International Council for
the Exploration of the Sea

C.M. 1980/G:3
Demersal Fish Committee
Ref. Pelagic Fish Committee

REPORT OF THE WORKING GROUP ON DIVISION IIIa STOCKS

Charlottenlund, 24.-28. March 1980

x) General Secretary,
ICES,
Palægade 2-4
1261 Kbh. K
Denmark.

INDEX

1. INTRODUCTION.

1.1. Venue and terms of reference.

The Working Group met at the Danish Fishery Research Institute, Charlottenlund, in the period 24-28 March 1980 with the following terms of reference (C.Res. 1979/2:36):

(1) evaluate any new data available on stock components in Division IIIa herring.

(2) assess TACs for 1981 for cod, whiting, haddock, plaice and sprat in Division IIIa.

(3) examine any data available, with particular emphasis on tagging data, which might provide estimates of migration rates, particular of cod and herring, between Division IIIa and the Baltic.

The Working Group was not asked to make an assessment of the herring stocks in IIIa, a task which has been referred to the "Herring Assessment Working Group for the Area South of 62°N".

1.2. Participation.

O. Bagge	(Denmark)	
E. Bakken	(Norway)	
A. Corten	(Netherlands)	
D.S. Danielssen	(Norway)	
O. Hagström	(Sweden)	
T. Jakobsen	(Norway)	
F. Lamp	(Fed.Rep.Germany)	
P. Lewy	(Denmark)	
K. Popp Madsen	(Denmark)	Chairman
E. Nielsen	(Denmark)	
R.J. Wood	(U.K.)	

2. HERRING

2.1. Stock components

2.1.1. Spawning grounds.

Spawning herring in Division IIIa has been reported from a considerable number of localities along the Danish, Norwegian and Swedish coasts. Figure 2.1 shows several positions where spawning herring have been regularly observed in spring. It should be noted, however, that the majority of spawning sites situated in the Skagerrak are not covered by the figure. It is not certain whether all the spawning sites shown have remained in use up till the present time. On the other hand, it is suspected that there are even more spawning sites in the southern and eastern Kattegat than actually indicated here.

The picture illustrates the complexity of the stock composition in the area. All spawning sites indicated here (including those along the west coast of Jutland) may provide recruits to the fishery in Div. IIIa. As the spawning sites are very scattered, and mostly close inshore, it is virtually impossible to monitor the changes in spawning stock size by most of the usual techniques (larval surveys, echo surveys, etc.).

2.1.2. Meristic characters.

Available data on meristic characters were considered at the 1979 meeting of the Working Group which recommended further data to be collected. At this year's meeting Denmark presented counts of VS and K_2 in a large number of samples of commercial landings and of research trawlings in connection with an acoustic survey in September 1979 (Table 2.1.1). Samples of Swedish catches have also been collected, but the analyses have not yet been completed. VS counts of herring caught near Rügen were reported by Biester (pers.com.). One VS sample from the Skagerrak were available from Norwegian purse seine catches. The new data on meristic characters were only considered in connection with the possible exchange of herring between the western Baltic and Division IIIa but are included in the present report as reference material for future evaluations.

Table 2.1.2 (Biester, pers. com.) shows the mean VS in herring samples from the Rügen springspawners. Anwand (1963) also reported on VS of these herring. He found a mean of 55.5-55.8. The data provided by Biester show somewhat higher means in the early part of the season. The VS-values of Rügen herring and of Kattegat spring spawners are obviously overlapping to a degree that makes it impossible to distinquish between these two stocks exclusively on the basis of meristic characters.

2.1.3. Tagging Data.

The results of a number of tagging experiments carried out in Ringkøbing Fiord, Limfiord (Jutland), Isefiord (Sjaelland), in the Kattegat, the Sound and in the Belt Seas from 1949 to 1972, which have previously been examined by the Danish-Swedish Study Group (CM 1974/H:11) were re-evaluated (Fig. 2.2-2.9)together with those from experiments carried out by Biester, Jönsson and Krüger (CM 1976/P:15) in the western Baltic on the Rügen spring spawning herring.

In addition the results of tagging experiments both by Ackefors (1978) and Höglund (unpublished) were examined.

In general the tagging experiments indicate limited migrations by herring spawning in spring within both the Skagerrak and the Kattegat while some of the Rügen herring after spawning clearly migrate through the Kattegat and into the Skagerrak in summer. There is evidence of migrations into both the Skagerrak and the Kattegat by herring which spawn along the westcoast of Denmark and in the Limfiord. It was also clear that the Sound is an important over-wintering area for both Kattegat and Rügen spawners.

The stock composition within IIIa is obviously quite complex and the results of the tagging experiments carried out to date do not allow any reliable estimate to be made of the proportion of Baltic immigrants within this area.

2.1.4. Herring Otolith Studies.

Following a recommendation by the Division IIIa Working Group last year an Otolith Workshop was held for two days at Lysekil (Sweden) during September 1979. Because of the short time available, attention was exclusively focused at an examination of the size of the first growth zone, both in samp-

les of pure spring and autumn spawning herring from various localities, and in samples of juvenile herring caught within Division IIIa. Each otolith was measured along the axis rostrum - post rostrum and in all but one case a significant difference was demonstrated between spring spawners and autumn spawners. A component of herring having large first growth zones similar to those in herring spawning in autumn both in the northern and central North Sea was found in a number of samples of 1-ring herring from the Skagerrak. This component was however virtually absent from both 1 and 2 ring herring examined from the Kattegat and in 2 ring herring from the Skagerrak. A summary of the results was presented to the 1979 Statutory Meeting of ICES (CM 1979/H:66). An extensive analysis of additional material at the Swedish Research Institute in Lysekil has been conducted since the Otolith Workshop, but unfortunately the results were not available at this meeting of the Working Group.

A brief examination was therefore carried out into the appearance and size of the otolith nucleus in samples of herring from the North Sea and Division IIIa collected during the 1980 IYHS. Some differences in the proportions of otolith with an opaque type of nucleus were detected between the two areas and in addition there seemed to be some difference in the hyaline nucleus size. However, due to opaque overgrowth no precise measurement could be made. This could, however, be achieved if the overgrowth was removed by grinding (Postuma 1974).

The working Group recommends that the measurement of the first growth zone should be continued and an investigation initiated into the size of the otolith nucleus in herring caught within Division IIIa and in samples of herring in spawning condition both within Div. IIIa and adjacent areas. It must also be stressed that meristic characters are essential for all herring included in these investigations.

In view of the interesting results from the examination of the otoliths of 1 ring herring made by the Otolith Workshop it is also recommended that an analysis should be carried out on the length distributions of 0-ring herring in

Div. IIIa and adjacent areas.

A second workshop should be arranged in 1981 in order to fully evaluate the results from all these investigations.

2.2. The Fishery.

2.2.1. Landings in weight.

The herring landings during the last decade are shown in Table 2.2.1 and 2.2.2 for the Kattegat and the Skagerrak, respectively. The preliminary landing figures for 1979, which are unlikely to be subject to any significant future corrections show a decline in both areas compared with 1977 and 1978. The declines are undoubtedly due to the restrictive TACs of 10 500 tonnes for the Skagerrak and 35 000 tonnes for the Kattegat. Even though these resulted in long periods with a ban on directed fishing for herring (Denmark: 154 days, Sweden: 130 days in the Skagerrak, 28 days in the Kattegat), the TACs were exceeded by 59 % and 33 % in the Skagerrak and the Kattegat respectively.

Because of the quotas and the minimum landing size of 20 and 18 cm in the Skagerrak and the Kattegat, resp., a certain amount of discarding at sea is bound to have taken place.

There is no direct estimate of these discards. An indirect estimate could be obtained from a fishing harbour on the north coast of Sjælland, Denmark, where about half of the Danish herring catches from the Kattegat are landed unsorted and then treated by shore based sorting machines. In 1979 about 4.1 % of the catch were discarded as unmarketable. This must probably be regarded as an underestimate of the discard rate for the entire Div. IIIa. Many of the bigger vessels have sorting machines installed on board in order to sort the catch into market categories before storing the fish in boxes in the hold. Under a restrictive quota system part of the smallest market-category may be discarded together with the unmarketable part of the catch in order to increase the value of the landings. An estimate for Swedish vessels indicates that discards at sea perhaps amounts to 10 % of the catch.

2.2.2. Catch in numbers.

Not all national fisheries in Div. IIIa were covered by adequate sampling for age distribution and numbers per unit weight landed. In such cases samples from concommittant fisheries in the same area, period and carried out with the same gear, were applied.

Swedish trawl catches in the Skagerrak were thus apartioned according to Danish trawl samples, Faroese purse seine landings according to Norwegian purse seine samples and Danish consumption landings in the Kattegat according to Swedish trawl samples. The results are shown in Table 2.2.3. Compared with earlier years the much reduced numbers caught of O- and 1-ringers are the dominant feature in 1979. This is attributable to the ban on industrial fishery for herring, the minimum landing sizes and partly the relative weakness of year class 1978 (1-ringers).

The figures are not corrected by any assumptions of discard rates.

2.3. Stock Size.

2.3.1. Biomass estimates from accustic Surveys.

An coustic survey was carried out in Div. IIIa in September 1979. The preliminary results were presented to ACFM at the 67th Statutory Meeting of ICES by an ad hoc Working Group. A full report will be presented to ICES at the Statutory Meeting in 1980.

The Div. IIIa Working Group accepted the conclusions of the ad hoc Group that this survey provided a reasonable estimate of herring stock size within Div. IIIa at the time of surveying. The results of a trawling survey which was carried out in conjunction with the acoustic survey by both research and commercial vessels under charter provided a sound basis for estimating the age composition of the acoustic biomass. The results of these surveys are summarized in Table 2.3.1. A total herring biomass of 277.3×10^3 tonnes was estimated for the area covered by the acoustic survey which was 6170 N m^2. This however was only about 40 % of the total sea area of 15843 N m^2 within Division IIIa. It was therefore concluded that the her-

ring biomass in Div. IIIa as a whole would have been at least of the order of 300 000 tons. It was possible to compare the result with that of a similar survey conducted in September 1976 (Hagström et al. 1979). This comparison is summarized in Table 2.3.2. The total areas which were covered by the acoustic surveys were divided into 7 sub-areas and these are shown in Fig. 2.10. While the areas covered were of similar size the abundance of herring differed to a remarkable extent between the two surveys. The total biomass of herring was almost twice as large in 1979 chiefly due to very much higher densities within sub-areas between the Skagerrak and the Kattegat).

The age composition and biomass per sub-area are given in Table 2.3.1 for the September 1979 survey. The abundance of 1-ring herring (1977/78 yearclass) was low while that of 2-ring fish (1976/77 yearclass) was quite high, with the possible exception of area 4. In fact 2-ring herring made up more than 43 % of the total stock in number. The low abundance of older herring is in agreement with age distributions from the area in previous years.

A comparison had already been made by the ad hoc Group on the strength of 1-ring herring both in 1976 and 1979. It concluded that this age group was 3-4 times more abundant in 1976 (1974/75 yearclass) than in 1979 (1977/78 yearclass). This confirs to some degree the low index of abundance obtained for this year-class in the 1979 IYHS.

A recent acoustic survey, carried out in March 1980 by RV JOHAN HJORT, gave a herring biomass estimate of 45 000 tons (Fig. 2.11). According to length measurements the herring were aged 1-ring mainly (80 %) and confined to the Kattegat. The results are in good agreement with previous findings in winter from Swedish investigations (Hagström et al, 1979). The adult stock at this time of year is concentrated in the overwintering areas which are situated in the Skerries, the Belt Seas and the Sound. Acoustic surveys conducted during winter in the open sea therefore lead to very low estimates of herring biomass as can clearly be seen from Table 2.3.3 which

presents the results of a number of surveys which have been carried out in Div. IIIa at different times of the year.

The March survey is, however, not very reliable. The survey grid consist of two straight lines through the eastern Kattegat and allocation of the estimated biomass on herring and sprat is based on six hauls only.

2.3.2. Recruitment.

During the International Young Herring Survey carried out in February 1980 a total of 32 hauls were made with the GOV trawl. Of these 14 hauls were made in the Skagerrak and 18 in the Kattegat. Herring were taken in every haul which was made in the Kattegat but were not present in 4 of the hauls made in the Skagerrak. The preliminary abundance index of the 1-ringers in Division IIIa was 582. This represents all herring < 20 cm. i.e. probably an overestimate of the abundance of this age group. Abundance indices of 1-ring herring in the IYHS are given in table below for the years 1972-1979:

Year	Year-class	Abundance index
1972	1970/71	78
1973	1971/72	181
1974	1972/73	726
1975	1973/74	455
1976	1974/75	1 339
1977	1975/76	204
1978	1976/77	575
1979	1977/78	3
1980	1978/79	582

The preliminary value of 582 obtained from the 1980 survey is somewhat higher than the mean value of 445 for year 1977/78 yearclass is of average strength in the Div. IIIa herring stock.

Table 2.1.1. Average length and meristic characters at age.
Skagerrak. Herring. 1979.

Sample no.	Date	Square no.	Winter rings	Av.length cm	K_2	VS	Nos. measured		
							Length	K_2	VS
346	7-5	44GO	1	19.87	-	-	4	-	-
			2	22.61	13.89	56.05	86	76	83
			3	24.87	13.75	56.12	8	8	8
			4	28.75	-	-	2	-	-
556	4-7	45F9	1	21.50	-	-	2	-	-
			2	25.06	13.81	56.16	56	36	55
			3	26.78	14.30	55.88	27	26	26
			4	28.55	13.90	56.50	10	10	10
			5	28.37	-	-	4	-	-
			7	29.25	-	-	1	-	-
576	11-7	45F9	2	24.96	14.04	56.18	46	23	44
			3	26.13	13.64	55.84	37	25	37
			4	27.53	14.18	55.71	14	11	14
			5	29.25	-	-	1	-	-
			6	30.00	-	-	2	-	-
668	11-7	44GO	1	15.29	13.50	56.05	23	12	20
584	18-7	44F8	2	23.35	13.72	56.02	73	50	66
			3	25.03	13.95	55.92	25	20	25
			4	28.00	-	-	2	-	-
597	25-7	44F8	1	20.75	-	-	2	-	-
			2	23.01	14.03	55.93	100	34	98
			3	25.75	-	-	4	-	-

Table 2.1.1.(continued)

Sample no	Date	Square no	Winter rings	Av.length cm	K_2	VS	Nos. measured		
							Length	K_2	VS
839	20-8	44GO	O	10.35	-	56.29	86	-	79
836	23-8	44GO	O 1	11.50 17.25	- -	56.43 -	138 8	- -	100 -
872	2-10	44F9-4	O	14.46	13.95	56.43	55	22	54
833	15-10	45GO	O 1 2 3	15.25 22.66 24.92 26.85	- 14.29 14.02 -	- 56.71 56.07 -	1 22 72 5	- 21 63 -	- 21 72 -
873	24-10	44GO-2	O	15.69	14.04	56.48	62	28	60

Table 2.1.1. . Average length and meristic characters at age. Kattegat. Herring, 1979.

(cont.)

Sample no.	Date	Square no.	Winter rings	Av.length cm	K_2	VS	Nos. measured		
							Length	K_2	VS
259	3-4	41G1	1 2 3	14.88 18.72 22.25	13.83 13.81 -	55.92 55.88 -	93 493 1	25 55 -	41 70 -
288	24-4	44GO-4	1 2 3	17.92 20.83 26.25	13.90 13.93 -	56.59 55.90 -	68 70 1	52 54 -	66 68 -
290	27-4	41G1	1 2	17.25 19.74	- 13.87	- 55.85	6 110	- 77	- 108
344	7-5	41G2	1 2	18.50 19.36	- 13.81	- 55.84	2 128	- 58	- 123
343	8-5	41G2	1 2	15.71 19.00	13.89 14.00	56.25 56.06	12 52	9 40	12 51
555	9-5	42G1	1 2	13.83 19.39	14.33 13.86	55.62 55.72	23 43	6 21	21 43
835	8-8	44GO-4	0 1 2	9.63 19.25 23.00	- - -	56.44 - -	102 4 2	- - -	96 - -

Table 2.1.1. (continued)

Sample no.	Date	Square no.	Winter rings	Av.length cm	K_2	VS	No. measured		
							Length	K_2	VS
838	20-8	44G1	0	10.37	-	56.50	100	-	94
837	21-8	44GO-4	0	10.51	-	56.49	70	-	68
799	11-10	41G2-3	1 2 3	20.66 22.52 27.75	13.86 13.88 -	56.21 55.89 -	35 118 2	28 103 -	34 114 -
969	6-11	41GO-3	0	12.98	-	55.95	100	-	96
968	16-11	39GO-4 Storebælt	0 1	11.89 16.81	13.85 -	56.00 -	96 4	47 -	94 -

Table 2.1.1. Average length and meristic characters at age. Danish-Swedish herring Survey, Sept. 1979.
(cont.)

Sample no.	Date	Square no.	Skagerrak Kattegat	Winter rings	Av.Length cm	K_2	VS	Nos. measured		
								Length	K_2	VS
KR 1	3-9	44F9-4	S	0	12.35	-	56.58	66	-	64
KR 2	3-9	44F9-3	S	0 1	12.93 17.83	- -	56.43 -	320 18	- -	100 -
KR 7	5-9	44GO-2	S	1 2	21.16 22.89	14.25 13.93	56.59 55.87	131 77	87 56	128 75
KR 8	5-9	44G1-1	K	0 1 2 3	13.25 20.57 22.91 23.75	- 14.12 13.89 -	- 56.52 55.76 -	2 109 77 1	- 80 53 -	- 97 75 -
KR 9	5-9	45GO-2	S	1 2 3	23.08 24.14 26.84	- 13.96 14.10	- 56.04 55.82	3 109 11	- 74 10	- 103 11
KR 11	6-9	45GO-1	S	1 2 3 4	22.25 24.30 26.62 28.00	- 13.87 13.89 -	- 56.01 55.75 -	5 73 20 2	- 47 18 -	- 72 20 -
KR 13	7-9	44GO-1	S	0 1	11.99 17.75	- -	56.43 -	482 1	- -	100 -
KR 14	10-9	44GO-4	K	0	11.31	-	56.35	135	-	40
KR 15	10-9	43GO-2	K	0 1 2	10.98 18.56 21.08	- - -	56.32 - -	289 21 3	- - -	102 - -
KR 21	13-9	43G1-4	K	0 1 2	14.11 18.44 21.21	13.83 13.93 13.56	56.42 55.96 55.88	140 26 27	42 14 18	138 26 26
KR 20	12-9	42G1-2	K	0 1 2	14.07 18.66 20.69	- 13.63 -	56.45 56.00 -	11 116 103	- 19 -	11 22 -

Table 2.1.1. (continued).

