PRELIMINARY REPORT FROM THE ACOUSTIC HERRING SURVEY FROM NORTH SHETLAND TO RONA WITH R/V "G.O. SARS" 13 - 29 July 1981.

by

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METHODS

Distribution and abundance of herring were estimated by aid of sonar mapping, echo integration and trawling. In addition data for "in situ" measurements of target strength were collected. These data are not processed yet and have to await further analyses. A Simrad EK 400/38 scientific echo sounder, a Simrad QD digital integrator and a NORD-10 computer were applied for echo integration.

Settings and technical data:

Frequency:	38 kHz
Transducer:	30 x 30 cm, ceramic
10 log Ψ:	-21 dB
TVG and Gain:	20 log R + 2·0.008·R -10 dB
Deviations from theoretical TVG:	< 0.5 dB at the actual depths.
Threshold:	50 millivolt

Bandwith; 3.3 kHz, pulse length; 1.07 millisecond

Source level + Voltage response: 134.9 dB, measured by aid of a 60 mm copper sphere with -33.7 dB target strength as described by Foote, Knudsen, Vestnes, Brede and Nielsen (1981).

The sonar was run at 1250 m basic range, 3^{o} tilt and auto training in 3^{o} steps within 30^{o} on each side.

For sampling and identification of echo recordings three different trawls were used; one pelagic trawl with maximum opening of 16 x 16 m, one pelagic trawl with maximum opening of 25 x 25 m and one bottom trawl with maximum opening of 20 x 6 m.

Hydrographic measurements were made with a CTD-zonde and zooplankton samples were taken with a Juday net.

For each trawl catch the species and size distribution was established. Stomacs were preserved from cod, haddock, whiting, saithe and mackerel. Length, weight, sex, maturity stage and otholits were taken from 100 individuals from each significant catch of herring.

Integrator readings were allocated to four categories: Herring, bottom fish, 0-group fish and plankton. The allocation were mainly based on the appearance of the recordings, supported by frequent trawling.

Average integrator values ($\bar{M}$) were calculated within 225 (n.mile)^2 squares. The herring biomass (B) within squares was estimated as $B = \bar{M} \frac{0.84}{24} \bar{L} \cdot 225$ (tonnes) where $\bar{L}$ = average fish length (cm). The conversion factor $\frac{0.84}{24} \cdot \bar{L}$ is based on an average target strength of -34 dB per kg for 24 cm herring and a -10 log $\bar{L}$ length dependence for average target strength per kg, (Bailey et al. 1980).

RESULTS

Figure 1 shows the survey grid and stations. A 10 mile grid (10 n.mile between parallell track lines) was run through most of the area. This was increased to 5 mile grid in areas with good herring recordings.

In the Shetland area (East of 4^{o}W) all the recordings identified as herring were dense schools typically extending from 20 to 60 m depth occurring clearly seperated from other fish recordings. During a couple of hours of darkness the schools slightly "loosened" but kept the school formation. Most of the schools

were found south-east of Foula and east of Somborough. Between first (15 - 20 July) and second (26 - 28 July) coverage of the area the schools had mooved slightly south-southwestward.

Smaller schools 5-10 m off bottom were recorded over wide areas, especially between 2° and 4°W. None of these were identified as herring. Both pelagic and bottom trawl hauls gave mainly Norway pout (0-gr), haddock and whiting (Table 1).

South of Sule Skerry and Rona (West of 4°W) the herring was, however, exclusively found in small schools close to bottom during daytime, while it raised about 20 m off bottom and scattered during the somewhat longer period of darkness in this area. The herring tended to be mixed with some haddock, whiting and gurnard (Table 2).

Figure 2 shows the distribution of echo sounder recordings and sonar contacts of herring along the track lines. The sonar was not run during the first 5 days of the cruise. The best sonar conditions were found in the area between Shetland and Orkney Islands where vertical temperature gradients were small. Schools detected in front of the vessel were often observed avoiding to the one or the other side when the vessel approached.

