DEPARTMENT OF AGRICULTURE FOR N. IRELAND
AGRICULTURAL AND ENVIRONMENTAL SCIENCES DIVISION

CRUISE REPORT: LF/18/98: SPRAT AND JUVENILE HERRING STUDY

VESSEL: R.V. *Lough Foyle* (DANI) **DATES:** 27 April - 1 May1998

AREA OF OPERATION: Irish Sea ; ICES Division VIIa

TYPE OF SURVEY: Acoustics / midwater trawling / plankton sampling

PERSONNEL:

M. Armstrong	(DANI; S.I.C.)
M. Dickey-Collas	(DANI)
M. McAliskey	(DANI)
J. Peel	(DANI)
C. Burns	(DANI)
R. Snyder	(QUB)

OBJECTIVES

i) To quantify food selection and intake of sprat and juvenile herring in the western Irish Sea, with particular reference to predation on eggs and larvae of commercial fish species.

ii) To estimate the biomass and population structure of sprat and juvenile herring in the study area.

iii) To investigate competition for resources between sprat and juvenile herring.

iv) To investigate growth and reproductive parameters of sprat.

METHODS

Phase 1 acoustics and plankton survey

A sphere-calibrated Simrad EK-500 acoustic system with 38 and 120 kHz split-beam transducers mounted in a towed body was employed to carry out echo integrations during daylight along transects in the western Irish Sea. A coarse grid of transects spaced 8 nautical miles apart was surveyed to map the general distribution of sprats, juvenile herring and zooplankton as well as to determine the physical characteristics of the water column (Fig. 1). Up to three stations on each transect were sampled mainly during darkness for zooplankton, temperature, salinity and fluorescence using a Gulf-3 high-speed sampler fitted with a 40 cm nose cone and 280 micron aperture net. On completion of the coarse grid, a more intensive grid comprising 11 transects of length 4 nautical miles, spaced at 1.5 mile intervals was surveyed acoustically to locate a suitable area of sprat concentration for the Phase 2 study of feeding and spawning (Fig. 2).

Instrument settings for the EK-500 are given in Table 1. Data were archived using Simrad EP-500 software and backed up daily on two replicate tapes. Acoustic targets were identified on the coarse grid by means of aimed tows of a Maritin 54m x 47m midwater trawl fitted with a 20-mm stretched-mesh liner and a Furuno netsonde. Species compositions and length frequencies were recorded from all trawl catches. Subsamples of sprats were preserved from each catch for recording of age, sex ratio, maturity stages, fecundity and spawning fraction, and for investigation of diet. Preservation was in 4% buffered formaldehyde with additional samples frozen. Samples of herring were also frozen for comparative diet analysis. Length-weight parameters were estimated for all fish species contributing significantly to the acoustic integrals.

The Gulf-3 pankton sampler was deployed in a double-oblique tow from the surface to just off the seabed, with the vessel proceeding at a constant speed of 3 knots through the water, as on previous surveys using this sampler. Net deployment and oceanographic parameters were recorded throughout each tow using the PRONET CTD package. The plankton sample from each tow was preserved in 4% buffered formaldehyde. The numbers of fish larvae and ctenophores in each sample were recorded on board.

Phase 2: study of diel feeding and spawning behaviour of sprat

The following sampling procedure was followed at 6-hour intervals (14h.00; 20h.00; 02h.00; 08h.00; 14h.00; 20h.00; Fig. 3):

1. Acoustic survey on three 0.75 n.mile transects at 0.25 n.mile spacing
2. One midwater trawl across box
3. Two Gulf-3 tows between each pair of acoustic transects, one to just off the seabed and the second sampling only the top half of the water column

CRUISE NARRATIVE

The vessel departed Belfast at 22h.40 on Sunday 26 April, and proceeded overnight to the start of transect 1 off Dundrum Bay (Fig. 1). Transects 1 to 8 and Gulf-3 stations 26, 32, 37 and 36 were completed on Monday 27 April. The remaining transects and Gulf-3 stations shown in Figure 1 were completed by 3am on Wednesday 29 April. The second grid (Fig. 2) was surveyed between 05h.30 and 12h.50, after which the vessel proceeded north to an area off Dundrum Bay (Fig. 2) where a suitable patch of sprat targets had been recorded. The Phase 2 study commenced at 14h.50 on 29 April. The sampling times were as follows:

Sampling session number	Start time	End time
1	14h.50	18h.00
2	20h.00	23h.30
3	02h.00	05h.35
4	08h.00	11h.50
5	14h.00	17h.55
6	20h.00	23h.35

Between sessions, the vessel drifted in the vicinity of the starting position for the next acoustic survey. On completion of session 6, the vessel returned to Belfast.

