Preliminary results from onboard sample analysis of egg numbers are presented, but full laboratory analysis will be carried out in the coming months. The data will be submitted to the Working Group on Mackerel and Horse Mackerel Egg Surveys, WGMEGS, in March 2011. Preliminary data will be used by the Working Group on Widely Distributed stocks, WGWIDE, in August - September 2010.

2 Materials and Methods

2.1 Scientific Personnel

Name	Service area/Affiliation	Role
Helen McCormick	MI - FSS	Scientist-in-charge Leg 1
Selene Hoey	MI - FSS	Scientist-in-charge Leg 2
Marcin Blaszkowski	MI - FSS	Scientist Leg 1
Turloch Smith	MI - FSS	Scientist Leg 1
Sean O' Connor	MI - FSS	Scientist Leg 1
Kyle Sweeney	MI - FSS	Scientist Leg 1
Imelda Hehir	MI - FSS	Scientist Leg 2
Gráinne Ni Chonchuir	MI - FSS	Scientist Leg 2
Gráinne Ryan	MI - FSS	Scientist Leg 2
Dermot Fee	MI - FSS	Scientist Leg 2
Dave Wall	IWDG	Cetaceans Leg 1

2.2 Survey Plan

2.2.1 Area of operation

The survey was carried out in the Celtic Sea and Southwest of Ireland, from 48.75N to 51.75N, and from 6W to 17W. This covered ICES areas VIIg, VIIh, VIIj and VIIk, (Figure 1). Survey sites were at 0.5 degrees spacing, both latitudinally and longitudinally. The survey was adaptive, and while theoretical eastern and western limits were set, in practice the presence or absence of eggs dictated moving to the next transect. Two consecutive zero samples would lead to a transect change. Survey protocols called for the survey area to be sampled on alternate transects. The intervening transect could be sampled on the return leg.

For operational reasons the survey was split in two. Leg 1 was conducted on board the *Celtic Explorer* from March 5th to 17th. This leg targeted the southern transects of the sampling area, and also carried out all the fishing tows. Leg 2 was carried out on the *Celtic Voyager* from March 19th to 29th and concentrated on the two northern transects of the area.

2.2.2 Specific operations

Plankton Hauls

At each station the GULF VII plankton sampler was towed at four knots on a V-shaped profile. The GULF was deployed over the stern, using a winch with 11mm co-axial cable in an armoured sheath. The water column was sampled to within five metres of the bottom, or a maximum depth of 200m. Attached to the sampler was a real-time CTD and flowmeter system, (Pronet), which collected temperature and salinity data, and measured the volume of water filtered during the tow. Once back aboard the cod-end was removed, a second cod-end was attached and the plankton net was washed down. The cod-ends were then brought to the lab, and the plankton sample was washed out. The sample was preserved in 4% buffered formalin. It was examined under a microscope after an hour and any eggs and fish larvae were removed. A second examination of each sample took place after 36 hours. A count was kept of mackerel and horse mackerel stage 1 eggs, mackerel and horse mackerel eggs of later stages, and other fish eggs. Note was also taken of the volume of water sampled by the GULF during each haul, as well as the salinity at 20m, and the water temperature at 5m, 20m, 50m, 100m, and deepest temperature.

Fishing Hauls

As part of the survey samples of mature mackerel and horse mackerel were collected at various latitudes. Fishing sites were selected close to the 200m contour line (Figure 2). Hauls were made using a herring pelagic net. Sampling targets were 80 mackerel gonads of stage 3 - 6, and 30 horse mackerel samples from stages 3 - 5, over four weight categories. Three 25 μ l replicate samples were collected from one gonad of each fish, and stored in tubes containing 1.2ml of 3.6% buffered formalin. The second ovary was stored, undamaged, also in 3.6% buffered formalin. The sampling protocols for both species are attached in the appendix.

A sample of 10 mackerel stomachs were also collected from each fishing tow for Faeroese scientists. They wish to check if adult mackerel are major predators on Blue whiting eggs and larvae.

2.3 Equipment and system details and specifications

GULF VII plankton sampler

11mm armoured co-axial cable

Pro-net CTD and flow sensor

Pro-monitor CTD and flow sensor

Pelagic Herring net

Seabird 911 CTD

Simrad ER-60

2.4 Protocols used

The protocols for the plankton are listed in the 2009 WGMEGS report. The gonad sampling of the mackerel and horse mackerel are listed in the 2009 WGMEGS report, and in the appendix of this report.

