CRUISE REPORT: SEAMAR/PML/1/99

VESSEL: R.R.S. CHALLENGER (Cruise 144)

DATES: 27 June - 26 July 1999

PERSONNEL: S.H. Coombs (PML)
D.V.P. Conway (PML)
N.C. Halliday (PML)
C.D. Barrett (PML)
T.J. Smyth (PML)
M.C. Bailey (Marine Laboratory, Aberdeen)
D.W. Pond (SOC)
K.B. Cook (University of Wales, Swansea)
J. Sidey (University of Plymouth)
1 x RVS support

1st leg (Southampton – Cork)

R. Proctor (POL)
P. Alvarez (AZTI, San Sebastian)
F. Geraghty (National University of Ireland, Galway)
G.J. Langler (Queen Mary and Westfield College, London)

2nd leg (Cork – Southampton)

M. Dickey-Collas (DANI, Belfast)
J. Coughlan (University College Dublin)
O. Gomez (AZTI, San Sebastian)

OBJECTIVES:

The cruise was organised in support of the EU SEAMAR (Shelf-Edge Advection, Mortality and Recruitment) contract to develop a bio-physical transport model for the planktonic stages of mackerel. The main cruise objectives were:

- To describe regional variations in growth and survival potential of mackerel larvae and post-larvae in relation to hydro-biological conditions
- To provide sea-truth calibration data for SeaWiFS remote sensing

METHODS:

The sampling grid (Fig 1) was arranged for an initial study of the broad-scale distribution of mackerel larvae and post-larvae and their feeding environment from the coast of Spain to the north-west of Ireland; subsequent finer scale sampling was carried out in selected areas. The main sampling methods included:

- 60cm (200µm) and 10cm Bongo (53µm) net tows for mackerel larvae and to measure zooplankton food availability
- MIK, Tucker Trawl and depth-stratified RMT net sampling for the post-larval stages
- Preservation of larvae and post-larvae for otolith daily growth rate, C/N, RNA:DNA and lipid content analyses.
- Zooplankton preservation for size-fractionated carbon biomass and lipid content
- U-Tow plankton sampling with fitted CTD and plankton sampling mechanism
- On-board particle size analysis by OPC, using ship's non-toxic sub-surface pumped supply
- On-board primary production incubations coupled with fluorescence and light profiles
- Rosette water bottle sampling for phytoplankton, chlorophyll *a*, pigment, nutrient, and lipid analyses
- Hydrographic characterisation by CTD profiles and ADCP measurements

ITINERARY:

27 June	Depart Southampton for first transect off NW Spain via Plymouth to collect 1 x delayed scientific staff
29 "	U-Tow test tow at shelf edge
30 "	Commence sampling on Transect 1, NW Spain (Fig. 1)
1 July	Continue sampling on passage to Transect 2
2 "	Sampling along Transect 2, off Bilbao
3 "	Sampling along Transect 3, La Rochelle
4 "	Continue sampling on passage to Transect 4
5 "	Sampling along Transect 4, Ushant
6 "	Continue sampling on passage to Transect 5
7 "	Sampling along Transect 5, Cockburn Bank
8 "	Proceed to Cork for mid-cruise break
10 "	Depart Cork for Transect 6, Mizzen Head
11 "	Sampling along Transect 6
12 "	Continue sampling along western edge of Porcupine Bank
13 "	Hove to due to poor weather conditions
14 "	Sampling along Transect 7, N Porcupine
15 "	Sampling on passage to, and along Transect 8, Donegal Bay
16 "	Detailed sampling along Transect 9, N Porcupine shelf edge
17 "	Sampling along Transect 10, N Porcupine Seabight
18 "	Start detailed shelf edge sampling from N Porcupine Seabight

22 " Complete detailed sampling at Transect 22, Goban Spur
23 " Commence Transect 23, Great Sole Bank
24 " Complete Transect 23
25 " U-Tow sampling tow along western English Channel
26 " Dock Southampton

OVERVIEW:

Sampling was carried out over an extensive area from off the coast of Spain to the north-west of Ireland (Fig. 1). All the main aims of the cruise were completed, thus providing information on the late spawning distribution of mackerel larvae, on the distribution of post-larvae, on feeding conditions on and off the shelf and for the SeaWiFS calibration.

As expected at this late stage of the spawning season, larvae only occurred in relatively low numbers in the more northern parts of the survey area. However, the absence of specimens over the central areas of Porcupine Bank and around its western and north-western was unexpected. Post-larvae were sparse, the larger specimens (>25mm) occurring mostly on the deep water side of the shelf-edge in the Porcupine Seabight; this restricted distribution is in agreement with the preliminary findings from concurrent sampling on the FS Heincke cruise.