The estimated herring biomass within squares is shown in Figure 3. The total estimate for the covered area west of 4°W is about 40 000 tonnes. In the Shetland area the first coverage gave about 100 000 tonnes and the second about 70 000 tonnes.

The samples from the Shetland area showed larger (and older) herring than the samples west of 4°W. Length distributions are shown in Figure 4 and Table 3 shows the age compositions.

The herring in the Shetland area was more mature than in the western area. The last trawl haul (July 28) south of Shetland gave 9% with running gonads.

DISCUSSION

Because of the observed avoidance, a significant amount of schools may have been lost for echo integration. Too little data were collected to quantify this underestimation. More systematic use of sonar during later surveys may give an answer.

In the Shetland area where herring schools were clearly separated from other fish, the allocation of integrator values is believed to be precise. However, in the western area the allocations were more uncertain.

REFERENCES

BAILEY, R.S., AGLEN, A., CORTEN, A., DINER, N. and SIMMONDS, J. 1980. Report on the ICES-coordinated acoustic survey of Herring stocks in 1980. ICES C.M. 1980/H: 24.

FOOTE, K.G., KNUDSEN, H.P., VESTNES, G., BREDE, R. and NIELSEN, R.L. 1981. Improved calibration of hydroacoustic equipment with copper spheres. ICES C.M. 1981/B: 20.

Table 1. Trawl catches made by G.O.SARS east of 4°W.

	Haul No.	Position	Date	Hour (GMT)	Duration (min.)	Catches in kg		Predominant species
						Herring	Others	
Pelagic trawl								
	240	60°35'N 00°17'W	14/7	2250	20		6.5	Norway pout (0-gr)
	242	59°55'N 00°52'W	15/7	1355	35		No catch	
	243	59°55'N 00°39'W	15/7	1610	50		6.3	Haddock
	244	59°56'N 00°46'W	15/7	2335	55	40.3	3.3	Herring
	245	59°45'N 01°15'W	16/7	0250	45	2.0	0.6	Herring
	247	59°05'N 00°05'W	17/7	0100	20		16.0	Norway pout (0-gr)
	248	58°45'N 02°12'W	17/7	0900	60		101.5	Whiting
	250	59°30'N 02°29'W	18/7	0250	60		35.3	Whiting
	251	59°29'N 02°29'W	18/7	0400	25		0.3	Whiting
	252	59°39'N 04°00'W	18/7	0940	20		3.3	Gurnard
	255	59°52'N 04°00'W	18/7	2350	20		No catch	
	256	59°43'N 02°33'W	19/7	2310	20	4000.-	+	Herring
	257	60°25'N 00°28'W	20/7	1725	30		+	Norway pout (0-gr)
	258	60°58'N 00°49'W	20/7	2215	20		57.6	Norway pout (0-gr)
	261	60°52'N 01°12'W	21/7	2135	15		50.0	Norway pout (0-gr)
	262	61°03'N 01°13'W	22/7	0035	30		202.2	Norway pout (0-gr)
	265	60°20'N 01°57'W	23/7	0040	45	1500.-		Herring
	266	59°51'N 01°31'W	23/7	0130	20		2.0	Whiting
	286	59°47'N 01°52'W	28/7	0140	50	34.1	11.9	Herring
	288	59°53'N 00°57'W	28/7	1430	30		+	Haddock (0-gr)
Bottom trawl								
	239	60°45'N 00°16'W	14/7	1750	60		195.5	Haddock
	241	60°15'N 00°02'W	15/7	0650	60		156.-	Haddock
	246	59°25'N 01°17'W	16/7	1330	60		204.6	Haddock
	249	59°29'N 01°27'W	17/7	1800	60		62.7	Whiting
	253	59°40'N 03°01'W	18/7	1345	45		108.5	Cod
	254	59°45'N 02°30'W	18/7	1730	30		26.7	Haddock
	259	60°47'N 01°43'W	21/7	0850	40		65.4	Haddock
	260	60°44'N 02°13'W	21/7	1315	30		144.5	Norway pout
	263	61°08'N 01°18'W	22/7	0345	30		172.1	Norway pout
	264	60°21'N 01°59'W	22/7	1435	15		22.2	Lesser-spotted dogfish
	284	59°47'N 02°29'W	27/7	1055	60		54.6	Lesser-spotted dogfish
	285	60°00'N 02°10'W	27/7	1830	30		51.3	Haddock
	287	59°47'N 01°30'W	28/7	0835	30		20.6	Haddock

