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REPORT OF THE JOINT NORWEGIAN-RUSSIAN ACOUSTIC SURVEY ON BLUE WHITING, SPRING 1992

by

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ABSTRACT

The third joint acoustic survey by research vesseles from IMR, Bergen and PINRO, Murmansk, on blue whiting in the spawning area was carried out in the period 17 March - 12 April 1992. The continental slope area west of The British Isles was surveyed in south-north direction by one vessel and in north-south direction at the same time by the other vessel. A ship-to-ship calibration of the acoustic instruments was performed in the mid-area, and the results used as basis for combination of the data collected. The geographical distribution of the stock was obtained for two different periods and hence the northward migration of post-spawners illustrated.

The spawning stock size was assessed to 4,3 mill. tonnes, which is at the same level as in 1991. The numerous 1989-yearclass, which already in 1991 recruited significantly to the spawning stock, had increased its contribution in 1992, and dominated the stock with more than 60 % in numbers.

In the northern and the cental areas the temperatures in general were the same as last year. In the southern area, however, the temperatures were slightly different from last year with colder water in the west, and some warmer in the east and southeast of the area.

The blue whiting gonads were found to be mature 1-2 weeks earlier than last year, i.e. back to a more normal schedule again.

INTRODUCTION

During the last two decades both Norway and USSR have more or less regularly conducted acoustic surveys on blue whiting west of the British Isles in the spring . Though radio connection was kept during the surveys, and exchange of information took place, separate estimates of the spawning stock size were presented in these years.

The third joint survey on blue whiting during spawning season was carried out during the period 18 March - 12 April 1992 by research vessels from IMR, Bergen and PINRO, Murmansk.

In 1990 the first joint survey was carried out on a more formal basis. The timing, however, of the two vessels area coverage, was rather unpresice and two separate estimates were presented also that year (Anon., 1991). In 1991 the timing was much better, and for the first time a combined assessment of the spawning stock was made (Monstad and Belikov, 1991).

The goals for the surveys are to obtain reliable estimates of the blue whiting spawning stock size, to have the geographical distribution pattern as well as the migration routes recorded to, get knowledge of the
stock structure in relation to length, age, maturity and condition, and to observe and register the hydrological conditions.

The acoustic instruments of the vessels had been pre-calibrated by the "Copper-sphere method" (Foote, 1981), and during the survey an inter-calibrabion between the two vessels were performed as well. This excercise gave valuable additional in situ information about the instruments' relationship, and the result was used as a basis for the combination of the two vessels data. The ship-to-ship calibration is described in Appendix.

MATERIAL AND METHODS

Planning for the survey started already at the post-survey meeting in 1991. As done for the previous joint surveys, further plans were then exchanged by correspondance, and the finalizing of details and comparison of results so far, took place at an open sea meeting in the middle of the survey when doing the intercalibration.

One vessel from each country participated:

R.V. "Pinro", Russia; 17 March - 14 April
R.V. "Johan Hjort", Norway; 18 March - 5 April

Log-data of cruise track and stations, together with informations of recordings and catches were exchanged daily by radio communication. The biological, acoustic and hydrological data were exchanged at the open sea meeting for the first half of the survey, and by mail for the second half. A post-survey meeting was held in Bergen for discussion and combination of the results and for preparation of the common survey report.

Due to extremely bad weather conditions, the two vessel could only start the survey several days later than planned. While "Pinro" then covered the area from north to south, "Johan Hjort" at the same time criss-crossed from south to north. This way the area in question was covered half the time period needed if both vessels had sailed at more or less parallell courses starting either from north or from south. A more synoptical picture of the geographical distribution was also obtained.

The shelf edge area west of The British Isles was covered between 50^0 and 62^0 N including the Porcupine and the Rockall banks (Fig.1 and 2).

Echo recordings were identified by the use of bottom and pelagic trawls, and biological samples were collected. Norway used a bottom trawl of 18 x 4 m opening and two pelagic trawls of 15 and 35 m vertical opening respectively. All of these had 11 mm mesh sized innernet in cod-end. The Russian vessel used a pelagic trawl with 45 m vertical opening and an innernet of 16 mm mesh size.

The setting of the acoustic instruments are given in Table 1 of the Appendix. While "Johan Hjort" used an EK-500 echo sounder connected to the BEI-system, "Pinro" used an EK-400 echo sounder connected to a Siors integrator. The recordings, given in terms as reflected square meters per square nautical mile based on copper sphere calibration, were continously integrated. These were allocated to species or group of species for each 5 nautical mile.

The area surveyed was handled as six separate subareas and further divided into rectangles (Fig. 5). The method used for the acoustic estimation was the same as for previous blue whiting surveys, for instance Anon. (1982), Monstad (1986) and Belikov et al. (1990), with the target strengt value of:

$$TS = 21.8 \log L - 72.8 \text{ dB}$$

where L is fishlength. For a 30 cm fish (cod) this give the density coefficient value of:

$$C_F = 1.488 \times 10^6 \times L^{-2.18}$$

The ship-to-ship calibration taking place in the middle of the survey, resulted in a relationship of:

$$Sa_{J.Hjort} = Sa_{Pinro} \times 1.38$$

for the depth layer 400 - 500 m, in which the majority of the blue whiting was recorded.

The estimates of abundance and biomass were made separately by either country, and the results combined on a subarea basis. This way of surveying the area, with one vessel starting from the north and the other one at the same time from the south, enabled the results to be combined for two separate periods, i.e. before and after 28 March when the two vessels met approximately at latitude 55^0 30′ N:

Period I: 17 - 28 March, "Pinro" in north
"Johan Hjort" in south.

Period II: 28 March-12 April, "Johan Hjort" in north
"Pinro" in south.

Nevertheless the stock size estimate was obtanned from the results of the first period.

The hydrological condition was observed by use of CTD (Neil Brown), observing the temperature and the salinity from sea surface to bottom in the shelf area, and down to 600 or 1000 m in the deep sea area further west.

RESULTS AND CONCLUSION

Distribution

Blue whiting was as usual recorded along the shelf edge area from south of Ireland to northeast of Shetland. During the first period, i.e. 17-28 March, the zero-line of the geographical distribution was not reached neither in the south nor in the north (Fig.3). While it continued along the shelf toward the Bay of Biscay in the south, it continued toward the continental shelf area west of Norway in the north.

In this time period the majority of the stock was distributed in the southern part, i.e. over the Porcupine bank area west and southwest of Ireland. More than 5 time the biomass was located in this area south of the latitude $55^0 30'$ N, than in the northern part. The highest density was actually found along the slope southwest of Ireland, at latitude $50^0 30'$ N, but very dense recordings were also obtained at the northern part of the Porcupine bank. That was around the position 54^0 N and 13^0 W where the commercial fishing fleet operated at that time.

In the north the recordings was not as continuously as in the south. The distribution was mostly scattered, and in an area northwest of The Hebrides blue whiting had not yet reached the slope. On the Rockall bank only extremely veak recorings of blue whiting were made, and due to lack of biological informations this observations are nonot includede in the total estimate.

During the second time period, i.e. 28 March - 12 April, the pattern of distribution had changed notably (Fig. 4). In the north the recordings of blue whiting were made more or less continuously. More blue whiting had come within the shelf edge area, and the highest density was here found north of St. Kilda at latitude $58^0 30'$ N.

In the south the distribution area had split up and shrinked in size, especially south of 53^0 N. The absolute highest densities were found at the northern part of the Porcupine bank. The very good concentrations, located during the first period near the shelf edge southwest of Ireland, were gone and the zero line in this area was now defined.

This change in the distribution pattern, with concentrations being more easterly located than usual, was also observed in 1991, and could be due to changes in the hydrological situation. The high concentrations in question were, however, located further north in 1991, i.e. between 52^0 and 51^0 N, and only a minor part was found south of 51^0 N (Monstad and Belikov, 1991).

Stock size estimates

The biomass estimates of the total blue whiting observed during the first period, 17-28 March, are shown on a rectangular basis on Fig. 5, together with markings of the various subareas used. The assessment of the combined results gave a biomass of 4.6 mill. tonnes, or an abundance of 40.2 x 10^9 individuals. Of this 4.3 mill. tonnes and 36.9 x 10^9 individuals belonged to the spawning stock.

The area west and southwest of Ireland is considered a mixing area for the southern, the northern and some smaller local blue whiting stocks. The absolute majority of blue whiting in this area is, however, considered by the Working Group to be of northern origin (Anon., 1986).

The dense concentrations south of 51^0 N represented 933 000 tonnes alone, which is 22 % in weight of the total biomass observed. When no biological characters were found to give evidence of these belonging to other stocks, they were allocated to the northern one. In 1991, when contributions from this area were allocated to other stocks, only 33 000 tonnes of blue whiting, or less than 1 % of the total stock, were then observed here.

The estimates by subareas and total are given in Table 1 for the first period of time , and the absolute length and age distribution in Table 2. In the south (subarea I-III) only 61 000 tonnes, or less than 2 % in weight were found to be immature, while in the north 123 000 tonnes, or 18 % were immature.

For the second period, only poor biological data were avaible, and hence a thrustful assessment of the stock size was not recommandable. Nevertheless a rough estimate gave indications of a stock size of 4.2 mill.tonnes during this period, i.e. at the same level as observed during the first period.

Throughout the spawning season the blue whiting create a dynamic distribution pattern in the spawning area. Mature blue whiting appear in the spawning area at the same time as postspawning individuals are disappearing. Hence the spawning stock, which is more or less constantly in a moving state, is very difficult to measure exactly. The results therefore naturally are as much depending on the time period chosen within the spawning season, as is the size of the area surveyed. Acoustic estimates of the spawning stock will therefore allways be underestimates.

The assessment for the spawning stock size of 4.3 mill. tonnes, is at the same level as the one obtained in 1991. The corresponding abundance estimates for 1991 and 1992 were 35.2 x 10^9 and 39.9 x 10^9 individuals respectively.

Stock composition

The distribution of length and age divided on subareas are shown on Fig. 6 for the first period. The age of the blue whiting varied from 1 to 10 years old, with the 3 year olds (1989-yearclass) dominating in all of the subareas. In the northern, as well as in the southern part of the area investigated, more young fish, i.e. 1 year olds, contributed more to the stock than they did in the middle part. In this area a significant contribution of 4 year olds occured.