WORK COMPLETED

Echo integration

The 38kHz and 120kHz echosounders were run continuously during the acoustic survey periods. Data were captured using EP-500 software and were backed up daily on duplicate digital audio tapes.

Target identification and biological analysis

Twelve midwater trawl tows were completed, six during Phase 1 and six during Phase 2, to identify acoustic targets and provide samples for biological analysis. The trawl positions for the Phase 1 survey are shown on Fig. 1. Details of the tows are given in Table 2. Species compositions and length frequencies were recorded for each catch. Samples of sprats and juvenile herring were preserved for feeding and spawning studies as detailed in the Methods section. During Phase 2, the length-frequency samples of sprat were also screened for sex and maturity stage. Length - weight parameters were estimated for the main species caught (Table 3).

Plankton sampling

A total of 20 Gulf-3 stations were sampled during Phase 1, and 24 during Phase 2. Data on net deployment and physical oceanographic parameters were archived using the PRONET system.

Results

During Phase 1, sprat and juvenile herring were found mainly in depths of 30-40m in a band running along the coast. The overall length frequencies of sprat and herring during Phase 1 and Phase 2 are shown in Fig. 4. Most sprat were mature. During Phase 2, a high incidence of spawning sprat with hydrated oocytes was recorded during early afternoon and early evening, with a low incidence during early morning.

Surface temperatures during Phase 1 varied around 9°C, with a slight thermocline resulting in up to a 0.6°C difference between surface and bottom (Fig. 5). Levels of fluorescence were comparatively high off Dundalk Bay (Fig. 5). Densities of fish larvae and ctenophores were highest to the south of Dundalk Bay (Fig. 6).

The results of this cruise will contribute to DANI studies on fish recruitment and zooplankton dynamics, by quantifying the predation of sprats and juvenile herring on zooplankton and on the eggs and larvae of fish.

ACKNOWLEDGEMENTS

The Ship's Master, Officers, Fishing Master, Engineers, Catering Staff and Crew are thanked for their cooperation and service during this cruise. The scientific staff are also acknowledged for their thorough work th oughout the cruise.

Signed
SIC M.J. Armstrong **date:** 1/5/98 **Ships master** [signature] **date:** 1 May 98

Head of
Aquatic Sciences R.J. Harney **date:** 8.5.98

Table 1 EK-500 instrument settings used during cruise LF1898

Transducer	ES38B	ES120-7
Frequency	38 kHz	120 kHz
(1) TRANSCEIVER MENU		
Absorption coefficient	10 dB/km	38 dB/km
Pulse length	Medium (1.0 ms)	Medium (0.3 ms)
Bandwidth	Wide	Wide
Max. power	2000 W	1000 W
Angle sensitivity	21.9	21.0
2-way beam angle	-20.9 dB	-20.6 dB
Sv transducer gain	26.11 dB	25.60 dB
TS transducer gain	26.43 dB	25.80 dB
3 dB beamwidth Alongship	6.83 deg	7.1 deg
3 dB beamwidth Athwartship	6.88 deg	7.1 deg
Alongship offset	-0.03 deg	0.0 deg
Athwartship offset	0.10 deg	0.0 deg

(2) OTHER SETTINGS	
Operation menu:	Ping rate = 0.6 s (50m,100m, 150m range) [25m range not used]
Log menu:	Mode = ping based Ping interval = 1480 (50, 100, 150m range)
Layer menu:	Super-layer = 9 - 120 Layers: 6-9, 9-20, 20-30, 30-40, 40-50, 50-60, 70-90, 90-120 metres
Printer / EP-500 settings:	Sv colour min. = -70 dB TS colour min. = -60 dB
TS detection menu: (both frequencies)	TS min. = -60 dB Min. echo length = 0.8 Max. echo length = 1.3 Max. gain compensation = 3.0 dB Max. phase deviation = 4.0 dB
Bottom detection menu:	Minimum level = -50 dB