RESULTS:

Zooplankton

Zooplankton samples were obtained on 92 tows to 100m depth using the 60cm coarse mesh (200µm) Bongo net (Table 1). One sample from each haul was preserved in formalin and the other size-fractionated (200-500, 500-1000, 1000-2000 and >2000µm), a sub-sample oven-dried at 60°C and stored over desiccant for subsequent dry weight and carbon analysis; the remainder of the size fractions being preserved in formalin for microscope analysis.

A similar preservation procedure was applied to a 53-200µm size fraction obtained from the 10cm fine mesh (53µm) Bongo sampler attached below the coarse mesh system (Table 1). Because the fine mesh Bongo system was lost at Station 61 and unfavourable weather conditions prevented the use of fine mesh vertical plankton tows (ship motion causing the net to rupture), all subsequent fine mesh samples were obtained by filtration of ~270l of near-surface water (4m depth).

Distribution of larvae

Preliminary results from the 200µm Bongo samples showed relatively low concentrations of mackerel larvae on the shelf off Ushant, in the main spawning area of Great Sole/ Cockburn Bank, west of Mizzen Head, on the Seabight flank of Porcupine Bank and on the north-west Irish/Malin shelf (Fig. 2).

Distribution of post-larvae

Sampling for mackerel post-larvae was by means of 111 MIK net and 56 neuston (2000 μm mesh) tows at selected stations (Tables 2 and 3). Damage to the standard MIK net (1500 μm), due to heavy catches of salps, required the alternative use of various combinations of other MIK nets and a 2m Tucker trawl (1000 μm mesh; see Table 4).

Post-larvae were sparse, only relatively few specimens >12mm in length (maximum length 56mm) being taken by either the MIK or the neuston net. These were taken mostly either over deep water (500-2000m depth) on the eastern slope margin of the Porcupine Seabight (Fig. 3), with a few also in a similar situation to the north of the Seabight and to the south of the Goban Spur, or over the shelf/shelf edge at Great Sole Bank and along the Ushant transect; the length of the latter specimens being generally less (<25mm) than elsewhere.

A 4-net RMT net system was deployed at 15 stations (Table 5) to 100m depth for vertical distribution sampling of post-larvae. On one night haul which had a significant catch of larger specimens (5-15mm), 94% were taken in the 0-25m depth layer.

Larval growth, condition and food quality

- **Otoliths**

  Mackerel larvae and post-larvae were preserved in buffered ethanol from sampling from 21 Bongo, 21 MIK, 3 Neuston and 5 RMT tows (Table 6) for subsequent otolith daily ring counts.

- **C/N**

  Because relatively few larvae were sampled and because of the priorities of the other analyses, there was a total of only 41 specimens preserved for CN analysis which were sampled at stations 45 and 142 (on shelf off Mizzen Head and over Great Sole Bank, respectively).

- **RNA:DNA**

  Mackerel larvae and post-larvae sampled at 14 stations (Table 7) were preserved in liquid nitrogen and dry ice for subsequent RNA:DNA analysis. Additional specimens of horse mackerel and other species were also preserved.

- **Lipids**

  Mackerel larvae and post-larvae sampled at 16 stations (Table 8; mostly from Transects 5, 6 and 23) were preserved in chloroform:methanol for subsequent lipid analysis. Additional specimens of various other fish species were also preserved intermittently.

  0-50m water samples obtained at stations along Transects 5, 6 and 23 (Table 9) were filtered (20-53μm and <20μm) and preserved at -20^{o}C for subsequent lipid analysis for food abundance and quality; sub-samples of size-fractionated 200μm Bongo zooplankton samples at the same stations were preserved similarly.

OPC

The deck-mounted OPC (Optical Plankton Counter) was run successfully using the non-toxic supply (4m depth). A total of 103 files of size-frequency distributions were obtained variously from station sampling and while on passage between stations (Table 10). Some degradation of data quality due to contamination by water bubbles was apparent during periods of poor weather at passage speeds between stations but otherwise the system functioned correctly. Unfamiliarity with the software led to loss of data for some files during the first part of the cruise.

U-Tow

A total of 56 U-Tow deployments were carried out (Table 11) at a sampling depth of 10m. A Plankton Sampling Mechanism fitted inside the U-tow took 179 valid discrete plankton samples (200μm) with concurrent CTD and flow measurements at 1 minute intervals. The plankton samples will be analysed subsequently for species composition and size distribution. Damage to the cored towing cable during initial tows required the system to be operated in self-contained log mode for the remainder of the cruise.

Hydrographic/optical sampling

CTD

At all stations, a CTD package mounted on the Bongo, MIK and RMT net deployments provided vertical profiles of temperature and salinity to 100m depth. Some supplementary continuous surface recordings of temperature, salinity, chlorophyll *a* and light transmission were also obtained from some sections along the ship's track.

ADCP

Current profiles to a maximum of 320m were obtained throughout the cruise by means of the 300Khz ADCP (Acoustic Current Doppler Profiler). Valid current measurements were apparently made while the system was operated in bottom lock mode; there is less certainty of the validity of the readings in deeper water, possibly due to inadequate recordings of the ship's speed and heading.