3 Results

Plankton Hauls

A total of 105 hauls were carried out, over five transects, (Figure 1, Table 1). Leg 1 was scheduled to carry out four transects. However eggs were encountered outside the “core” sampling area. As the survey is adaptive sampling continued along the transects until two zero counts were recorded. Due to the increased distribution of the eggs it was only possible to sample three of these transects, comprising 64 stations. Egg numbers for the missing transect will be interpolated.

Leg 2 sampled the two northern transects and covered 41 stations. During Leg 2 it was also possible to resample six stations, close to the 200m contour line, within a short space of time. This will help with the variance estimate. Weather conditions encountered by the *Celtic Voyager* were difficult. It was also necessary to change over to the backup CTD system, the Pro-monitor, mid way through the cruise. This change had no impact on data collection.

All eggs and larvae were extracted from the plankton samples while at sea. The eggs were subsequently identified and staged in the laboratory ashore.

Mackerel stage 1 eggs were recorded at 70% of the stations, and were found mainly found on the three southern transect and close to the 200m contour line, (Figure 3). The highest station count was 1298 at station 73.

Horse mackerel were found at only 21% of stations and in very low numbers, (Figure 4). The highest number recorded was 13 at station 91. The eggs were mainly found on the southern transect and close to the 200m contour line on all other transects.

Fish Hauls

A total of four hauls were carried out. Mackerel and horse mackerel samples were collected from hauls 1, 3 and 4. In total 52 mackerel and 28 horse mackerel were sampled for fecundity and atresia.

It was only possible to fill the bottom three of the mackerel weight categories with samples well spread between the weights. Samples were collected for all four horse mackerel categories, but the majority of the samples were in the 151 – 250g group. There was only one fish in both the largest and smallest categories.

These samples will be analysed in the laboratory over the next few months.

4 Discussion and Conclusions

The survey was very successful. Despite the fact that the survey area increased five transects were sampled, which facilitated the interpolation of figures for the sixth transect. By carrying out all the fishing operations on the *Celtic Explorer* it meant that the *Celtic Voyager*, with its more limited space, could concentrate on plankton sampling.

Acknowledgements

Much appreciation is expressed to the skippers and crews of the *Celtic Explorer* and *Celtic Voyager*. Their many skills kept the survey functioning. Thanks are also expressed to the scientists who worked on the survey.

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ICES, 2010. Report of the working group on mackerel and horse mackerel egg surveys. ICES CM 2010/SSGESST:02