Table 2 Details of trawl catches taken during cruise LF1898

Tow	Date	Shooting details						Total	percentage composition by weight					Mean length (cm)	
		Time	Latitude		Longitude		depth (m)	catch kg.	sprat	herring	mackerel	gadoids	other	sprat	herring
1	27-Apr	7h.55	54	10.92	5	32.60	35	140	63.4	23.9	0.1	12.6	0.0	9.5	20.1
2	27-Apr	11h.26	54	4.00	5	43.40	37	75	90.6	1.6	0.0	7.9	0.0	10.2	18.3
3	27-Apr	15h.55	53	56.04	6	1.65	30	95	77.1	22.6	0.0	0.3	0.0	10.1	17.2
4	28-Apr	7h.03	53	25.27	5	53.28	42	245	1.1	16.7	0.0	82.2	0.0	9.6	15.3
5	28-Apr	10h.30	53	34.26	5	48.68	68	19	30.9	61.8	0.0	7.3	0.0	7.2	13.7
6	28-Apr	12h.27	53	34.00	5	58.73	28	29	8.8	86.1	0.0	5.1	0.0	8.8	14.6
7	29-Apr	15h.41	54	6.57	5	38.28	43	96	98.3	1.4	0.0	0.3	0.0	9.8	17.2
8	29-Apr	20h.50	54	6.80	5	38.59	28	203	83.1	16.2	0.0	0.8	0.0	10.5	19.2
9	30-Apr	2h.45	54	6.54	5	38.42	39	37	50.4	3.7	0.0	41.3	4.6	10.0	17.8
10	30-Apr	8h.57	54	6.73	5	36.92	34	123	22.7	71.7	0.0	5.6	0.0	10.6	18.6
11	30-Apr	15h.25	54	6.35	5	38.33	38	270	80.7	19.1	0.0	0.2	0.0	10.6	19.5
12	30-Apr	20h.50	54	6.97	5	37.31	29	198	79.7	17.0	0.0	3.3	0.0	11.4	18.1

Table 3 Length - weight parameters estimated during cruise LF1898
(Lengths in cm; weights in g)

SPECIES	INTERCEPT	SLOPE	SAMPLE SIZE
Herring	0.00461	3.101	157
Sprat	0.00445	3.163	159
Haddock	0.00750	3.057	32
Whiting	0.00695	2.989	63

