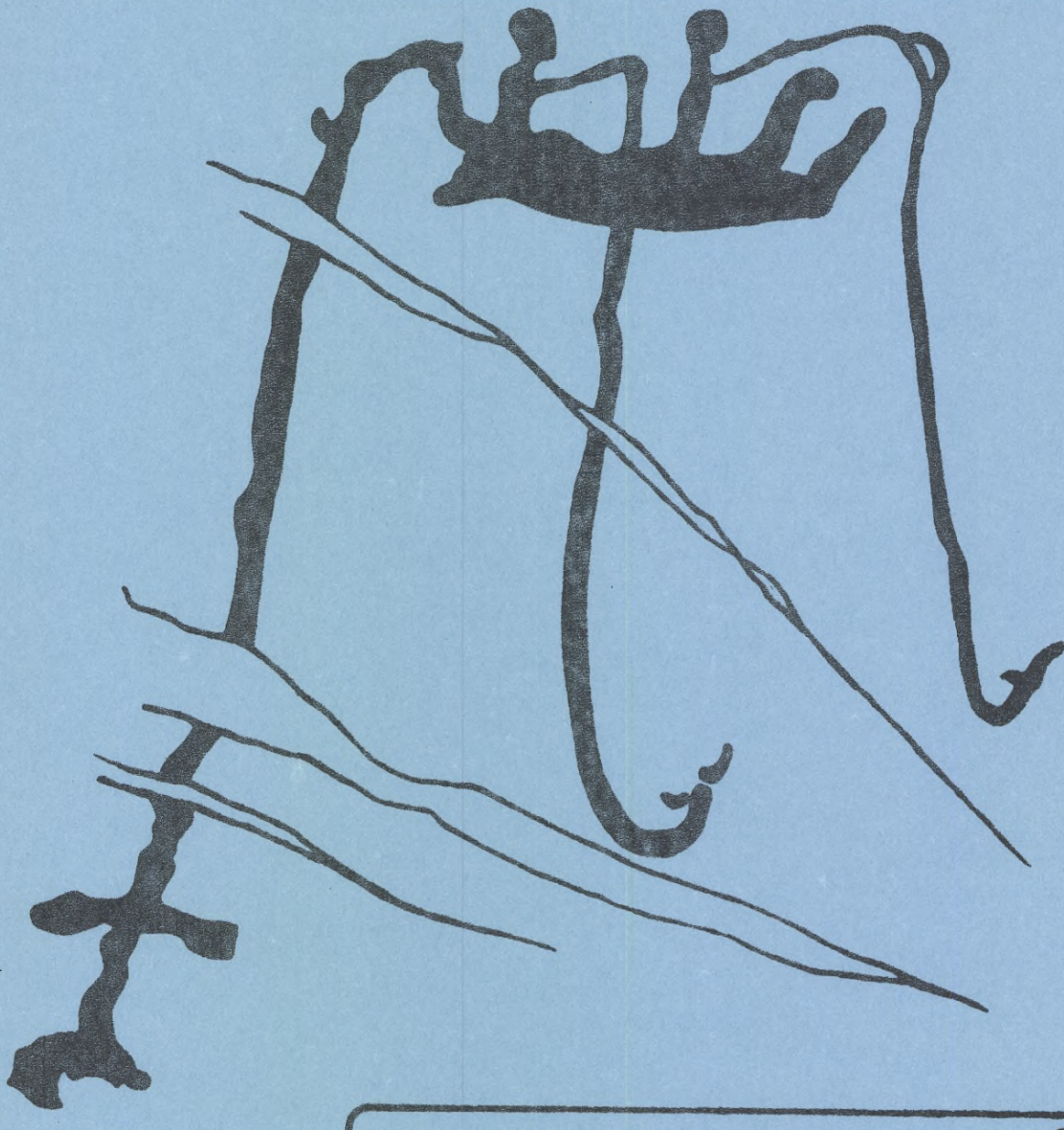
Ödemål, Kville sn, Bohuslän

Hällristning
Fiskare från
bronsåldern

Rock carving
Bronze age
fishermen



MEDDELANDE från
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On the winter-spring spawning herring in the Kattegat

by

Hans Ackefors

November 1977

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ABSTRACT

The fishery of adult herring in the Kattegat is based mainly on winter-spring spawning herring. Earlier, up to the end of 1960's autumn spawning herring were also an important component in the fishery. There are three stocks of winter-spring spawning herring that might be separated at least during the spawning time; Kattegat Winter Spawners (= Skagerrak Spring Spawners)(January-February), Kattegat Spring Spawners (March-May) and Kattegat Coastal Spring Spawners (April-June).