The total length and age distributions are shown on Fig. 7. As mentioned above, the 1989-yearclass predominated, contributing in number with 63 % to the stock. As expected, this rich yearclass now recruits to the spawning stock in a notable way, and the difference from 1991 is significant when it only contributed with 23 % to the spawning stock.

On Fig. 8 is given the total weight-lenght relatonship for the whole survey period.

The blue whiting gonads were found to be approximately 1-2 weeks earlier mature than observed in 1991, and more or less at the same season maturation progression as in 1990 (Monstad and Belikov, 1991).

Hydrograpy

During the study period the meteorological situation consisted of SW and W cyclonic winds with speeds of 10-15 m/s predominating. Atmospheric pressure ranged from 950-970 mbars. In the beginning of April a movement of an anticyclone with an average pressure of 1000-1015 mbars was observed. The mean meteorological situation during the cruise was unfavourable.

The horizontal temperature distributions are shown in Fig. 9 A-D for the sea surface, 200 400 and 600 m respectively. In 1992 the highest temperatures (11.3-11.6 ^{0}C) were recorded in the south of the study area. In 1992, in the south of the study area, the temperature of the 0-200 m layer was generally higher than in 1991. In the area from the south of the study area to the south east of the Porcupine Bank, water temperatures of the 0-200 m layer were between 0.2 and 0.6^{0}C higher than in 1991.

In the western part of the Irish economic zone, however, temperatures of the 0-200 m layer were 0.2 to 0.4^{0}C lower than last year. This suggests that the Northern Atlantic current was weaker in 1992 than in 1991.

Generally, water temperatures were the same as last year in the central and northern parts of the study area.

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Table 1. Estimates of blue whiting by subareas west of The British Isles, spring 1992; Period I: 17-28 March. Combined results of R.V."Johan Hjort" and R.V."Pinro".

Subarea No.	Subarea Latitude	Square naut. miles	Abundance $N \times 10^{-6}$ Immat.	Abundance Mature	Abundance Sum	Biomass $t \times 10^{-3}$ Immat.	Biomass Mature	Biomass Sum	$\bar{w}$	$\bar{l}$	Density tonnes/ $n.mil^2$	Cond. factor
VI	Faroes/Shetl. 60°00′-61°30′	5557	1362	1362	2724	108	218	326	134.9	26.7	59	7.1
V	Hebrides- N 58°00′-60°00′	1492	494	529	1023	62	68	130	127.9	27.4	87	6.2
IV	Hebrides- S 55°30′-58°00′	3811	-	3722	3722	-	518	518	135.0	27.5	136	6.5
III	Porcupine- N 53°30′-55°30′	5525	31	12324	12355	3	1346	1349	109.2	27.6	244	5.1
II	Porcupine- M 51°30′-53°30′	13315	533	8182	8715	23	999	1022	117.3	28.1	77	5.0
I	Porcupine- S 50°00′-51°30′	5289	911	10740	11651	35	1176	1211	104.0	27.1	229	5.0
Total		34989	3331	36859	40190	231	4325	4556	113.0	27.5	130	5.4

Table 2. Total estimate of blue whiting west of The British Isles, spring 1992; Period I; 17 - 28 March. Combined results of R.V. "Johan Hjort" and R.V. "Pinro".

cm	years 1	2	3	4	5	6	7	8	9	10	Total N x 10^{-6}	Biomass t x 10^{-3}	$\bar{w}$
17	100										100	2.5	25.0
18	291										291	8.7	29.9
19	602	28									620	21.9	35.3
20	366	82									419	18.4	43.9
21	309	60									340	17.6	51.8
22	75	241	144								459	27.6	60.1
23	43	326	738								1095	72.3	66.0
24		457	1046	57							1550	116.9	75.4
25		26	3870	293							4027	351.8	87.4
26		81	6899	829	146						7561	720.3	95.3
27			6257	1461	180						7488	788.7	105.3
28			4081	1421	162	37	25				5210	617.1	118.4
29			1713	1332	511	85					3310	445.6	134.6
30			302	615	212	122	14	52			1248	188.0	150.6
31			46	537	219	217	82	5			1069	176.9	165.5
32			3	175	250	280	182	45	38		965	171.4	177.6
33				94	172	128	101	41	93		623	122.3	196.3
34				77	91	150	105	213	39		651	140.0	215.1
35					95	372	119	55	4		645	140.6	218.0
36					11	34	91	144			280	68.1	243.2
37						23	30		14		67	18.1	270.1
38						10			20		30	8.1	270.0
39							36	11	9		56	16.0	285.7
40								9	11		20	6.8	340.0
41									10		10	3.0	300.0
N	1786	1301	25099	6891	2049	1458	785	575	238		40182		
B	71.7	87.8	2556.6	885.3	337.3	281.4	160.5	125.2	50.4			4556.2	
$\bar{w}$	40.1	66.8	101.9	128.5	164.8	193.1	204.1	217.7	211.8				113.4
$\bar{l}$	20.0	22.3	27.0	28.7	30.6	33.2	34.1	34.7	35.1		27.5		

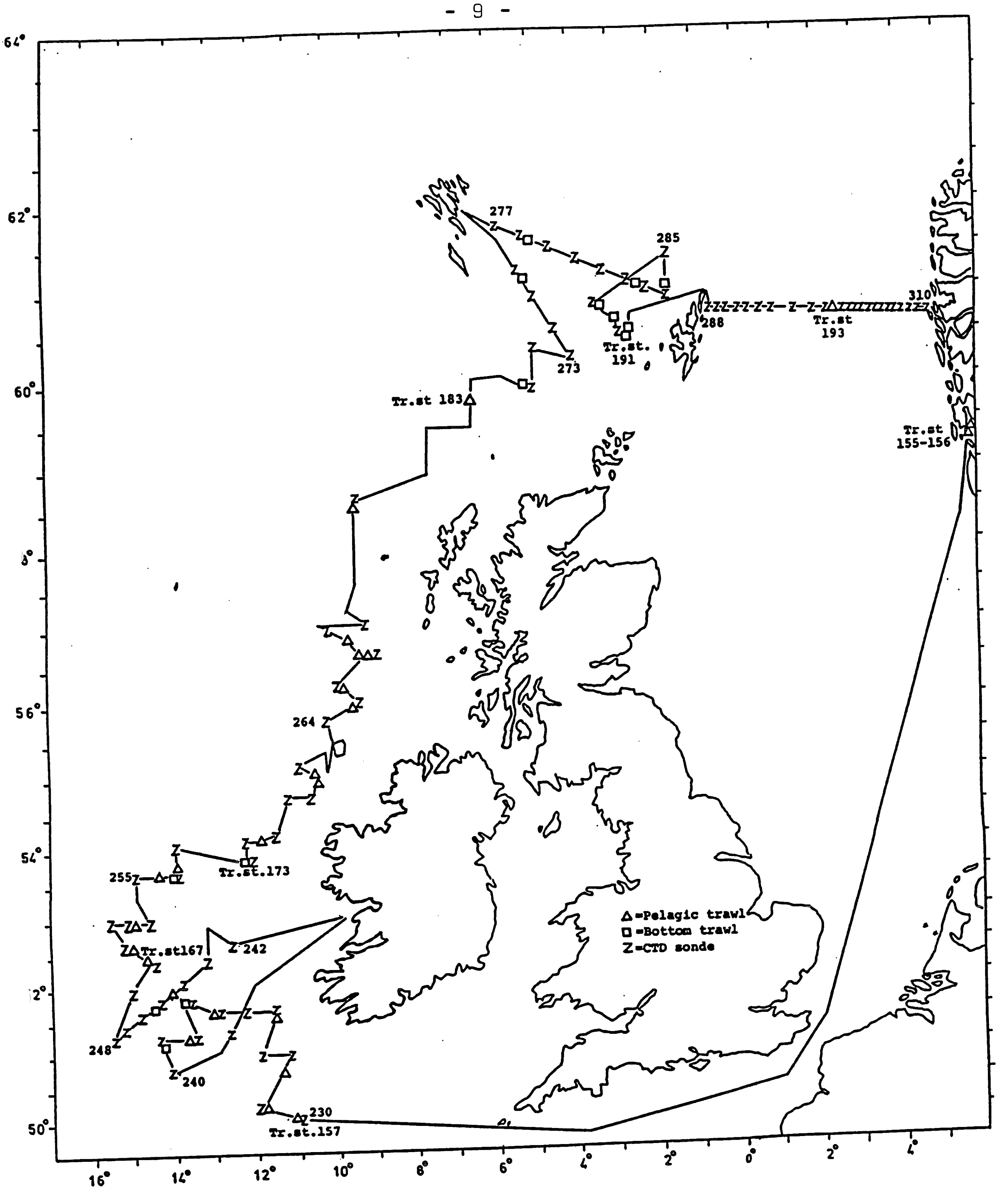


Fig. 1. Cruise track and stations of R.V. "Johan Hjort" 10 March - 6 April 1992.