Table 2. Trawl catches made by G.O.SARS west of 4°W.

Haul No.	Position	Date	Hour (GMT)	Duration (min.)	Catches in kg Herring	Catches in kg Others	Predominant species
Pelagic trawl							
267	59°10'N 04°00'W	23/7	1155	30		0.3	Haddock
269	58°40'N 05°55'W	23/7	2300	40	0.2	12.4	Gurnard
270	58°40'N 06°00'W	24/7	0025	20	450.-	18.5	Herring
272	58°51'N 05°50'W	24/7	1010	60	4.3	2.6	Herring
274	58°46'N 05°48'W	25/7	0320	30	2.0		Herring
275	58°46'N 04°54'W	25/7	0650	50		2.4	Haddock
277	58°45'N 04°55'W	25/7	1105	45		0.4	Haddock
278	59°18'N 04°49'W	25/7	1535	30		No catch	
279	58°58'N 04°20'W	26/7	0445	110	0.1	16.1	Norway pout (0-gr)
280	59°15'N 04°14'W	26/7	1510	30		6.5	Whiting
282	59°30'N 04°43'W	26/7	2155	15		10.9	Norway pout (0-gr)
283	59°35'N 04°35'W	27/7	0100	30		10	Norway pout (0-gr)
Bottom trawl							
268	58°42'N 06°05'W	23/7	2200	15	32.0	137.8	Haddock
271	58°51'N 05°40'W	24/7	0825	45		50.1	Haddock
273	59°20'N 06°20'W	24/7	1810	60		441.5	Sheppy argentine
276	58°46'N 04°52'W	25/7	0900	60		133.7	Haddock
281	59°26'N 04°30'W	26/7	1840	60		91.2	Whiting

Table 3. Age composition (%) in samples taken by "G.O. Sars" July 1981.

Year Class	79	78	77	76	75	74	73	<73	No. of oto-liths
Age (winter rings)	1	2	3	4	5	6	7	>7	
East of 4°W	0.4	0.4	3.8	33.6	10.9	7.6	41.2	2.1	238
West of 4°W	0	12.5	47.9	26.7	4.2	0.4	8.3	0	240