INTRODUCTION

During the period of heavy herring fishery, 1747-1809, along the Swedish west coast and also during the herring period, 1877-1906, immense quantities of herring migrated into the Skagerrak and the Kattegat as spent herring in late autumn and early winter. The herring penetrated into the coastal zone in the eastern Skagerrak and the northern most part of the Kattegat. There are good evidences to prove that the majority of the herring belonged to the bank herring of the North Sea (Höglund 1972). Since the end of the last herring period (1920's) adult autumn spawning bank herring have usually not penetrated into the coastal zone of the inner Skagerrak during their winter migration except for some years in the 1940's, 50's and 60's. In 1936 K A Andersson published a brief paper about the herring groups in the Skagerrak, the Kattegat and the Baltic. During that time the fishery was to a great extent based on autumn spawners. The most important group was the Kobbergrund herring (VS = 56.35) which spawned in the Kattegat in September-October. The herring migrated into the Skagerrak at the end of July or the beginning of August and they left the Kattegat area towards the end of the year. According to Swedish investigations this herring stock is now nearly extinct (Ackefors 1977). Andersson (op cit) mentioned two other small stocks of autumn spawning herring. One of the stocks spawned in the Kattegat (VS = 55.98-56.08) and the other spawned in the Sound (VS = 55.49-55.56). There were also spring spawning herring in the Kattegat and the Skagerrak at that time with an average number of vertebrae near to 57, which spawned from February to the first part of April, i.e. the Skagerrak Spring Spawners.

The present fishery of adult herring in the Kattegat is, however, based mainly on winter-spring spawning herring and to a minor part autumn spawners..The juvenile fishery consists of both spring and autumn spawning herring. The latter component belongs either to local autumn spawning herring from the Kattegat or to the North Sea bank herring. Hence the Kattegat as well as the Skagerrak and the North Sea is also a nursery area for the North Sea bank herring. The aim of this paper is to describe the meristic characters of the winter-spring spawning herring in the Kattegat in the 1970's, which today make the great bulk of the catches in the Kattegat.

METHODS AND MATERIAL

Herring samples taken by commercial trawlers 1972-1976 in the Kattegat were analysed. Age was determined from scales and otoliths and maturity stages of the gonads according to maturity scale recommended by ICES (Parrish & Saville 1965). Only samples with maturity stages V, VI and VII are included in this paper. Vertebrae (VS) and keeled scales (K_2) were counted. The weight and the length were also determined. The length at the age of one year (l_1) was backcalculated from the scales.

As shown in fig. 1 the herring came from the eastern part of the Kattegat and from the northern part of the Sound. In addition the author has got samples from Danish areas (Randers fiord, Isefiord, Hvide Sand and Limfiord) (fig. 2). The samples were analysed by the Sea Fishery Institute in Charlottenlund, Denmark. The mean values for VS, K_2 and l_1 of herring in maturity stage III or more are reported. The condition factor was calculated according to the formula $C=\frac{W}{L^3}\cdot 10^5$ where W is the mean weight of all herrings in stage V, L^3 is the cubic mean length.

RESULTS AND DISCUSSION

During the year 1972 to 1976 the main part of the analysed adult herring from the Kattegat consisted of winter-spring spawning herring. Herring in the maturity stages V, VI and VII appeared in the samples from the end of January until the end of May (fig. 3). If we exclude two samples (K 13, K 44 in table 1) with a mixture of stage V and VII we can distinguish between two separate populations with different spawning times. The Kattegat Winter Spawners (= the Skagerrak Spring Spawners) (VS = 56.7-57.3, K_2 = 14.2-14.7, l_1 = 11.9-14.7), spawning in January and February and the Kattegat Spring Spawners (VS = 55.7-

56.5 (most samples 55.8-56.2), K_2 = 13.8-14.2, l_1 = 12.3-14.5), spawning from the end of March until May. Detailed information about mean values for each sample are given in table 1. In table 2 the samples have been split up into year-classes and the mean values for VS and K_2 in each year-class are given. Analysed samples from the Danish fiords indicate that we might have a third winter-spring spawning stock in the Kattegat, viz. the Kattegat Coastal Spring Spawners (VS = 55.5-56.1, K_2 = 13.7-14.2, l_1 = 10.3-13.9) (fig. 2 and table 3), which spawn from the middle of April until June. As the mean values are similar to those of the Kattegat Spring Spawners the two stocks cannot be distinguished from each other except during spawning time.

According to Biester et al. (1976) a spring spawning stock from the Rügen area (in the Baltic) occurs in the Kattegat and the Skagerrak area from early summer until the end of the year, which has been confirmed by tagging experiments. The VS and K_2 values are similar to those of the Kattegat spring spawning herring; VS = 56.00 and K_2 = 13.6-14.0 (Heincke 1898). Biester & Hering (1977) found that VS values nowadays range 55.61-56.16.