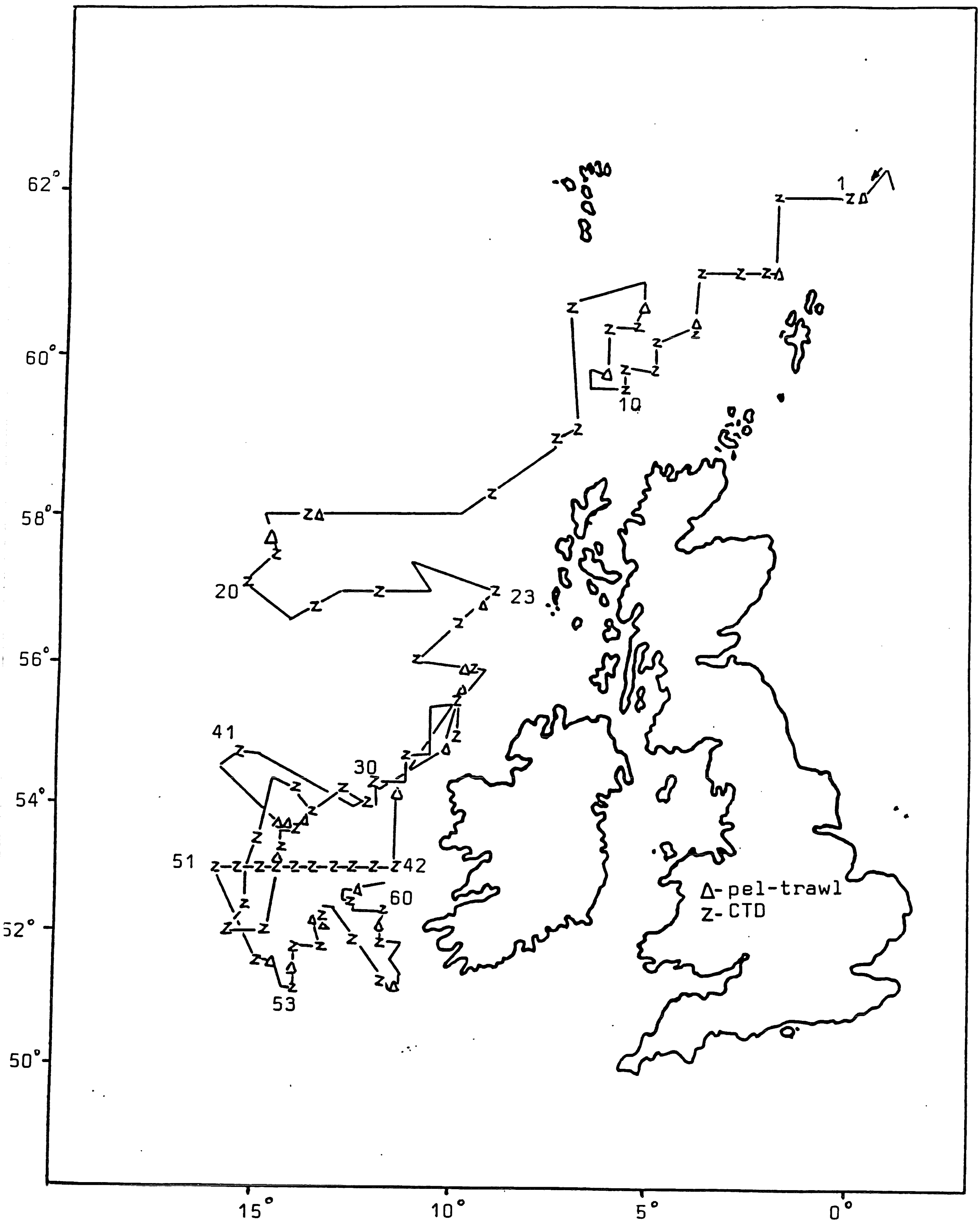


Fig. 2. Cruise track and stations of R.V. "Pinro" 17 March - 12 April 1992.

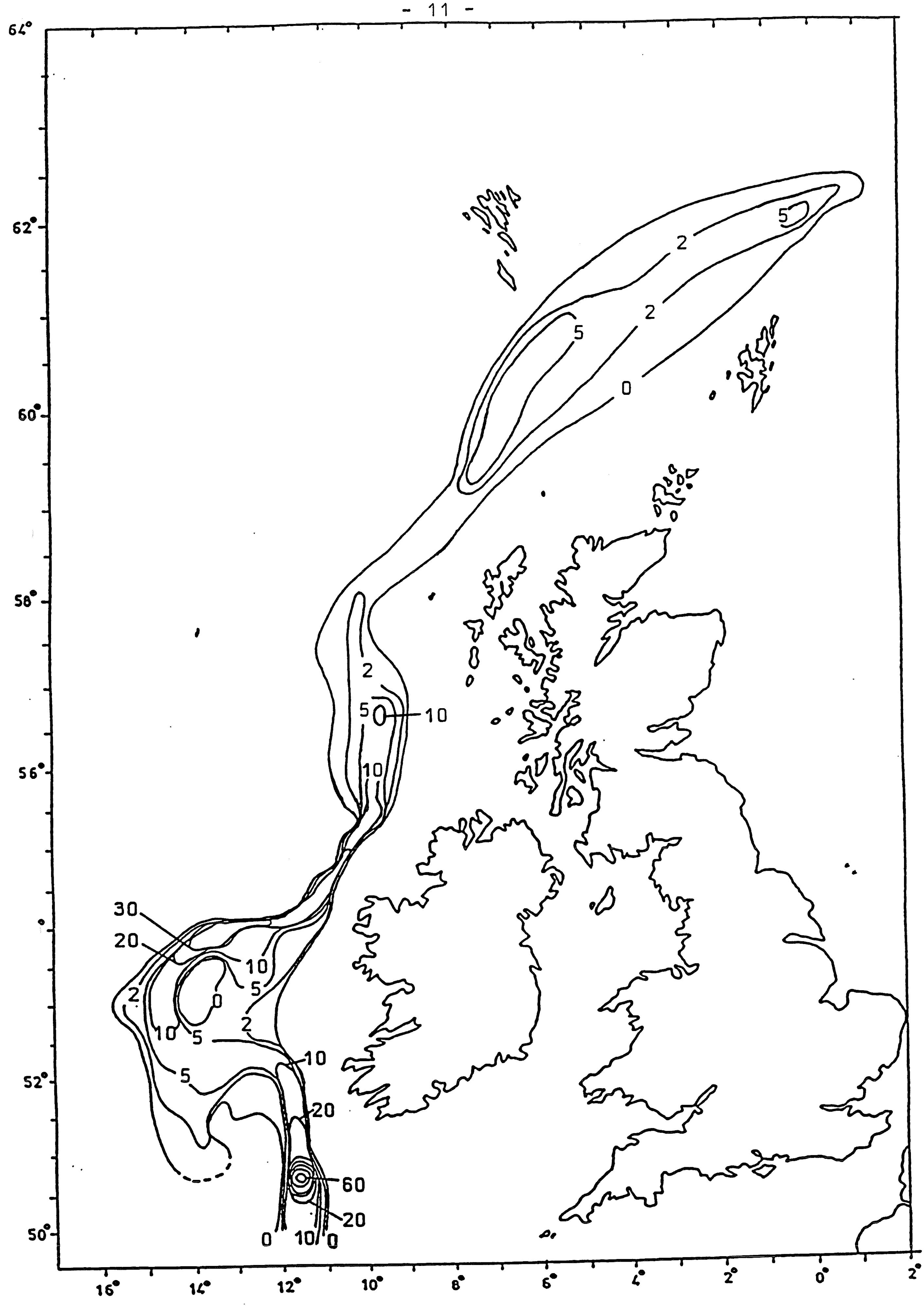


Fig. 3. Density distribution of blue whiting in spring 1992; Period I: 17 - 28 March. Combined recordings of R.V."Johan Hjort" and R.V."Pinro". Echo intensity in m² per (n.mile)² x 1/100.

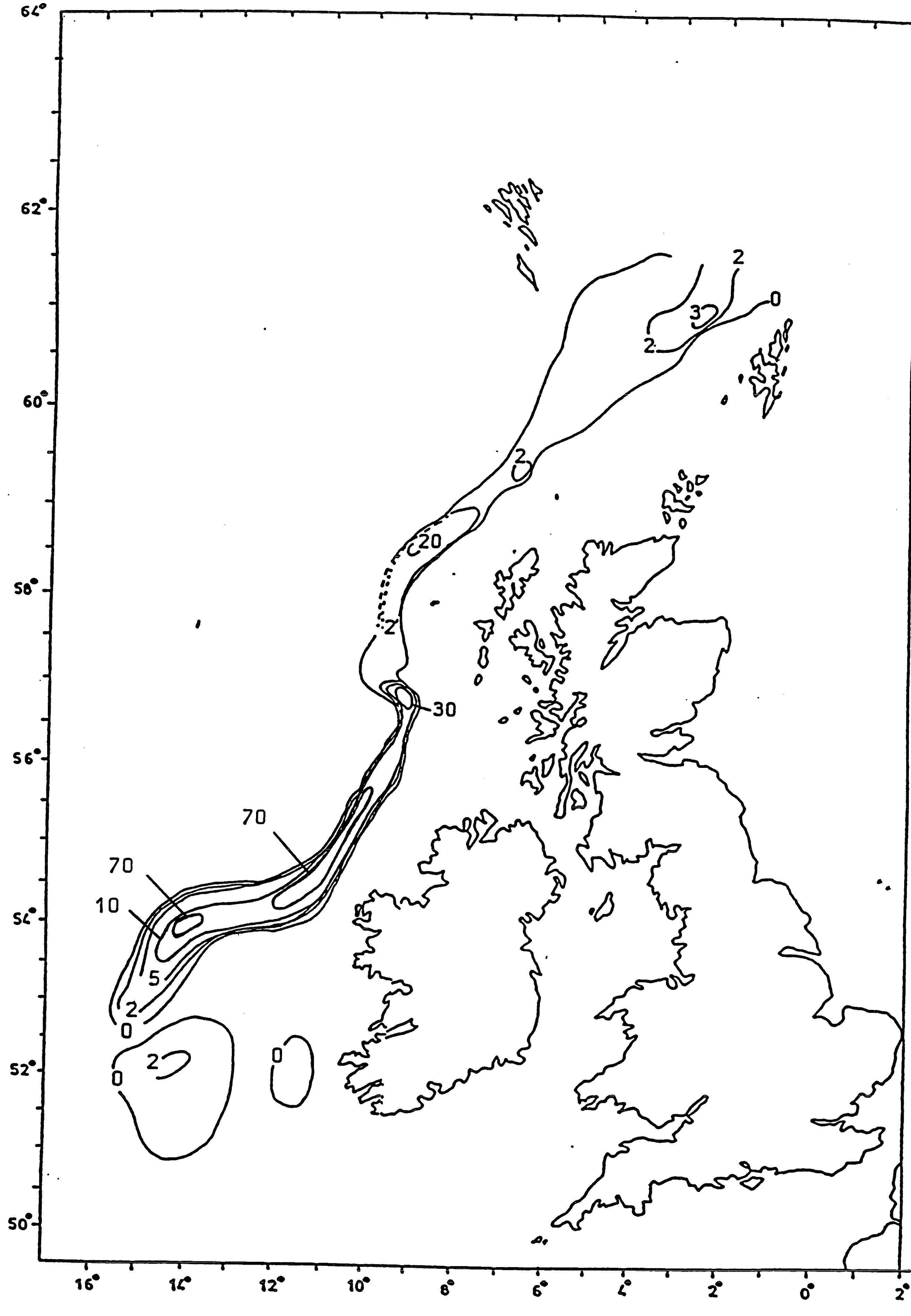


Fig. 4. Density distribution of blue whiting in spring 1992; Period II 28 March-12 April. Combined recordings of R.V."Johan Hjort" and R.V."Pinro". Echo intensity in m^2 per $(n.mile)^2$ x 1/100.