SeaWiFS

Primary production experiments were carried out at 17 stations (Fig. 1, Table 12) by on-board incubation from pre-dawn water bottle sampling; filtered samples from the water bottles were preserved for subsequent HPLC absorption analysis and samples frozen for nutrient analysis. Concurrent samples for nutrient and microzoo/phytoplankton analysis (Lugols) were also taken and a vertical chlorophyll *a* profile obtained. Supplementary observations of light and fluorescence profiles were taken at midday and continuous records obtained for surface PAR .

Table 1. Main station positions and Bongo hauls (200µm Bongo samples at all).

Haul no.	Station no.	Date	Start time (BST)	Start position	53 µm sample
1	3	30/06/1999	08:35	44°50.9N 07°29.8'W	Bongo
2	4	30/06/1999	13:41	44°31.0 N 07°30.0'W	Bongo
3	5	30/06/1999	17:52	44°10.0'N 07°29.9'W	Bongo
4	6	30/06/1999	20:54	43°52.6'N 07°30.1'W	Bongo
5	8	01/07/1999	06:13	44°29.9'N 06°59.6'W	Bongo
6	9	01/07/1999	11:10	44°29.9'N 06°01.4'W	Bongo
7	10	01/07/1999	17:12	43°54.1'N 05°30.3'W	Bongo
8	12	02/07/1999	09:26	43°30.5'N 02°45.4W	Bongo
9	13	02/07/1999	12:15	43°50.0'N 02°45.0W	Bongo
10	14	02/07/1999	16:03	44°09.8'N 02°45.0W	Bongo
11	15	02/07/1999	19:40	44°29.6'N 02°44.9W	Bongo
12	17	03/07/1999	08:30	44°59.9'N 04°29.2W	Bongo
13	18	03/07/1999	11:44	45°14.7'N 04°13.0W	Bongo
14	19	03/07/1999	14:50	45°29.8'N 03°53.2W	Bongo
15	20	03/07/1999	18:08	45°45.5'N 03°33.8W	Bongo
16	21	03/07/1999	20:53	46°00.1'N 03°17.0W	Bongo
17	22	03/07/1999	23:45	46°13.6'N 03°00.5W	Bongo
18	23	04/07/1999	07:12	46°29.7'N 03°59.1W	Bongo
19	24	04/07/1999	10:16	46°36.6'N 04°28.5W	Bongo
20	25	04/07/1999	13:30	46°43.0'N 04°59.8W	Bongo
21	26	04/07/1999	17:34	47°12.4'N 05°08.6W	Bongo
22	27	04/07/1999	21:41	47°41.3'N 05°18.8W	Bongo
23	28	05/07/1999	01:54	48°11.1'N 05°29.7W	Bongo
24	29	05/07/1999	07:05	47°51.0'N 05°58.5'W	Bongo
25	30	05/07/1999	11:14	47°30.4'N 06°54.1'W	Bongo
26	31	05/07/1999	15:30	47°09.68'N 07°05.25'W	Bongo
27	32	05/07/1999	19:41	46°49.2'N 07°34.9'W	Bongo
28	33	05/07/1999	23:24	46°59.6'N 08°13.7'W	Bongo
29	35	06/07/1999	10;18	47°29.6'N 09°58.8'W	Bongo
30	36	06/07/1999	16:00	47°46.1'N 11°00.4'W	Bongo
31	37	06/07/1999	21:25	47°59.6'N 11°58.8'W	Bongo
32	38	07/07/1999	02:08	48°20.8'N 11°24.4'W	Bongo
33	39	07/07/1999	08:21	48°40.7'N 10°44.9'W	Bongo
34	40	07/07/1999	12:50	48°59.8'N 10°06.5'W	Bongo
35	41	07/07/1999	17:52	49°08.4'N 09°31.1'W	Bongo
36	42	07/07/1999	22:07	49°37.5'N 08°53.8'W	Bongo
37	43	08/07/1999	03:12	49°56.8'N 08°15.4'W	Bongo
38	44	10/07/1999	20:18	51°23.3'N 10°09.2'W	Bongo
39	45	10/07/1999	23:45	51°17.3'N 10°40.7'W	Bongo
40	46	11/07/1999	06:06	51°10.7'N 11°13.4'W	Bongo
41	47	11/07/1999	09:43	51°05.1'N 11°43.2'W	Bongo
42	48	11/07/1999	14:36	50°59.0'N 12°13.9'W	Bongo
43	49	11/07/1999	19:16	50°51.0'N 12°56.4'W	Bongo
44	50	11/07/1999	23:35	50°42.3'N 13°37.8'W	Bongo