The Kattegat Spring Spawners constitutes the main part of the catches in the Kattegat during the whole year. It is also dominating in the catches from April until September in the Skagerrak area. As stated above the stock cannot be separated from the stocks spawning in the Danish fiords and in the Rügen area. However, it is likely that the Kattegat Spring Spawners make the most important stock. The Kattegat Winter Spawners which spawn in January-February cannot be distinguished from the Skagerrak Spring Spawners, which spawn along the Norwegian Sørland and Swedish Bohuslän coast. Some of the samples had different K_2 values but there were also samples with overlapping values (cf. fig. 3). The condition factor was also calculated but no real differences could be demonstrated. Hence, we have to consider the herring as one population. It was proposed by Andersson (1964) that the winter spawning "stock" of Kattegat should be referred to the Skagerrak spring spawning stock.

The Kobbergrund herring (or the Kattegat Autumn Spawners) constituted until the end of 1960's the most important part of the northern part of Kattegat fishery. As mentioned above they spent about 4-5 months (August-December) in the Kattegat. Our analyses from 1965-1968 showed that the meristic characters were; VS = 56.1-56.3, K_2 = 14.2, l_1 = 14.0-15.2. It is quite obvious that the values of the meristic cha-

racters are overlapping those of the Kattegat Spring Spawners. By combining the meristic characters with the studies of the otoliths and the maturity stages of the gonads, it might however, be possible to distinguish this stock from the spring spawning herring.

The meristic characters and the spawning seasons of the different stocks can be summarized in the following way:

Stock	Spawning time	VS	K_2	l_1
1. Kattegat Winter Spawners	January-February	56.7-57.3	14.2-14.7	11.9-14.7
2. Kattegat Spring Spawners	March-May	55.7-56.5	13.8-14.2	12.3-14.5
3. Kattegat Coastal Spring Spawners	April-June	55.5-56.1	13.7-14.2	10.5-13.9
4. Kattegat Autumn Spawners	September-October	56.1-56.3	14.2	14.0-15.2

From the table it is obvious that there might be some overlapping between 2 or 3 of the stocks. Putting all the analysed data together including otoliths and maturity stages it is usually possible to distinguish between the stocks spawning in winter, spring or autumn. In addition to the above mentioned stocks there are local spring and autumn spawning populations in the area.

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Table 1. Analysed herring samples in maturity stages V, VI and VII from the Kattegat, 1972 - 1976.

Sample	Date	Place	Catch position	VS	K_2	l_1 (cm)	Mean length (cm)	Mean weight (g)	Maturity stage
K 12	1972-01-28	Mölle	N 56°17' E 12°28'	57,29 (99)	14,66 (96)	13,58 (99)	30,4 (135)	235,7 (100)	V,VI
K 13	1972-03-14	Rå S. Hälsingborg	N 55°59,5' E 12°42'	56,35 (97)	14,35 (95)	13,72 (95)	30,1 (199)	205,6 (100)	V,VII
K 14	1972-04-17	Laholms b	N 56°34' E 12°48'	56,16 (96)	13,98 (97)	14,45 (97)	30,1 (122)	189,8 (100)	VII
K 18	1973-04-13	N. Röde bank	N 56°44' E 12°06'	55,91 (66)	14,00 (66)	13,98 (66)	29,0 (70)	172,0 (70)	VII
K 27	1974-02-14	3'NE Fladen	N 57°13' E 11°52'	56,84 (98)	14,54 (97)	12,82 (97)	27,5 (100)	171,4 (100)	VI
K 30	1974-04-04	Nidingen	N 57°18' E 11°50'	56,08 (100)	14,14 (94)	13,10 (98)	29,4 (99)	176,1 (99)	VII
K 40	1975-02-02	Höganäs	N 56°14,5' E 12°26'	56,78 (96)	14,19 (99)	13,76 (95)	27,8 (95)	187,0 (95)	V,VI
K 41	1975-02-14	Kungsbacka fjord	N 57°23,6' E 12°15'	56,71 (96)	14,41 (99)	14,69 (84)	29,5 (85)	192,0 (85)	VII
K 42	1975-02-25	Skälderviken	N 56°17' E 12°25'	56,95 (100)	14,49 (96)	11,94 (100)	28,2 (100)	177,7 (100)	V,VI
K 43	1975-02-25	W. Rörö	N 57°47' E 11°32'	56,93 (97)	14,28 (98)	12,80 (98)	28,2 (100)	193,8 (100)	VI
K 44	1975-03-04	Skälderviken	N 56°20' E 12°38'	56,60 (97)	14,50 (91)	13,69 (79)	28,4 (80)	181,8 (80)	V,VII
K 45	1975-04-01	5'N Lilla Middelgrund	N 57°02,7' E 11°55'	56,11 (98)	14,09 (97)	14,35 (100)	30,2 (100)	178,4 (100)	VII

Table 1., cont.