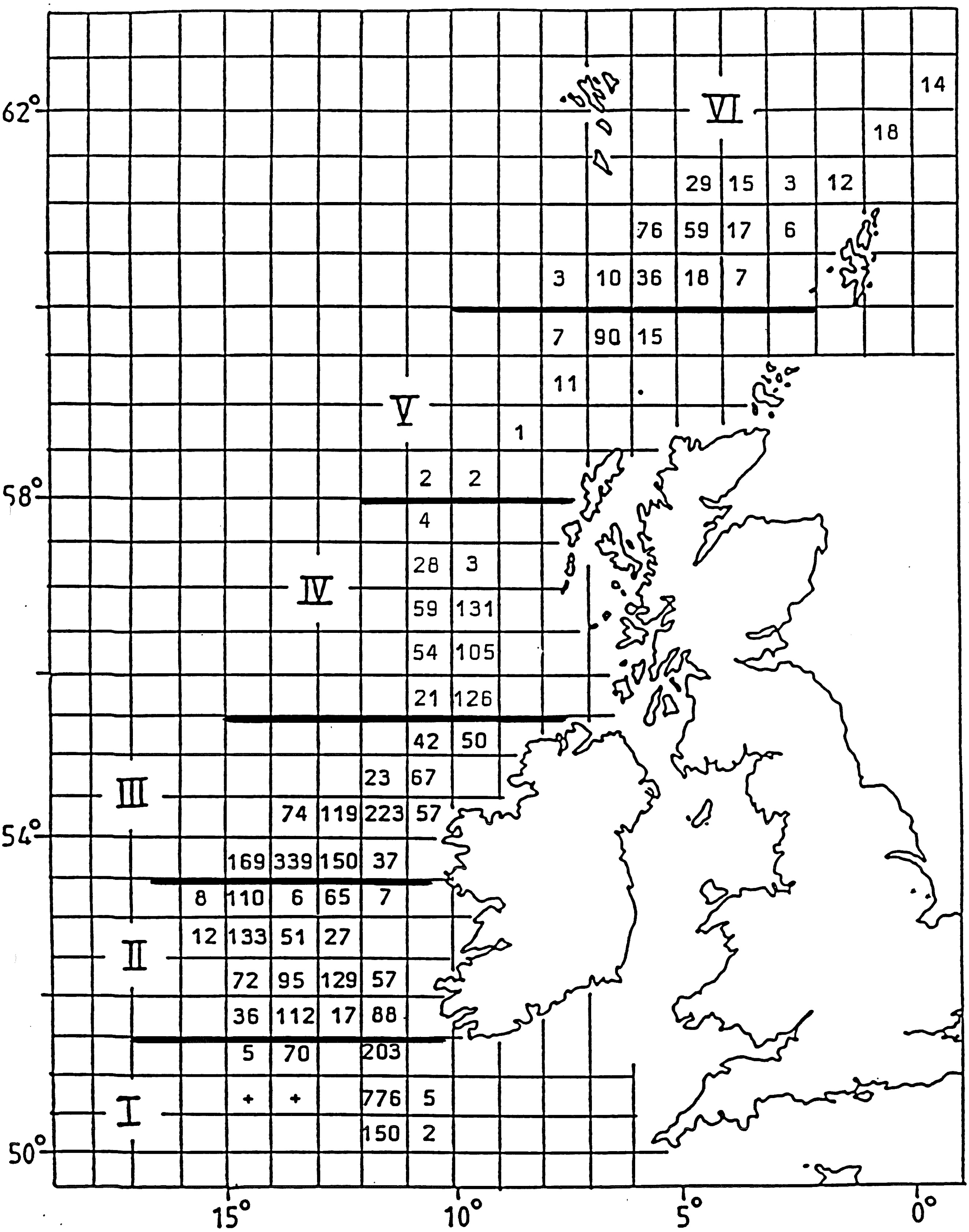


Fig. 5. Blue whiting biomass ('000 tonnes) in spring 1992; Period I: 17 - 28 March. Rectangles and subareas I - VI used in the assessments.

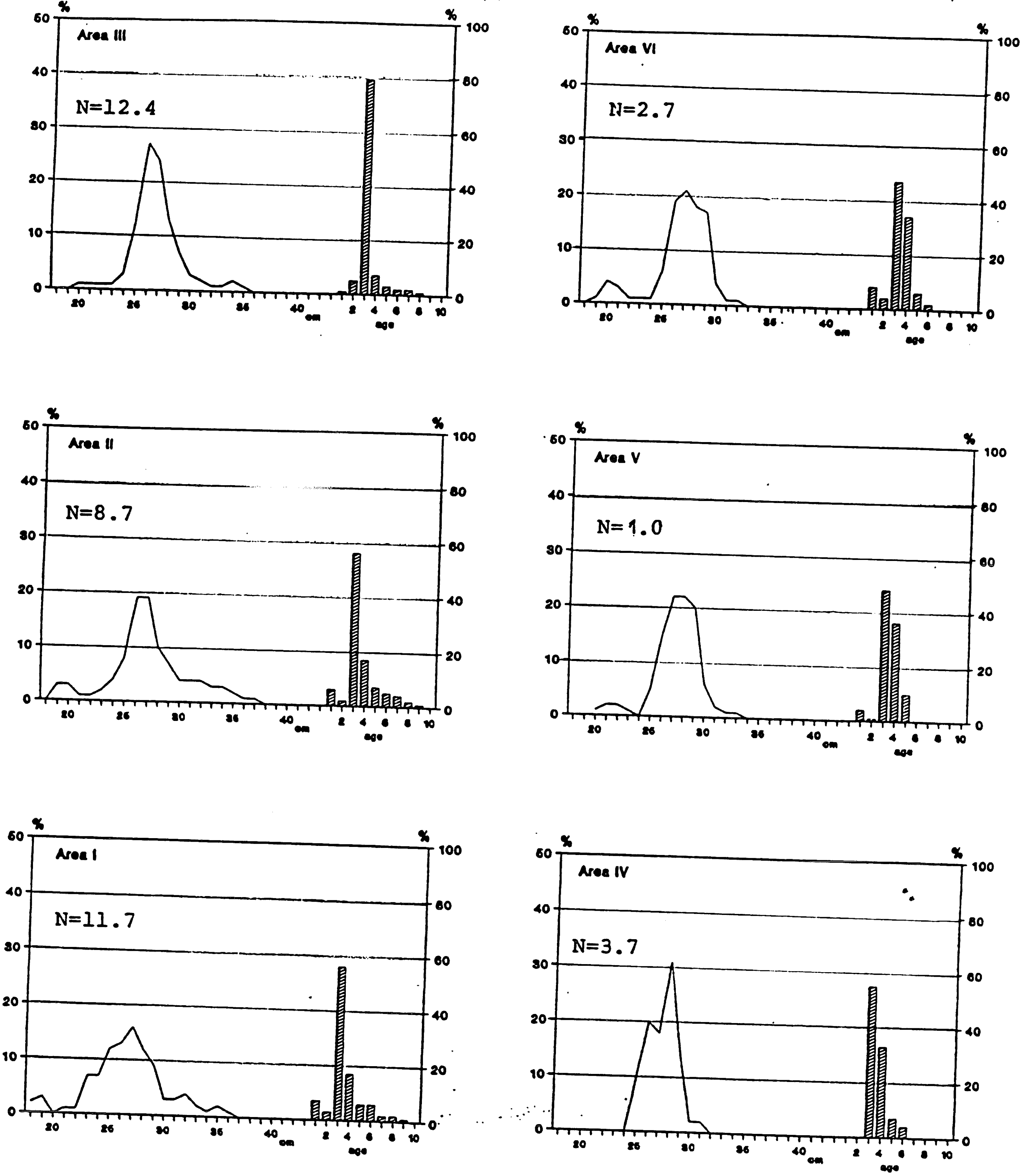


Fig. 6. Length and age distributions of blue whiting by subareas I - VI west of the British Isles in spring 1992; Period I: 17 - 28 March. N x 10^{-9}, weighted by abundance.

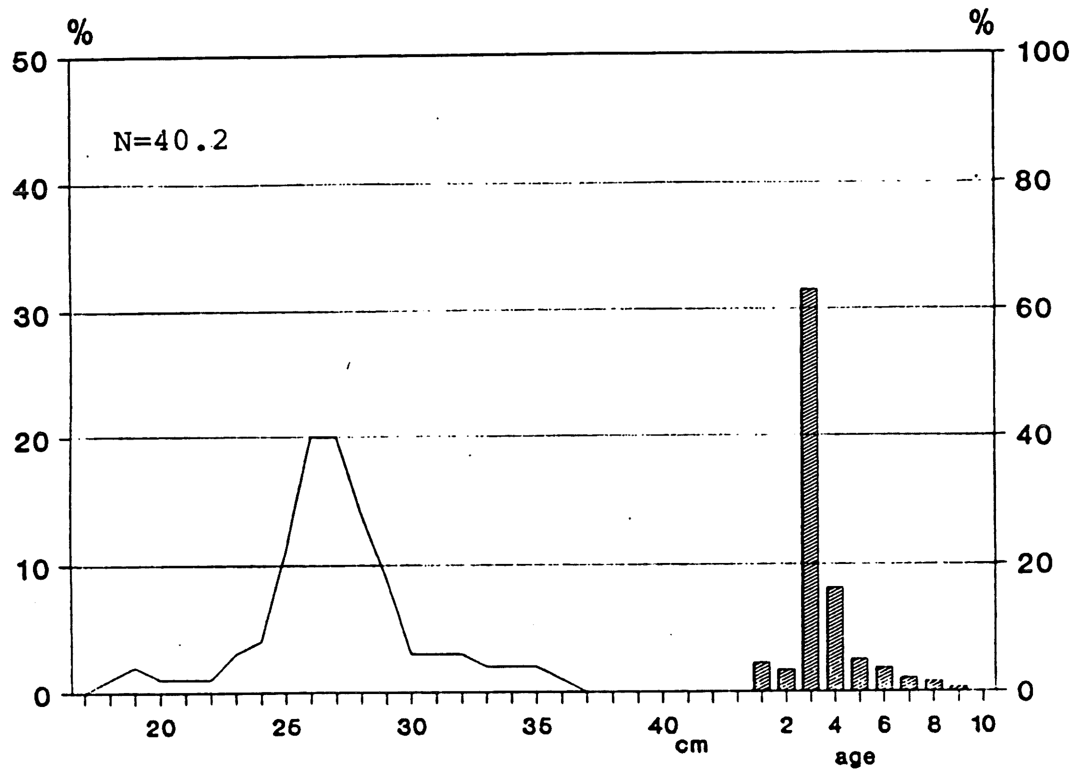


Fig. 7. Total length and age distribution (N %) of blue whiting in the area west of the British Isles, spring 1992; Period I: 17 - 28 March. N x 10^{-9}, weighted by abundance.