45	51	12/07/1999	07:31	50°59.0'N 14°59.8'W	Bongo
46	52	12/07/1999	12:07	51°29.7'N 15°00.0'W	Bongo
47	53	12/07/1999	16:41	51°59.8'N 15°00.1'W	Bongo
48	54	12/07/1999	20:56	52°29.2'N 15°00.0'W	Bongo
49	55	13/07/1999	01:15	52°59.9'N 15°00.0'W	Bongo
50	56	13/07/1999	20:22	53°30.0'N 16°02.9'W	Bongo
51	57	14/07/1999	01:42	53°29.9'N 15°00.6'W	Bongo
52	58	14/07/1999	06:15	53°30.4'N 14°29.9'W	Bongo
53	59	14/07/1999	09:08	53°30.8'N 13°58.9'W	Bongo
54	60	14/07/1999	13:48	53°30.0'N 12°59.9'W	Bongo
55	61	14/07/1999	19:13	53°30.1'N 12°00.0'W	Fine Bongo lost
56	62	15/07/1999	00:20	53°51.9'N 11°13.0'W	1\2 m net
57	63	15/07/1999	09:01	54°28.2'N 9°54.9'W	Surface filtration
58	64	15/07/1999	13:05	54°54.0'N 9°39.2'W	Surface filtration
59	65	15/07/1999	17:55	55°01.1'N 10°15.7'W	Surface filtration
60	66	15/07/1999	21:52	55°08.1'N 10°52.6'W	Surface filtration
61	67	16/07/1999	01:55	55°16.2'N 11°30.4'W	Surface filtration
62	68	16/07/1999	10:19	54°27.7'N 11°59.9'W	Surface filtration
63	69	16/07/1999	11:48	54°24.9'N 11°55.9'W	Surface filtration
64	70	16/07/1999	13:23	54°20.2'N 11°51.4'W	Surface filtration
65	71	16/07/1999	15:15	54°15.5'N 11°47.5'W	Surface filtration
66	72	16/07/1999	16:53	54°10.7'N 11°42.7'W	Surface filtration
67	73	16/07/1999	18:14	54°07.0'N 11°39.3'W	Surface filtration
68	74	17/07/1999	14:00	52°48.4'N 12°32.0'W	Surface filtration
69	75	17/07/1999	17:06	52°32.3'N 12°31.6'W	Surface filtration
70	76	17/07/1999	19:49	52°16.0'N 12°33.0'W	Surface filtration
71	77	17/07/1999	22:04	52°00.6'N 12°31.7'W	Surface filtration
72	81	18/07/1999	06:39	52°07.3'N 11°32.6'W	Surface filtration
73	82	18/07/1999	09:24	51°57.5'N 11°53.6'W	Surface filtration
74	83	18/07/1999	12:15	51°45.4'N 12°14.3'W	Surface filtration
75	84	18/07/1999	14:55	51°34.5'N 12°35.1'W	Surface filtration
76	89	18/07/1999	23:38	51°37.0'N 11°13.4'W	Surface filtration
77	90	19/07/1999	02:25	51°30.3'N 11°34.0'W	Surface filtration
78	91	19/07/1999	05:34	51°22.8'N 11°54.4'W	Surface filtration
79	92	19/07/1999	07:56	51°16.2'N 12°13.5'W	Surface filtration
80	93	19/07/1999	10:23	51°09.4'N 12°33.6'W	Surface filtration
81	123	21/07/1999	20:27	49°53.7'N 12°34.7'W	Surface filtration
82	125	22/07/1999	06:24	49°42.8'N 11°14.5'W	Surface filtration
83	134	23/07/1999	08:12	48°25.5'N 12°40.9'W	Surface filtration
84	135	23/07/1999	11:15	48°48.5'N 12°22.6'W	Surface filtration
85	136	23/07/1999	13:52	48°55.8'N 12°01.7'W	Surface filtration
86	137	23/07/1999	17:51	49°09.5'N 11°19.8'W	Surface filtration
87	138	23/07/1999	20:17	49°03.8'N 11°38.8'W	Surface filtration
88	139	24/07/1999	02:05	49°18.9'N 10°52.2'W	Surface filtration
89	139	24/07/1999	03:40	49°18.4'N 10°54.5'W	No sample
90	140	24/07/1999	08:03	49°27.8'N 10°26.2'W	Surface filtration
91	141	24/07/1999	11:48	49°38.8'N 09°52.8'W	Surface filtration
92	142	24/07/1999	16:34	49°51.1'N 09°16.5'W	Surface filtration

Table 2. MIK net hauls.