Sample	Date	Place	Catch position	VS	K_2	l_1 (cm)	Mean length (cm)	Mean weight (g)	Maturity stage
K 46	1975-04-01	S.Marstrand	N 57°50' E 11°29'	56,54 (95)	13,88 (92)	12,26 (95)	28,4 (100)	184,9 (100)	V,VI
K 47	1975-04-14	N.Lilla Middelgrund	N 56°50' E 11°55'	55,97 (102)	14,09 (94)	13,78 (100)	28,4 (103)	151,3 (103)	VII
K 48	1975-04-21	NE Lilla Middelgrund	N 57°02,2' E 12°03,7'	55,90 (100)	13,87 (93)	13,16 (98)	28,4 (98)	145,9 (98)	VII
K 49	1975-04-28	SW Träslövs-läge	N 56°56,2' E 12°06'	55,94 (100)	13,96 (94)	13,20 (100)	29,1 (100)	171,9 (100)	VII
K 50	1975-05-05	4'NE Lilla Middelgrund	N 57°01' E 11°58'	56,01 (99)	14,10 (94)	12,50 (98)	28,6 (99)	164,5 (99)	VII
K 51	1975-05-20	10'NE Lilla Middelgrund	N 57°03' E 12°05'	55,74 (96)	13,96 (91)	12,80 (98)	27,4 (100)	143,9 (100)	VII,VIII
K 52	1976-04-07	Varberg	N 57°09' E 12°02,5'	56,21 (97)	14,15 (93)	14,48 (98)	30,2 (99)	193,9 (99)	VII
K 53	1976-05-10	Träslövsläge	N 57°04' E 12°02'	56,01 (95)	14,10 (93)	12,64 (99)	30,1 (99)	187,2 (99)	VII

Table 2. Analysed herring samples from the Kattegat, by year-classes. Mean values for VS and K_2 are given. Other data according to table 1. S = spring.

Year	Sample	S 73	S 72	S 71	S 70	S 69	S 68	S 67	S 66	S 65	S 64	+ S 63
1972	K 12					57,43(7) 14,57(7)	57,29(38) 14,81(36)	57,50(24) 14,59(22)	57,08(25) 14,54(26)	57,33(3) 14,33(3)	57,00(1) 16,00(1)	57,00(1) 14,00(1)
1972	K 13					56,33(3) 14,67(3)	56,29(17) 14,11(18)	56,21(29) 14,21(29)	56,31(26) 14,38(24)	56,71(7) 13,83(6)	56,50(2) 15,00(2)	56,83(6) 15,17(6
1972	K 14				58,00(1) 14,00(1)	56,86(7) 14,17(6)	56,37(27) 14,26(31)	55,93(40) 13,62(39)	56,00(8) 13,88(8)	56,00(11) 14,30(10)		56,00(2) 15,00(1
1973	K 18			56,00(4) 13,75(4)	56,60(5) 14,40(5)	55,92(25) 13,92(26)	55,85(20) 14,26(19)	55,50(6) 13,43(7)	55,00(2) 14,00(2)	56,25(4) 14,00(3)		
1974	K 27			56,69(50) 14,62(50)	56,92(37) 14,38(37)	57,43(7) 14,57(7)	57,00(2) 15,00(2)	57,00(1) 15,00(1)				
1974	K 30			56,67(6) 14,60(5)	56,18(17) 14,00(17)	56,12(42) 14,24(37)	56,00(20) 14,10(20)	55,75(8) 13,88(8)	56,00(5) 14,00(5)	55,00(1) 15,00(1)		
1975	K 40	57,00(1) 14,00(1)	56,73(51) 14,23(53)	56,83(29) 14,10(29)	57,11(9) 14,20(10)	58,00(1) 15,00(1)						
1975	K 41		56,20(10) 13,90(10)	56,85(34) 14,50(36)	56,88(17) 14,41(17)	56,77(13) 14,62(13)	57,00(4) 15,00(5)	56,00(2) 14,00(2)	56,00(1) 15,00(1)			
1975	K 42		56,77(26) 14,38(26)	57,00(50) 14,69(48)	57,00(19) 14,00(17)	57,00(4) 15,00(4)	58,00(1) 14,00(1)					
1975	K 43		56,90(39) 14,26(39)	56,89(38) 14,42(38)	57,13(15) 14,07(15)	56,80(5) 14,00(5)	14,00(1)					
1975	K 44		56,62(13) 14,50(12)	56,76(50) 14,81(47)	56,50(6) 14,00(7)	56,83(6) 14,43(7)	55,67(3) 14,00(1)					

Table 2., cont.