Sample no.	Date	Square no.	Skagerrak Kattegat	Winter rings	Av.Length cm	K_2	VS	Nos. measured		
								Length	K_2	VS
KR 19	12-9	42G2-3	K	0	13.87	-	-	4	-	-
				1	19.00	13.97	56.03	87	37	79
				2	21.46	13.83	55.75	158	105	147
KR 18	12-9	42G1-4	K	0	13.80	-	56.50	10	-	8
				1	19.12	13.75	56.03	65	51	62
				2	21.11	13.98	55.69	66	54	64
KR 17	11-9	41G1-2	K	0	13.72	-	56.19	17	-	16
				1	20.23	14.11	56.36	66	27	36
				2	22.00	13.85	55.83	309	114	138
KR 16	11-9	41G1-3	K	0	13.79	-	56.52	27	-	21
				1	18.50	13.53	55.87	118	51	87
				2	21.99	13.85	55.84	239	91	106
				3	25.42	-	-	3	-	-

Table 2.1.1. (cont.) Average length and meristic characters at age. Fiord-herring, 1979.

Sample no.	Date	Fiord	Winter rings	Av.Length cm	K_2	VS	Nos. measured		
							Length	K_2	VS
354	9-5	Ringkøbing	2	22.08	13.56	55.90	43	39	42
			3	24.74	13.89	55.72	102	95	97
			4	27.43	14.00	56.00	14	13	12
			5	30.75	-	-	1	-	-
369	24-5	Ringkøbing	1	17.58	-	-	3	-	-
			2	21.81	13.53	55.95	67	64	66
			3	24.82	13.91	55.65	22	22	20
			4	27.89	14.14	55.86	7	7	7
			5	30.75	-	-	1	-	-
314	2-5	Limfjorden	2	23.98	13.88	56.17	72	67	70
			3	26.00	13.82	55.66	82	77	80
			4	28.18	14.25	56.12	8	8	8
368	22-5	Limfjorden	2	23.04	13.94	55.90	51	49	48
			3	25.82	13.96	55.64	113	108	109
			4	28.00	-	-	2	-	-
			6	29.75	-	-	1	-	-
281	24-4	Randers	2	23.63	14.20	55.94	17	15	17
			3	25.63	13.67	55.75	85	84	83
			4	27.28	13.88	55.66	34	33	32
			5	29.18	13.33	55.43	7	6	7
			6	28.91	-	-	3	-	-
			7	30.50	-	-	2	-	-

Table 2.1.1. (continued)

Sample no.	Date	Fiord	Winter rings	Av.Length cm	K_2	VS	Nos. measured		
							Length	K_2	VS
361	14-5	Randers	2 3 4 5	23.24 25.63 27.25 29.25	13.70 13.71 - -	55.73 55.50 - -	80 79 4 3	76 73 - -	71 74 - -
353	8-5	Holbæk	2 3 4 5 6 7 8	21.46 24.13 25.67 23.85 23.75 28.75 30.75	13.83 13.77 13.95 13.75 14.50 - -	55.84 55.94 55.69 55.55 56.00 - -	69 33 58 12 11 1 1	63 31 56 12 10 - -	69 32 58 11 10 - -
946	1-11	Limfiorden	0 1	13.04 16.65	14.19 14.33	56.36 56.60	33 10	31 9	33 10
947	2-11	Limfiorden	0 1	13.27 19.40	14.54 -	56.42 -	26 1	24 -	26 -
975	8-11	Limfiorden	0 1	12.52 16.40	14.17 14.40	56.37 55.89	140 20	124 20	131 19

Table 2.1.1. Average length and meristic characters at age.
Danish herring, Øresund, 1979

Sample no.	Date	Øresund	Winter rings	Av. Length cm.	K_2	VS	Nos. measured		
							Length	K_2	VS
792	10-10	Sletten	1	24.75	-	-	1	-	-
			2	25.76	13.88	55.98	50	49	48
			3	27.32	14.00	55.94	34	30	33
			4	28.66	14.25	56.22	18	16	18
			5	29.45	14.20	55.40	5	5	5
793	11-10	Dragør	2	26.72	14.09	56.21	43	35	42
			3	27.50	13.98	55.73	49	40	48
			4	28.31	13.80	55.94	17	10	17
			5	28.25	-	-	1	-	-
977	27-11	Dragør	1	24.25	-	-	1	-	-
			2	26.53	13.98	56.06	66	59	65
			3	27.77	13.92	55.74	42	38	42
			4	28.32	14.14	55.71	7	7	7
			5	28.75	-	-	3	-	-
			6	31.25	-	-	2	-	-
			7	30.75	-	-	1	-	-
983	11-12	Sletten	1	25.25	-	-	1	-	-
			2	26.73	14.04	56.25	81	75	79
			3	28.00	14.11	55.83	30	28	30
			4	28.65	-	-	5	-	-

Table 2.1.2. Mean VS in samples of herring spawning off Rügen.
(Dr. E. Biester, personal communication).

Date	VS
4 Mar. 1977	56.16
17 "	56.14
31 "	56.08
18 Apr.	55.76
25 "	55.75
2 May	55.80
13 "	55.61
3 June	55.58

Table 2.1.3. Mean VS per age group in samples from Norwegian catches in the Skagerrak 10-16 July 1979.
Number of spring and autumn spawners based on otolith type.

Age gr.	Mean VS	N	Spring	Autumn
1	56.57	60	6	56
2 ,	56.29	110	55	47
3	56.09	34	20	8
4	55.50	8	4	2

Table 2.2.1. Herring landings. Kattegat 1970-1979 (in tonnes)
C = landed for human consumption. I = industrial landings and bycatch.

Year	Sweden		Denmark		Total		Grand Total
	C	I	C	I	C	I	
1970	31 400	9 053	10 562	28 872	41 962	37 925	79 887
1971	36 586	13 174	10 588	39 589	47 174	52 763	99 937
1972	26 214	13 758	12 740	40 015	38 954	53 773	92 727
1973	27 969	12 449	8 713	69 412	36 682	81 861	118 543
1974	22 356	17 423	7 705	46 835	30 061	64 258	94 319
1975	20 074	3 695	8 619	40 355	28 693	44 050	72 743
1976	27 652	2 611	7 820	33 929	35 472	36 540	72 012
1977	31 502	5 658	5 190	33 015	36 692	38 673	75 365
1978	31 766	3 427	20 042	9 199	51 808	12 626	64 434
1979	22 732	2 540	17 422	3 915	40 154	6 455	46 609

Table 2.2.2. Herring landings. Skagerrak 1970-79 (in tonnes).

Year	Denmark	Faroe Isl.	Germany Fed.Rep.	Iceland	Norway	Sweden	Total	Norwegian fiords	Grand total
1970	30 107	-	-	6 453	7 581	26 930	71 071	1 830	72 901
1971	26 985	5 636	-	3 066	6 120	19 763	61 570	3 166	64 736
1972	34 900	4 115	-	7 317	1 045	19 644	67 021	4 222	71 241
1973	42 098	5 265	-	15 938	836	20 429	84 566	1 680	66 246
1974	35 732	7 132	36	231	698	11 683	55 512	1 720	57 214
1975	29 997	8 053	108	1 209	196	12 348	51 911	1 459	53 370
1976	7 326	1 553	6	123	-	6 505	15 513	2 304	17 817
1977	19 889	10 064	32	-	-	8 109	37 587	1 837	39 424
1978	6 425	1 041	28	-	1 860	11 551	20 905	2 271	23 176
1979	5 153	817	181	-	2 460	8 104	16 715	2 259	18 974

Table 2.2.3. Herring. Division IIIa, 1979.
Landing in numbers per age group (x 10^{-6}).

Age W.R.	Skagerrak	Kattegat	Div. IIIa Total
0	54.22	170.15	224.37
1	18.29	100.36	118.65
2	85.44	454.19	539.63
3	23.38	44.70	68.08
4	8.44	4.95	13.39
5	3.08	0.79	3.87
6	0.28	0.21	0.49
7	0.18	0.02	0.20
8+	-	-	-

Table 2.3.1. Estimated biomass and age compositions of herring in numbers x 10^{-6} by agegroups (winter rings) in Skagerrak-Kattegat September 1979. The areas are shown in Fig. 2.2.

	1	2	3	4	5	6	7	Total
Area Nm^2	599	1058	200	950	578	1152	1633	6170
Mean mm/NM	8.68	5.62	2.47	8.70	5.94	9.76	4.17	-
Biomass herring tons x 10^{-3}	60.2	14.4	0.3	100.4	1.2	45.5	55.3	277.3
Herring number x 10^{-6}	414.2	108.2	20.8	1265.3	104.2	786.2	798.6	3497.5
wr/Number x 10^{-6}								
0	-	-	20.8	531.06	98.6	179.9	93.1	923.2
1	27.8	17.4	0.0	536.4	4.9	132.7	215.1	934.3
2	310.2	81.5	-	194.0	0.7	444.6	483.3	1514.3
3	60.7	8.9	-	3.3	-	29.0	5.9	107.8
4	11.6	0.4	-	-	-		1.2	13.2
5	3.9	-	-	-	-		-	4.3

Table 2.3.2. Herring abundance by areas in September 1976 and 1979.

Subarea no.	Area covered (Nm^2) 1976	1979	Density tons (Nm^2) 1976	1979	Total herring biomass tons x 10^{-3} 1976	1979
1	117	599	4.4	100.5	0.51	60.2
2	1425	1058	13.9	13.6	19.8	14.4
3	240	200	2.2	1.4	0.51	0.27
4	888	950	13.7	105.7	12.2	100.4
5	784	578	10.4	2.1	8.1	1.2
6	1169	1152	60.0	39.5	65.5	45.5
7	872	1633	44.2	33.9	38.6	55.3
Total	5495	6170			145.2	277.3

Table 2.3.3. Acoustic estimates of herring biomass in Div. III a.

Year	Month	Areacovered ($N\ m^2$)	Herring biomass (tonnes)
1976	June	4470	89 700
	Sept.	5625	149 000
1977	Febr.	5480	52 000
1978	April	4844	102 000
1979	Sept.	6170	277 300

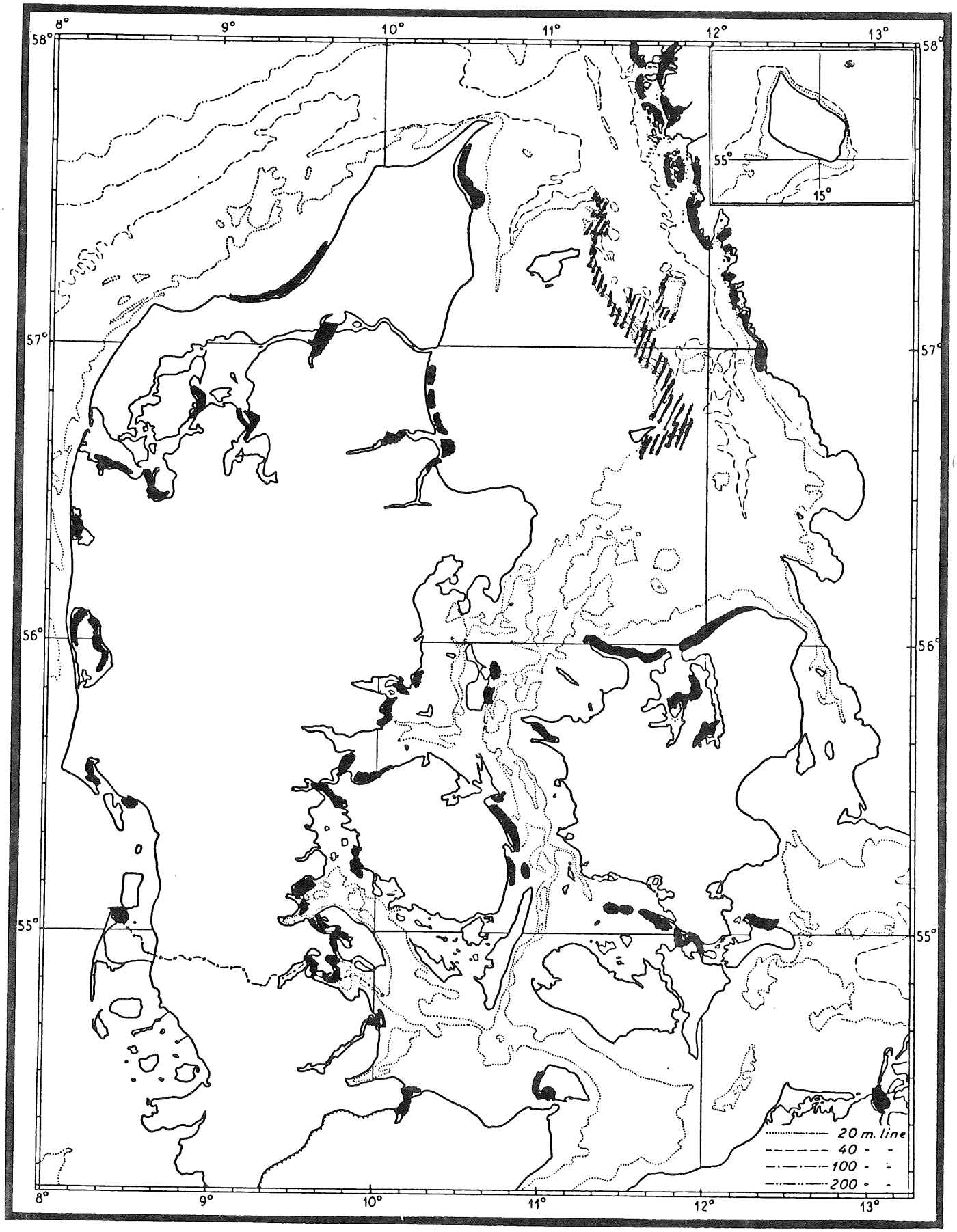


Fig. 2.1. Spawning sites recorded for spring spawning herring in the transition area between she Skagerrak and the Baltic (After Jensen 1949).

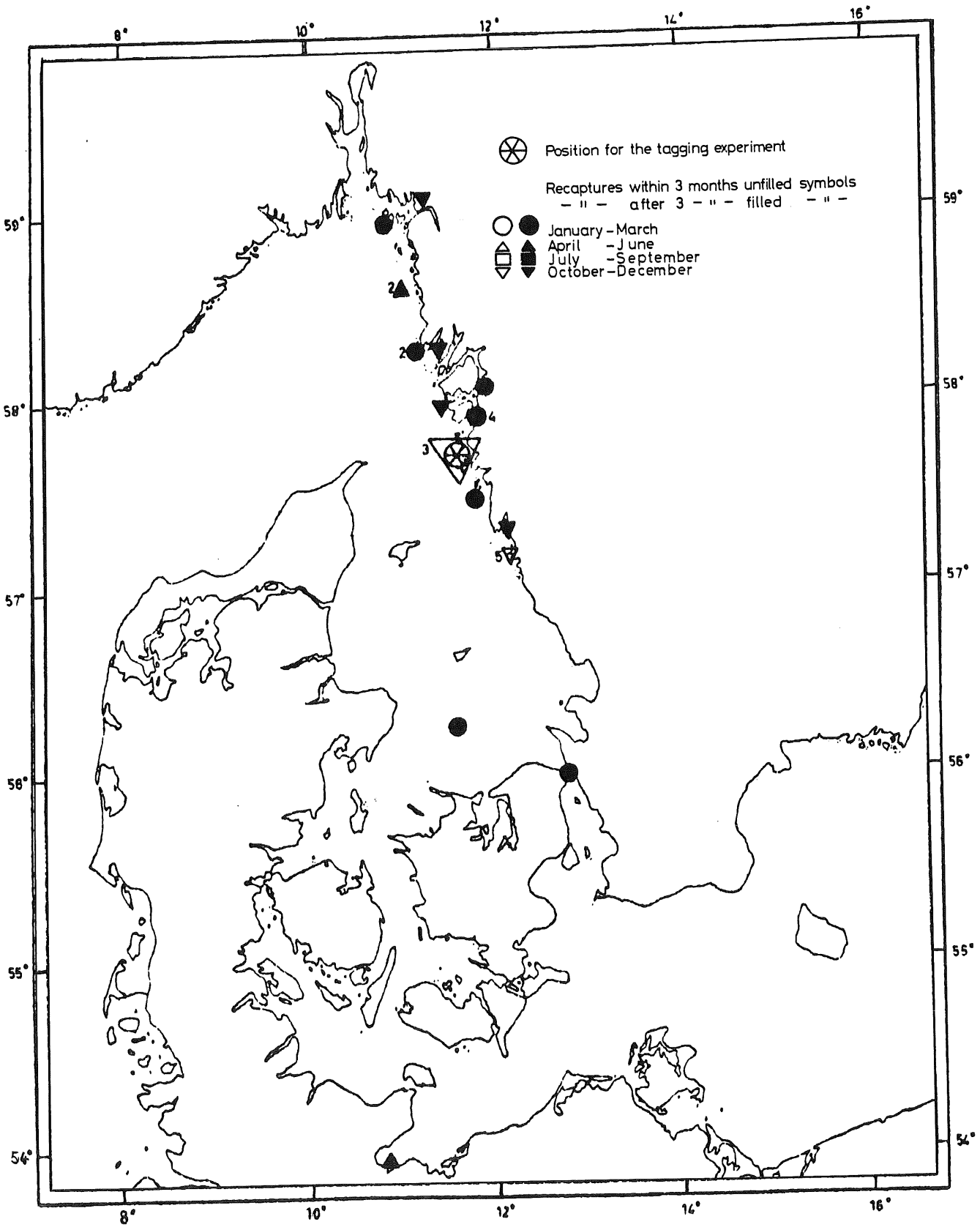

Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December
8°
10°
12°
14°
16°
59°
58°
57°
56°
55°
54°
1
2
3
4
5

Fig. 2.2.