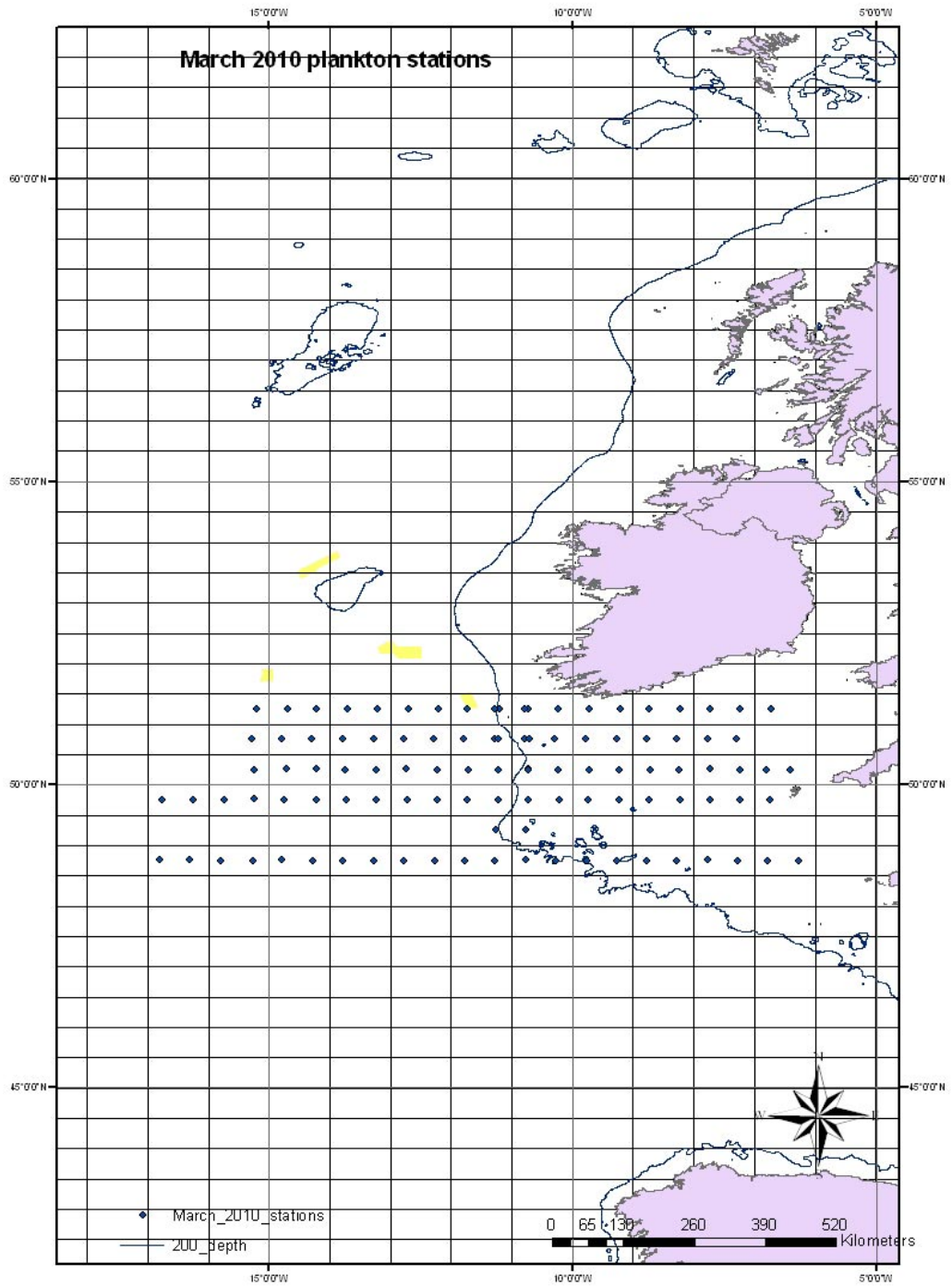


Figure 1 Survey plankton stations.