Year	Sample	S 73	S 72	S 71	S 70	S 69	S 68	S67	S 66	S 65	S 64	+ S 63
1975	K 45		56,43(7) 14,71(7)	56,19(27) 14,12(26)	55,91(32) 14,06(31)	56,13(24) 14,00(25)	56,40(5) 14,00(5)	56,00(1) 14,00(1)	56,50(2) 13,50(2)			
1975	K 46		56,60(10) 14,10(10)	56,77(22) 13,86(21)	56,45(53) 13,84(51)	56,40(10) 13,90(10)						
1975	K 47	57,00(1) 15,00(1)	56,25(8) 14,17(6)	55,85(39) 14,09(34)	56,07(29) 14,03(29)	55,87(15) 14,00(14)	56,13(8) 14,38(8)	55,50(2) 13,50(2)				
1975	K 48		56,00(5) 14,20(5)	55,90(60) 13,91(56)	55,83(24) 13,76(21)	56,14(7) 13,86(7)	55,00(1) 13,00(1)	56,00(1) 13,00(1)				
1975	K 49		56,43(7) 13,86(7)	55,92(25) 14,09(23)	55,89(37) 13,80(35)	55,84(19) 13,94(18)	56,00(8) 14,29(7)	56,00(3) 14,33(3)	56,00(1) 14,00(1)			
1975	K 50		56,40(5) 14,20(5)	56,17(46) 14,28(43)	55,81(26) 13,96(24)	55,76(17) 14,00(17)	55,33(3) 13,00(3)	58,00(1) 14,00(1)				
1975	K 51		55,59(17) 14,06(16)	55,72(50) 13,86(49)	55,79(19) 14,18(17)	56,00(6) 13,83(6)	56,00(3) 14,00(2)	56,00(1) 14,00(1)				
1976	K 52	56,22(9) 14,40(9)	56,19(27) 14,25(28)	56,23(31) 14,04(28)	56,36(11) 13,90(10)	56,17(12) 14,17(12)	56,00(1) 15,00(1)	56,50(2) 14,00(2)	56,00(2) 14,50(2)	56,00(1) 13,00(1)		
1976	K 53	56,00(1) 14,00(1)	56,29(7) 14,14(7)	55,82(34) 14,03(32)	56,00(22) 14,09(22)	56,35(20) 14,21(19)	55,75(8) 13,89(9)	56,00(2) 15,00(2)				

Table 3. Analysed herring from the Danish fiords. Herring analysed by the Fishery Institute, Charlottenlund.

Area	Month	VS	K_2	L_1	Age group	n
Randers fiord	April	55.56	13.71	11.56	3	42
"	"	55.56	13.94	13.75	5	16
"	"	55.90	13.70	11.62	3	21
"	"	55.58	13.67	12.52	4	19
Isefiord	April	56.00	13.85	13.27	2	30
"	"	55.51	13.74	11.95	3	42
"	"	56.20	13.67	13.80	4	15
"	"	55.74	14.11	12.84	5	19
"	"	55.92	13.87	11.12	3	25
Hvide Sand	April	55.83	13.83	10.30	3	49
"	"	56.24	14.14	12.36	2	21
"	"	55.93	13.78	10.51	3	98
Limfiord	April	56.02	14.11	13.91	2	53
"	"	55.76	13.88	11.77	3	37
"	"	55.61	14.09	11.43	3	36
"	"	56.00	13.97	13.13	4	34

LEGENDS

Fig. 1. The catch positions of the herring samples from the Kattegat and the northern part of the Sound.

Fig. 2. The Danish Fiords, Hvide Sand and the Jammer Bay with spawning herring in April-June, which migrate after spawning into the Kattegat area. Analysed herring samples from four of the fiords are reported in table 3.

Fig. 3. K_2 and VS values of herring samples versus time for the Kattegat Winter Spawners (KW), the Kattegat Spring Spawners (KS) and the Skagerrak Spring Spawners (SS).

Fig.1.