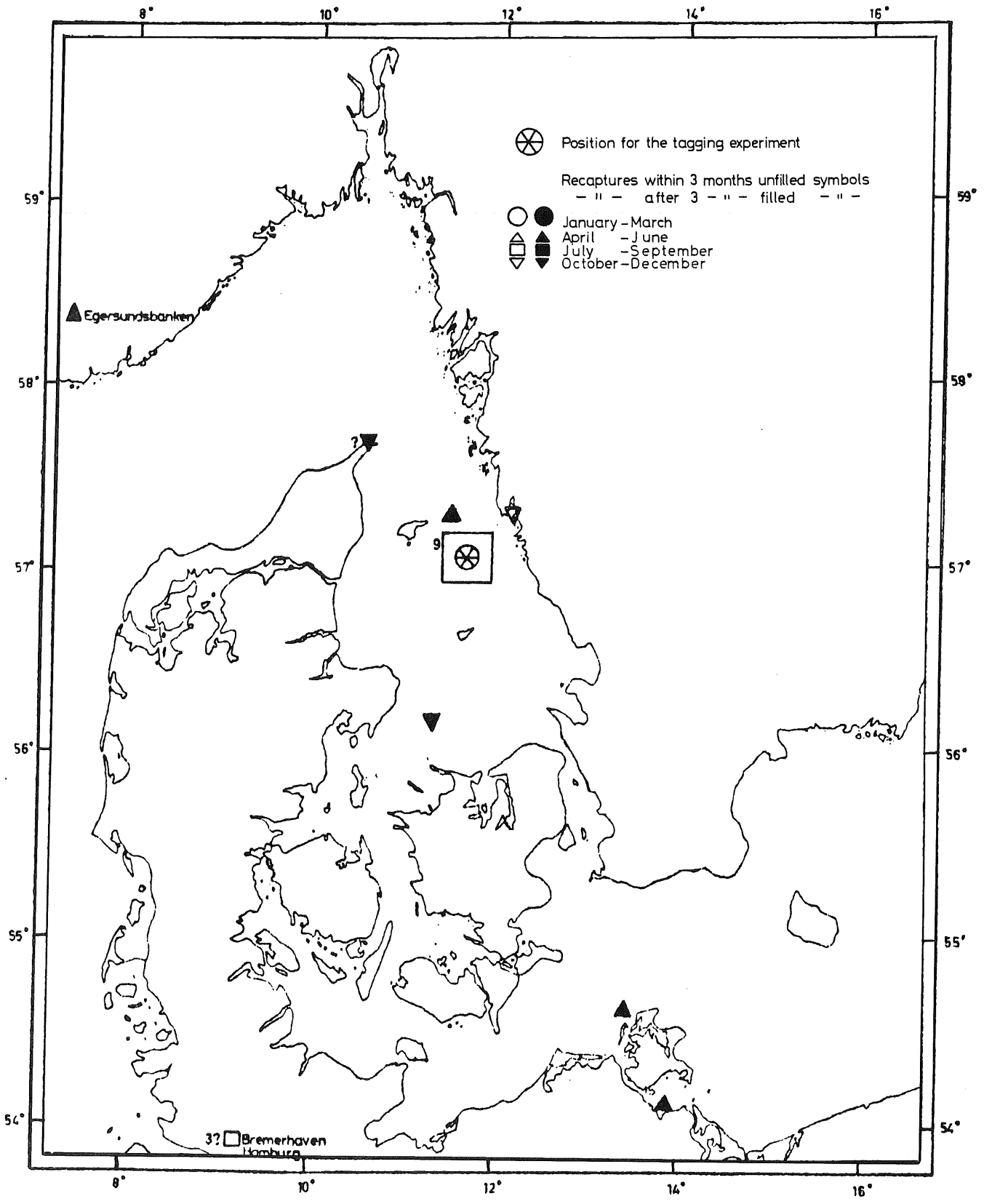

8°
10°
12°
14°
16°
59°
58°
57°
56°
55°
54°
Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December
Egersundsbanken
?
9
3?
Bremerhaven
Hamburg

Fig. 2.3.

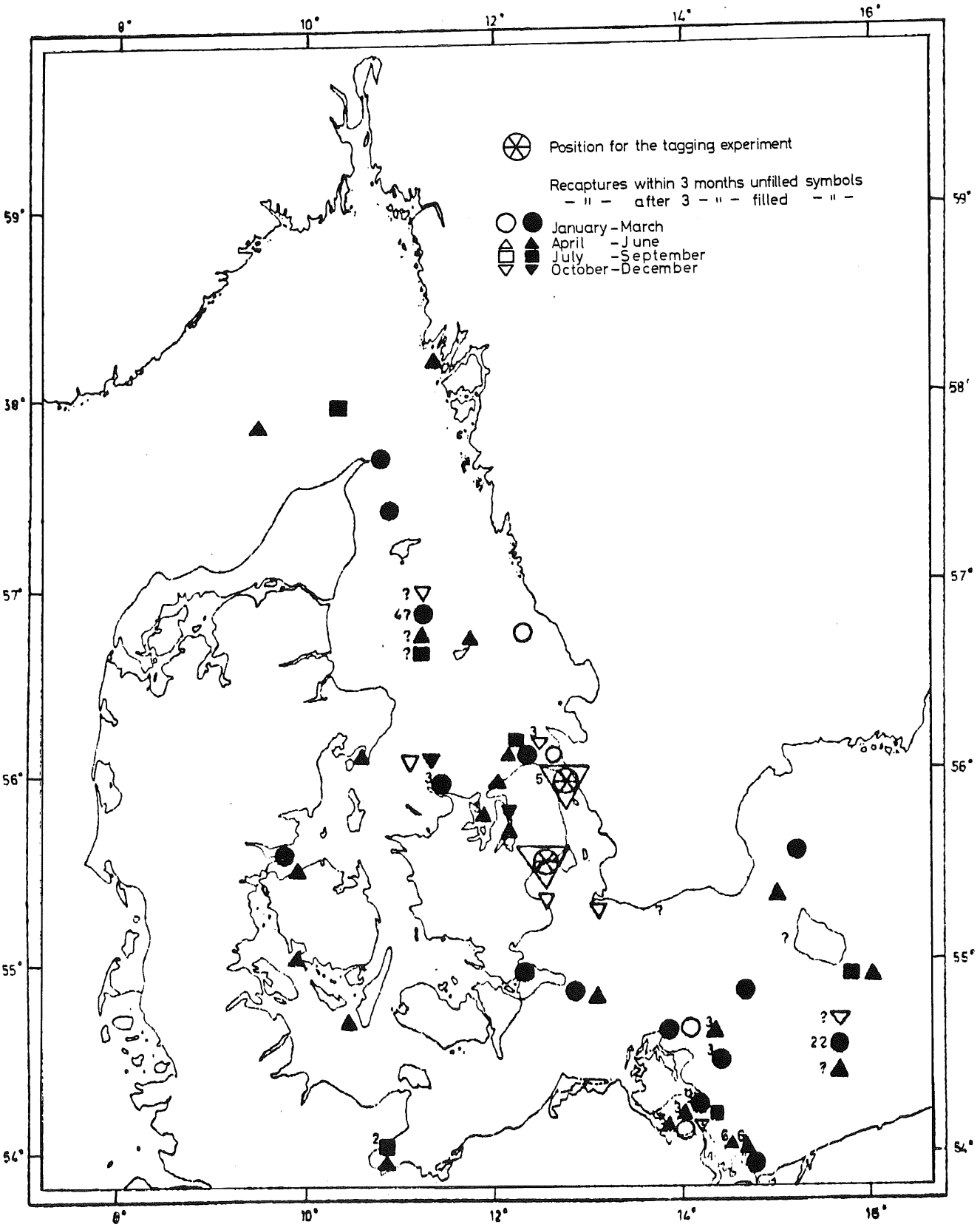

Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December
8°
10°
12°
14°
16°
59°
58°
57°
56°
55°
54°

Fig. 2.4.

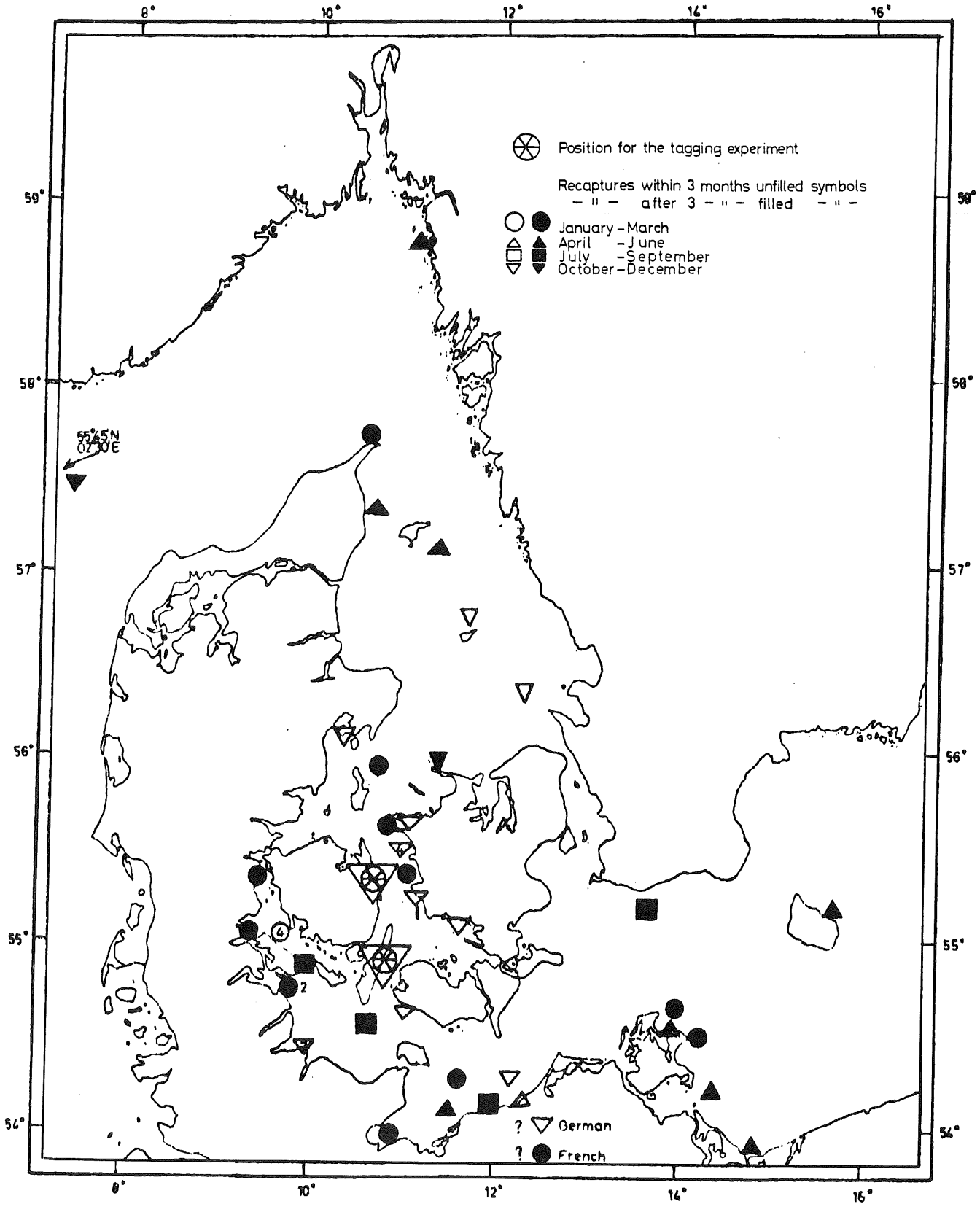

8°
10°
12°
14°
16°
59°
58°
57°
56°
55°
54°
Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December
55°5N
02°30E
? German
? French

Fig. 2.5.

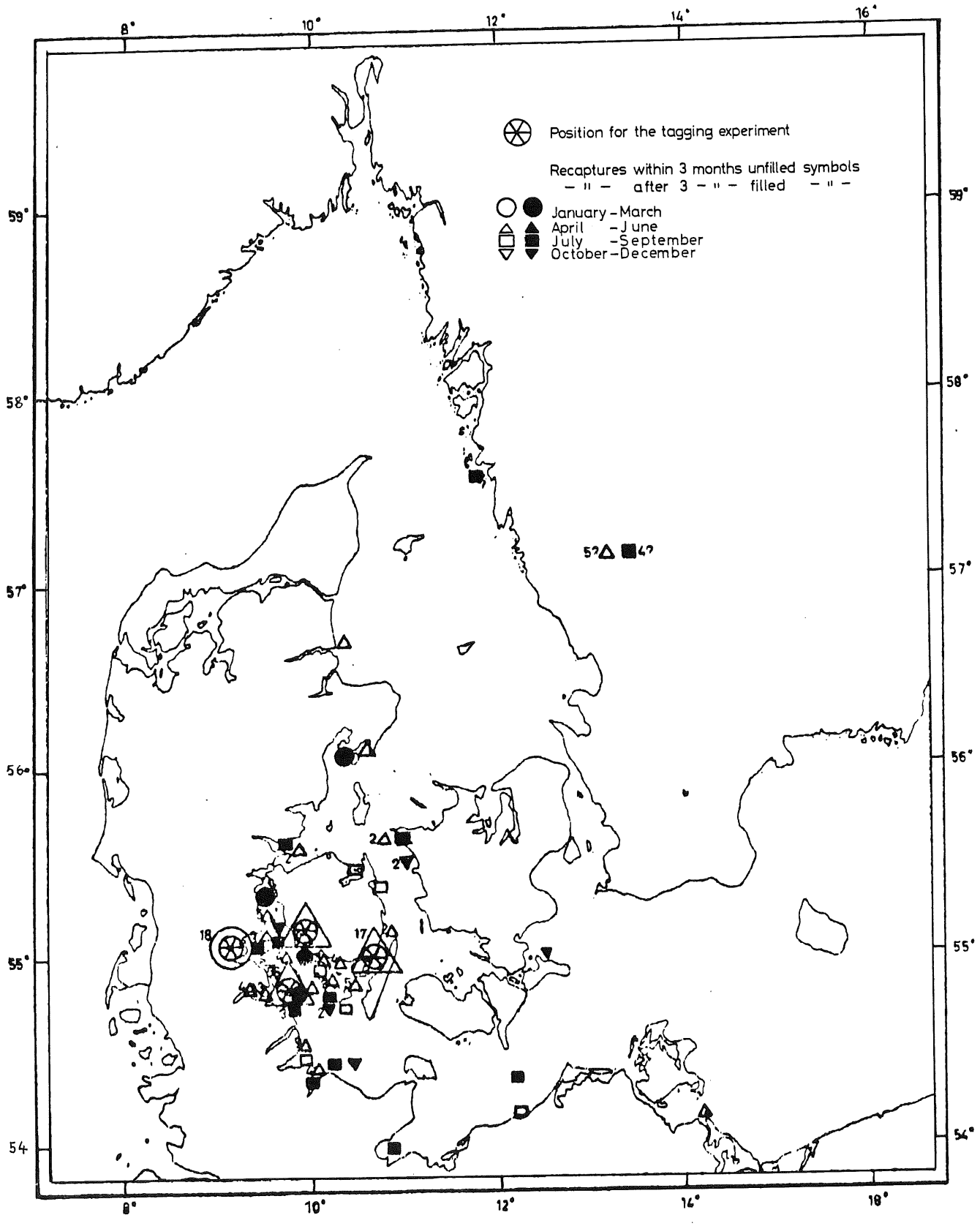

Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December
8°
10°
12°
14°
16°
59°
58°
57°
56°
55°
54°
52
47
2
2
18
17

Fig. 2.6.

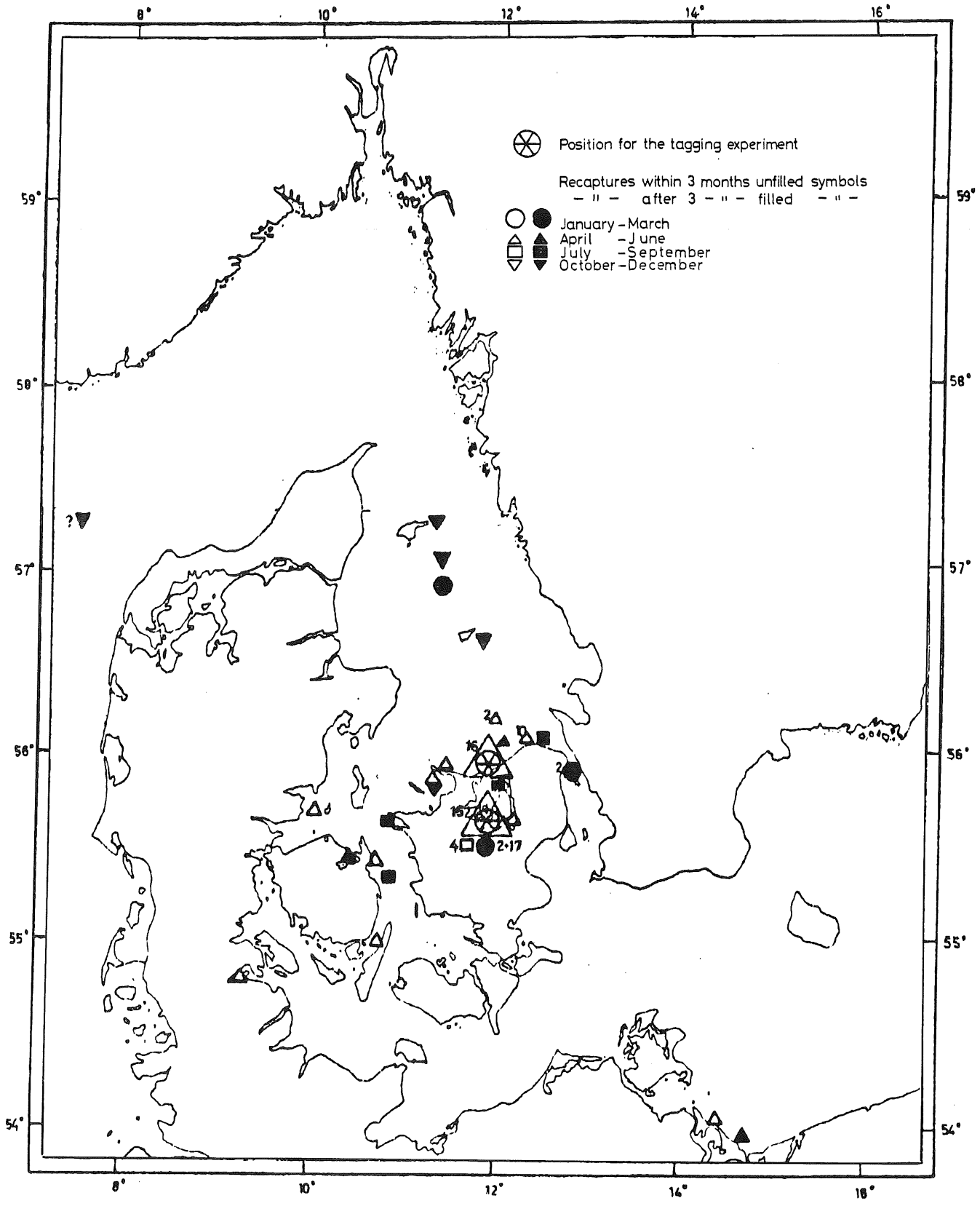

Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December
8°
10°
12°
14°
16°
18°
59°
58°
57°
56°
55°
54°
?
2
16
2
15
4
2·17

Fig. 2.7.