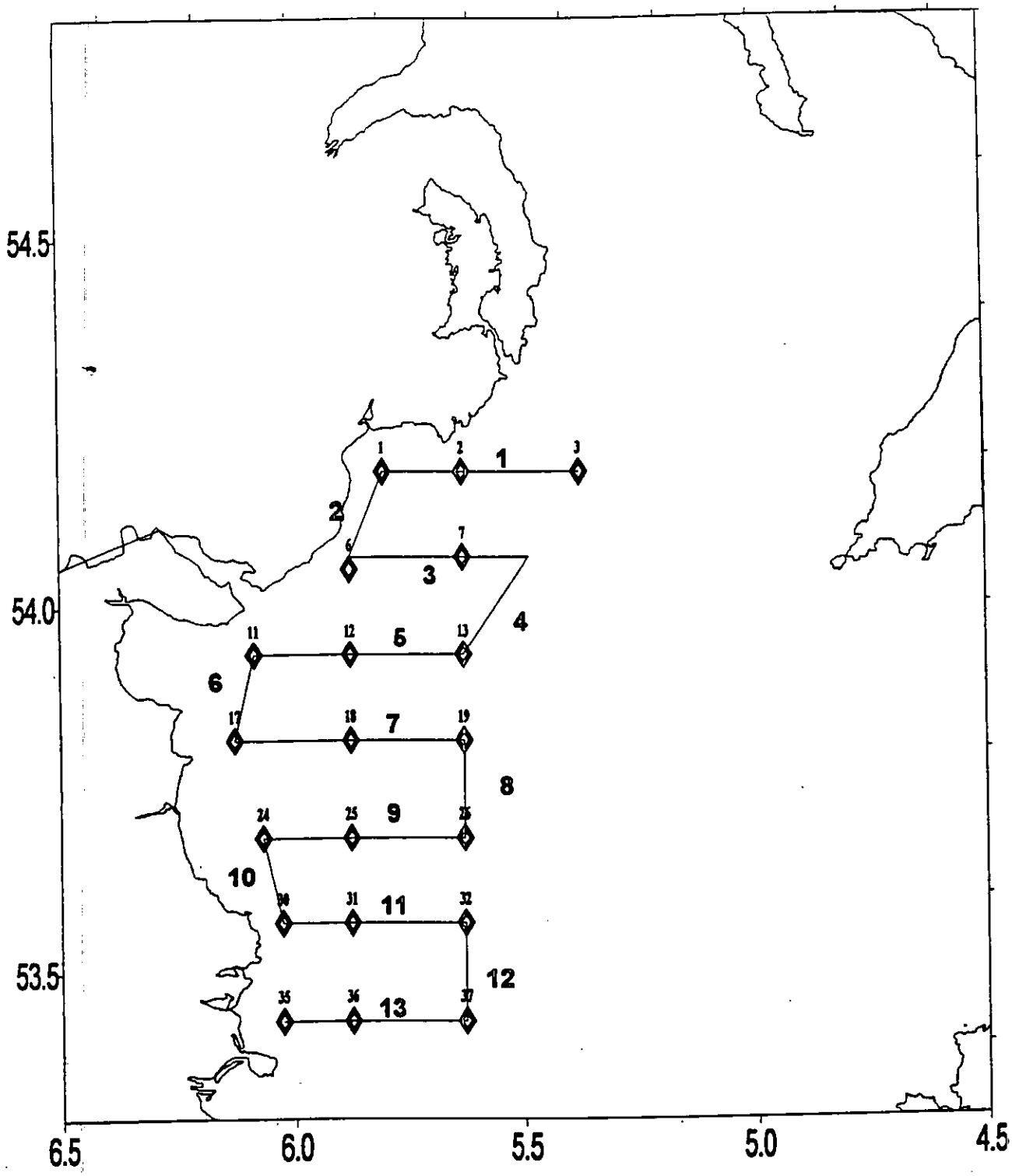


Fig. 1 Phase 1 acoustic survey grid for cruise LF1898. Positions of Gulf-3 plankton stations are shown, together with numbers of the acoustic transects and plankton stations.