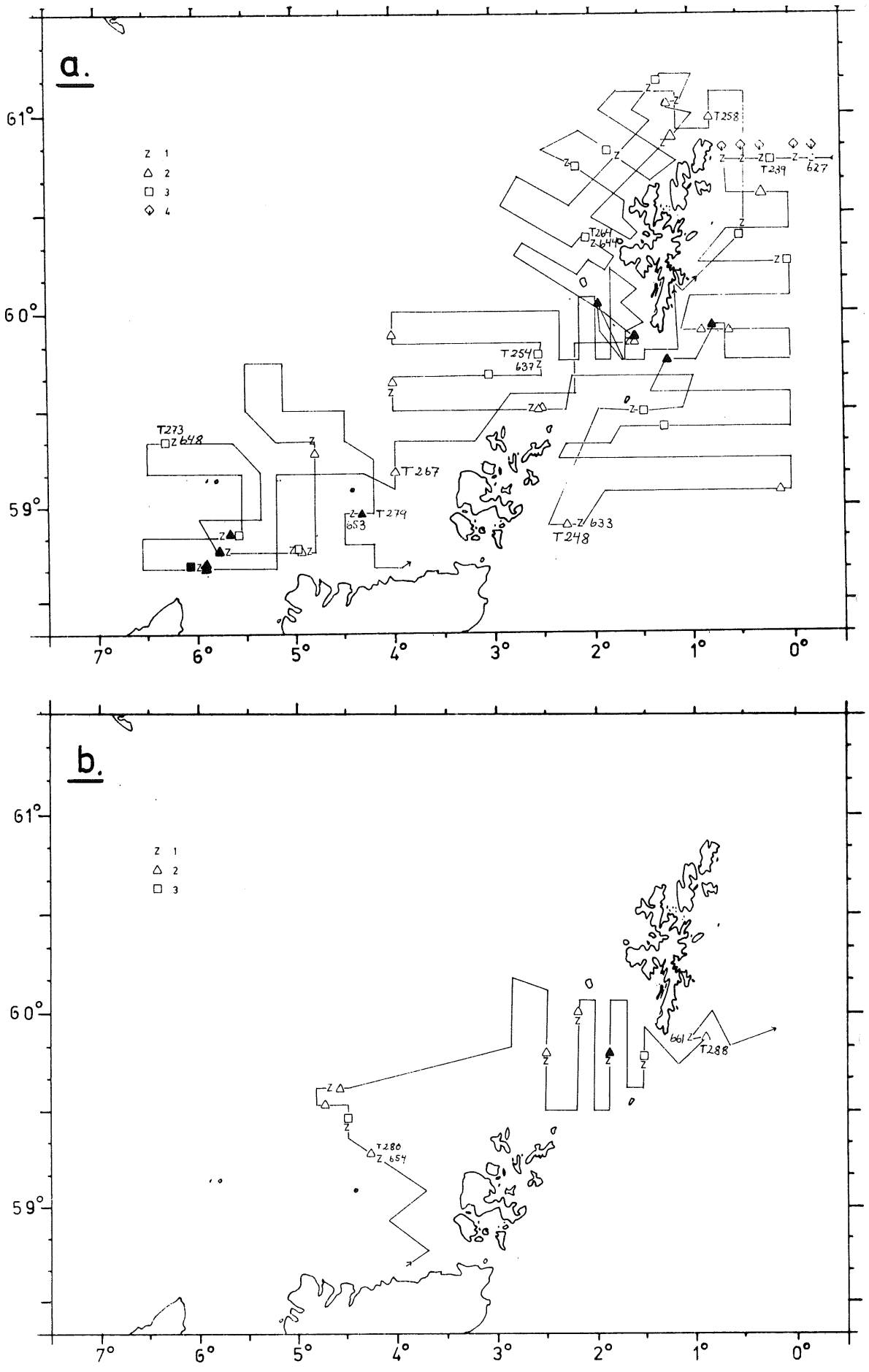


Figure 1. Survey grid and stations "G.O. Sars". 1: Hydrographic station, 2: Pelagic trawl, 3: Bottom trawl 4: Zooplankton sample. Black symbols means catches of herring.