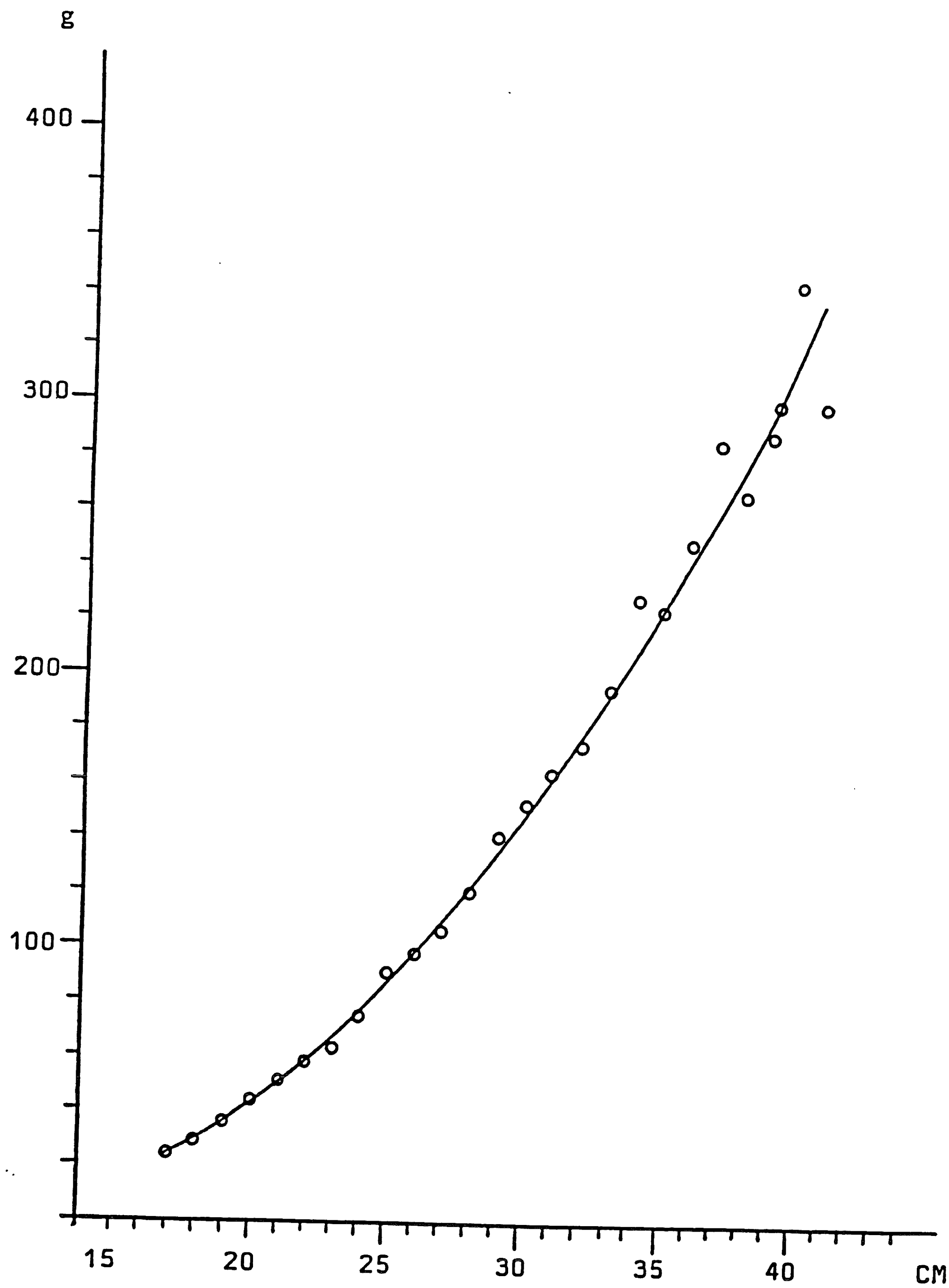


Fig. 8. Weigth - length relationship of blue whiting in the spawning area, spring 1992. Curve drawn by hand.

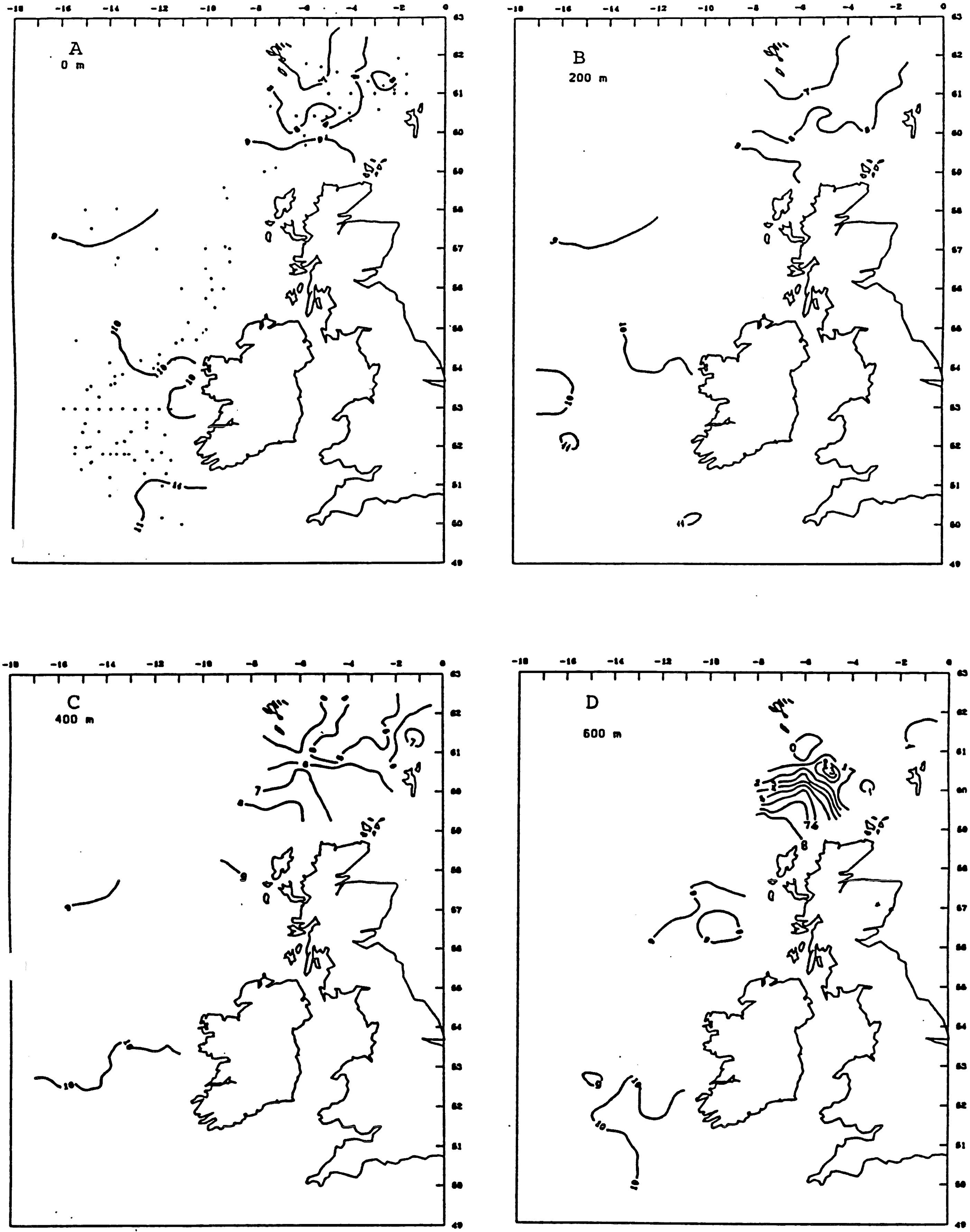


Fig. 9. Temperature, t⁰ C, at sea surface, 200, 400 and 600 m depths spring 1992. Dots in 10 A indicate positions of observations.

APPENDIX

INTERCALIBRATION BETWEEN R.V "JOHAN HJORT" AND R.V "PINRO" 28 March 1992

Introduction

The intercalibration was carried out in the afternoon of March 1992 on a 27 n. mile track between positions N 55°04, W 10°10 and N 55°30, W 09°44.

R/V "Pinro" was sailing in front and R/V "Johan Hjort" followed 0.5 n. mile behind and 10 degrees to the port side. The cruising speed was approximately 7 knots. The intercalibration was performed on varying concentrations of blue whiting and plankton at 400-600 m depth, and on smaller fish in the upper layer at 200-300 m depth.

The equipment and the setting of the instruments were the same as during the joint survey, and are given in the text-table below:

	"J. Hjort"	"Pinro"
Echo sounder	Simrad EK 500	Simrad EK 400
Frequency	38 kHz	38 kHz
Transducer type	ES38B/split	30 x 30 cheramical
Transducer beam	7,1° x 7,1°	8° x 8°
Transmitter power(nom)	2000 w	2500 w
Pulse length	1,0 ms	1,0 ms
Band width	3,6 kHz	3,3 kHz
Main area	0-500 m	0-500 m
Threshold	-82 dB	-74 dB
Area comp.	20 log R	20 log R
Absorbtion	10 db/km	8,5 db/km
Integrator	BEI/EK500	SIORS
Threshold	-82 db	-25 db/-68 dB (EK 400+SIORS)
Gain (output ref.)	40 dB	5 dB

Integration was done in four channels and the settings were:

Ch. 1	200-300 m
Ch. 2	300-400 m
Ch. 3	400-500 m
Ch. 4	500-600 m

For R.V."Pinro", however, the channels' width were 99 m.

The navigational log counter on board R/V "Johan Hjort" was used as a reference of distance, and the integrator reset function on R/V "Pinro" was operated for each nautical mile sailed, prompted by signals transmitted on VHF radio. The weather conditions were favourable during the entire performance.

Analysis.