Haul no.	Station no.	Date	Start time (BST)	Start position	Depth sampled (m)	Mesh
1	4	30/06/1999	14:58	43°54.1'N 07°29.6'W	101	1.5mm
2	6	30/06/1999	21:28	43°54.1'N 07°29.6'W	101	1.5mm
3	9	01/07/1999	12:12	44°29.8'N 05°59.9'W	100	1.5mm
4	13	02/07/1999	13:06	43°50.3'N 02°44.6'W	100	1.5mm
5	15	02/07/1999	20:24	44°29.7'N 02°46.3'W	100	1.5mm
6	17	03/07/1999	09:05	45°00.2'N 04°30.3'W	100	1.5mm
7	19	03/07/1999	15:25	45°30.2'N 03°52.7'W	100	1.5mm
8	21	03/07/1999	21:28	46°00.9'N 03°15.9'W	100	1.5mm
9	23	04/07/1999	07:41	46°30.0'N 04°00.6'W	100	1.5mm
10	25	04/07/1999	14:06	46°43.1'N 05°00.2'W	100	1.5mm
11	27	04/07/1999	22:03	47°41.9'N 05°19.0'W	100	1.5mm
12	30	05/07/1999	11:42	47°29.9'N 06°35.1'W	100	1.5mm
13	32	05/07/1999	20:03	46°48.6'N 07°35.8'W	100	1.5mm
14	35	06/07/1999	10:48	47°30.0'N 10°01.2'W	100	1.5mm
15	37	06/07/1999	21:49	47°59.8'N 11°59.8'W	100	1.5mm
16	39	07/07/1999	08:59	48°41.4'N 10°43.9'W	100	1.5mm
17	41	07/07/1999	18:29	49°19.5'N 09°28.9'W	100	1.5mm
18	43	09/07/1999	03:50	49°57.3'N 08°16.1'W	100	1.5mm
19	44	10/07/1999	20:57	51°23.3'N 10°10.7'W	85	1.5mm
20	45	11/07/1999	00:55	51°16.9'N 10°42.1'W	100	1.5mm
21	46	11/07/1999	00:56	51°12.5'N 11°13.3'W	100	1.5mm
22	47	11/07/1999	10:28	51°04.5'N 11°46.9'W	100	1.5mm
23	47	11/07/1999	11:08	51°05.2'N 11°46.3'W	100	1.5mm
24	47	11/07/1999	11:54	51°06.1'N 11°46.3'W	100	1.5mm
25	48	11/07/1999	15:15	50°59.3'N 12°14.0'W	100	1.5mm
26	49	11/07/1999	20:00	50°51.2'N 12°57.4'W	100	1.5mm
27	50	12/07/1999	00:13	50°41.9'N 13°40.5'W	100	1.5mm
28	51	12/07/1999	08:16	51°00.9'N 15°00.5'W	100	1.5mm
29	52	12/07/1999	12:48	51°29.9'N 15°00.0'W	100	1.5mm
30	53	12/07/1999	17:25	51°59.6'N 15°00.2'W	100	1.5mm
31	54	12/07/1999	21:38	52°31.2'N 14°59.9'W	50	1.5mm
32	56	13/07/1999	20:50	53°30.8'N 16°04.8'W	100	1.5mm
33	57	14/07/1999	02:24	53°30.0'N 15°00.1'W	100	1.5mm
34	58	14/07/1999	06:37	53°30.5'N 14°31.3'W	100	1.5mm
35	59	14/07/1999	09:27	53°29.9'N 14°00.1"W	100	1.5mm
36	60	14/07/1999	14:15	53°30.0'N 13°00.0'W	100	1.5mm
37	61	14/07/1999	19:42	53°29.9'N 12°01.4'W	100	1.5mm
38	62	15/07/1999	00:45	53°52.0'N 11°14.4'W	100	1.5mm
39	63	15/07/1999	09:27	54°27.8'N 9°57.0'W	95	1.5mm
40	64	15/07/1999	13:00	54°54.0'N 9°40.1'W	90	1.5mm
41	64	15/07/1999	14:05	54°54.1'N 9°40.0'W	65	1.5mm
42	65	15/07/1999	18:20	55°00.9'N 10°17.1'W	100	1.5mm
43	66	15/07/1999	22:18	55°07.4'N 10°54.4'W	100	1.5mm
44	67	16/07/1999	02:20	55°15.9'N 11°32.6'W	100	1.5mm
45	68	16/07/1999	10:43	54°27.2'N 12°01.3'W	100	1.5mm
46	69	16/07/1999	12:15	54°24.6'N 11°57.1'W	100	1.5mm
47	70	16/07/1999	13:40	54°19.9'N 11°52.0'W	100	1.5mm
48	71	16/07/1999	15:35	54°15.2'N 11°48.3'W	100	1.5mm
49	72	16/07/1999	17:15	54°10.2'N 11°43.5'W	100	1.5mm
50	73	16/07/1999	18:40	54°06.7'N 11°40.4'W	100	1.5mm
51	74	17/07/1999	14:24	52°47.9'N 12°34.4'W	100	1.5mm
52	74	17/07/1999	15:00	52°48.0'N 12°33.0'W	50	1.5mm
53	75	17/07/1999	17:29	52°32.0'N 12°33.1'W	100	1.5mm
54	77	17/07/1999	22:30	52°00.0'N 12°35.3'W	100	1.5mm
55	78	18/07/1999	00:06	52°01.9'N 12°18.6'W	75	1.5mm
56	79	18/07/1999	01:35	52°04.7'N 12°03.7'W	75	1.5mm