a. July 14 - 26

b. July 26 - 28

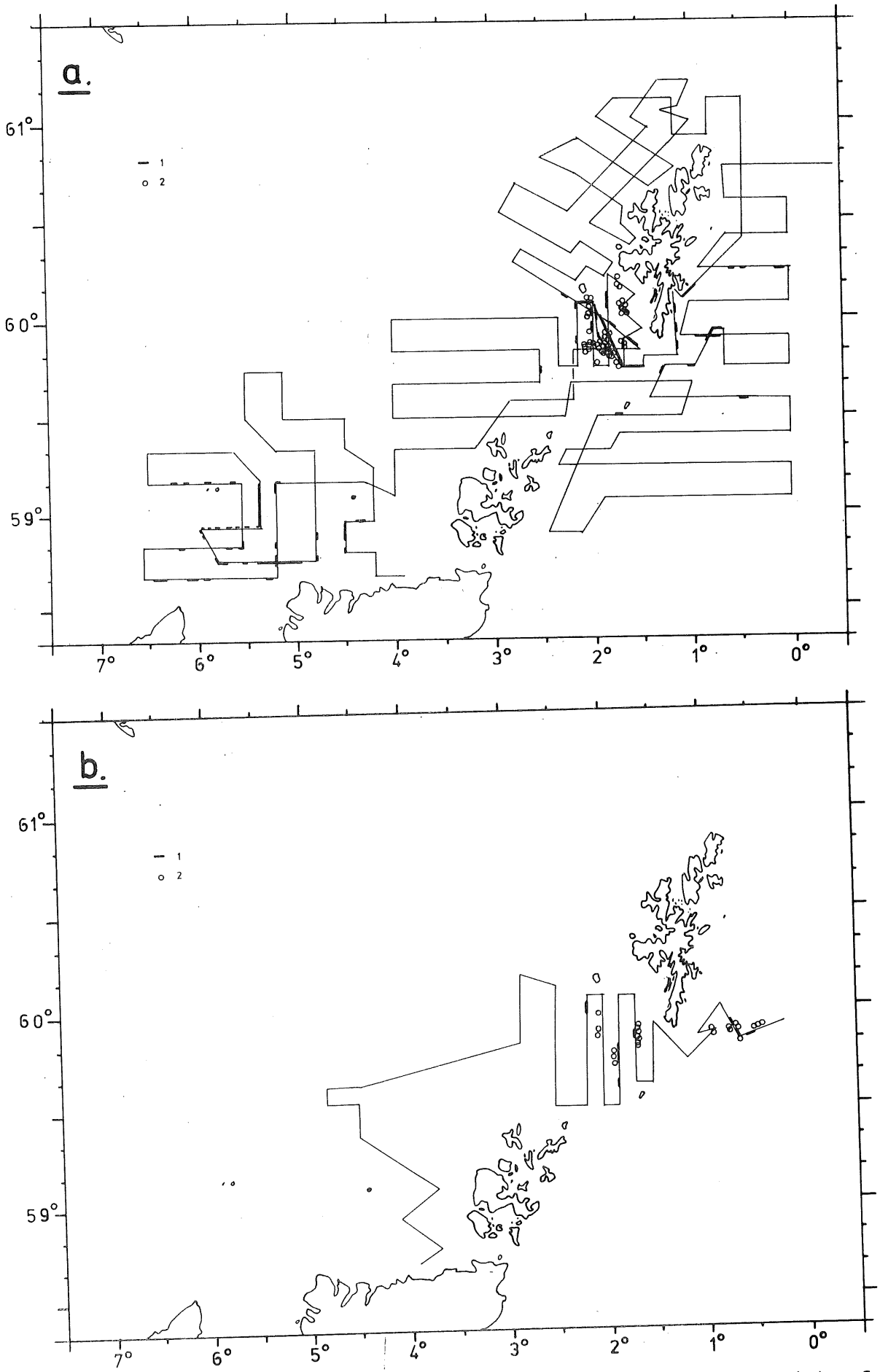


Figure 2. Echo sounder recordings (1) and sonar contacts (2) of herring, "G.O. Sars".