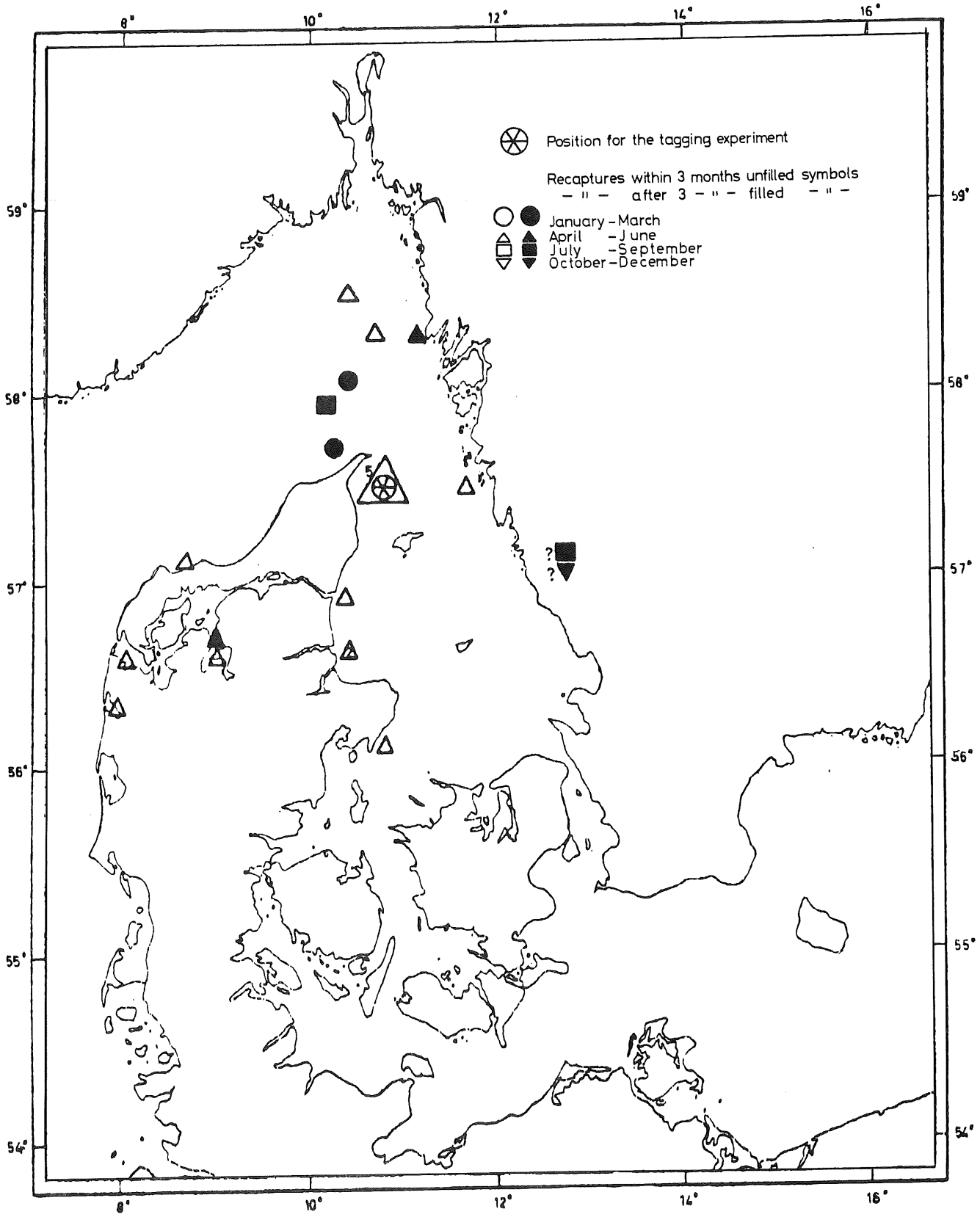

8°
10°
12°
14°
16°
59°
58°
57°
56°
55°
54°
Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December
5
?
?

Fig. 2.8.

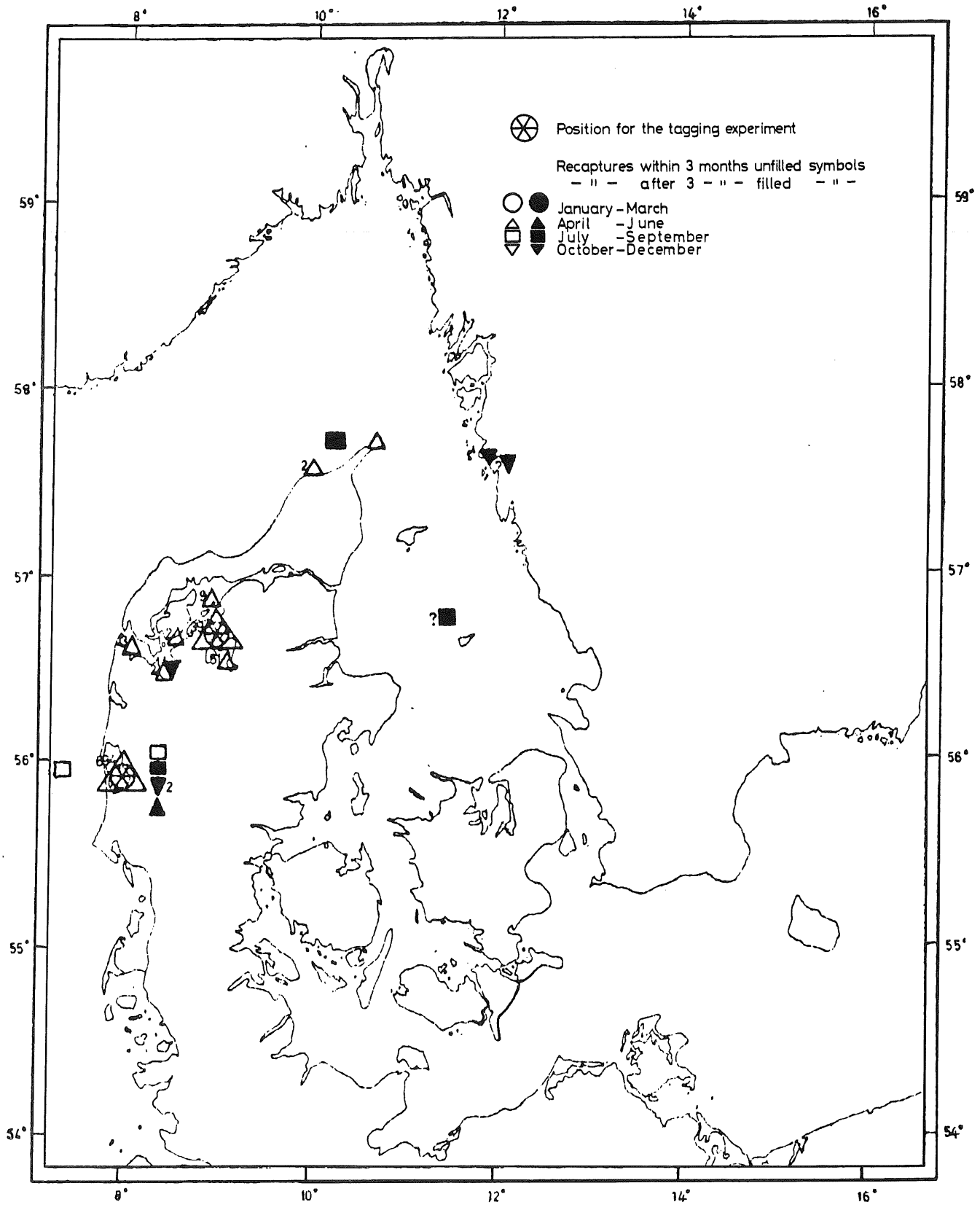

8°
10°
12°
14°
16°
59°
58°
57°
56°
55°
54°
Position for the tagging experiment
Recaptures within 3 months unfilled symbols
– " – after 3 – " – filled – " –
January – March
April – June
July – September
October – December

Fig. 2.9.

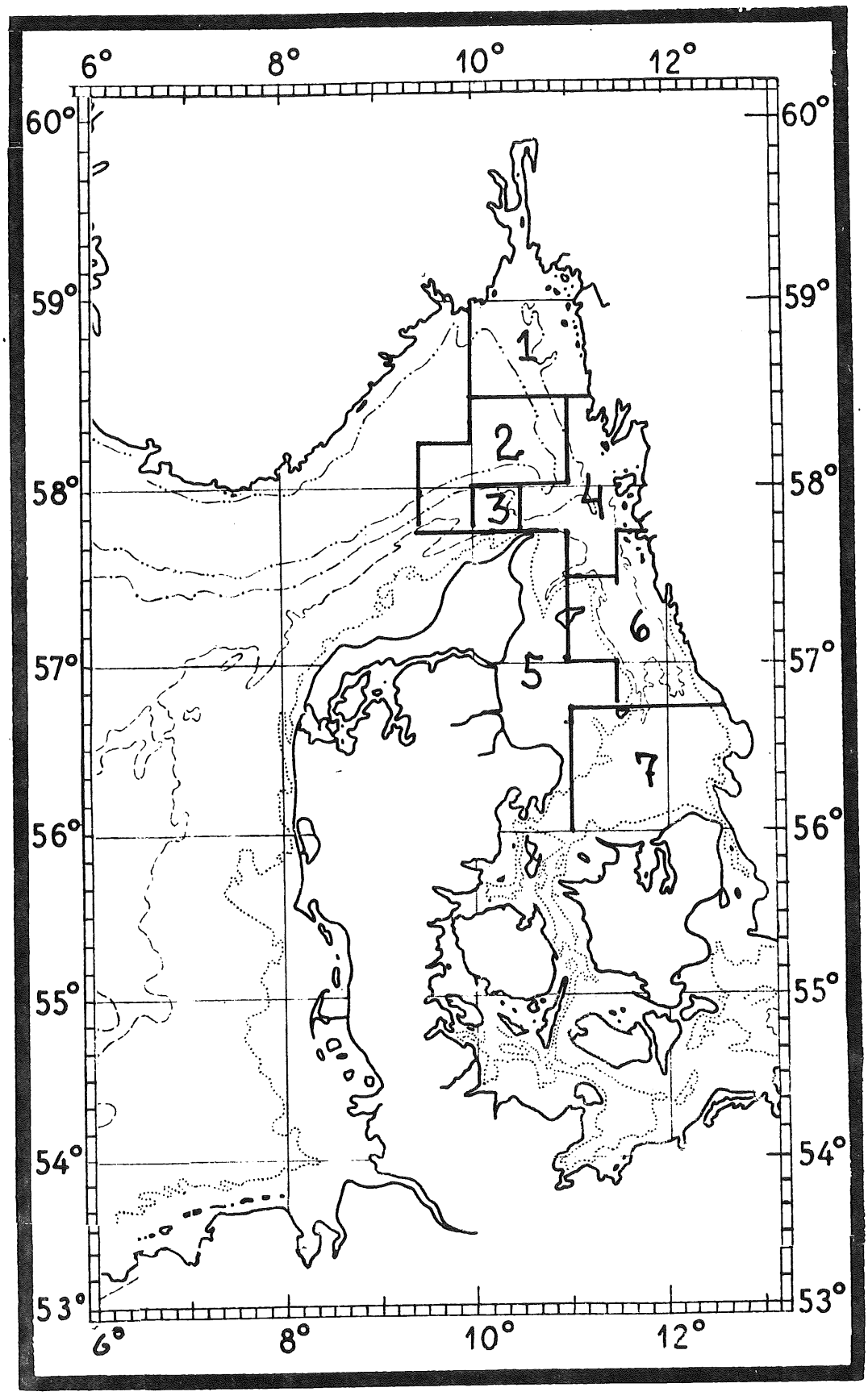


Fig. 2.10. Area subdivisions used for calculating biomass. Swedish acoustic surveys, Sept. 1979.

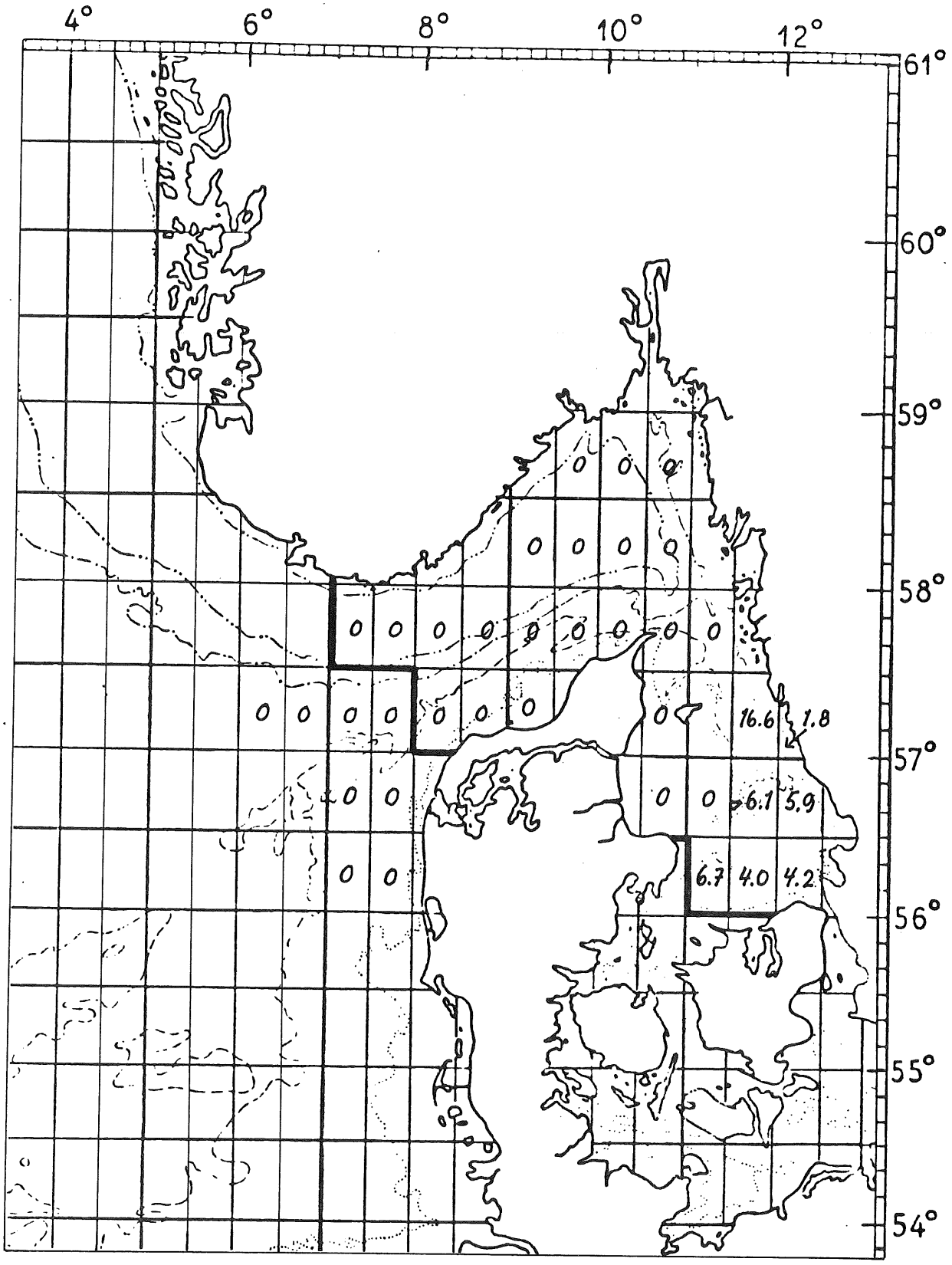


Fig. 2.11. Herring biomass (x 10^{-3} tonnes) in Div. IIIa based on an echo survey carried out by R/V "JOHAN HJORT" March 1980. $\bar{L}$ 15.4-18.4 cm. (Total biomass: 45 300 tonnes).

3. SPRAT

3.1. The Fishery.

Table 3.1.1 shows the landings of sprat in Division III a and IVa east (Norwegian fiords). The landing in IVa east were the same as in 1978 while a minor increase took place in the total landings in Div. IIIa. As in the last two years the Danish landings were about 75% of the total. The 1979 fishery was,as in 1978, restricted by a TAC. The Danish sprat fishery was closed due to the exhaustion of the national quotum, which was divided on quarterly subquotaes, in the following periods: 26.5-30.6, 11.9-20.9 and 30.10-31.12.

The quarterly landings in the Kattegat and the Skagerrak are shown in table 3.1.2. As in 1978 the highest catches were taken in July-September. Allthough the Danish sprat fishery was closed in the last two months in 1979 an increase took place in the international landings in the last quarter compared with 1978.

3.2. Stock Assessment.

3.2.1. Age Composition.

Based on samples from Danish catches for industrial purposes, landing in number per age group were calculated for each quarter for the years 1975-79 (Table 3.2.1). As usual, no data were available from the Swedish and Norwegian landings. As the Swedish and Norwegian catches are assumed to contain a higher percentage of older age-groups, the observed Danish age compositions could not be applied to these.

3.2.2. Recruitment estimates.

Hagström (1979) analysed the data on sprat from the International Young Herring Surveys in the Skagerrak and the Kattegat during the first quarter of the years 1972-1979.. He concluded, that the bottom trawl surveys give a good index of abundance of 1-group sprat in Division IIIa.

In the years investigated, the following indices of year class strength have been obtained:

Year class	Index
1971	1 004
1972	1 322
1973	1 324
1974	5 074
1975	464
1976	1 403
1977	4 223
1978	886
1979	4 253

The index of the 1979 year class indicates this as being comparable in strength to that of 1977, while the 1978 year class seems to be weak.

As pointed out in previous reports on Div. IIIa stocks and by Hagström (1979) some correlation is indicated between the index and the landings of the same year class as 0- and 1-group during winter. The strong 1977 year class dominated in the industrial landings in the last quarter of 1978 (Table 3.2.1). The 1979-year class, however, is not dominating in relation to older year classes according to the age composition in Danish landings but as the total number caught in the last quarter of 1979 is strongly curtailed by catch quota restrictions it still seems resonable to assume that the 1979 year class must be strong as shown both by the IYHS index and by the echo survey in March 1980 (See the section below).

3.2.3. Stock size estimated from Norwegian acoustic surveys.

An acoustic survey of the Kattegat and the Skagerrak was carried out during the first two weeks of March 1980 by R/V "Johan Hjort". A 38 kHz echo sounder and a computer system was used for echo integration, and traces were sampled by pelagic trawl. Based on the 6 trawl samples and daily scrutiny of echo recordings the integrated echo intensities of organisms other than sprat were subtracted.

Fig. 3.1 shows the mean echo intensities for sprat, I, as mm deplection per nautical mile, given for rectangles of 30' of latitude by 15' of longitude. The highest intensities were observed in the northern part of the Kattegat, while very

low intensities were found over the deeper part of the Skagerrak.

An earlier survey, covering the Skagerrak and only the northernmost part of the Kattegat, was carried of by R/V "Johan Hjort" in November 1979. The general distribution pattern and echo intensities of sprat were similar to those observed during the March 1980 survey.

The echo intensities assigned to sprat were converted to biomass by applying an average length dependant target strength, TS, of sprat. The TS is derived from experimental measurements of sprat and relates to the transducer beam angle as well as the performance data of the equipment of R/V "Johan Hjort". The conversion factor so obtained was: $5.6 \times 10^6 \times L^{-2}$ individuals of

$$\frac{34 \times L \text{ tonnes/square nautical mile}}{\text{m/m deflection/nautical mile}}$$

(L is the mean fish length in cm).

(Asgeir Aglen, Institute of Marine Research, Bergen. Pers. Com.).