57	80	18/07/1999	03:00	52°06.9'N 11°49.6'W	75	1.5mm
58	80	18/07/1999	03:35	52°06.9'N 11°49.2'W	75	1.5mm
59	81	18/07/1999	07:05	52°06.7'N 11°32.9'W	100	1.5mm
60	82	18/07/1999	09:44	51°56.8'N 11°54.1'W	100	1.5mm
61	83	18/07/1999	12:36	51°45.0'N 12°15.1'W	100	1.5mm
62	84	18/07/1999	15:20	51°34.0'N 12°36.3'W	100	1.5mm
63	85	18/07/1999	16:54	51°34.1'N 12°18.5'W	75	1.5mm
64	86	18/07/1999	18:23	51°35.0'N 12°02.6'W	75	1.5mm
65	87	18/07/1999	20:02	51°36.0'N 11°46.9'W	75	Net split
66	94	19/07/1999	13:10	51°07.0'N 12°20.1'W	75	10mm
67	95	19/07/1999	14:40	51°06.3'N 12°06.0'W	61	10mm
68	96	19/07/1999	16:33	51°05.4'N 11°50.4'W	100	10mm
69	97	19/07/1999	18:31	51°04.3'N 11°35.7'W	30	10mm
70	98	19/07/1999	20:00	51°03.4'N 11°20.5'W	50	10mm
71	100	19/07/1999	22:32	51°00.9'N 11°30.7'W	50	10mm
72	101	20/07/1999	00:36	51°01.0'N 11°45.3'W	30	10mm
73	102	20/07/1999	02:38	51°01.0'N 11°52.0'W	76	10mm
74	103	20/07/1999	03:20	51°01.0'N 11°57.9'W	75	10mm
75	104	20/07/1999	04:20	50°59.9'N 12°06.5'W	84	10mm
76	104	20/07/1999	05:18	51°00.1'N 12°06.4'W	16	10mm
77	105	20/07/1999	06:19	51°00.0'N 12°13.4'W	80	10mm
78	106	20/07/1999	08:28	50°57.8'N 12°00.1'W	118	10mm
79	107	20/07/1999	10:35	50°54.9'N 11°46.0'W	34	10mm
80	108	20/07/1999	12:35	50°52.0'N 11°31.0'W	95	10mm
81	109	20/07/1999	14:40	50°49.9'N 11°16.0'W	100	10mm
82	110	20/07/1999	16:43	50°46.0'N 11°25.4'W	50	10mm
83	111	20/07/1999	18:33	50°41.0'N 11°38.2'W	50	1.5mm
84	112	20/07/1999	20:53	50°37.0'N 11°53.3'W	50	1.5mm
85	113	20/07/1999	22:39	50°31.7'N 11°59.0'W	50	1.5mm
86	114	21/07/1999	00:15	50°28.1'N 11°50.0'W	42	Net burst
87	115	21/07/1999	02:25	50°23.9'N 11°32.7'W	60	10mm
88	116	21/07/1999	04:54	50°19.8'N 11°16.8'W	54	10mm
89	117	21/07/1999	06:30	50°17.0'N 11°02.7'W	55	10mm
90	118	21/07/1999	08:56	50°11.9'N 11°15.9'W	100	10mm
91	119	21/07/1999	11:43	50°08.7'N 11°32.6'W	55	10mm +1.5mm
92	120	21/07/1999	13:45	50°04.8'N 11°47.0'W	30	10mm +1.5mm
93	121	21/07/1999	15:35	50°01.7'N 12°01.8'W	65	10mm +1.5mm
94	122	21/07/1999	17:33	49°57.8'N 12°14.8'W	45	10mm +1.5mm
95	123	21/07/1999	19:39	49°53.7'N 12°30.7'W	50	10mm +1.5mm
96	125	22/07/1999	07:16	49°43.8'N 11°16.4'W	100	10mm +1.5mm
97	126	22/07/1999	09:39	49°45.4'N 11°28.6'W	100	10mm +1.5mm
98	128	22/07/1999	13:30	49°49.8'N 11°59.1'W	100	10mm +1.5mm
99	129	22/07/1999	16:41	49°39.7'N 11°32.7'W	100	10mm +1.5mm
100	130	22/07/1999	18:42	49°34.9'N 11°48.1'W	80	10mm +1.5mm
101	131	22/07/1999	20:39	49°32.0'N 12°03.0'W	38	10mm +1.5mm
102	133	23/07/1999	01:33	49°23.9'N 12°33.7'W	60	10mm +1.5mm
103	134	23/07/1999	08:47	48°41.3'N 12°41.3'W	50	10mm +1.5mm
104	135	23/07/1999	11:44	48°49.2'N 12°20.9'W	50	10mm +1.5mm
105	136	23/07/1999	14:24	48°56.0'N 12°00.8'W	50	10mm +1.5mm
106	137	23/07/1999	17:00	49°02.9'N 11°40.8'W	75	10mm +1.5mm
107	138	23/07/1999	20:47	49°10.3'N 11°18.4'W	105	10mm +1.5mm
108	139	24/07/1999	02:33	49°19.2'N 11°51.4'W	100	10mm +1.5mm
109	140	24/07/1999	08:40	49°28.3'N 10°24.0'W	40	10mm +1.5mm
110	141	24/07/1999	12:20	49°39.4'N 09°51.4'W	100	10mm +1.5mm
111	142	24/07/1999	15:56	49°50.8'N 09°17.4'W	100	10mm +1.5mm