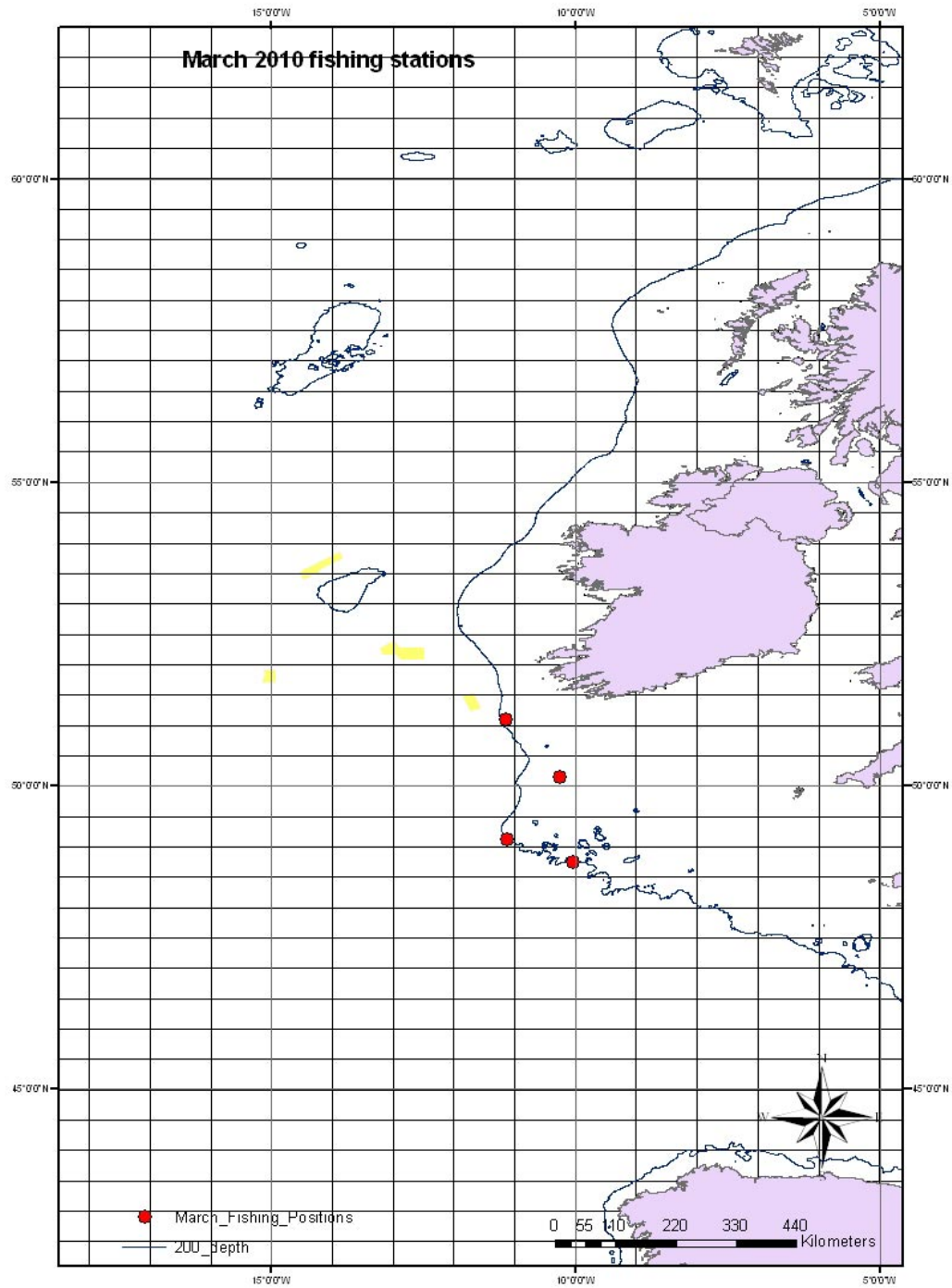


Figure 2 Fishing sites

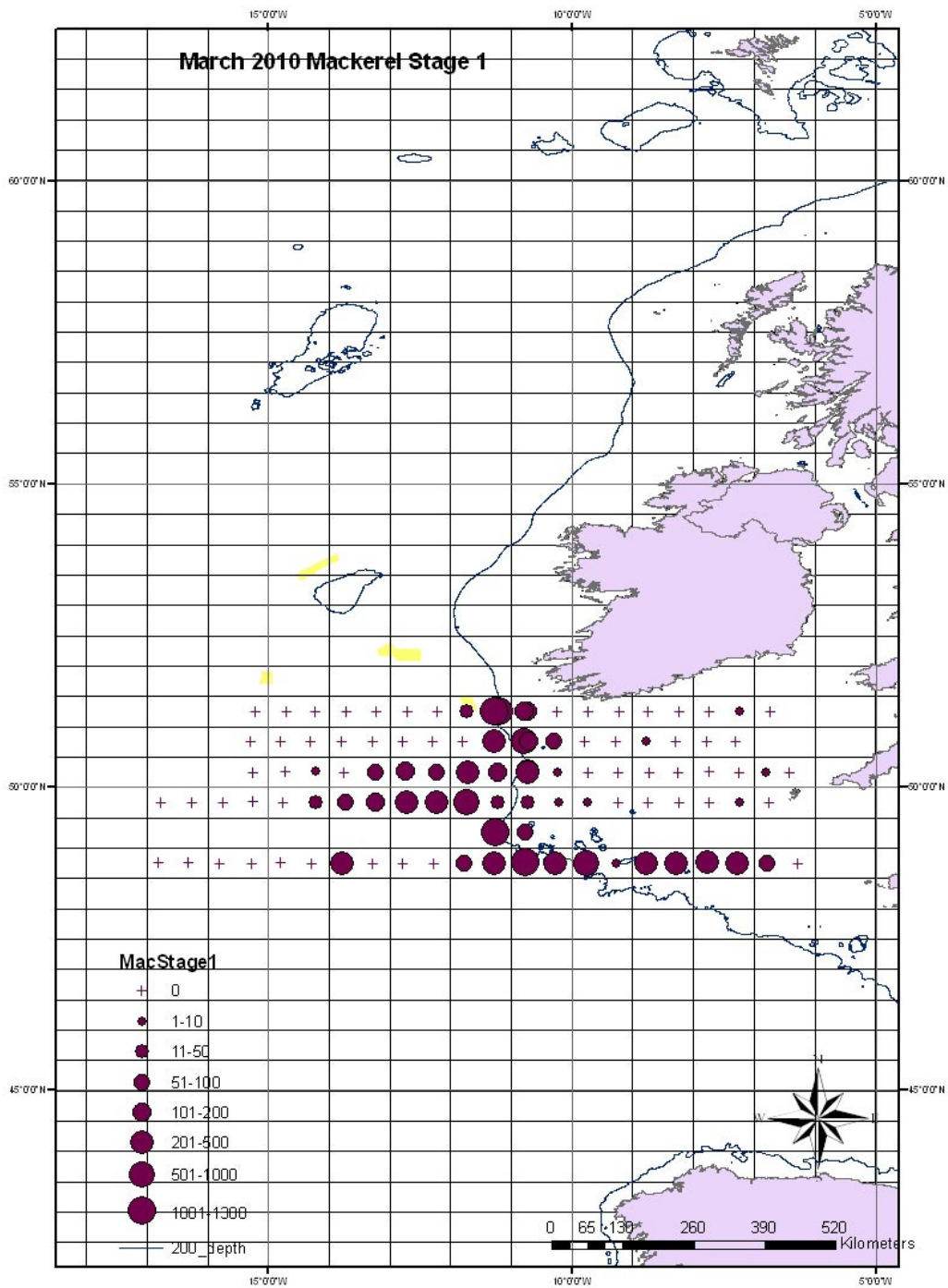