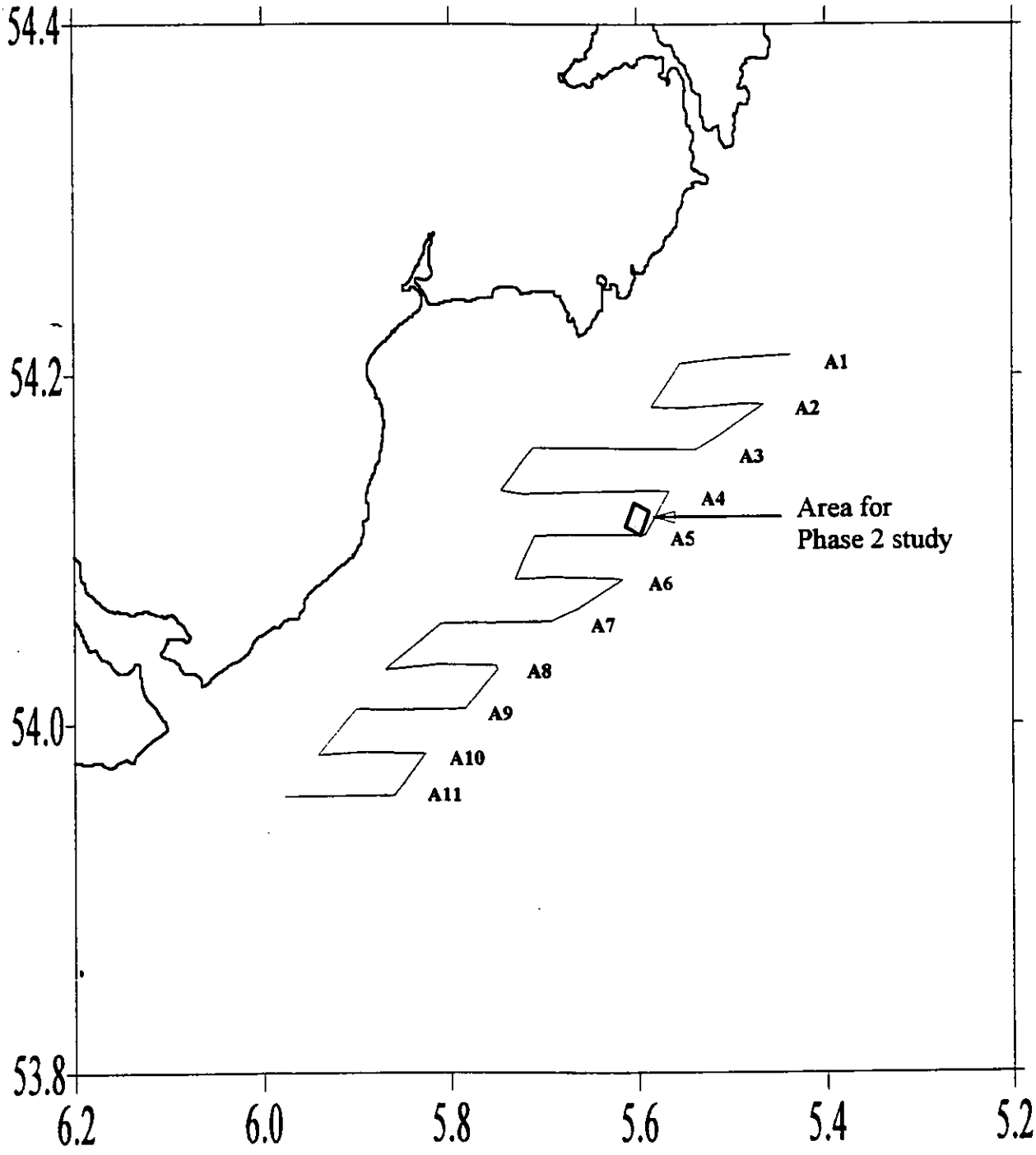


Figure 2 Transect plan for intensive acoustic survey to locate suitable area for Phase 2 study of diel feeding and spawning behaviour of sprat. The area chosen for the Phase 2 study is shown (see Fig. 3).