Table 4. 2m Tucker Trawl tows

Haul no.	Station no.	Date	Start time (BST)	Start position	Depth sampled (m)
1	88	18/07/1999	22:02	51°37.0'N 11°27.2'W	75
2	89	19/07/1999	00:17	51°37.0'N 11°14.6W	100
3	90	19/07/1999	02:45	51°29.9'N 11°35.4'W	100
4	91	19/07/1999	05:56	51°22.8'N 11°55.2'W	100
5	92	19/07/1999	08:33	51°14.9'N 12°15.0'W	100
6	93	19/07/1999	11:04	51°08.4'N 12°35.1'W	100
7	99	19/07/1999	21:30	51°02.1'N 11°28.4'W	75

Table 5. RMT net hauls

Haul no.	Station no.	Date	Start time	Start position	No. of samples
1	7	30/06/1999	23:06	44°00.1N 07°29.8'W	3
2	7	01/07/1999	00:14	44°00.0'N 07°30.1'W	4
3	11	02/07/1999	01:01	43°54.0'N 04°01.8'W	4
4	16	03/07/1999	00:24	44°40.1'N 03°19.7'W	1
5	22	04/07/1999	00:36	46°14.2'N 03°00.0'W	3
6	28	05/04/1999	02:36	48°11.7'N 05°30.0W	4
7	33	06/04/1999	00:15	47°00.1'N 08°15.3'W	4
8	38	07/07/1999	03:10	48°21.3'N 11°23.8'W	4
9	40	07/07/1999	13:54	49°00.6'N 10°05.3W	4
10	42	07/07/1999	23:04	49°38.5'N 08°50.9'W	4
11	101	20/07/1999	01:38	51°01.0'N 11°46.0'W	3
12	124	21/07/1999	22:37	49°51.9'N 12°13.8'W	4
13	127	22/07/1999	11:47	49°47.7'N 11°44.7'W	4
14	132	22/07/1999	23:01	49°27.5'N 12°19.4'W	4
15	139	24/07/1999	04:44	49°18.9'N 10°53.3'W	4

Table 6. Stations at which mackerel larvae were sampled for RNA:DNA analysis.

Station no.	Position	Date	Time (BST)	Gear	. of specimens preserv
45	1 17N 10 42\	11/07/1999	~ 0030	Neuston 22	6
45	1 17N 10 42\	11/07/1999	~ 2315	Bongo 39	63
45	1 17N 10 42\	11/07/1999	~ 0015	MIK 20	23
64	4 54N 09 40\	15/07/1999	~ 1330	MIK 40	10
64	4 54N 09 40\	15/07/1999	~ 1340	MIK 41	16
74	2 48N 12 33\	17/07/1999	~ 1400	MIK 51	30
75	2 32N 12 33\	17/07/1999	~1705	Bongo 69	5 (1st net) 8 (2nd net)
75	2 32N 12 33\	17/07/1999	~ 1730	MIK 53	10 (8-15mm)
81	2 07N 11 33\	18/07/1999	~ 0730	MIK 59	6
81	2 07N 11 33\	18/07/1999	~ 0740	Bongo 72	22
89	1 36N 11 14\	19/07/1999	~ 0000	T02	21
89	1 36N 11 14\	18/07/1999	~ 1130	Bongo 76	8
140	9 28N 10 25\	24/07/1999	~ 0830	Bongo 90	4
140	9 28N 10 25\	24/07/1999	~ 0830	MIK 109	6

Table 3. Neuston net tows.