Figure 3 Numbers of Stage 1 mackerel eggs.

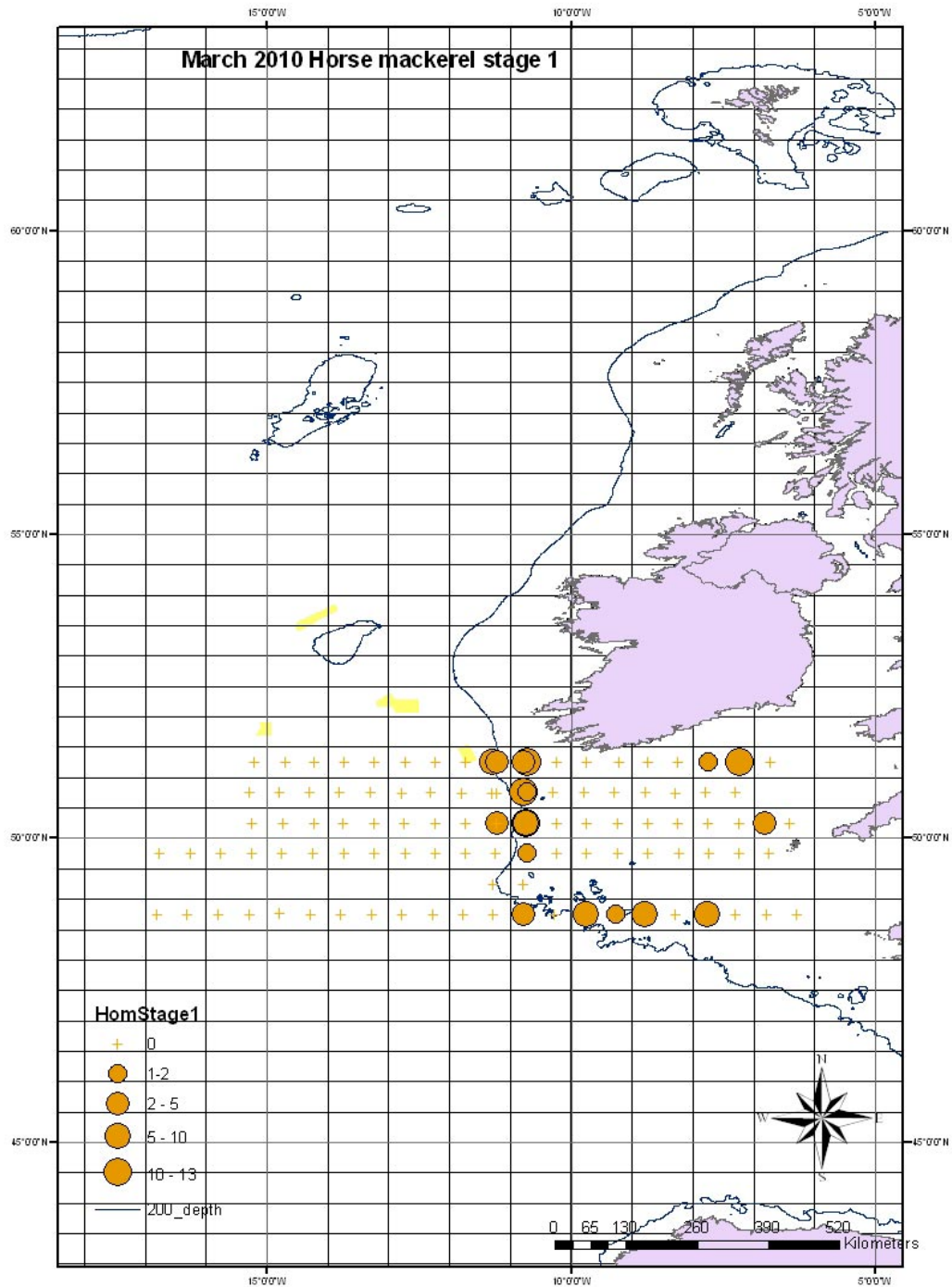


Figure 4 Numbers of Stage 1 horse mackerel eggs.