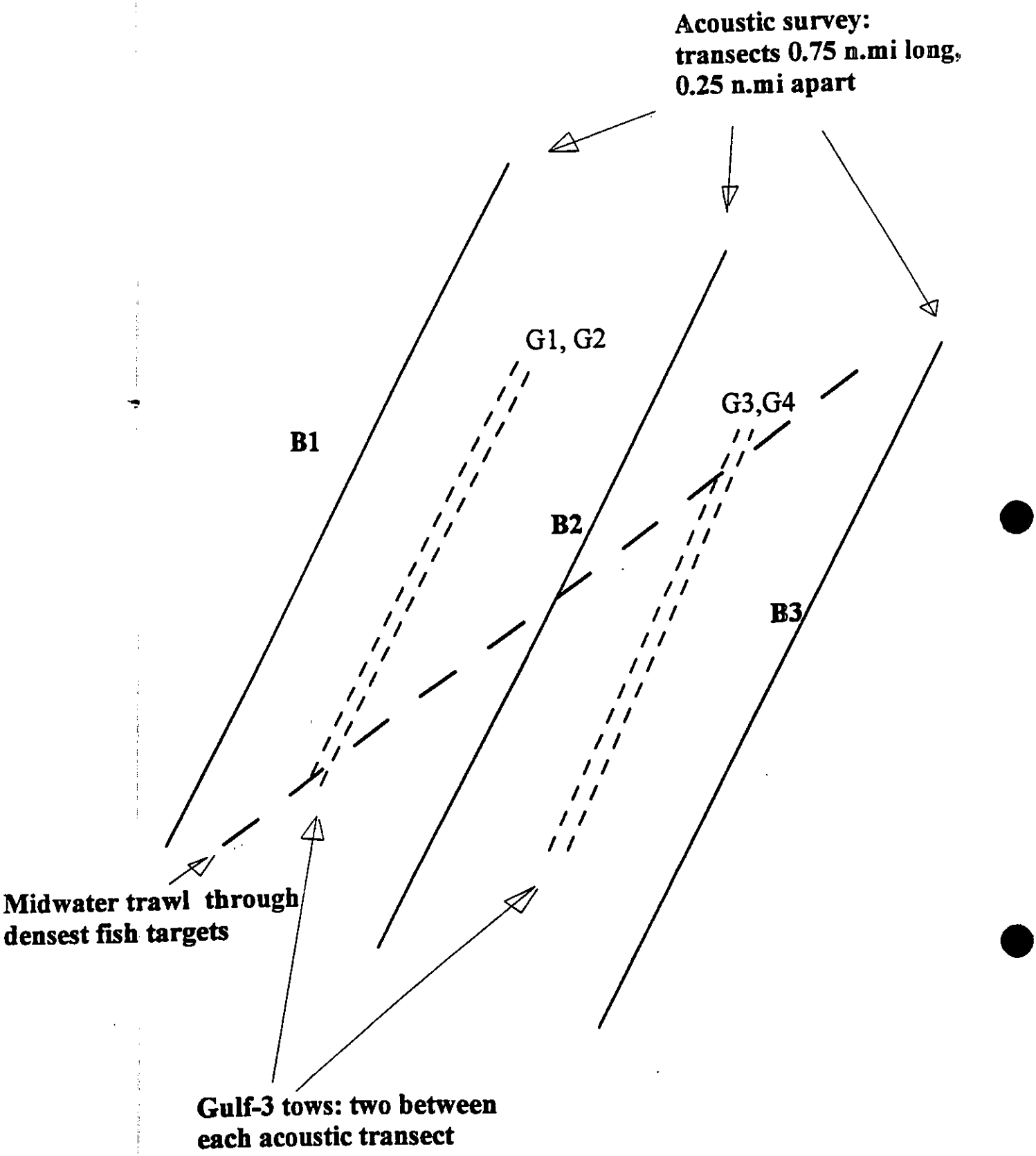
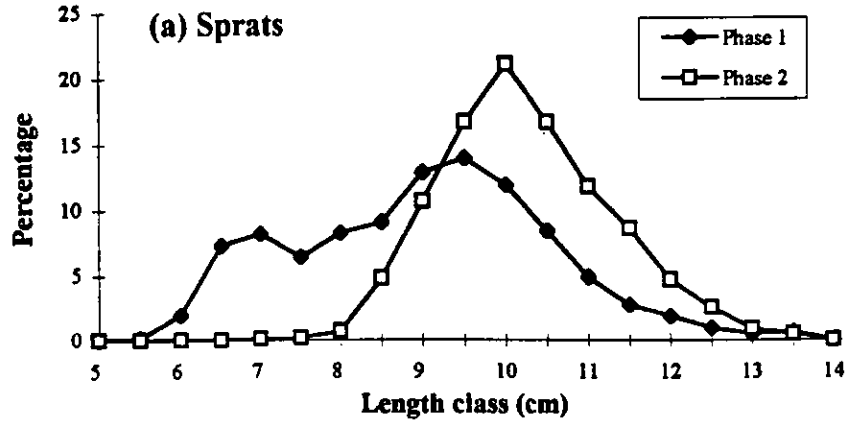


Fig. 3 Experimental design for study of diel patterns of feeding and spawning in sprat. See Fig. 2 for location of the study.



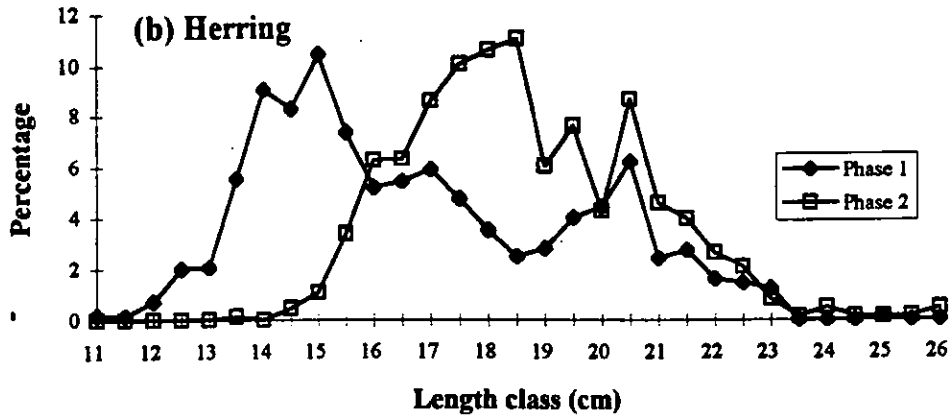


Figure 4 Length frequencies of sprat and herring from Phase 1 and Phase 2 of cruise LF1898.