The observed fish echo intensities were divided on herring, 1-group sprat (1979 year class) and 2-group sprat. The proportions, P_i, of the different categories (species, length) were calculated from the trawl sample data and length measurements:

$$P_i = \frac{N_i \cdot L^2{}_i}{\sum^{n} N_i \cdot L^2{}_i}$$

where L_i is the mean length and N_i the number of category in the catches. Age was not determined, but all sprats below 10.5 cm in length were assumed to be 1-group. Age-length key provided from Swedish sampling supported this assumption.

The conversion from echo intensities to biomass was made separately for each area rectangle taking into consideration the mean lengths representative for that rectangle and in case of coastal regions also the partial surface area. For some rectangles extrapolations from neighbouring rectangles were made. For the Oslofiord, data from the survey in November 1979 were used. On this basis, biomass in tonnes of the 1-group and the $\geq$ 2-group sprat was calculated for

each rectangle in the Skagerrak and the Kattegat. The result is presented in Figures 3.2 and 3.3.

The total sprat biomass in Division IIIa is estimated at 150 000 tonnes of which 88 500 tonnes is assigned the 1-group (1979 year class).

3.2.4. Stock size estimate from Swedish acoustic surveys.

An acoustic survey was carried out in the Skagerrak and the Kattegat in September 1979 by R/V "Argos" assisted by a charted term of Danish commercial pair trawlers. The main objective of the survey was to assess the strength of 1-group herring (Section 2.3).

The echo integration was carried out with a 120 kHz echo sounder connected to a analog 2-chanel integrator (Simrad QM 14 k II).

The total number of hauls amounted to 30 of which 5 were taken outside the area covered by the acoustic survey. Most of the hauls were carried out by the commercial trawlers.

Based on general knowledge of the area, 7 subareas were defined as being fairly homogeneous with respect to the species composition of the fish population. (Fig. 2.2).

The integrated intensities referred to fish were raised to total biomass by applying a conversion factor of 15 tonnes/ mm/Nm^2 (Hagström et al, 1979).

The species composition in the trawl catches was used to divide the total biomass into herring, sprat and other fish.

The estimated biomass of sprat in the area covered (6170 Nm^2) was 229 000 tonnes, most of which was found in the Kattegat as shown below by the distribution on subareas (See Fig. 2.2):

Subarea no	tonnes $_3$ (x 10^{-3})	Subarea no	Tonnes $_3$ (x 10^{-3})
1	0	5	49.2
2	0	6	107.6
3	7.1	7	43.2
4	21.8		
		Total	228.9

As in the case with herring a comparison was done between the estimates of sprat biomasses in September 1976 and 1979. In 1976 the sprat biomass was found to be 135 000 tonnes in a similar area ((5625 Nm^2) which is only half of that found in 1979.

The estimated biomass of sprat in 1979 was converted to number per age group using data from Danish landings in September as only two samples from the survey were analised as to age. Data from the Skagerrak were used for area 3 and 4 and for areas 5-6-7 the Kattegat data were applied.

Age composition and mean number per kilogram used are represented in Table 3.4.1.

The calculation gave a sprat stock in number of 21.31×10^9 in the area covered. The estimated biomass and age composition are given in Table 3.4.2.

3.2.5. Comparisons of results of the acoustic surveys.

A combination of the biomass estimates from "ARGOS" in September 1979 and "JOHAN HJORT" in March 1980 was used to estimate the stock size of sprat. The September survey will probably give an underestimate of the O-group (1979 year class). This is caused by the very small size of the O-group at that time, and also because the O-group is distributed in the uppermost water layers, partly above the transducer level of the echo sounder. The older sprats, however, are generally found at depths more suitable for echo surveys. In addition, most of the older sprats are distributed in the open part of Skagerrak and Kattegat. During winter these sprats migrate to the coastal areas, particularly the skerries on the Swedish west coast, or to the deepest parts of the Kattegat. This effects the echo survey, and it is assumed that the March survey which was confined to the open sea has underestimated the biomass of the older sprat. On the other hand, the March estimate of the 1-group (1979 year class) is likely to be more reliable. It is implicit in the 1-group estimate that the abundance observed off the coast is valid also for the entire area rectangles including

fiords and skerries.

For these reasons, it was considered more appropriate to use the September survey as an estimate of the biomass of older sprat, and the March survey as an estimate of the O-group;

Survey	Year class	Tonnes $\times 10^{-3}$	Number $\times 10^{-9}$
"J.H." Mar.1980	1979	88.5	44.3
"A" Sep.1979	1978	193.4	16.5
" "	1977	4.5	0.2
" "	1976	2.3	0.1
" "	1975	0	0
" "	1974	2.7	0.1

3.3. Management Advice.

3.3.1. Recruitment.

From the result of the IYFS in February 1980 it appears that yearclass 1979, which will be the main component of the catches in 1980 and in the early part of 1981, is comparable in strength to yearclasses 1974 and 1977.

Yearclass 1974 formed basis for the total landings in 1975 of 110 000 tonnes. Yearclass 1977 was the main component of the catch in 1978 of 75 000 tonnes. The latter figure was achieved despite the fact that the Danish sprat fishery was closed in the period 15/8-31/12 i.e. 4 1/2 month of the main season. Without restrictions the landing figure in 1978 would undoubtedly have exceeded 100 000 tonnes.

Despite the uncertainties about the conversion factors used in the acoustic surveys, the estimated stock in September 1979 may be compared to the estimate made in 1976. This indicates, that the stock size in 1979 was twice the stock size in 1976. The total landings in the latter year was 60 000 tonnes as compared with 78-79 000 tonnes

in 1979. Also the landings in 1979 were curtailed be restrictions and e.g. the Danish fishery was closed for a total of 117 days not including the introduced ban on fishing in week-ends in the Kattegat.

The stock situation at the beginning of 1980 would thus appear to be above average. The recruiting yearclass is indicated as strong and the biomass of older sprat to be clearly stronger than that in the reference year of 1976.

3.3.2. Total allowable Catch.

It seems clear that a TAC for the current year (1980) could now be determined on a more factual basis. The TAC for 1980 suggested by the Working Group in 1979 was 70 000 tonnes, as this catch corresponded to the average catch taken in 1976-1978.

The new estimates indicate that the Tac for 1980 could have been set at about 100 000 tonnes.

This illustrates the problem of calculating TAC's for a short lived species like the sprat. The Working Group has in previous reports shown that no realistic TAC can be determined for a period starting about one year after the assessment meeting of the Group. As demonstrated above it is, however, possible to assess the stock and so to propose a TAC for the current year.

For these reasons, the Working Group cannot propose a TAC for the whole of 1981, but it advices that at present, as a precautionary measure, a TAC is only set for the first half of 1981. This TAC, based on the average catches in the first half of years in which a strong yearclass has been present i.e. 1975 and 1978 would be about 25 000 tonnes.

The TAC for the second half of 1981 should not be decided until after the Working Group meeting in 1981, when a more factual basis for such a decision will be available.

Table 3.1.1 Landings of sprat in Division IIIa and in Norwegian fjords in Div. IVa (10^{-3} tons)[x]

Year	SKAGERRAK				KATTEGAT			IIIa total	Norwegian fjords south of 62°N	Grand total
	Denmark	Sweden	Norway	Total	Denmark	Sweden	Total			
1969	0.8	1.9	1.7	4.4	0.8	1.6	2.4	6.8	11.8	18.6
1970	1.1	2.4	2.4	5.9	3.1	6.0	9.1	15.0	6.4	21.4
1971	0.7	2.4	2.9	6.0	1.5	9.6	11.1	17.1	4.4	21.5
1972	0.8	3.3	2.4	6.5	1.4	17.9	19.3	25.8	6.9	32.7
1973	19.4	2.5	3.2	25.1	19.3	16.2	35.5	60.6	8.8	69.4
1974	17.3	2.0	1.2	20.5	31.6	18.6	50.2	70.7	3.3	74.0
1975	14.9	2.1	1.9	18.9	69.7	20.9	90.6	109.5	2.9	112.4
1976	12.8	2.6	2.0	17.4	30.4	13.5	43.9	61.3	0.6	61.9
1977	7.2	2.2	1.2	10.6	53.3	9.8	63.1	73.7	5.4	79.1
1978	23.1	2.2	2.7	28.0	36.1	9.4	45.5	73.5	5.2	78.7
1979	17.3	8.1	1.8	27.2	45.8	6.4	52.2	79.4	5.0	84.4

x) Data provided by Working Group members.

Table 3.1.2. Landings of sprat in Division IIIa by quarters (tons)

Year	Months	Kattegat	Skagerrak	Total
1975	Jan-Mar	6 569	2 316	8 885
	Apr-Jun	11 610	450	12 060
	Jul-Sep	53 347	7 976	61 323
	Oct-Dec	19 541	8 248	27 789
	Total	91 067	18 990	110 057
1976	Jan-Mar	9 462	913	10 375
	Apr-Jun	4 867	997	5 864
	Jul-Sep	18 070	5 493	23 563
	Oct-Dec	10 253	10 001	20 254
	Total	42 652	17 404	60 056
1977	Jan-Mar	9 340	1 507	10 847
	Apr-Jun	10 499	189	10 688
	Jul-Sep	24 217	2 808	27 025
	Oct-Dec	18 938	6 067	25 005
	Total	62 994	10 571	73 565
1978	Jan-Mar	13 139	2 899	16 038
	Apr-Jun	7 949	6 313	14 262
	Jul-Sep	18 511	15 175	33 686
	Oct-Dec	6 757	4 398	11 155
	Total	46 356	28 785	75 141
1979	Jan-Mar	8 848	2 817	11 665
	Apr-Jun	5 549	1 042	6 591
	Jul-Sep	25 898	8 053	33 951
	Oct-Dec	11 922	15 218	27 140
	Total	52 217	27 130	79 347

Table 3.2.1. Danish landings of sprat in Division IIIa in numbers at age (x 10^{-6}).

Year	Months	0	1	2	3	4	5
1975	Jan-Mar		435.86	200.44	56.28	2.46	
	Apr-Jun		230.75	398.91	146.51	0.16	
	Jul-Sep	32.81	5 979.74	527.61	50.92	0.34	
	Oct-Dec	139.22	985.73	54.32	0.68		
	Total	172.03	7 632.08	1 181.28	254.39	2.96	
1976	Jan-Mar		336.00	164.95	9.11	1.23	0.65
	Apr-Jun		556.41	57.07	27.38	0.91	
	Jul-Sep	509.96	2 334.72	171.39	16.80	2.21	
	Oct-Dec	918.64	1 084.09	23.24	0.55		0.11
	Total	1 428.60	4 311.22	416.65	53.84	4.35	0.76
1977	Jan-Mar		2 515.11	408.99	11.29		
	Apr-Jun		2 177.51	483.23	20.70	3.37	
	Jul-Sep	725.13	2 185.47	208.70	30.26	7.42	1.21
	Oct-Dec	1 948.34	813.86	142.90	0.79		
	Total	2 673.47	7 691.95	1 243.82	63.04	10.79	1.21
1978	Jan-Mar		4 376.51	203.89	12.52		
	Apr-Jun		5 004.51	33.18	3.57		
	Jul-Sep	23.99	3 987.97	61.57	14.70	0.70	
	Oct-Dec	261.12	262.21	16.70	0.84		
	Total	285.11	13 631.20	315.34	31.63	0.70	
1979	Jan-Mar		1 098.75	426.69	60.68	1.92	1.94
	Apr-Jun		763.41	239.49	2.39	-	-
	Jul-Sep	690.32	3 674.64	7.37	1.59	-	1.99
	Okt-Dec	260.04	1 360.87	22.45	2.51	-	3.13
	Total	950.36	6 897.67	696.00	67.37	1.92	7.06

Table 3.4.1. Danish landings of Sprat in September 1979 from Div. IIIa by number per agegroup (x 10^{-6}) and mean number per kilogram.

Age group	Skagerrak	Kattegat
0	0.46	96.41
1	117.39	308.34
2	2.34	3.98
3		1.59
4		-
5		1.99
No/kilogramme	78.82	94.72

Table 3.4.2. Estimated biomass and age compositions of sprat in numbers (x 10^{-9}) in the Skagerrak and the Kattegat September 1979. No Sprat were recorded in Area 1 and 2.

Age group/Area	3	4	5	6	7	Total
0	-	0.01	1.09	2.39	0.96	4.45
1	0.55	1.68	3.50	7.66	3.07	16.46
2	0.01	0.03	0.05	0.10	0.04	0.23
3			0.02	0.04	0.02	0.08
4			-	-	-	-
5			0.02	0.05	0.02	0.09
Total nos (x10^{-9})	0.56	1.72	4.68	10.24	4.11	21.31
Biomass (10^{-3}tonnes)	7.1	21.8	49.2	107.6	43.2	228.9

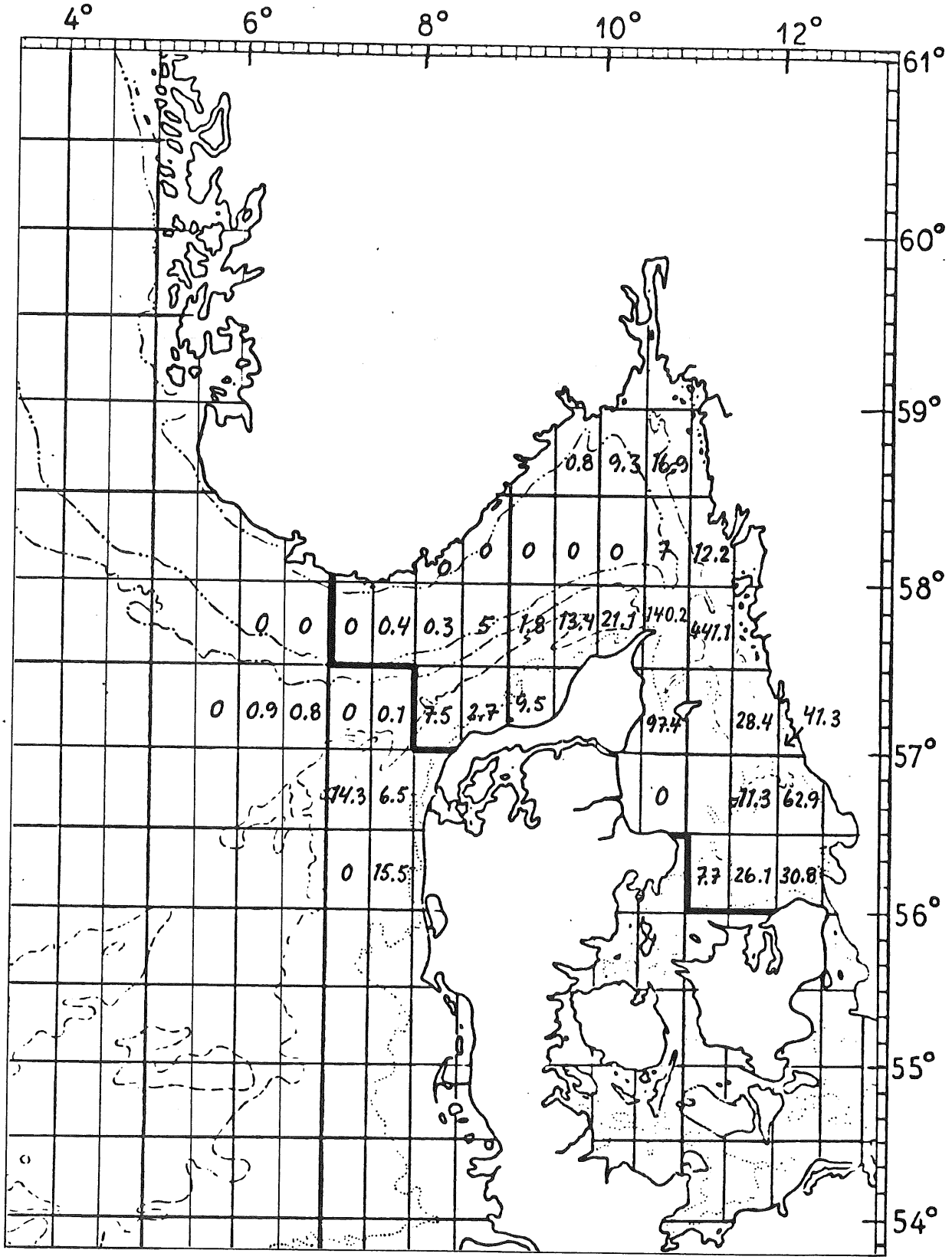


Fig. 3.1. Sprat. Echo intensities measured during an echo-survey carried out by R/V "Johan Hjort" March 1980 (mm/naut.m.).

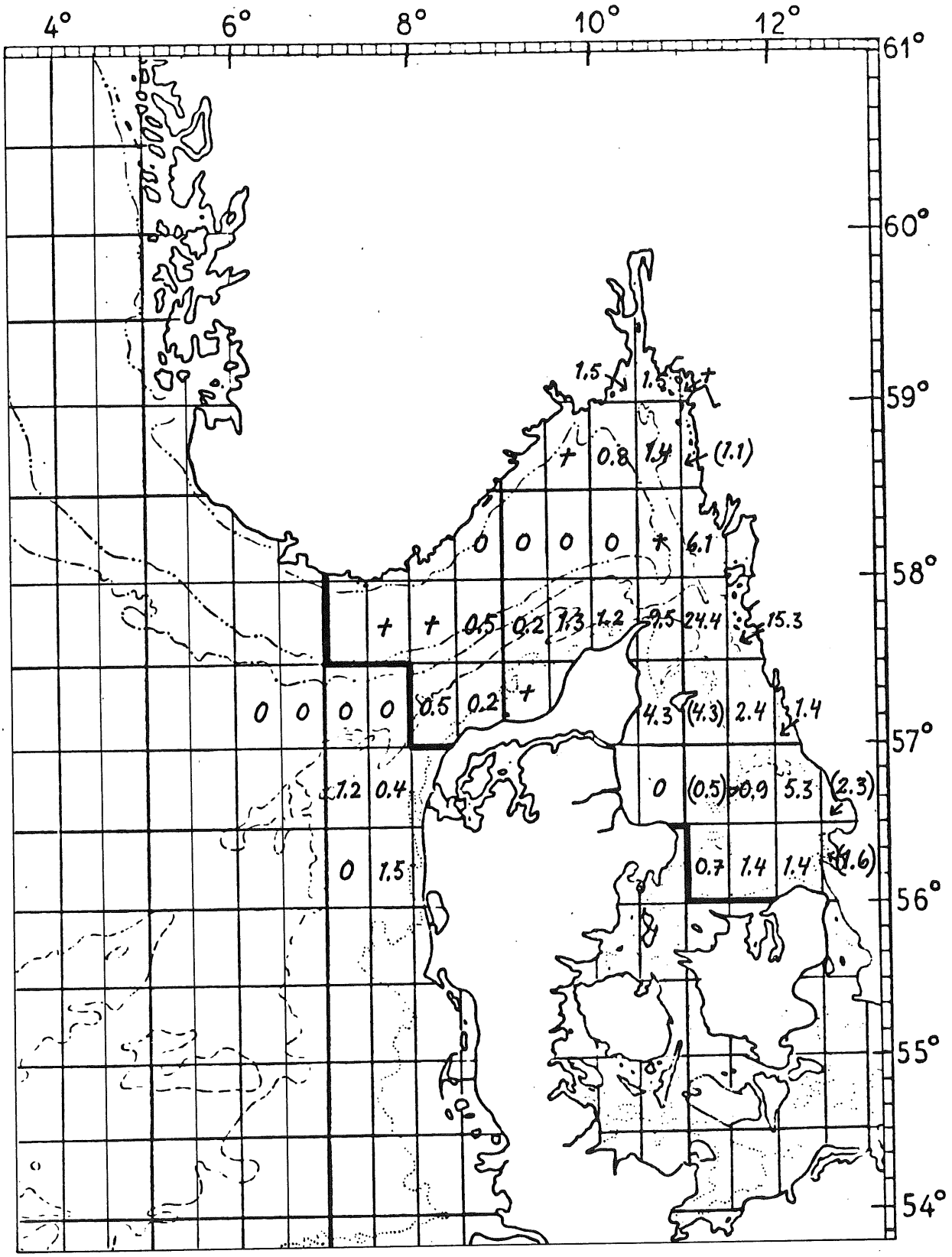


Fig. 3.2. 1-group Sprat. Biomass (x 10^{-3} tonnes) in Div. IIIa based on an echo-survey carried out by R/V "Johan Hjorth", March 1980. Extrapolated values in brachets. Total biomass in IIIa 88 500 tonnes).