A detailed analysis of the recording papers from both vessels was done on board R/V "Johan Hjort" and R/V "Pinro" by scientists from both vessels. The recording of each nautical mile were compared. Data from miles where the two vessels had obtained different recordings were deleted from further processing. The integrator values of R/V "Pinro" were changed by detail TVG correction inside each channel, as shown in Table 1.

The primary integrator values for all channels are shown in Table 2, the definitive integrator values for all channels are shown in Table 3. The deleted data are marked with an asterisk. As can be seen from this table, The values correspond satisfactorily, except perhaps for Channel 4, where correlation between values was lower. A possible reason for this is a difference in threshold - R/V "Johan Hjort" had recorded much more plankton and small organisms than R/V "Pinro" in this channel, and the voltage response of EK500 is higher than EK400/SIORS, and there is a difference in TVG functioning.

Results of the linear regression and geometrical mean linear regression, using the equations

$$Sa_{J.Hjort} = A' \times Sa_{Pinro} + B'$$

$$Sa_{Pinro} = A'' \times Sa_{J.Hjort} + B''$$

$$GMLR = (A'/A'')^{1/2}$$

are shown in the lower part of Table 4. GMLR is the geometrical mean between integrator values in the equations. Geometrical mean linear regression exclude the error because of irregular distribution measure values (Ricker W.E. 1973: "Linear Regressions in Fishery Research". J.Fish.Res.Board Can. 30: 409-434).

In Fig. 1. the integrator values for all four channels are displayed in succession for each n. mile sailed. A distribution diagram, where the values of R/V "Pinro" are plotted against the corresponding values of R/V "Johan Hjort" is shown in Figs. 2-6. The analysis shows a reasonably good correlation for channel 1 and a satisfactory correlation for channels 2,3 and for 3+4, but correlation between values in channel 4 was lower. A possible reason for this is lower TVG Range in echo sounder EK400. However, the arithmetical mean (AM) and the geometrical mean (GMLR) of the integrator values in the channel 4 for all 27 points and for 25 points (2 points were deleted), gives the same relationship (AM (AM = 1.39, GMLR =1.34-1.31), as the regression analysis in channel 3.

After several detailed discussions between Norwegian and Russian scientists, it was recommended that the following relationship should be used for the integrator values obtained during the spring 1992 blue whiting survey at 400-500 m depth:

$$Sa_{J.Hjort} = 1.38 \times Sa_{Pinro}$$

It is also recommended that the channel width for channel 4 should be 500-550 m in the future, because TVG Range equals 560 m in echo sounder EK400 on R/V "Pinro".

It is also recommended that the gain and the threshold settings of the instruments should, as far as possible, be the same for the participating vessels of future surveys.

APPENDIX

TABLE 1.

TVG CORRECTION FACTOR

R/V "PINRO"

ECHO SOUNDER EK400, RANGE COMPENSATION 20 LOG R, ABSORPTION 10.0 DB/KM

CH	DEPTH	DEPTH M	TVG CORRECTION FAKTOR	MEAN TVG CORRECTION FAKTOR	
1	200-300	200	1.38	1.45	1.46
		225	1.46		
		250	1.50		
		250	1.50	1.49	
		275	1.49		
		300	1.48		
2	300-400	300	1.48	1.54	1.58
		325	1.53		
		350	1.62		
		350	1.62	1.62	
		375	1.62		
		400	1.61		
3	400-500	400	1.61	1.64	1.70
		425	1.64		
		450	1.66		
		450	1.66	1.74	
		475	1.74		
		500	1.82		
4	500-600	500	1.82	1.78	1.88
		525	1.80		
		550	1.73		
		550	1.73	1.91	
		565	1.70		
		575	1.80		
		590	2.05		
		600	2.25		

APPENDIKS

TABLE 2..

NTERCALIBRATION JOHAN HJORT AND PINRO (28.03.92)   THE VERSION 1

	PINRO					JOHAN HJORT				
CH:	1	2	3	4	3+4	1	2	3	4	3+4
NM:	200-300 M	300-400 M	400-500 M	500-600 M	400-600 M	200-300 M	300-400 M	400-500 M	500-600 M	400-600 M
1:	24 *	9	217	255	472	398 *	44	404	402	806
2:	40	15	134	246	380	160	62	198	244	442
3:	68	21	204	276	480	121	91	499	271	770
4:	96	10	57	242	299	121	69	70	269	339
5:	0	27	67	182	249	14	68	185	227	412
6:	0	9	68	223	291	31	67	77	235	312
7:	0	9	47	204	251	6	37	40/46"	124	164/170"
8:	0	35	47	215 *	262 *	1	113	133	595 *	728 *
9:	0	18	58	195	253	20	15	93	169	262
10:	0	9	38	154	192	36	60	111	162	273
11:	8	9	48	245	293	16	34	83	252	335
12:	17	46	100	175	275	34	184	261	273	534
13:	59	45	98	253	351	173	134	192	267	459
14:	16	387 *	76	258	334	103	250 *	143	342	485
15:	196	44	67	247	314	454	138	171	309	480
16:	39	9	46	263	309	113	12	84	298	382
17:	98	58	198	339	537	109	118	263	317	580
18:	129	80	240	446 *	686 *	90 *	116	256	284 *	540 *
19:	53	46	75	118	193	86	184	180	205	385
20:	27	69	74	115	189	68	70	134	183	317
21:	282	122	110	164	274	244	148	177	225	402
22:	627	220	218	280	498	791	110	231	295	526
23:	68	21	34	184	218	101	77	80	229	309
24:	18	138	21	145	166	56	329	72	223	295
25:	46	168	54	188	242	41	434	157	278	435
26:	54 *	87	31	142	173	24 *	120	82	171	253
27:	36	236	43	130	173	51	290	51	169	220

200-300 M	SA(JH) = 1.16 SA(PI) + 42.6,	R = 0.86	(ALL VALUES)
(SMALL FISH)	SA(JH) = 1.28 SA(PI) + 33.6,	R = 0.96	(WITHOUT 1)
300-400 M	SA(JH) = 0.75 SA(PI) + 71.0,	R = 0.67	(ALL VALUES)
(BL.WH. + PL)	SA(JH) = 1.08 SA(PI) + 55.3,	R = 0.71	(WITHOUT 14)
400-500 M	SA(JH) = 1.34 SA(PI) + 41.3,	R = 0.83	(ALL VALUES)
(BLUE WHITING)	SA(JH) = 1.38 SA(PI) + 39.9,	R = 0.84	(WITHOUT SOME VALUES)
500-600 M	SA(JH) = 0.51 SA(PI) + 147.7,	R = 0.40	(ALL VALUES)
(PL. + BL.WH.)	SA(JH) = 0.76 SA(PI) + 86.4,	R = 0.69	(WITHOUT 8,18)
	ARITHMETICAL MEAN = 1.30		
400-600 M	SA(JH) = 0.83 SA(PI) + 166.2,	R = 0.65	(ALL VALUES)
(PL. + BL.WH.)	SA(JH) = 1.16 SA(PI) + 63.4,	R = 0.80	(WITHOUT 8,18)

APPENDIKS

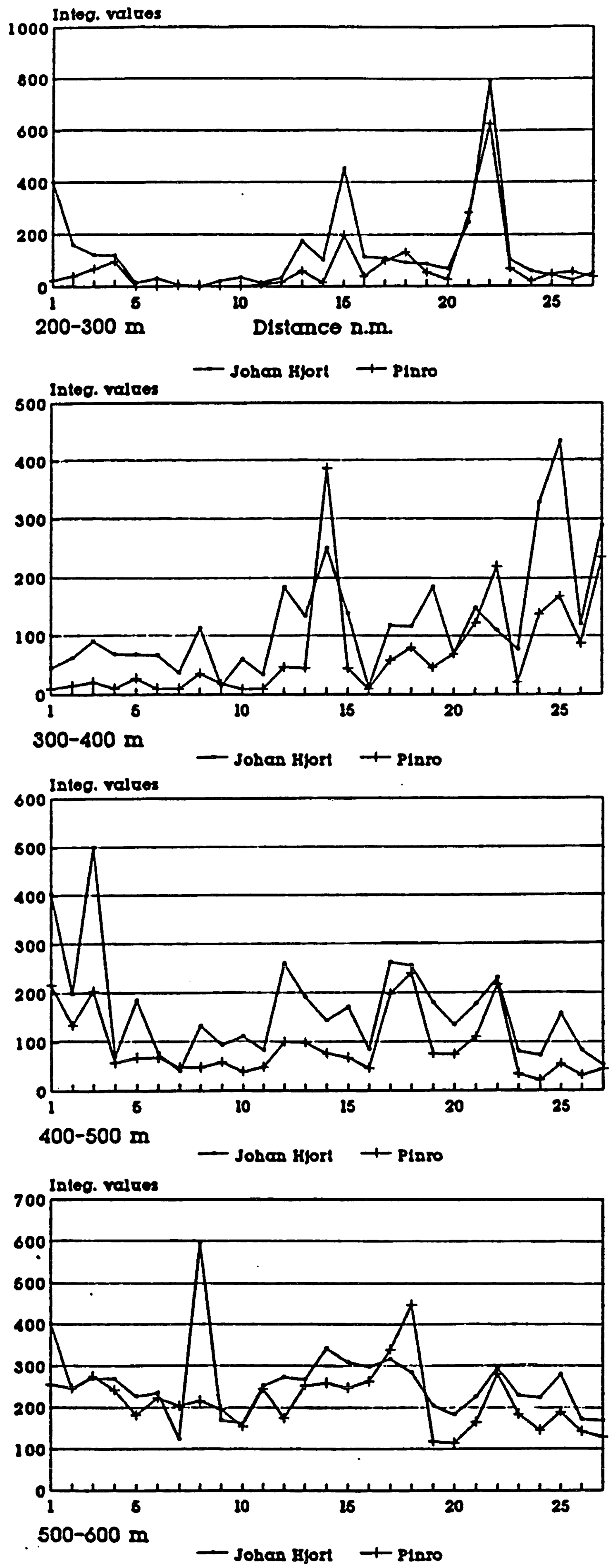
TABLE 3.