Haul no.	Station no.	Date	Start time (BST)	Start position
1	3	30/06/1999	09:30	44°50.3'N 07°30.3'W
2	5	30/06/1999	18:18	44°09.3'N 07°30.1'W
3	8	01/07/1999	05:50	44°29.9'N 07°00.0W
4	10	01/07/1999	17:37	43°53.9'N 05°30.1W
5	11	02/07/1999	02:12	43°53.7'N 03°59.1'W
6	12	02/07/1999	09:46	43°30.3'N 02°45.1'W
7	14	02/07/1999	16:40	44°10.9'N 02°45.1'W
8	18	03/07/1999	12:20	45°14.8'N 04°13.0'W
9	20	03/07/1999	18:32	45°45.1'N 03°32.8'W
10	24	04/07/1999	10:39	46°36.7'N 04°29.9'W
11	26	04/07/1999	17:56	47°12.9'N 05°09.3'W
12	29	05/07/1999	07:03	47°50.2'N 05°59.7'W
13	31	05/07/1999	15:54	47°09.9'N 07°05.2'W
14	36	06/07/1999	16:25	47°45.4'N 11°01.2'W
15	38	07/07/1999	04:30	48°20.9'N 11°24.2'W
16	39	07/07/1999	08:43	48°41.2'N 10°44.1'W
17	40	07/07/1999	13:30	49°00.1'N 10°06.0'W
18	41	07/07/1999	18:12	49°19.0'N 09°30.0'W
19	42	07/07/1999	22:29	49°38.2'N 08°52.3'W
20	43	08/07/1999	03:35	49°56.9'N 08°15.2'W
21	44	10/07/1999	20:35	51°23.0'N 10°08.5'W
22	45	11/07/1999	00:30	51°17.7'N 10°42.0'W
23	46	11/07/1999	06:36	51°11.9'N 11°13.3'W
24	47	11/07/1999	10:10	51°04.5'N 11°45.6'W
25	48	11/07/1999	15:00	50°58.7'N 12°15.2'W
26	49	11/07/1999	19:42	50°50.1'N 12°57.3'W
27	50	11/07/1999	23:34	50°41.9'N 13°39.3'W
28	51	12/07/1999	07:56	51°00.2'N 15°00.2'W
29	52	12/07/1999	12:30	51°30.0'N 15°00.0'W
30	53	12/07/1999	17:05	52°00.2'N 14°59.4'W
31	54	12/07/1999	21:21	52°30.4'N 15°00.1'W
32	96	19/07/1999	17:06	51°04.6'N 11°51.4'W
33	101	20/07/1999	00:57	51°01.0'N 11°46.7'W
34	104	20/07/1999	04:39	50°59.9'N 12°07.5'W
35	105	20/07/1999	06:55	51°00.5'N 12°15.7'W
36	109	20/07/1999	15:07	50°50.2'N 11°17.7'W
37	110	20/07/1999	16:12	50°45.9'N 11°24.4'W
38	111	20/07/1999	19:00	50°41.4'N 11°39.6'W
39	114	20/07/1999	00:39	50°28.3'N 11°51.6'W
40	118	21/07/1999	09:32	50°13.0'N 11°17.3'W
41	119	21/07/1999	11:20	50°08.4'N 11°30.6'W
42	120	21/07/1999	14:20	50°05.5'N 11°50.0'W
43	121	21/07/1999	16:19	50°02.7'N 12°04.6'W
44	122	21/07/1999	18:09	49°58.4'N 12°16.8'W
45	123	21/07/1999	20:10	49°53.8'N 12°32.9'W
46	124	21/07/1999	23:27	49°52.8'N 12°17.3'W
47	125	22/07/1999	06:52	49°43.2'N 11°15.7'W
48	126	22/07/1999	09:18	49°44.5'N 11°27.2'W
49	127	22/07/1999	11:13	49°46.6'N 11°43.2'W
50	128	22/07/1999	14:03	49°50.2'N 12°00.9'W
51	129	22/07/1999	17:15	49°38.4'N 11°31.6'W
52	130	22/07/1999	18:13	49°35.6'N 11°49.6'W
53	131	22/07/1999	21:26	49°32.9'N 12°05.4'W
54	132	22/07/1999	23:45	49°28.7'N 12°21.0'W
55	133	23/07/1999	01:15	49°24.0'N 12°32.9'W
56	138	23/07/1999	21:53	49°11.8'N 11°16.8'W

Table 5. RMT net hauls

Haul no.	Station no.	Date	Start time	Start position	No. of samples
1	7	########	23:06	44°00.1N 07°29.8'W	3
2	7	########	00:14	44°00.0'N 07°30.1'W	4
3	11	########	01:01	43°54.0'N 04°01.8'W	4
4	16	########	00:24	44°40.1'N 03°19.7'W	1
5	22	########	00:36	46°14.2'N 03°00.0'W	3
6	28	########	02:36	48°11.7'N 05°30.0W	4
7	33	########	00:15	47°00.1'N 08°15.3'W	4
8	38	########	03:10	48°21.3'N 11°23.8'W	4
9	40	########	13:54	49°00.6'N 10°05.3W	4
10	42	########	23:04	49°38.5'N 08°50.9'W	4
11	101	########	01:38	51°01.0'N 11°46.0'W	3
12	124	########	22:37	49°51.9'N 12°13.8'W	4
13	127	########	11:47	49°47.7'N 11°44.7'W	4
14	132	########	23:01	49°27.5'N 12°19.4'W	4
15	139	########	04:44	49°18.9'N 10°53.3'W	4