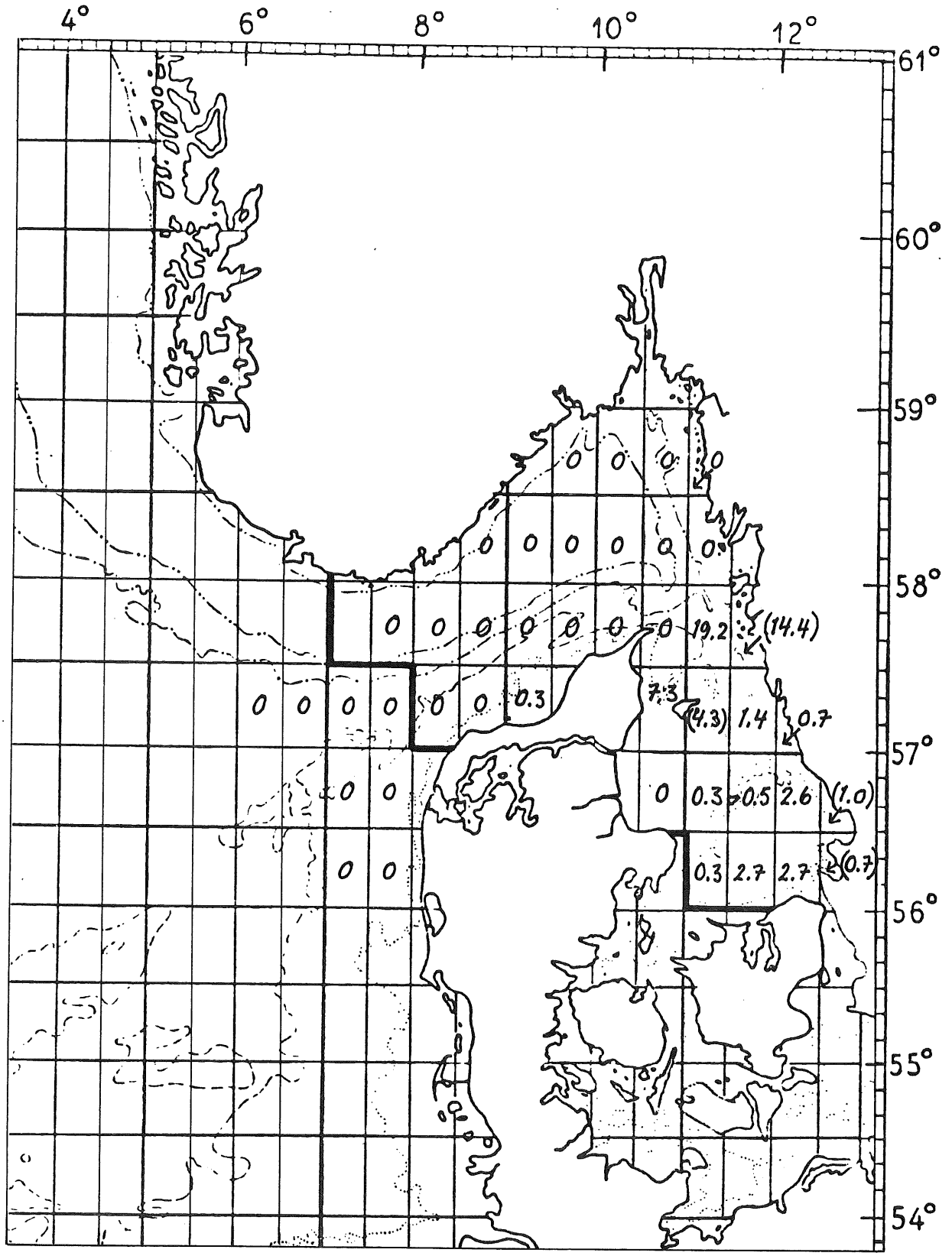


Fig. 3.3. 2-group and older sprat. Biomass (x 10^{-3} tonnes) in Div. IIIa based on an echo-survey carried out by R/V "Johan Hjort", March 1980. Extrapolated values in brackets. (Total biomass: 58 400 tonnes).

4. COD.

4.1. Migration of Cod.

The results of tagging experiments carried out in the Kattegat and adjacent areas were dealt with in the report of the Study Group on Division IIIa Stocks (1978) in order to estimate the stock components in the Kattegat. It was concluded that the tagging experiments gave no clear evidence of emigration from the Kattegat to the adjoining areas, but a migration in the opposite direction was indicated.

The distribution of recaptures from tagging experiments in the Sound (subdivision 23) in March and October 1973 (Bagge 1974) showed that respectively 48% and 51% of these were taken in the Kattegat in the first year after tagging, 22% and 17% in the second year and 20% and 0% in the third year. The stock size of cod in subdivision 23 is not known.

Tagging experiments in the Mecklenburg Bay (Berner 1969) and Kiel Bay (Bagge 1958, 1970, Thurow (in prep.)) showed a distribution of recaptures with a much smaller proportion in the Kattegat. These tagging localities are, however, much more distant from the southern border of the Kattegat (140 and 90 nautical miles) as compared to the tagging locality in the Sound (15 nautical miles); and also the fish could be exposed to heavy trawling effort en route.

A method to identify otoliths of Baltic-Belt Sea origin applied to samples from the SW Kattegat (Bagge and Steffensen in prep.) has identicated a Baltic-Belt Sea component of 33-37% in age groups III and IV only.

Skagerrak tagging experiments (Anon 1969) have indicated a migration from the Danish Skagerrak coast into the northern Kattegat in May-August and southwest towards the North Sea in winter. A tagging experiment in the North Sea (Bagge 1973) off Thorsminde on the Danish westcoast showed a similar pattern of migration. Danielssen (1969 and in prep.) demonstrated by further tagging experiments along the Danish and Norwegian Skagerrak coast that there is no connection between the Norwegian coastal cod and the Danish coastal cod.

Migration creates severe problems in formulating a longterm management objective for any stock. Having no reliable estimate of the immigration and emigration rates in Div. IIIa makes it impossible to produce a meaningfull yield curve and accordingly it is difficult to assess at what level the fishing mortality will give an optimal longterm yield.

4.2. The Fishery.

A full separation of cod landings from Division IIIa into Kattegat and Skagerrak landings is done only by Denmark and Sweden. Landings in the Federal Republic of Germany are separated only for vessels larger than 35 GRT. However, the F.R.G. landings are small and the possible error made by assuming that vessels smaller than 35 GRT fish only in the Kattegat will be negligible. Norwegian catches are taken only in the Skagerrak and this also seems to be the case for the two other countries with cod landings from Division IIIa in recent years, Belgium and Netherlands. Thus it is possible to split the cod landings from Division IIIa into Kattegat and Skagerrak landings with a high degree of accuracy.

Landings from the Kattegat increase by 1500 tonnes from 1978 to 1979 to reach 14859 tonnes, compared with an average of 18300 tonnes for 1972-77 (Table 4.2.1). The Danish fishery was restricted by closed seasons in March and June-July in order to enforce quota regulations. Denmark also increased the legal minimum landing size for cod from 33 cm to 38 cm.

Danish cod landings by quarters from the Kattegat are given in Table 4.2.2.

4.3. VPA. Kattegat.

4.3.1. Age Distribution.

As in previous years only Danish age distribution for 1979 were available. The Danish catch at age figures are therefore raised to the total international landings from the Skagerrak and the Kattegat respectively. The results are shown in Table 4.3.1 and Table 4.5.2.

4.3.2. Fishing mortality.

The VPA assumes no migration and M = 0.2.

The landing figures for 1979 in periods when directed fishing for cod was banned, compared with the landings in corresponding periods in 1978 indicate a decrease of 10% in fishing effort.

The exploitation pattern in 1979 was assumed to be the same as in 1974-76. The fishing mortality for 2 year old fish was assumed to be 0.3 as a consequence of the increase of the minimum landing size from 33 to 38 cm.

The fishing mortality was further adjusted to make the mean fishing mortality in 1979 10% lower than in 1978. (Table 4.3.2). The calculated fishing mortalities are also shown in Table 4.3.2 while the stock in number is shown in Table 4.3.3.

4.4. Prognosis for cod in the Kattegat.

4.4.1. Recruitment.

The size of the recruiting year classes are highly important to the outcome of the prognosis for the Kattegat cod. The biggest problem is the choice of input for recruitment of the 1979 year class, which from the IYHS survey in the Kattegat is estimated as being more than twice as numerous as any other year class after 1970 (Table 4.4.1). Although correlation between the survey estimates and the VPA has been poor, the year classes of cod in the Kattegat show some correlation with year classes in the North Sea and with estimates of 0-group strength from shore seine surveys on the Norwegian Skagerrak coast. Both indicate a strong 1979 year class. Thus, for the prognosis the 1979 year class has been set at 50 million individuals at age 1. For the year classes 1978 and 1980 the average recruitment for the year classes 1970-74 of 26 millions have been used (Table 4.3.3).

4.4.2. Weight at age.

Danish gutted mean weight at age, raised by a factor of 1.18 was used in the prognosis (Table 4.2.2). The sum of products of weights and numbers landed actual landing figure.

4.4.3. Results.

The input data for the prognosis are given in Table 4.4.2. To take the TAC of 16400 tonnes in 1980 will require that $F_{80}=0.96.F_{79}$. This has been used as the only option for 1980 in the predictions for 1981. Fig. 4.4.1 shows catch in 1981 and spawning stock biomass in 1982 as functions of F_{81}/F_{79}.

For $F_{81}=F_{79}$ the catch will be 22100 tonnes, for $F_{81}=F_{80}$ the catch will be 21500 tonnes. Some of the predicted catches are given in the following table.

Prognoses. Catch in tonnes.

Year	F	Catch
1979	F_{79}	14 800
1980	$.96 \cdot F_{79}$	16 500
1981	$.8 \cdot F_{79}$	18 700
-	$1.0 \cdot F_{79}$	22 100
-	$1.2 \cdot F_{79}$	25 200

According to the VPA the spawning stock biomass amounted to about 30 000 tonnes in 1977 (Fig. 4.4.2). It may decrease to a level of about 22 000 tonnes in 1980, but will again increase to around 30 000 tonnes in 1981 if the size of the 1979 year class is correctly estimated.

4.5. Cod in the Skagerrak.

4.5.1. The Fishery.

Landings from the Skagerrak in 1979 decreased by nearly 9000 tonnes from 1978 to give a total of 17154 tonnes (Table 4.5.1) Norwegian and Swedish landings increased and the decrease is almost exclusively the effect of reduced Danish landings. The Danish Fishery was severely restricted by quota regulations which were enforced by closing the fishery in certain seasons.

4.5.2. The age composition in the landings exists only for 1978 and 1979 and is entirely based on Danish data as given in Table 4.5.2. The catches are dominated by 2 and 3 year old fish.

The quota for 1980 is 15500 tonnes, but Norway can in addition to this take 2000 tonnes with passive gears inside the Norwegian base-line, allowing for a total catch of 17500 tonnes. Although there is no basis for an evaluation of the state of this stock, it is reasonable to believe that the 1979 year class is relatively strong (see section 4.4.1). A TAC for 1981 set at the 1980 level should therefore lead to a decrease in the exploitation rate.

Table 4.2.1. Cod landings from the Kattegat 1970-79.

Year	Denmark	Sweden	F.R.G [1)]	Total
1970	9 841	4 015	21	13 877
1971	11 748	3 962	22	15 732
1972	13 451	3 957	34	17 442
1973	14 913	3 850	74	18 837
1974	17 043	4 717	120	21 880
1975	11 749	3 642	94	15 485
1976	12 986	3 242	47	16 275
1977	16 668	3 400	51	20 119
1978	10 293	2 893	204	13 390
1979	11 045 [2)]	3 763	51	14 859

1) Landing statistics incompletely split on the Kattegat and the Skagerrak. The figures are estimated by the Working Group.

2) The fishery closed:
26/2-5/4
2/6-31/7

Table 4.2.2. Danish landings of cod by quarters (tonnes)

Kattegat 1973-79

	1973	1974	1975	1976	1977	1978	1979
Jan-Mar.	8229	10038	5824	7010	10899	5949	6839
Apr.-June	2391	2331	2650	2093	1960	1822	1996
July-Sep.	1619	1706	1426	1433	1629	886	636
Oct.-Dec.	2663	2967	1848	2450	2180	1636	1574
Total	14902	17042	11748	12986	16668	10293	11045

Skagerrak 1973-79

	1973	1974	1975	1976	1977	1978	1979
Jan.-Mar.	1837	1829	3752	4452	4941	3848	3963
Apr.-June	1970	1598	3932	4124	4071	5671	5143
July-Sep.	1487	1246	3335	4856	4472	5873	2244
Oct.-Dec.	1382	2021	3151	5415	5134	8222	2657
Total	6676	6694	14170	18847	18618	23614	14007

Table 4.2.3. Cod landings from Division III a - Kattegat and Skagerrak.
(Danish and Swedish landings from national sources, other countries from Bulletin Statistique).

Year	Denmark	Norway	Sweden	Others	Total
1970	13 300	882	5 979	56	20 217
1971	17 662	1 355	6 002	35	25 054
1972	20 410	1 201	5 882	56	27 549
1973	21 566	1 253	5 540	101	28 460
1974	23 737	1 197	6 097	213	31 244
1975	25 920	1 190	4 559	146	31 815
1976	31 833	1 241	4 537	513	38 124
1977	33 475	979	5 137	726	40 317
1978	33 907	1 442	3 485	464	39 298
1979	25 052	1 745	5 039	174	32 010

Table 4.3.1. Cod in the Kattegat. Catch in numbers (x 10^{-3})

CATCH AT AGE

age	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	15049	38	5	591	188	166	1	88	88
2	7937	3811	623	4250	3610	4431	2218	6015	2697
3	6936	6422	2167	6943	2906	6983	7078	2551	5820
4	1918	2427	3954	4543	3251	1835	4942	2100	956
5	887	809	2280	1538	661	1039	492	913	991
6	207	433	780	349	429	287	376	83	237
7	30	94	212	68	47	189	137	99	15
8	30	38	160	31	19	52	102	71	56

The last age group is a plus-group.

Table 4.3.2. Cod in the Kattegat. Fishing mortalities calculated by VPA.

FISHING MORTALITIES

age	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.580	0.002	0.000	0.022	0.008	0.019	0.000	0.007	0.001
2	0.360	0.280	0.037	0.456	0.181	0.264	0.361	0.357	0.300
3	0.673	0.557	0.255	0.721	0.655	0.625	0.875	0.929	0.700
4	0.607	0.530	0.818	1.309	0.921	1.226	1.354	0.709	1.200
5	0.686	0.562	1.556	0.918	0.663	0.892	1.538	1.055	0.900
6	0.452	0.881	2.036	1.213	0.723	0.691	1.010	1.406	0.900
7	0.449	0.382	1.793	1.262	0.499	0.842	0.865	0.828	0.900
8	0.600	0.800	1.500	1.000	0.800	0.800	0.800	0.800	0.900
Mean	0.654	0.559	0.725	0.915	0.763	0.730	1.054	0.859	0.774

Table 4.3.3. Cod in the Kattegat. Stock in numbers (x 10^{-3})

STOCK IN NUMBERS

age	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	37363	22871	15539	29984	25850	9987	26860	14050	97140
2	28771	17126	18691	12718	24015	20995	8027	21999	11424
3	15451	16428	10595	14741	6603	16411	13204	4580	12609
4	4606	6454	7702	6725	5871	2809	7195	4508	1480
5	1950	2056	3110	2782	1488	1914	675	1521	1816
6	623	804	959	537	909	627	642	119	434
7	91	525	273	103	131	561	257	191	24
8	40	48	181	37	24	65	128	89	68

Run identification: cod in the Kattegat

SPAWNING BIOMASS (TONS)

1971	1972	1973	1974	1975	1976	1977	1978	1979
54705	42226	42086	39804	27224	34433	36520	20528	24034

Table 4.4.1. Cod in the Kattegat. Spawning stock and recruitment.

Year / Year Class	Spawning stock ($\geq$ 4 years) (tonnes)	Recruitment	
		R_1 from VPA (1000 fish)	Abundance indices for 1-group cod from IYHS
1971	34 703	22 886	8.15
1972	42 226	15 539	17.87
1973	42 086	29 984	29.05
1974	39 804	25 850	4.59
1975	27 224	9 987	3.22
1976	34 433	26 860	8.11
1977	36 520	-	35.07
1978	-	-	12.82
1979	-	-	71.10

Table 4.5.1. Cod landings from the Skagerrak 1970-79

Year	Denmark	Sweden	Norway	Others	Total
1970	3 459	1 964	882	35	6 340
1971	5 914	2 040	1 355	13	9 322
1972	6 959	1 925	1 201	22	10 107
1973	6 673	1 690	1 253	27	9 643
1974	6 694	1 380	1 197	92	9 363
1975	14 171	917	1 190	52	16 330
1976	18 847	873	1 241	466	21 427
1977	18 618	560	979	675	20 832
1978	23 614	592	1 442	260	25 908
1979	14 007[x)]	1 279	1 745	123	17 154

x) The fishery closed:

26/2 - 5/4
1/5 - 13/5
1/6 - 31/7
10/8 - 30/9

Table 4.5.2. Cod in the Skagerrak. Landings in numbers in 1978 and 1979 ($\times 10^{-3}$)

Age	1978	1979
1	4 593	589
2	11 833	4 639
3	3 059	3 062
4	821	501
5	193	219
6	176	42
7	47	33
8+	55	28
Total	20 777	9 113
Catch in tonnes	25 908	17 154

Fig. 4.4.1. Cod in the Kattegat.