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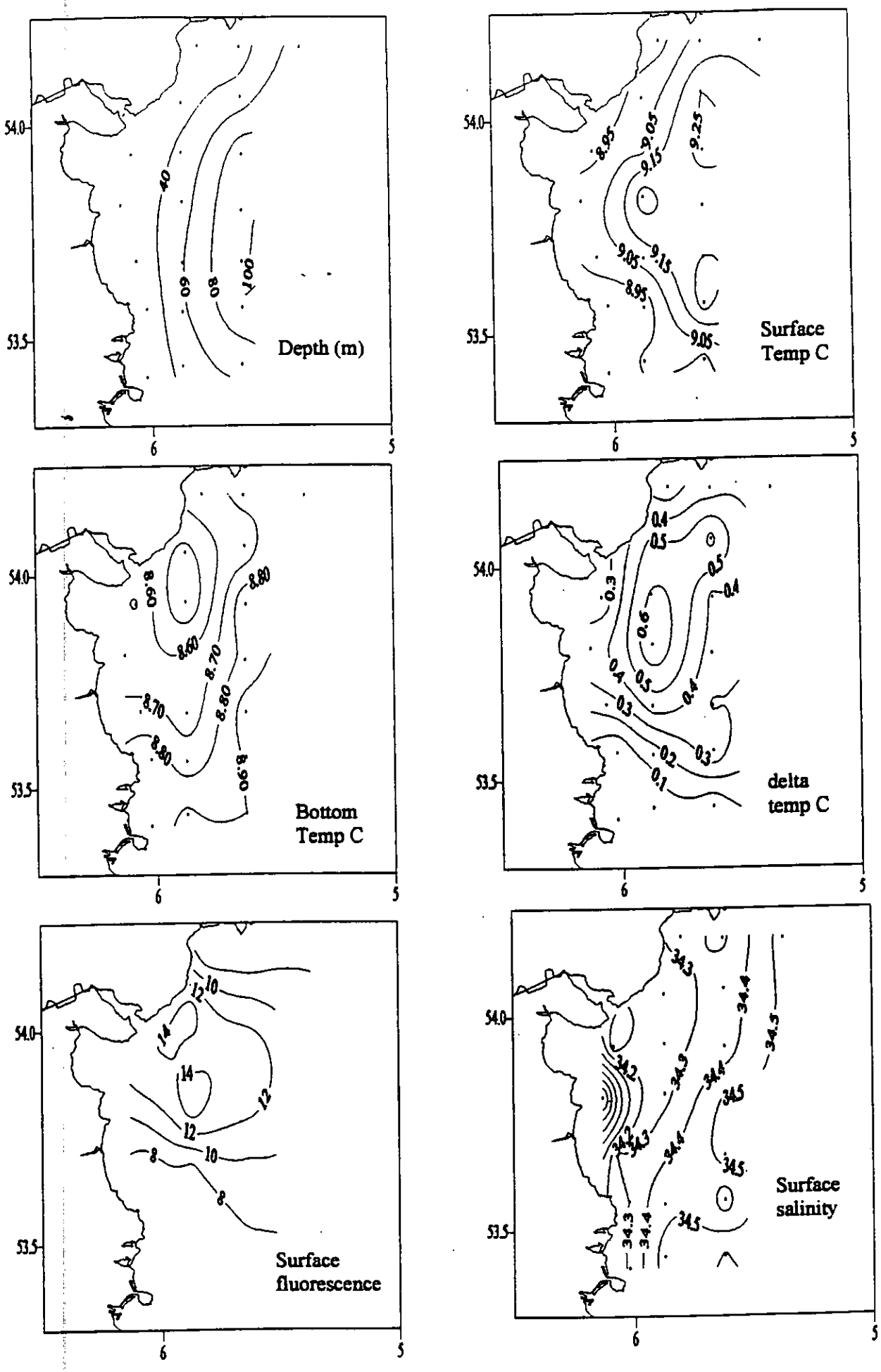