a. July 14 - 26

b. July 26 - 28

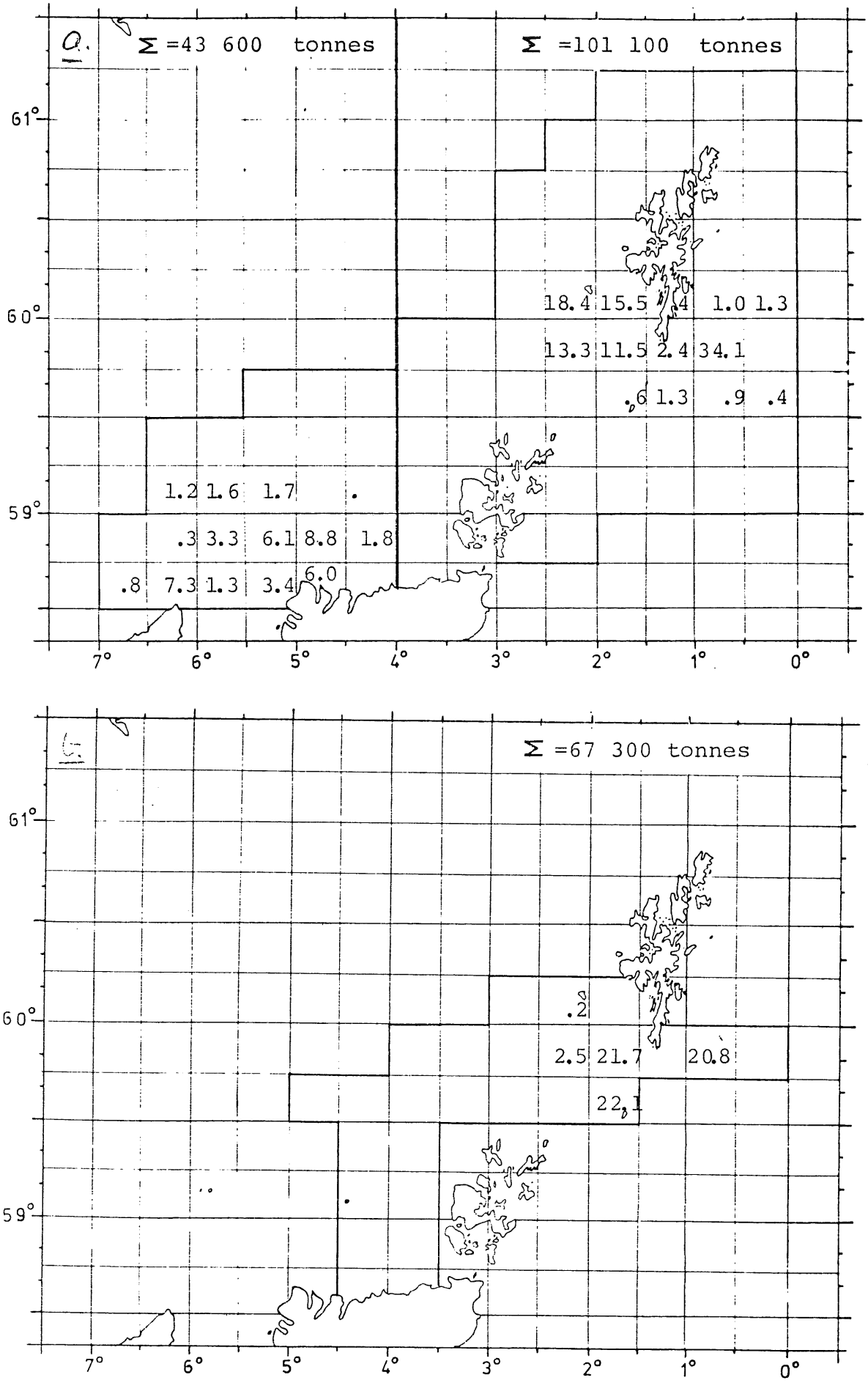
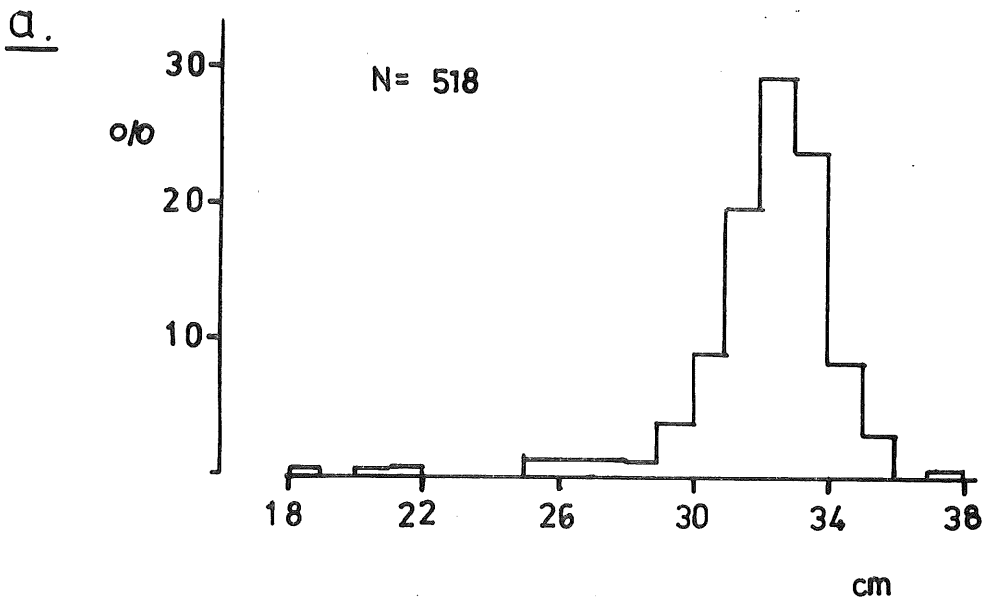