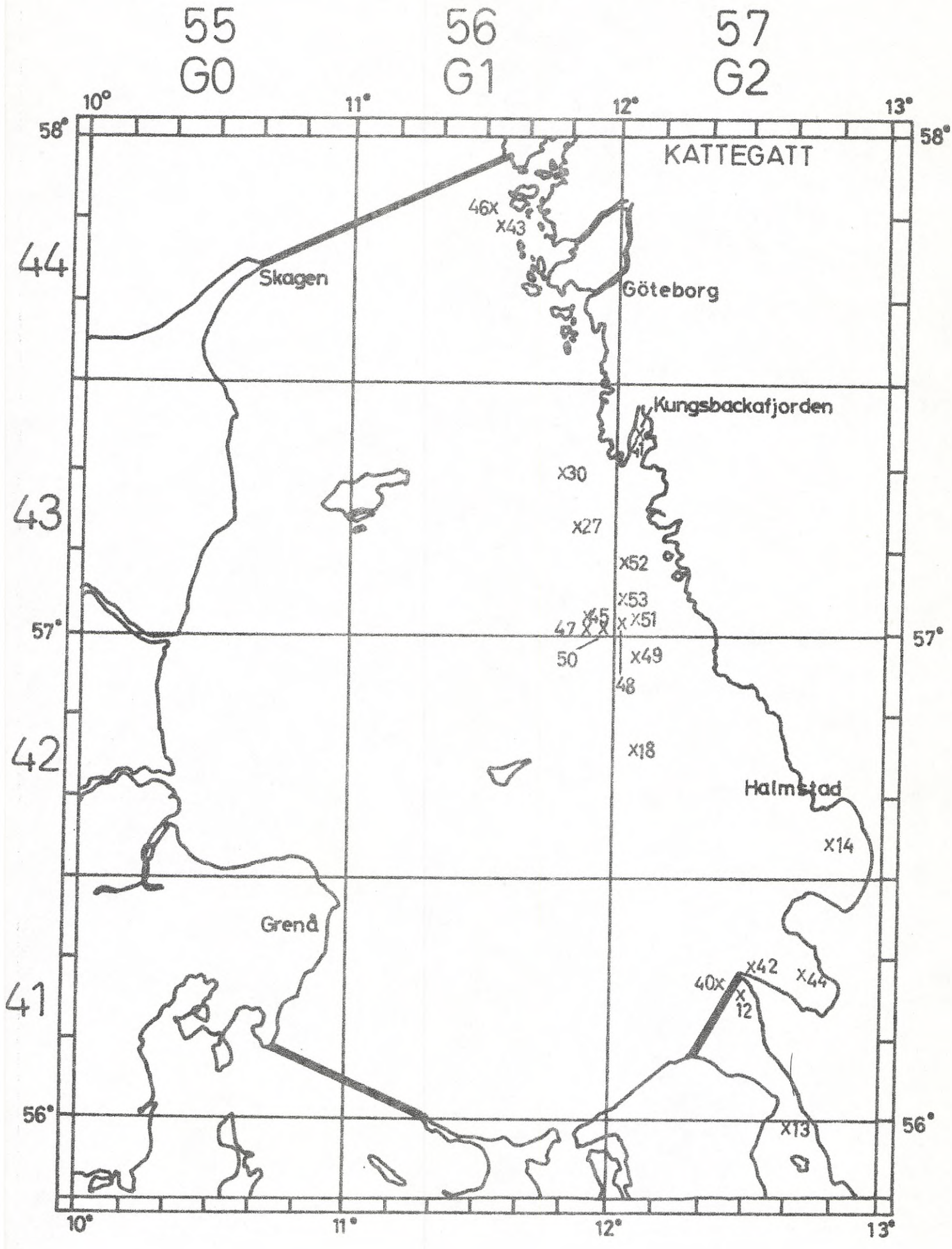
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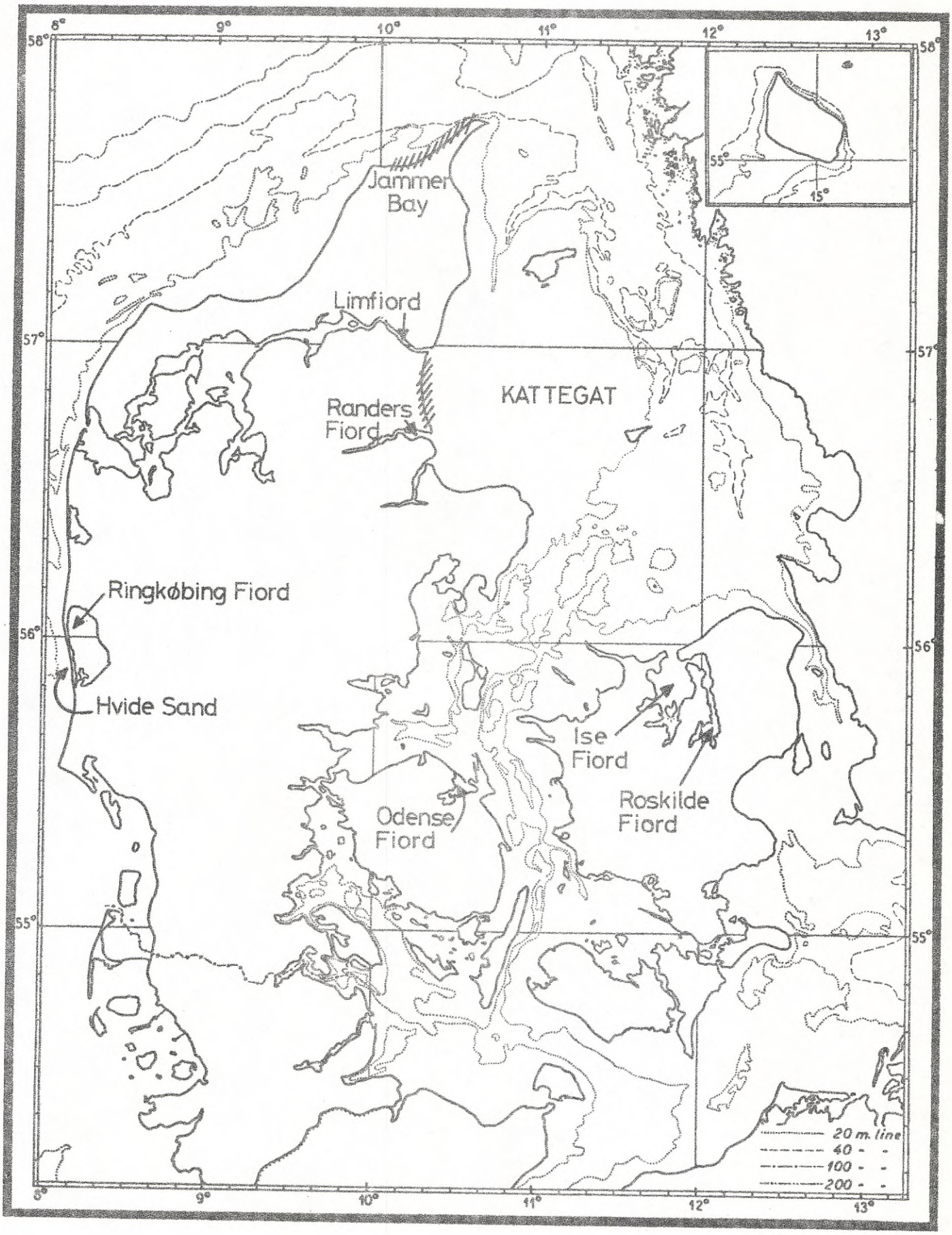
Fig. 2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Ringkøbing Fiord