INTERCALIBRATION JOHAN HJORT AND PINRO (28.03.92) THE VERSION 2

	PINRO					JOHAN HJORT				
CH:	1	2	3	4	3+4	1	2	3	4	3+4
NM:	200-300 M	300-400 M	400-500 M	500-600 M	400-600 M	200-300 M	300-400 M	400-500 M	500-600 M	400-600 M
1	24 *	9	222	197	419	398 *	44	404	402	806
2	40	15	140	190	330	160	62	198	244	442
3	67	22	204	214	418	121	91	499	271	770
4	95	10	57	203	260	121	69	70	269	339
5	0	28	65	153	218	14	68	185	227	412
6	0	9	66	187	253	31	67	77	235	312
7	0	9	47	171	218	6	37	46	124	170
8	0	36	45	233 *	278 *	1	113	133	595 *	728 *
9	0	18	56	164	220	20	15	93	169	262
10	0	9	38	141	179	36	60	111	162	273
11	8	9	48	208	256	16	34	83	252	335
12	17	47	96	149	245	34	184	261	273	534
13	58	46	95	215	310	173	134	192	267	459
14	16	387 *	73	228	301	103	250 *	143	342	485
15	194	54	80	240	329	454	138	171	309	480
16	39	9	44	221	265	113	12	84	298	382
17	97	60	191	299	490	109	118	263	317	580
18	128	82	232	375 *	607 *	90	116	256	284 *	540 *
19	52	47	72	99	171	86	184	180	205	385
20	27	71	71	97	168	68	70	134	183	317
21	279	126	106	143	249	244	148	177	225	402
22	621	227 *	210	235	445	791	110 *	231	295	526
23	67	21	34	155	189	101	77	80	229	309
24	18	138	20	122	142	56	329	72	223	295
25	46	168	54	188	242	41	434	157	278	435
26	53	90	30	119	149	24	120	82	171	253
27	36	236	41	109	150	51	290	51	169	220

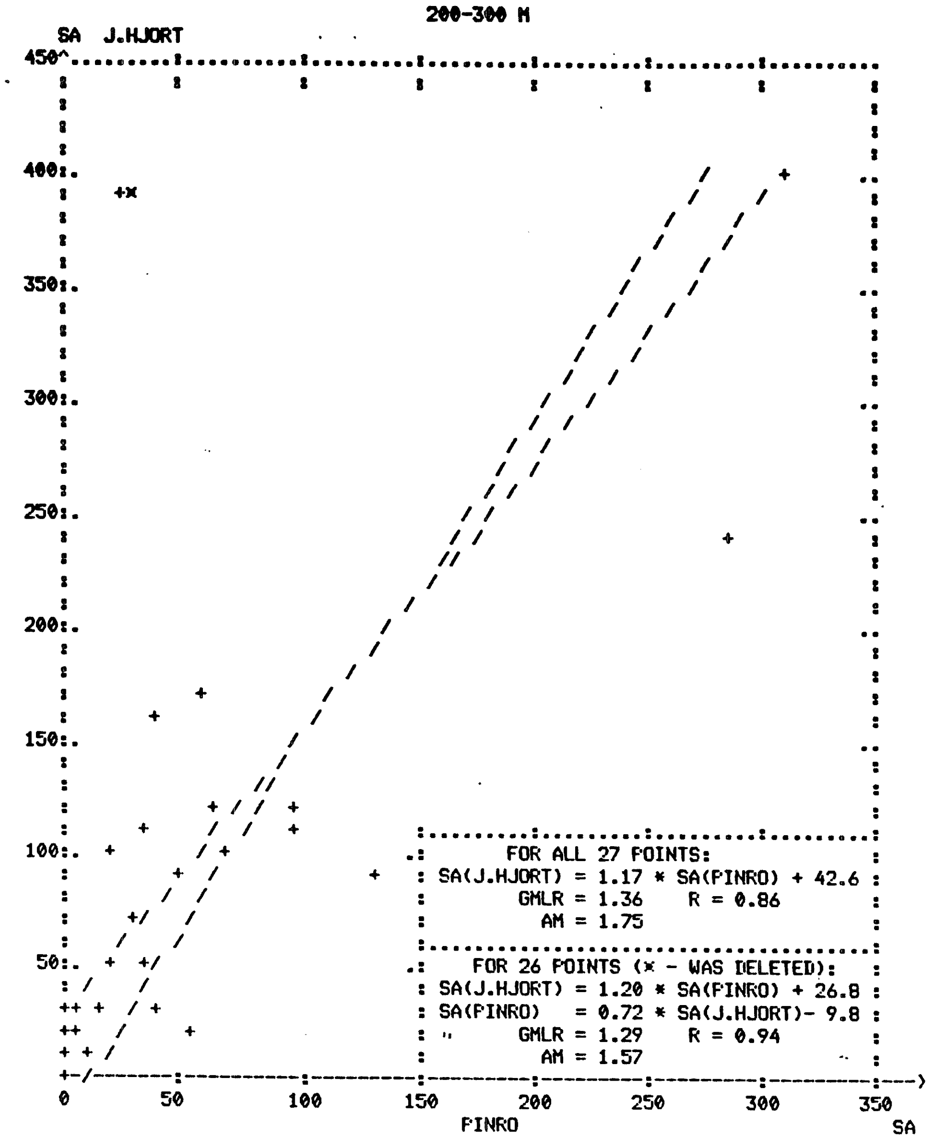
200-300 M (SMALL FISH)	SA(JH) = 1.17 SA(PI) + 42.6 ; R = 0.86	(ALL VALUES)
	SA(JH) = 1.20 SA(PI) + 26.8 ; R = 0.90	(WITHOUT 1)
300-400 M (BLUE WHITING + PLANKTON)	SA(JH) = 0.74 SA(PI) + 70.0 , R = 0.67	(ALL VALUES)
	SA(JH) = 1.06 SA(PI) + 54.8 , R = 0.71	(WITHOUT 14)
	SA(JH) = 1.45 SA(PI) + 40.1 , R = 0.84	(WITHOUT 14,22)
	GMLR = 1.48 - 1.74, AM = 1.95 - 2.18	
400-500 M (BLUE WHITING)	SA(JH) = 1.38 SA(PI) + 41.5 , R = 0.84	(ALL VALUES AND WITHOUT SOME VALUES)
	SA(JH) = 1.38 SA(PI) + 39.9 , R = 0.84	
	GMLR = 1.65, AM = 1.82	
500-600 M (BLUE WHITING + PLANKTON)	SA(JH) = 0.75 SA(PI) +119.2 , R = 0.51	(ALL VALUES)
	SA(JH) = 0.85 SA(PI) + 93.6 , R = 0.68	(WITHOUT 8,18)
	GMLR = 1.31, AM = 1.33	
400-600 M (BLUE WHITING + PLANKTON))	SA(JH) = 0.98 SA(PI) +153.0 , R = 0.69	(ALL VALUES)
	SA(JH) = 1.28 SA(PI) + 70.8 , R = 0.80	(WITHOUT 8,18)
	GMLR = 1.60, AM = 1.53	
300-600 M (BL.+ PL)	SA(JH) = 0.73 SA(PI) +293.5 , R = 0.58	(ALL VALUES)
	SA(JH) = 1.51 SA(PI) + 55.5, R = 0.74	(WITHOUT 8,14,18,22)
	GMLR = 1.59, AM = 1.69	

Intercalibration J. Hjort- Pinro
March 28 1992



APPENDIX Fig. 1. Observed integrator values.