Figure 3. Estimated biomass (1000 tonnes) within squares, "G.O. Sars".

a. July 14 - 26

b. July 26 - 28



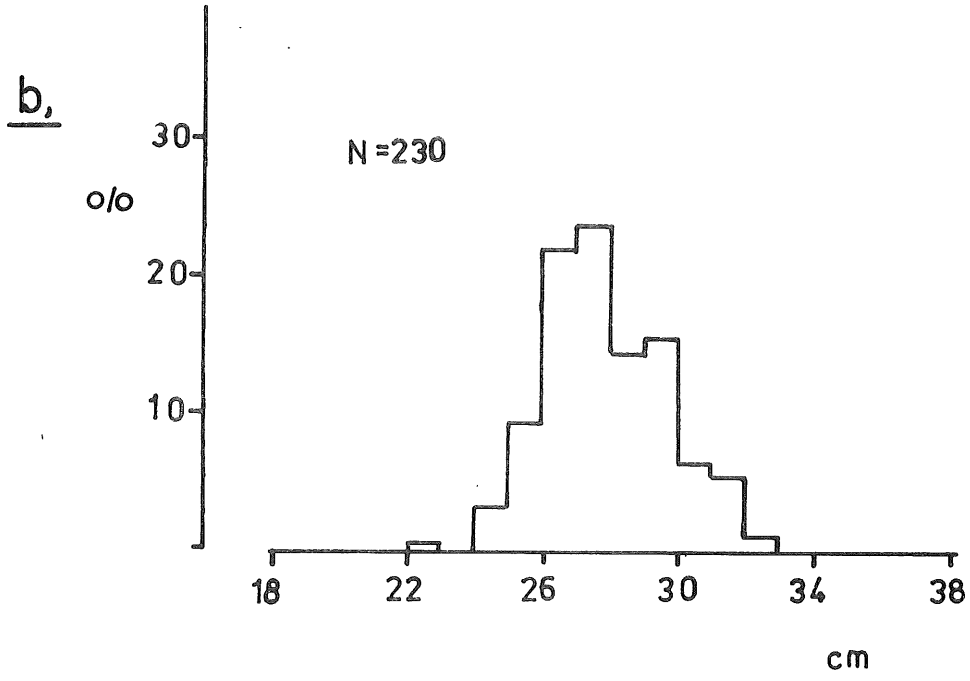


Figure 4. Length distribution of herring, "G.O. Sars".
(N = number measured)

a. East of 4°W

b. West of 4°W