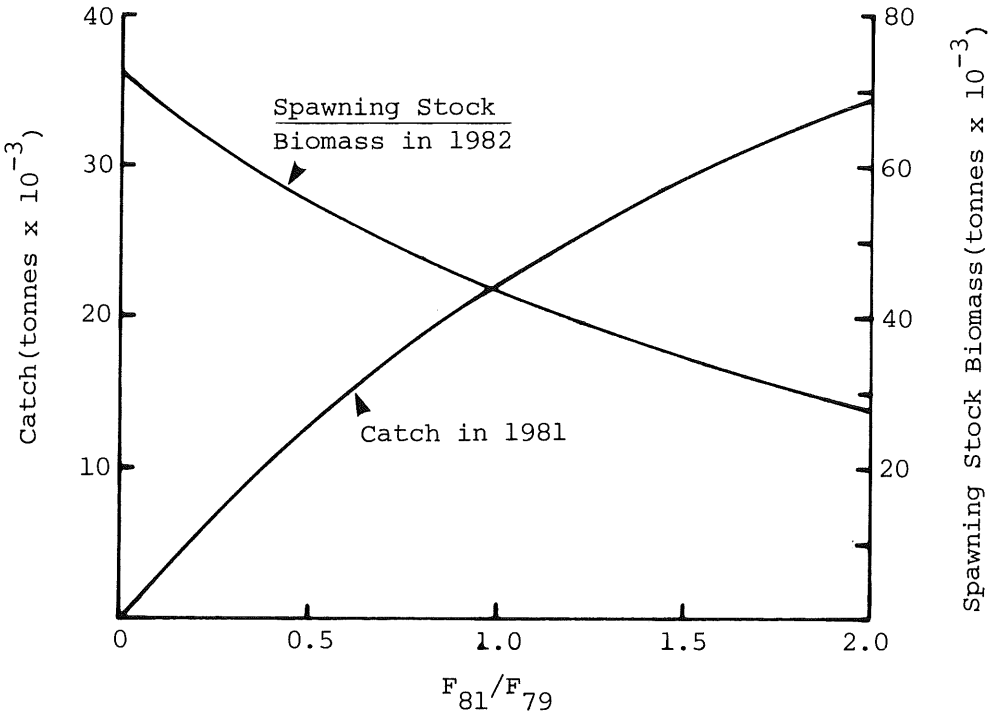
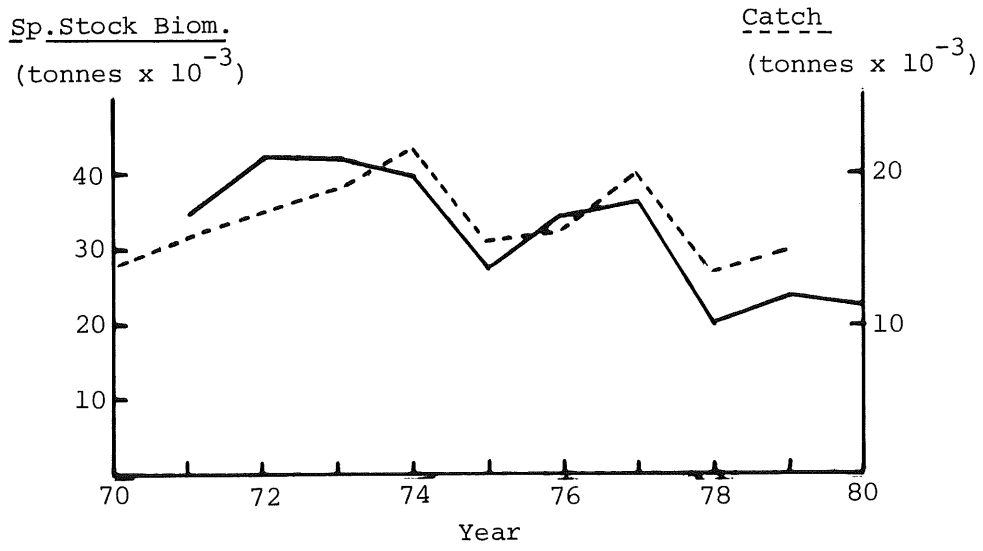


Fig. 4.4.2.



5. HADDOCK

5.1. Biology

5.1.1. In the last 2 years a separate, precautionary TAC on haddock has been proposed by ICES for Div. IIIa. As no biological basis for an assessment existed, a simple average of the last 4-5 years landings was recommended.

According to its terms of reference the present W.G. was asked to recommend a TAC for 1981.

This raises the question as to which degree the Div. IIIa haddock can be regarded as a selfcontained unit or merely as an extension of the North Sea stock. In the first case an individual TAC based upon a specific assessment of the haddock in Div. IIIa is, of course, necessary.

In the latter case it could perhaps be feasible to allocate a IIIa TAC as a certain percentage of that for the North Sea.

5.1.2. The literature contains very little information on the life history of Haddock in Div. IIIa. Poulsen (1928) described the invasion of haddock into the Belt Seas and the western Baltic in 1926-28. This and earlier cases were linked with a strong influx of high salinity water from the Skagerrak. Molander (1950) described the Swedish haddock fishery during three decades and gives the average landings per voyage for a number of years. In Fig. 5.1 the values for the Skagerrak are plottet against those for the North Sea. There is no close correlation apparent between the two areas in this material. Another feature which should have had a marked effect on the landings from the Skagerrak is the outstandingly strong year class 1967 in the North Sea. The landing figures in Table 5.1 do not indicate any spectacular increase concomittant with that in the North Sea as one should expect were the haddock stock in Div. IIIa closely connected with the North Sea stock. 0 and I-group surveys often indicate a patch of young haddock close to the entrance to the Skagerrak and more or less separated from the main occurence in the northern North Sea. Surveys in the Skagerrak proper are, however, very incomplete and no firm conclusions can be made from the material presently available.

5.1.3. On this basis the Working Group tentatively concluded that the haddock stock in Div. IIIa could be selfcontained to some degree, that it is reasonable to assume that some influx of young stages from the North Sea takes place but that the size of this could be more dependent on hydrographic conditions than on North Sea year class strength.

5.2. Landings.

These are shown in Table 5.1 for the period 1969-79. Even though the landings of some countries could not be divided on Subarea IV and Div. IIIa in the first half of the Seventies and consequently not be included in the total landings it is reasonable to assume that they increased gradually until 1976-77 when total landings amounted to 9-10 000 tonnes. In 1979 they dropped to about half that level. The TAC set for 1979 (9 000 tonnes) were not even nearly exhausted according to the preliminary landing figures. The decrease in 1979 must therefore be explained by a reduction in availability and not as a result of the regulatory restrictions which in fact were not restrictive at all in that year.

5.3. Age Composition and Mean Weight.

Data were only available for Danish landings and were recorded for the first time. The numbers caught per age group are shown in the following table:

Age (W.R.)	Nos. x 10^{-3}	Mean weight[x] (grms) Div.IIIa	Mean weight (grms)[xx] Subarea IV
1	4.0	434	210
2	1062.5	438	256
3	1756.3	776	374
4	575.5	1252	529
5	188.3	1795	648
6	79.6	3040	858
7	13.9	2130	1104

x) Gutted weight raised by 1.18
xx) From CM 1979/G:7

The mean weights, also shown in the table, indicate a much faster growth of the haddock in Div. IIIa than of those in the North Sea which are included in the table for comparison. This feature was discussed by Poulsen (cited above) who ascribed the growth differentials to different feeding habits. While North Sea haddock feed extensively on echiderms and other calciferous animals the diet of the Div. IIIa haddock is dominated by euphausids.

5.4. Prognosis.

On basis of the data presented above and without any indices of recruitment, the W.G. did not find itself in a position to propose a TAC on biological grounds. The declining catches in 1978-79 may indicate a reduction in stock size which would justify a TAC set at a lower level than in 1979. As a tentative proposal the W.G. then agreed on suggesting a TAC for haddock in Div. IIIa of 4 500 tonnes. This is somewhat lower than the actual landings in 1979 and could secure the stock from any sharp increases in F until further information on this stock can be gathered.

Table 5.1. Nominal landings of Haddock from the Skagerrak and the Kattegat.

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Belgium	-	-	-	-	-	-	-	181	118	25	28
Denmark	982	810	2101	2816	2832	4417	5015	7488	6907	4978	4124
German Dem.Rep.	..a)	..a)	..a)	..a)	1	-	-	1	-	-	-
Germany,Fed.Rep.	22	46	9	20	+	+	12	1	16	11	1[d]
Netherlands	-	-	-	-	-	-	5	59	81	20	5[e]
Norway	52	73	139	153	242	175	122	191	156	168	236
Sweden	..b)	..b)	..b)	..b)	..b)	..b)	921	1075	2485	1435[c]	325
U.K.(England & Wales)	-	13	-	-	16	26	40	59	-	-	-
U.K.(Scotland)	-	-	-	-	-	+	-	-	-	-	-
Total	1056	942	2249	2989	3091	4618	6115	9055	9763	6637	4719

a) IIIa included in IV
b) IIIa included in IVa
c) IIIa includes IVa,b.
d) Derived from final catch figures Jan-June an estimates for Jul-Dec.
e) Jan-Oct.

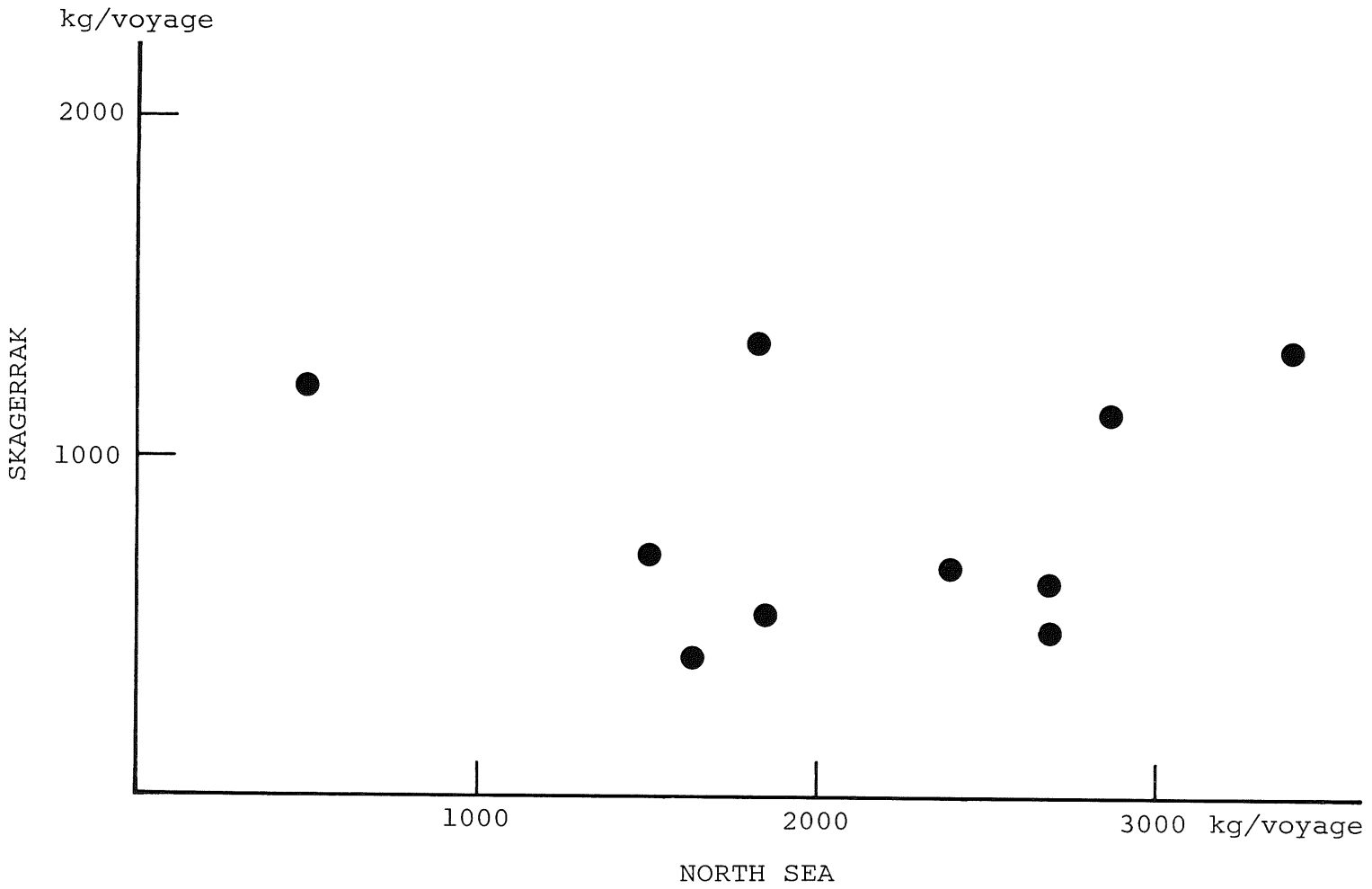


Fig. 5.1. Average catch of haddock per voyage from the Skagerrak plotted against that from the North Sea 1930, 1933-40, 1947-48 (after Molander 1951).

6. WHITING.

6.1. The Fishery.

The landing statistics are shown in Table 6.1. In case of whiting it has not even been possible to allocate the Swedish landings to the North Sea and to Div. IIIa prior to 1975. Table 6.1 shows, however, that Danish landings have contributed more than 90% of the total landing figures since 1974 and consequently the Danish landings should give a fairly precise picture of the development during the last decade.

From a peak of about 29 000 tonnes in 1974, landings went down to a level of 19 000 tonnes in 1975-76. Then followed a sharp increase to the record figure of 48 000 tons in 1978.

The preliminary figure for the Danish landings in 1979 indicate a sharp decline of about 65% from 1978. This is mainly due to a closure of the fishery in the period 17.-31. March 1979 immidiately followed by a ban on directed fishing on whiting for industrial purposes.

6.2. Stock Assessment.

There are no data available which permit a proper assessment to be done. Data on recruitment strength are, however, available from the Swedish participation in IYHS and are shown below:

Year class	Index of whiting < 20 cm
1976	134
1977	497
1978	592
1979	945

Yearclass 1979 appears to be very strong and was evenly distributed over the area of survey in contrast to year class 1978 which showed an uneven distribution pattern. The index for the latter is therefore less reliable and is strongly influenced by the number of statistical rectangles included in the calculation.

As yearclass 1979 appears to be even stronger than the strong yearclass of 1977 which gave basis for the record landings of 48 000 tonnes in 1978, the Working Group felt that the TAC for

1981 could be increased to 30 000 tons from the 22 000 tonnes recommended for 1980. The W.G. based this view on the change in exploitation pattern which should be the result of the Danish ban on industrial fishing for this species. This would change the main effort from the 1-group to the the 2-group and older fish.

Table 6.1. Whiting landings from Division IIIa (from Bulletin Statistique).

Year	Denmark	Norway	Sweden	Others	Total
1970	13 115	15	IIIa incl. in IV a	-	13 130
1971	13 971	17	↓	1	13 989
1972	14 538	24		-	14 562
1973	22 479	67		1	22 547
1974	28 749	89		4	28 842
1975	19 018	57	611	4	19 690
1976	17 870	48	1 002	57	18 977
1977	18 116	55	973	41	19 185
1978	48 216	58	318	32	48 624
1979[x)]	16 943[xx)]	52	990	14	17 999

x) preliminary

xx) The fishery closed: 17/3-31/3

7. PLAICE.

7.1. Landings.

7.1.1. Kattegat.

Only Denmark and Sweden provided catch data for the Kattegat and the Skagerrak separately. The Federal Republic of Germany has very small catches estimated at 10-50 tonnes per year. As in the previous report it was not possible to separate all the German landings. Therefore Table 7.1.1 only shows the Danish and Swedish landings from the Kattegat.

7.1.2. Skagerrak.

Danish landings from the Skagerrak show an increasing tendency over the last five years. (Table 7.1.1). The reduced landings in 1979 are mainly due to reduced catches in the 4. quarter.

In addition to the Danish and Swedish landings those of all other countries fishing in Division III a are included in Table 7.1.2. While the landings from the Fed. Rep. of Germany, Norway and the U.K. are negligible and those of Belgium are moderate, the Netherlands have reported extensive landings since 1976 as taken from Division IIIa. In accordance with the footnote to Table 7.1.2 only part of these are included in the assessment.

Danish landings by quarters are given in Table 7.1.3.

7.2. Virtual Population Analysis (V.P.A.). Kattegat.

7.2.1. Age Distribution.

The age composition as numbers landed per age-group is given in table 7.2.1. The data are based on sampling of the Danish landings and were raised to the total landings in the Kattegat.

7.2.2. F at Age Array.

As no effort data were available for the Kattegat area, nothing definite could be said about the actual level of F. An average F based on the 1969-1971 values obtained

by a trial V.P.A. run were used as input figures. The catch levels and age compositions in 1969-71 appear to be similar to those in the last three years (Table 7.2.2.).

7.2.3. Weight at age data.

Danish weight at age data were available for 1979. A sum of product check shows a discrepancy of about +8% compared with the actual landing figure. The Working Group agreed to use the 1979 weights for the prognosis (Table 7.2.4). No weight at age data were available before 1978. Therefore the 1978 data were used in calculating the spawning stock biomass in the periode 1968 to 1978, and the 1979 data for 1979 and the prognosis.

7.2.4. Results of the V.P.A.

In the V.P.A. M was set at 0.1. The calculated F-values, stock in numbers and spawning stock biomasses are shown in tables 7.2.2, 7.2.3 and in Figure 7.2.

Figure 7.2.1 indicates a decrease in the spawning stock from 1971 to 1977, so that the present level equals the one prior to 1971.

The landings in the same period show a slight decreasing trend but with much smaller fluctuations than those of the spawning stock.

7.3. Prognosis.

7.3.1. The Kattegat.

The landings in 1981 and the spawning stocksizes per 1. January 1982 were calculated for several values of F in 1981. The exploitation pattern in the period 1980-81 was assumed to be the same as in 1979. The F value in 1980 was assumed to be that of 1979.

Inputdata for the prognosis is given in Tables 7.2.3 and 7.3.1.

Two prognoses were made

(i) using the aritmetic mean recruitment for agegroup I as calculated by V.P.A. for the periode 1968-77.

(ii) using a mean recruitment from the more recent period 1974-1977.

Case (i) gives an average recruitment of 51,7 x 10^6 while

case (ii) gives a value of 63.0 x 10^6. Catch and spawning stock was plotted against a range of F-values in 1981 relative to F in 1979 (see Fig.7.3).The results of the prognoses indicate, that if the fishing mortality in 1981 is kept at the 1979 level the expected landings would be about 8500-9000 tonnes. There is, however, indications that the 1976 yearclass is much above the average recruitment level used in the prognoses. This yearclass will enter the fishery in 1980 and could change the basis for the predicted catch levels both in that year and in 1981. The Working Group must point out, that the TAC set for 1981 is susceptible to revision when and if the yearclass 1976 prove to be as strong as indicated.