Hvide Sand
Ise Fiord
Roskilde Fiord
Odense Fiord
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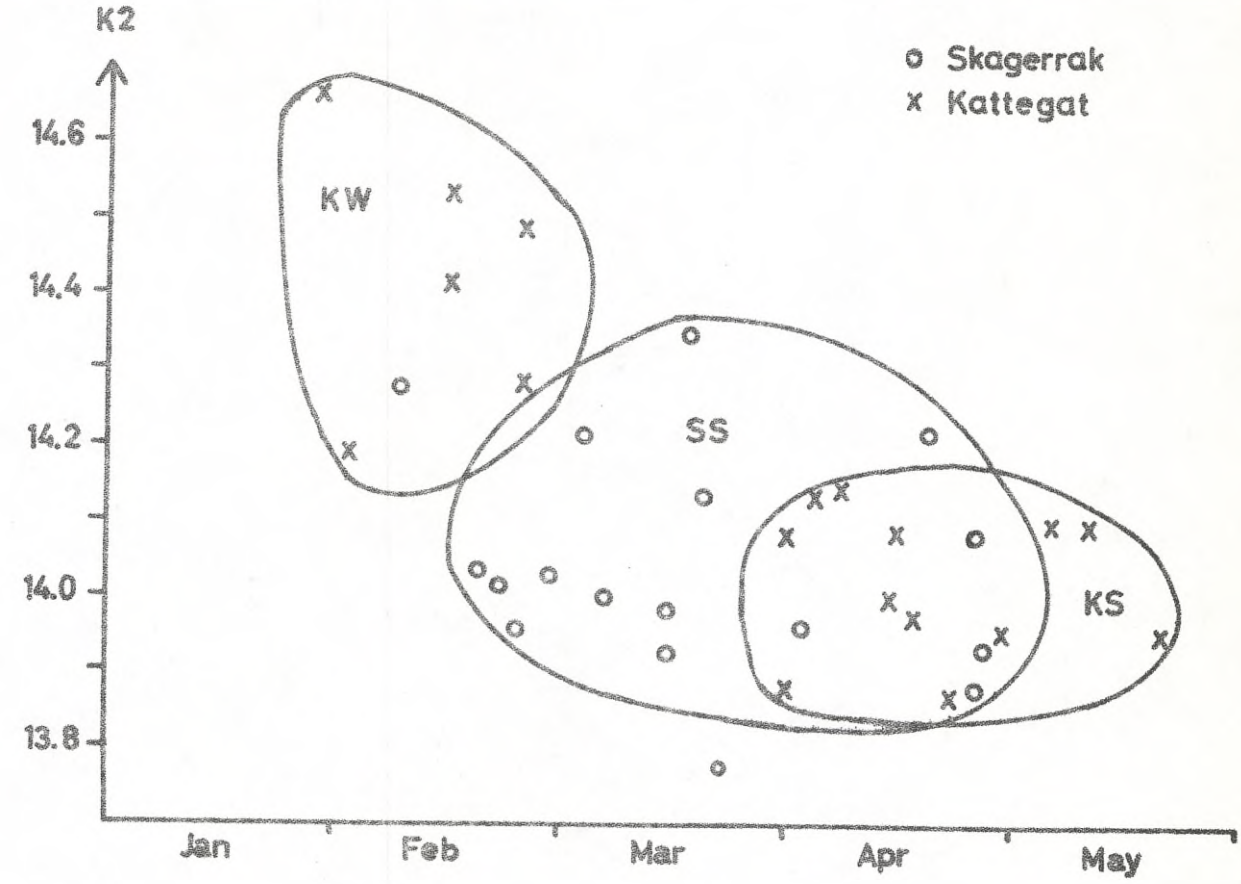
100 - -
200 - -