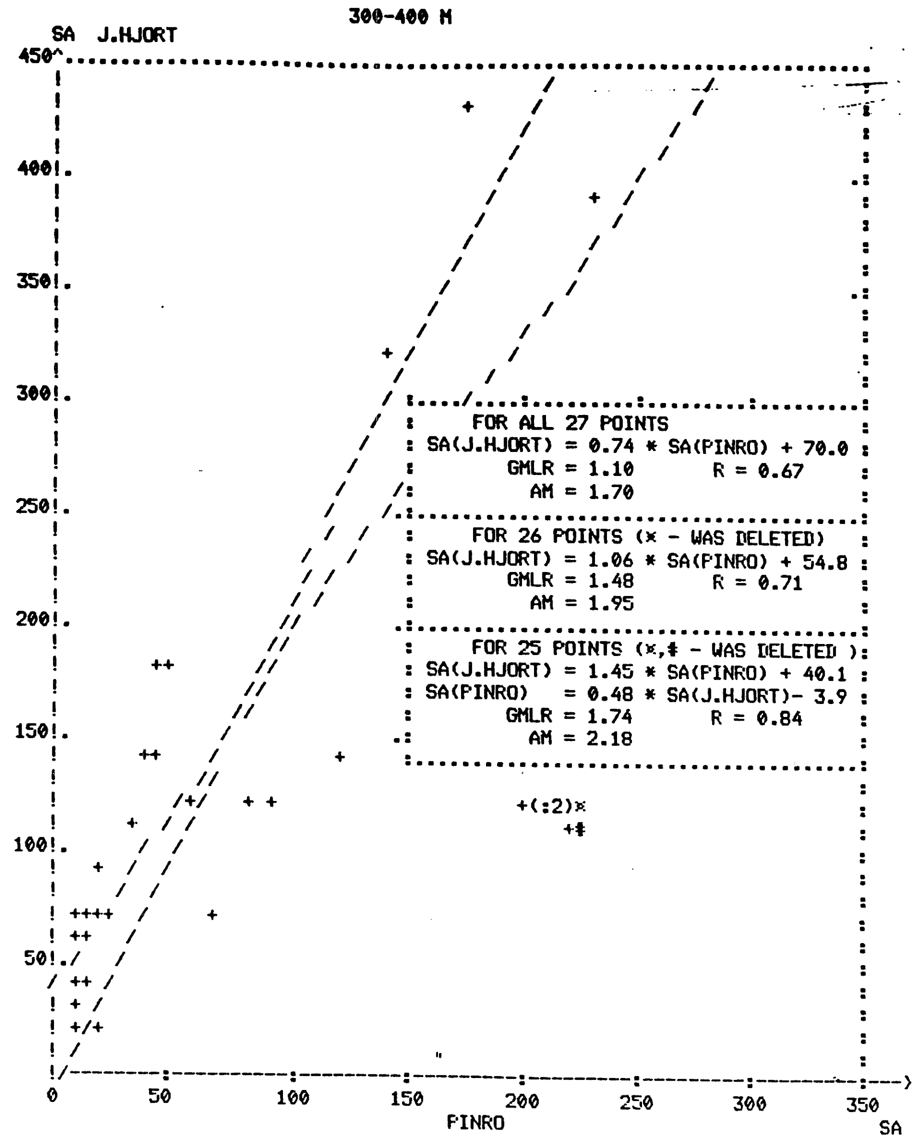
APPENDIX



Appendix

FIGURE 2. PLOT OF CORRESPONDING INTEGRATOR VALUES AND REGRESSION LINE

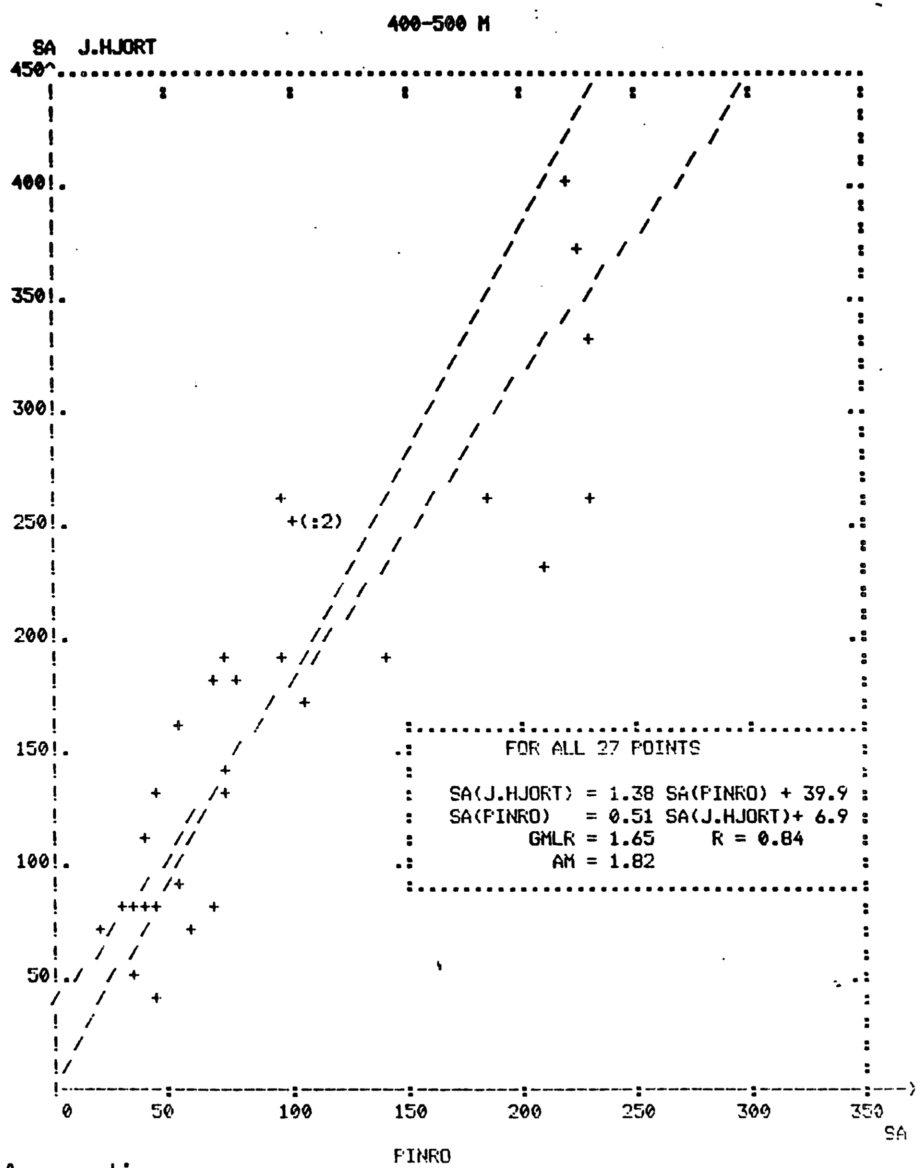
APPENDIX



Appendix

FIGURE 3. PLOT OF CORRESPONDING INTEGRATOR VALUES AND REGRESSION LINE

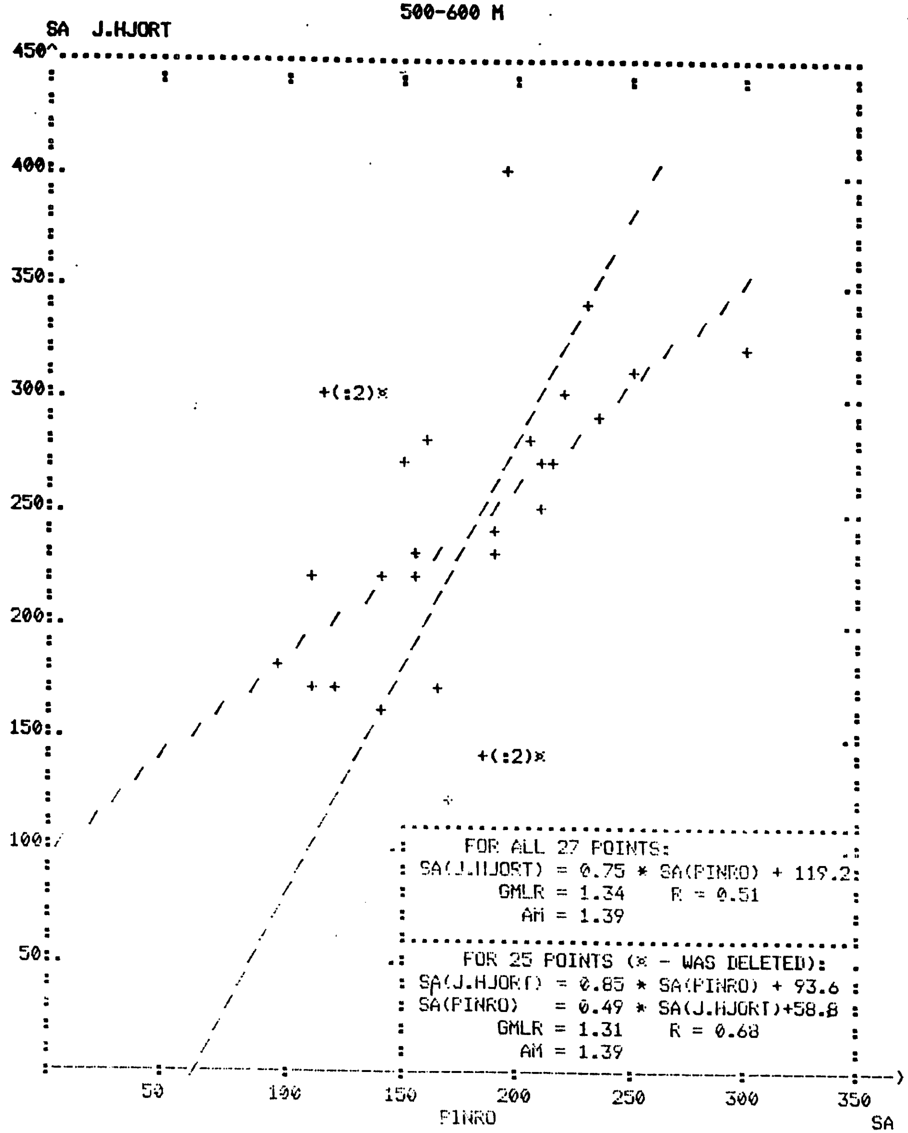
APPENDIX



Appendix

FIGURE 4. PLOT OF CORRESPONDING INTEGRATOR VALUES AND REGRESSION LINE.

APPENDIX



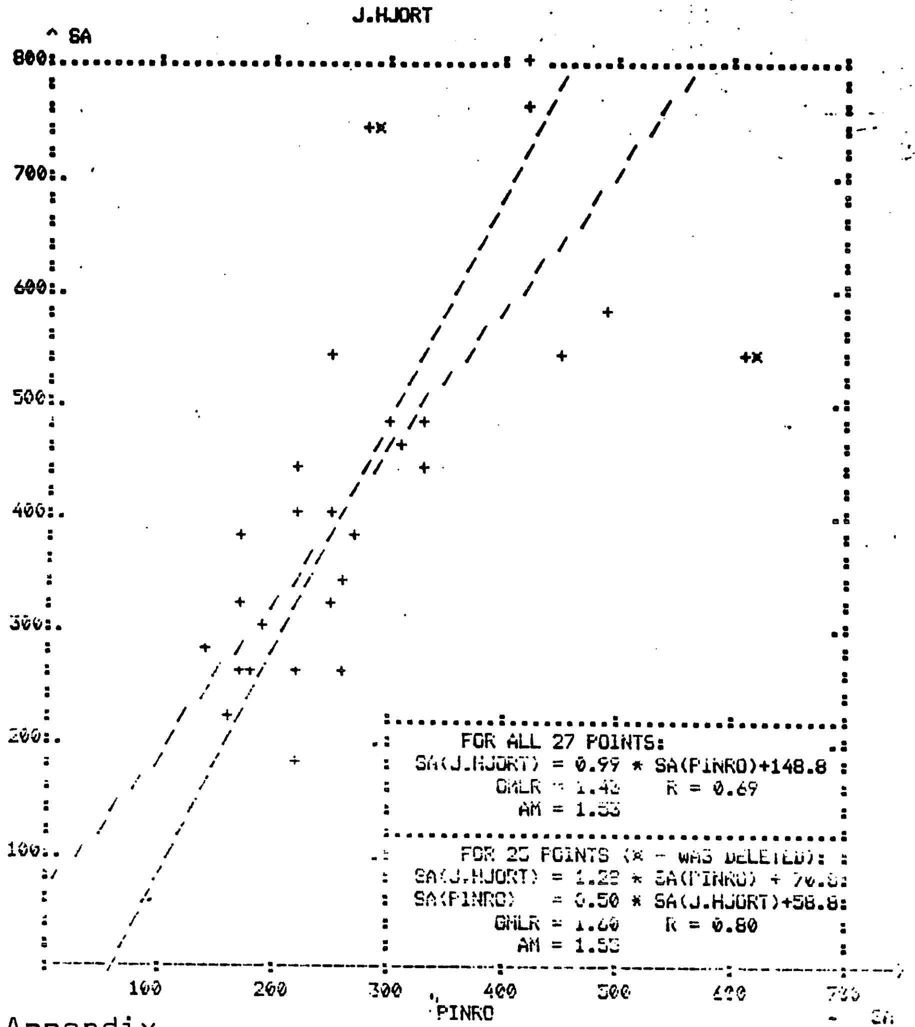
Appendix

FIGURE 5. PLOT OF CORRESPONDING INTEGRATOR VALUES AND REGRESSION LINE

APPENDIX

400-600 M

J.HJORT



Appendix

FIGURE 6. PLOT OF CORRESPONDING INTEGRATOR VALUES AND REGRESSION LINE