Figure 5 Physical characteristics of water column on LF1898, 27-29 April 1998

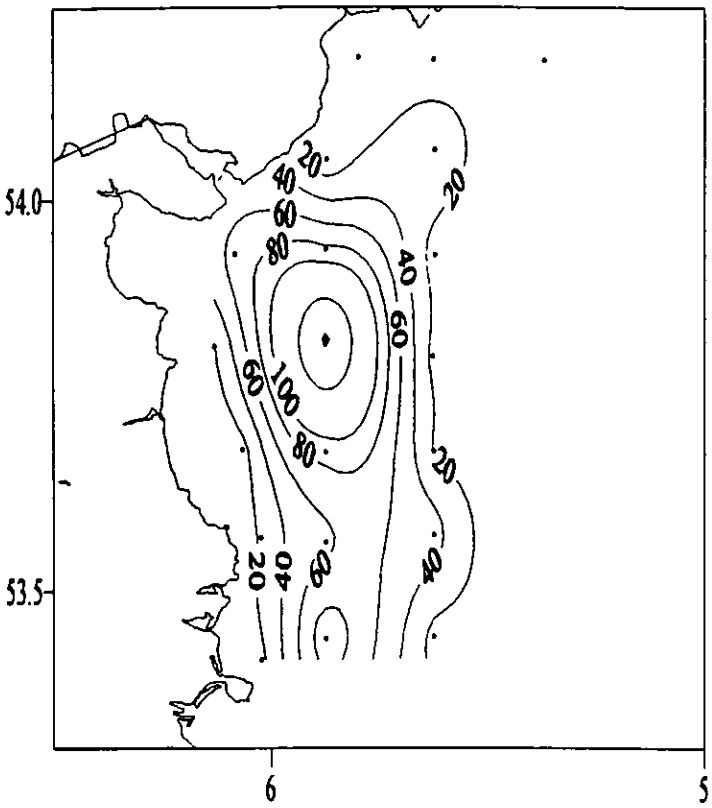

Figure 6a No of fish larvae per m² on LF1898. Dominated by sand eels, dab, sprat and rocklings.

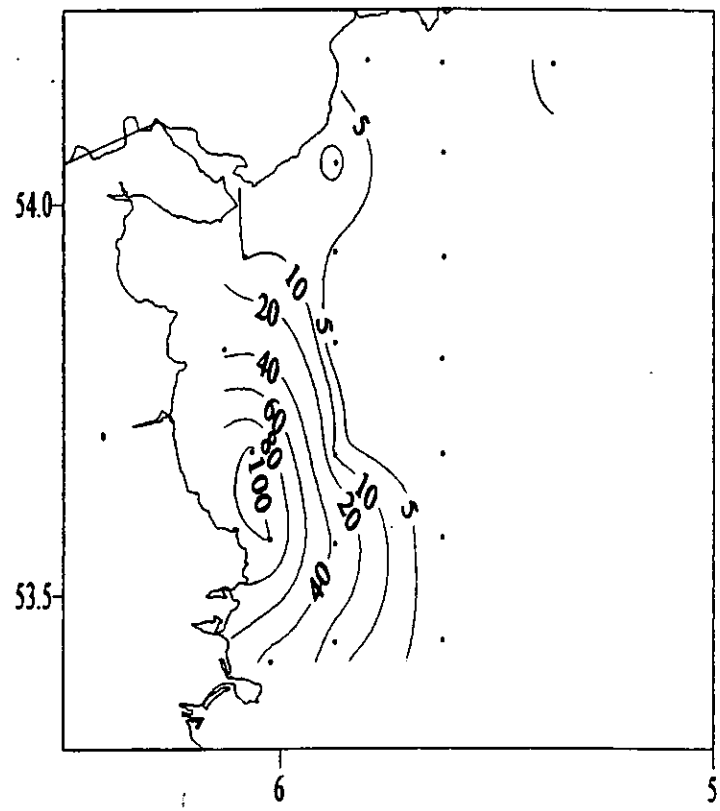

Figure 6b. No of ctenophores per m² on LF1898