7.3.2. The Skagerrak.

Data on landings in number at age from the Skagerrak are only available from Denmark and only for the last two years. Both in 1978 and 1979 the main components of the landings were age group 4 and 5 (Table 7.3.3). Due to market demands the landings of older fish were rather low in both years.

Weight at age data from Danish Skagerrak landings are given in Table 7.3.2. The sum of products calculated from these data and the number per age-group in 1979 (Table 7.3.3) differs from the actual Danish landings (Table 7.1.1) by only - 2%.

Because the data were insufficient for a prognosis, the Working Group agreed to suggest the same TAC as in 1979 and 1980 i.e. 14 000 tonnes. This would stabilize the catch at the same level until more data are available.

Table 7.1.1. Plaice catches from the Skagerrak.

(tons)

Year	Denmark	Sweden	Total
1970	3 219	57	3 276
1971	3 741	64	3 805
1972	5 095	70	5 165
1973	3 871	80	3 951
1974	3 429	70	3 499
1975	4 888	77	4 965
1976	9 251	81	9 332
1977	12 855	142	12 997
1978	13 383	94	13 477
1979	11 045	105	11 150

Plaice landings from the Kattegat.

(tons)

Year	Denmark	Sweden	Total
1970	11 582	381	11 963
1971	15 819	331	16 150
1972	15 504	348	15 852
1973	10 021	231	10 252
1974	11 401	255	11 656
1975	10 158	369	10 527
1976	9 487	271	9 758
1977	11 611	300	11 911
1978	12 685	368	13 053
1979	9 756	281	10 037

Table 7.1.2. Plaice-landings.Kattegat and Skagerrak combined (Division III a). Denmark and Sweden from national sources, other countries from Bulletin Statistique.

Year	Denmark	Sweden	Other Countries	Total
1970	14 096	438	40	14 574
1971	18 629	395	19	19 043
1972	19 618	418	80	20 116
1973	13 346	311	54	13 711
1974	14 248	325	57	14 630
1975	14 508	446	199	15 153
1976	18 738	385	5 331 x)	24 454
1977	24 323	442	12 268 x)	37 033
1978	26 156	462	4 160 x)	34 938
1979 xx)	20 801	386	2 185 x)	23 372

x) Including Dutch catches. A large part of these is assumed to have been taken from the North Sea (1976: 4575 tonnes, 1977: 11384 tonnes, 1978: 3680 tonnes, 1979 a): 1532 tonnes).

a) Jan.-Oct.

xx) Preliminary figures.

Table 7.1.3. Danish landings of plaice by quarters in the Kattegat and the Skagerrak.

Kattegat 1973-79

	1973	1974	1975	1976	1977	1978	1979
Jan.-Mar.	2330	2950	2127	2637	2526	2410	2002
Apr.-June	1302	2738	2372	2096	2497	2487	2786
July-Sep.	2265	2861	2781	2183	2924	3815	2525
Oct.-Dec.	4124	2852	2878	2571	3663	3973	2443
Total	10021	11401	10158	9487	11610	12685	9756

Skagerrak 1973-79

	1973	1974	1975	1976	1977	1978	1979
Jan.-Mar.	1046	840	668	1732	2119	1289	967
Apr.-June	902	971	949	2234	3617	3522	5097
July-Sep.	1028	1098	1514	2944	4614	4302	2963
Oct.-Dec.	895	520	1757	2341	2505	4270	2018
Total	3871	3429	4888	9251	12855	13383	11045

Table 7.2.1. Plaice in the Kattegat. Catch in numbers.

age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	1	1	1	1	1	1470	50	140	10	10	1
2	3790	1150	3660	680	1120	8590	3100	7880	8657	3330	147
3	20320	14070	11830	8190	21790	5830	21630	7330	11026	20150	9686
4	10570	10510	9760	23570	17720	6260	3470	8140	2100	9230	27862
5	2280	2840	3140	14170	7910	3130	2620	1040	3060	2680	8685
6	790	760	710	1670	1110	1770	1020	730	431	900	1144
7	500	300	650	350	200	510	740	420	280	230	227
8	260	300	370	190	120	180	330	350	207	270	49
9	180	270	370	330	80	20	120	150	87	210	48
10	70	240	240	260	80	10	80	110	74	150	35
11	0	50	80	80	30	30	50	50	10	100	17
12	50	100	140	40	60	30	140	10	13	190	40

age	1979
1	55
2	881
3	6589
4	17164
5	7870
6	1709
7	580
8	114
9	57
10	52
11	38
12	18

NATURAL MORTALITY AT AGE:

age	1	2	3	4	5	6	7	8	9	10	11	12
mort.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Table 7.2.2. Plaice in the Kattegat. The F value from the V.P.A.

age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	0.000	0.000	0.000	0.000	0.000	0.057	0.001	0.002	0.000	0.000	0.000
2	0.071	0.020	0.090	0.018	0.076	0.193	0.147	0.167	0.110	0.063	0.005
3	0.663	0.361	0.256	0.266	0.992	0.607	0.887	0.530	0.329	0.355	0.236
4	0.850	0.769	0.404	1.021	1.287	0.776	0.794	0.902	0.251	0.446	1.043
5	0.595	0.510	0.483	1.573	1.074	0.721	0.782	0.515	0.936	0.512	0.872
6	0.177	0.357	0.203	0.526	0.406	0.650	0.480	0.456	0.370	0.702	0.380
7	0.258	0.085	0.518	0.131	0.086	0.294	0.551	0.330	0.282	0.307	0.335
8	0.147	0.217	0.129	0.248	0.055	0.093	0.280	0.485	0.239	0.425	0.088
9	0.177	0.201	0.401	0.145	0.141	0.010	0.075	0.178	0.188	0.361	0.110
10	0.053	0.335	0.246	0.482	0.043	0.021	0.047	0.082	0.112	0.418	0.079
11	0.000	0.044	0.159	0.109	0.083	0.018	0.125	0.034	0.009	0.195	0.078
12	0.010	0.030	0.150	0.100	0.100	0.100	0.100	0.030	0.010	0.200	0.100
Mean	0.567	0.429	0.315	0.769	0.975	0.573	0.753	0.593	0.348	0.391	0.637

age	1979
1	0.000
2	0.043
3	0.294
4	0.731
5	0.854
6	0.362
7	0.300
8	0.250
9	0.200
10	0.150
11	0.110
12	0.100
Mean	0.564

Table 7.2.3. Plaice in the Kattegat. The calculated stock in nos.

age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	68269	49065	44846	17662	56758	27913	59585	96490	62944	55290	24291
2	57799	51646	44431	40604	15985	51408	23859	53868	87181	56951	30122
3	43635	43697	54839	36720	36094	13400	36361	18645	41260	70661	48366
4	19257	26446	36725	38396	25461	12108	8609	14295	9931	26878	44834
5	5516	7444	8572	18552	12517	6563	5041	2702	5250	6994	15577
6	5111	2055	4047	4785	3481	3671	2799	2086	1460	1863	3791
7	2305	3874	1681	2988	2557	2098	1828	1567	1196	913	835
8	1994	1612	3221	906	2371	2124	1415	954	1026	817	608
9	1165	1552	1174	2563	840	2031	1751	967	536	720	483
10	1426	883	1153	711	2006	503	1619	1470	735	598	458
11	3673	1218	572	516	397	1739	445	1570	1226	595	257
12	5281	3555	1355	441	662	531	1545	555	1373	1100	441
	52216x)	30437	32540	53097	27365	16976	20689	15411	19571	30509	32083

age	1979
1	577987
2	21988
3	27116
4	34572
5	14506
6	5695
7	2340
8	540
9	504
10	392
11	363
12	199
	25516x)

x) Spawning biomass

Table 7.2.4. Plaice in the Kattegat. Mean weight at age 1978 and 1979 (smoothed curve).

Age	1978	1979[x)]
1	.200	.120
2	.230	.220
3	.240	.260
4	.260	.280
5	.300	.320
6	.460	.350
7	.720	.500
8	.780	.780
9	.800	.880
10	.820	.900
11	.830	.900
12	.830	.900

x) gutted weight.

Table 7.3.1. Plaice in the Kattegat. Inputdata for the prognosis run.

Age	Catch in no.	Rel.F.
1	55	.000
2	881	.050
3	6589	.344
4	17164	.856
5	7870	1.000
6	1709	.424
7	580	.351
8	114	.293
9	87	.234
10	52	.175
11	38	.129
12	18	.129

Table 7.3.2. Plaice in the Skagerrak. Catch in numbers x 10^3 and mean weight at age from danish landings.

Age	1978	1979	Weight at age
1	-	-	
2	352.3	233	.240
3	6397.8	3088	.260
4	12682.2	11725	.268
5	16810.3	12416	.310
6	7040.6	5819	.350
7	406.6	1922	.477
8	16.2	61	.699
9	17.3	1	1.092
10	16.0	+	1.712
11	4.6	+	1.216
12	0		

Table 7.3.3. Plaice in the Skagerrak. Catch in numbers x 10^3 and mean weight (gutted) at age.

Age	1978	1979
1	-	-
2	352	233
3	6 397	3 088
4	12 682	11 725
5	16 810	12 416
6	7 040	5 819
7	406	1 922
8	16	61
9	17	1
10	16	+
11	4	+

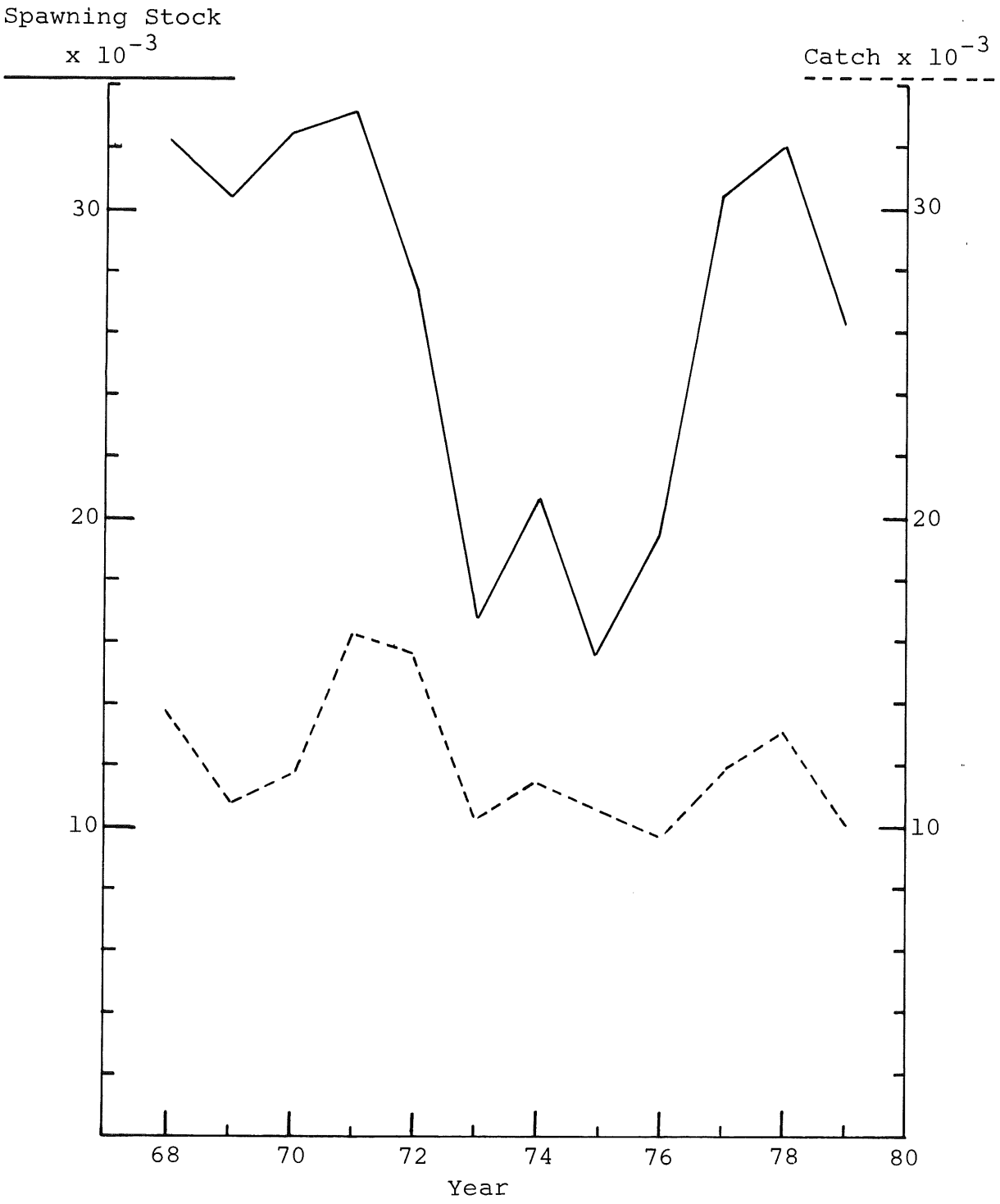


Fig. 7.2. Plaice, Kattegat.
Landings and calculated spawning stock.

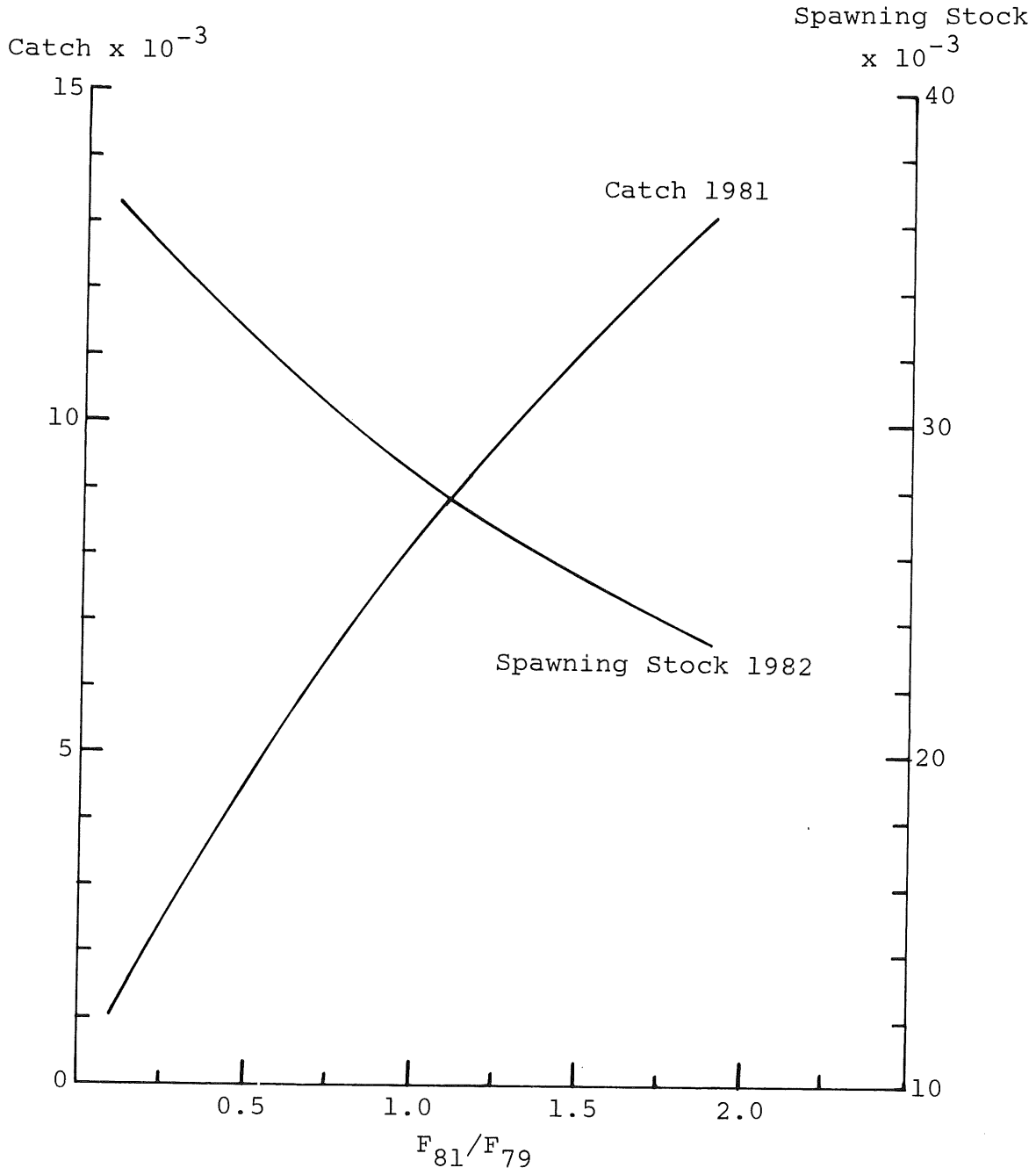


Fig. 7.3. Plaice, Kattegat. Predicted catch in 1981 and spawning stock size at the beginning of 1982 for an array of fishing mortalities in 1981 relativ to that in 1979.

8. RECOMMENDATIONS.

The Working Group on Div. IIIa Stock recommends

1) in view of the possibility that certain herring stocks are being exploited in IIIa as well as in the Belt-Seas and western Baltic there is a need for closer cooperation between the Working Groups on Div. IIIa stocks and on Baltic pelagic stocks. This could be achieved by

   (i) The IIIa W.G. being joined by scientists from DDR and perhaps Poland

   or (ii) The Working Groups sharing time and venue.

2) A joint work shop on stock components in Div. IIIa should be set up in order to analyse the increasing amount of data available on length, otoliths, meristic characters a.o. The Workshop should be held immidiately prior to the 1981 meeting of the Assessment Working Group on Div. IIIa Stocks.

3) The International Young Herring Surveys should be intensified in Div. IIIa especially in the western part of the Skagerrak. The Norwegian acoustic survey in the Skagerrak and the Kattegat in winter should preferably coincide with the IYHS.

4) The International O-group Gadoid Surveys should be extended to include the Skagerrak area.

9. REFERENCES.

Anon 1971	ICES CM 1971/F:5 (Mimeo)
Bagge 1970	ICES CM 1970/F:27 (Mimeo)
" 1973	ICES CM 1973/F:7 (Mimeo)
" 1974	Øresundsvattenkommittens Undersökninger 1971-74
Danielsen 1969	Fisk.Dir.Skr.Ser. Havunders. 15:331-338.
Hagström et al. 1979	ICES CM 1979/H:36 (Mimeo)
Lindquist 1977	ICES CM 1977/H:3 (Mimeo)
Molander 1950	Fishery Board of Sweden, Ser.Biol., Rep. No. 1.
Postuma 1974	J.Cons. Int.Explor.Mer, 35: 121-129.