Fig. 3.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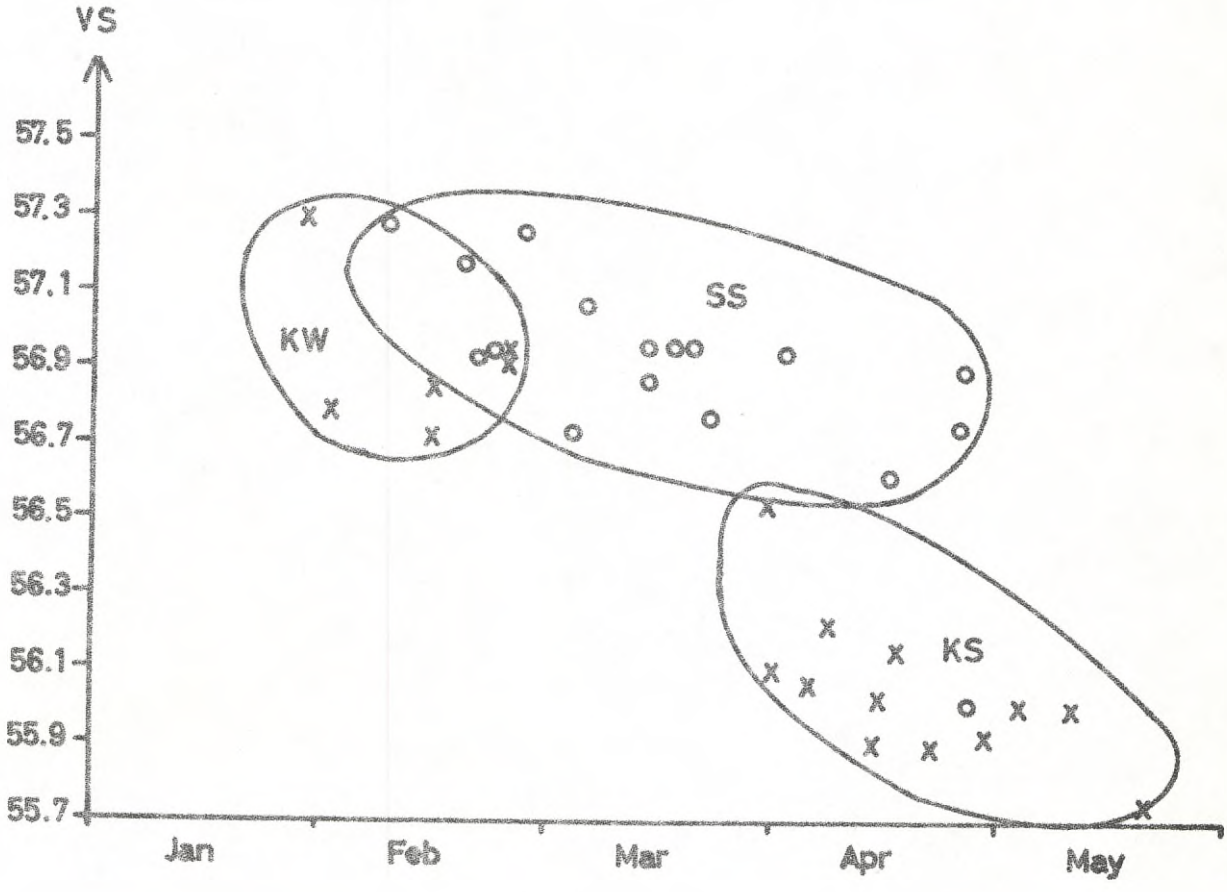
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