Table 1 Plankton stations and associated Stage 1 egg numbers.

Haul no	Date	Time Start	Latitude	Longitude	Sample Depth Metres	Mac 1a	HOM 1a
1	08/03/2010	06:40	49.7523	-6.7375	95		
2	08/03/2010	09:34	49.7510	-7.2342	112	11	
3	08/03/2010	11:46	49.7492	-7.7243	127	5	
4	08/03/2010	13:50	49.7518	-8.2202	128	2	
5	08/03/2010	16:02	49.7508	-8.7247	93	4	
6	08/03/2010	18:09	49.7490	-9.2232	135	4	
7	08/03/2010	20:28	49.7515	-9.7388	136	12	
8	08/03/2010	22:44	49.7498	-10.2170	136	12	
9	09/03/2010	01:02	49.7510	-10.7263	151	35	2
10	09/03/2010	03:16	49.7510	-11.2270	200	23	
11	09/03/2010	05:41	49.7500	-11.7280	200	465	
12	09/03/2010	08:05	49.7518	-12.2220	201	167	
13	09/03/2010	10:29	49.7498	-12.7195	200	258	
14	09/03/2010	12:52	49.7498	-13.2290	200	76	
15	09/03/2010	15:18	49.7510	-13.7283	200	40	
16	09/03/2010	17:43	49.7527	-14.2260	201	25	
17	09/03/2010	20:11	49.7565	-14.7437	201	2	
18	09/03/2010	22:40	49.7590	-15.2357	197		
19	10/03/2010	01:15	49.7498	-15.7465	200		
20	10/03/2010	05:22	49.7435	-16.2543	201		
21	10/03/2010	07:48	49.7457	-16.7652	200		
22	10/03/2010	16:03	48.7533	-16.8068	200		
23	10/03/2010	18:45	48.7535	-16.3053	200		
24	10/03/2010	21:39	48.7495	-15.7920	201		
25	11/03/2010	00:19	48.7478	-15.2695	201	2	
26	11/03/2010	03:01	48.7637	-14.7840	200		
27	11/03/2010	05:47	48.7508	-14.2762	200		
28	11/03/2010	08:32	48.7505	-13.7758	200	199	
29	11/03/2010	11:14	48.7497	-13.2715	200		
30	11/03/2010	13:38	48.7493	-12.7725	199		
31	11/03/2010	16:03	48.7503	-12.2665	201	1	
32	11/03/2010	18:19	48.7502	-11.7745	201	43	
33	11/03/2010	20:37	48.7415	-11.2722	202	263	
34	12/03/2010	01:42	49.2498	-11.2638	202	825	
35	12/03/2010	03:48	49.2495	-10.7730	155	48	
36	12/03/2010	06:41	48.7527	-10.7737	201	877	4
37	12/03/2010	09:06	48.7505	-10.2752	153	214	
38	12/03/2010	12:50	48.7513	-9.7617	175	357	6
39	12/03/2010	14:45	48.7507	-9.2688	161	17	3
40	12/03/2010	16:42	48.7502	-8.7795	165	277	7
41	12/03/2010	20:45	48.7498	-8.2755	135	312	
42	12/03/2010	22:59	48.7523	-7.7678	150	217	6
43	13/03/2010	01:05	48.7485	-7.2790	133	199	1
44	13/03/2010	03:04	48.7502	-6.7792	135	52	

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45	13/03/2010	05:05	48.7497	-6.2753	129		
46	13/03/2010	16:29	50.2492	-6.3973	92	5	
47	13/03/2010	18:24	50.2493	-6.8067	100	11	4
48	13/03/2010	20:11	50.2495	-7.2260	105	1	
49	13/03/2010	22:14	50.2515	-7.7315	95	1	
50	14/03/2010	00:20	50.2502	-8.2333	121	2	
51	14/03/2010	02:30	50.2507	-8.7232	125	1	
52	14/03/2010	04:45	50.2507	-9.2260	133	3	
53	14/03/2010	07:01	50.2497	-9.7277	122	5	
54	14/03/2010	09:06	50.2498	-10.2238	130	10	
55	14/03/2010	13:49	50.2527	-10.7315	177	217	7
56	14/03/2010	16:16	50.2492	-11.2210	200	130	4
57	14/03/2010	18:34	50.2508	-11.7227	200	296	1
58	14/03/2010	20:52	50.2507	-12.2218	200	43	
59	14/03/2010	23:14	50.2523	-12.7305	200	84	
60	15/03/2010	00:38	50.2503	-13.2233	195	38	
61	15/03/2010	04:01	50.2498	-13.7378	200	4	
62	15/03/2010	06:13	50.2530	-14.2208	201	9	
63	15/03/2010	08:35	50.2520	-14.7190	200		
64	15/03/2010	11:05	50.2492	-15.2377	200		
65	20/03/2010	23:13	51.2543	-7.2327	80	14	10
66	21/03/2010	01:41	51.2498	-7.7355	86	2	3
67	21/03/2010	04:20	51.2507	-8.2287	90		
68	21/03/2010	06:21	51.2512	-8.7295	95		
69	21/03/2010	09:00	51.2498	-9.2077	99		1
70	21/03/2010	11:30	51.2490	-9.7290	96	2	
71	21/03/2010	13:52	51.2507	-10.2315	85	1	
72	21/03/2010	16:15	51.2508	-10.7262	162	113	11
73	22/03/2010	17:32	51.2508	-11.2040	193	1298	5
74	22/03/2010	20:28	51.2518	-11.7238	200	31	
75	23/03/2010	01:18	51.2510	-12.2160	201		
76	23/03/2010	10:54	51.2497	-12.7050	200	1	
77	23/03/2010	13:45	51.2493	-13.2218	200		
78	23/03/2010	16:27	51.2508	-13.7112	200	4	
79	23/03/2010	19:14	51.2498	-14.2140	201	1	
80	23/03/2010	21:54	51.2468	-14.6827	200		
81	24/03/2010	00:47	51.2502	-15.1982	201		
82	24/03/2010	06:36	50.7512	-15.2862	201		
83	24/03/2010	10:41	50.7507	-14.7852	201		
84	24/03/2010	13:12	50.7503	-14.3007	197		
85	24/03/2010	15:45	50.7505	-13.7900	200	1	
86	24/03/2010	18:30	50.7527	-13.2813	201		
87	24/03/2010	21:25	50.7490	-12.7773	201		
88	25/03/2010	00:55	50.7515	-12.2938	198		
89	25/03/2010	04:29	50.7497	-11.7863	201		
90	25/03/2010	07:59	50.7495	-11.2838	201	178	
91	25/03/2010	12:02	50.7505	-10.7827	166	445	13
92	25/03/2010	15:26	50.7508	-10.2887	131	44	1
93	25/03/2010	18:50	50.7500	-9.7803	104		
94	25/03/2010	21:51	50.7500	-9.2727	117	2	

95	26/03/2010	01:22	50.7517	-8.7730	101	7	
96	26/03/2010	04:57	50.7492	-8.2770	106		
97	26/03/2010	08:22	50.7505	-7.7762	100	3	
98	26/03/2010	11:41	50.7500	-7.2850	96	6	
99	26/03/2010	16:28	51.2495	-6.7222	80	1	
100	27/03/2010	11:11	50.7630	-10.7128	161	92	2
101	27/03/2010	15:06	50.2497	-10.7298	166	175	10
102	27/03/2010	17:46	50.2497	-11.2132	201	5	
103	27/03/2010	22:10	50.7473	-11.2113	201		
104	28/03/2010	03:26	51.2498	-11.2830	191	919	6
105	28/03/2010	05:58	51.2502	-10.7810	161	82	4

Horse mackerel sampling procedure at sea

Before the cruise:

Fill the labelled 2.5 ml eppendorf tubes with 1,2 ml of 3,6% buffered (sodium phosphate) formaldehyde

During the cruise:

Measure the weight of the whole catch and select a subsample of 100 fish and measure the total weight of the subsample.

Measure total length, weight, maturity (Walsh scale) and sex of each fish in the subsample.

Select females in maturity stages 3-5 (see table 3.1.2 WGMEGS 2006) from the subsample for fecundity analysis. Be sure to divide the females equally into the 4 weight categories: < 150g, 151-250g, 251-350g and >351g. If the size range of fish is restricted in the catch the remaining sample quota should be taken from the more abundant classes to fill the weight classes.

Measure or take:

- Total length
- Total weight
- Maturity
- Otoliths for age reading
- Weight of gut, ovary and liver. (if it is not possible to take these weights at sea, take the pipette and atresia samples and fix the remainder of the ovary. Subsequently weigh the ovary in the lab. Gut and liver should also be frozen and weighed in the lab. The fixed and frozen weights should be corrected to fresh weights.)

Ovary sampling:

- From the ovary take 3 * 25µl samples with a pipette and immediately put each sample in individual coded eppendorf tubes.
- Make sure that all the ovary samples are covered with formaldehyde.

After the cruise :

Send the eppendorf samples for analysis to the different institutes referred to in table 1.

Colour code	Country	Institute and address	Responsible person
Blue	Norway	IMR, Nordnesgaten 50,PB 1870, 5817 Bergen-Nordnes, Norway	Merete Fonn
Pink	Ireland	MI, Rinville, Oranmore, Co. Galway, Ireland	Selene Hoey
Green	Netherlands	IMARES, Haringkade 1, 1976 cp Ymuiden, Netherlands	Cindy van Damme
White	Spain	IEO, Cabo Estay-Canido, 36280 - VIGO (Pontevedra) Spain	Jose Ramon Perez

Fecundity whole mount analysis procedure for horse mackerel

Transfer the unstained sample to a tray and try to separate the oocytes.

Under the microscope check for spawning markers, if there are hydrated oocytes, atretic hydrated oocytes or ≥ 5 POFs, the sample should not be analysed for fecundity.

Distribute the sample randomly in the tray and measure the oocyte diameters for the whole sample.

Count all oocytes $>185\mu\text{m}$ in the sample

Formula to calculate Potential Fecundity:

Pot. fec. = Number of oocytes / weight of the pipette sample * ovary weight

Formula to calculate Relative Potential Fecundity:

Rel. Pot. Fec. = Potential fecundity / total fish weight

Mackerel sampling procedure at sea

Before the cruise:

Fill the labelled 2,5 ml eppendorf tubes with 1,2 ml of 3,6% buffered (sodium phosphate) formaldehyde

During the cruise:

Measure the weight of the whole catch and select a subsample of 100 fish and measure the total weight of the subsample.

Measure total length, weight, maturity (Walsh scale) and sex of each fish in the subsample.

Select females in maturity stages 3-6 from the subsample of 100 (if there are less than 100 fish take them all) for fecundity and atresia analysis. Be sure to divide the females equally into the 4 weight categories: < 250g, 251-400g, 401-550g and >551g. If the size range of fish is restricted in the catch the remaining sample quota should be taken from the more abundant classes to fill the weight classes.

Measure or take:

- Total length
- Total weight
- Maturity
- Otoliths
- Weight of gut, ovary and liver. (If it is not possible to take these weights at sea, take the pipette and atresia samples and fix the remainder of the ovary. Subsequently weigh the ovary in the lab. Gut and liver should also be frozen and weighed in the lab. The fixed and frozen weights should be corrected to fresh weights.)

Ovary sampling:

- From the ovary take 3 * 25µl samples with a pipette and immediately put each sample in individual coded eppendorf tubes.
- Make sure that all the ovary samples are covered with formaldehyde.

Atresia sampling:

- Place the other ovary in a bottle filled with 3.6% buffered, (sodium phosphate) formaldehyde.
- Make sure that all the ovary sample is covered with formaldehyde

After the cruise:

From the fixed half ovary cut two 5mm thick slices and put them in a labelled cassette. If the ovary is very large you may have to use two cassettes. Separate the cassettes into 4 colour coded bottles filled with 70% ethanol.

Send the cassettes and eppendorf samples for analysis to the different institutes referred to in table 1.

Table 1

Colour code	Country	Institute and address	Responsible person
Blue	Norway	IMR, Nordnesgaten 50,PB 1870, 5817 Bergen-Nordnes, Norway	Merete Fonn
Red	Ireland	MI, Rinville, Oranmore, Co. Galway, Ireland	Selene Hoey
Yellow	Scotland	FRS, Marine Laboratory, Victoria Road, Torry, Aberdeen AB9 8DB, Scotland.	Findlay Burns
White Even numbers	Spain	IEO, Cabo Estay-Canido, 36280 - VIGO (Pontevedra) Spain	Jose Ramon Perez
White Uneven numbers	Spain	AZTI, Foundation Herrera Kaia, Portualde z/g 20110, Pasaia, Basque Country, Spain	Maria Santos