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Rock carving
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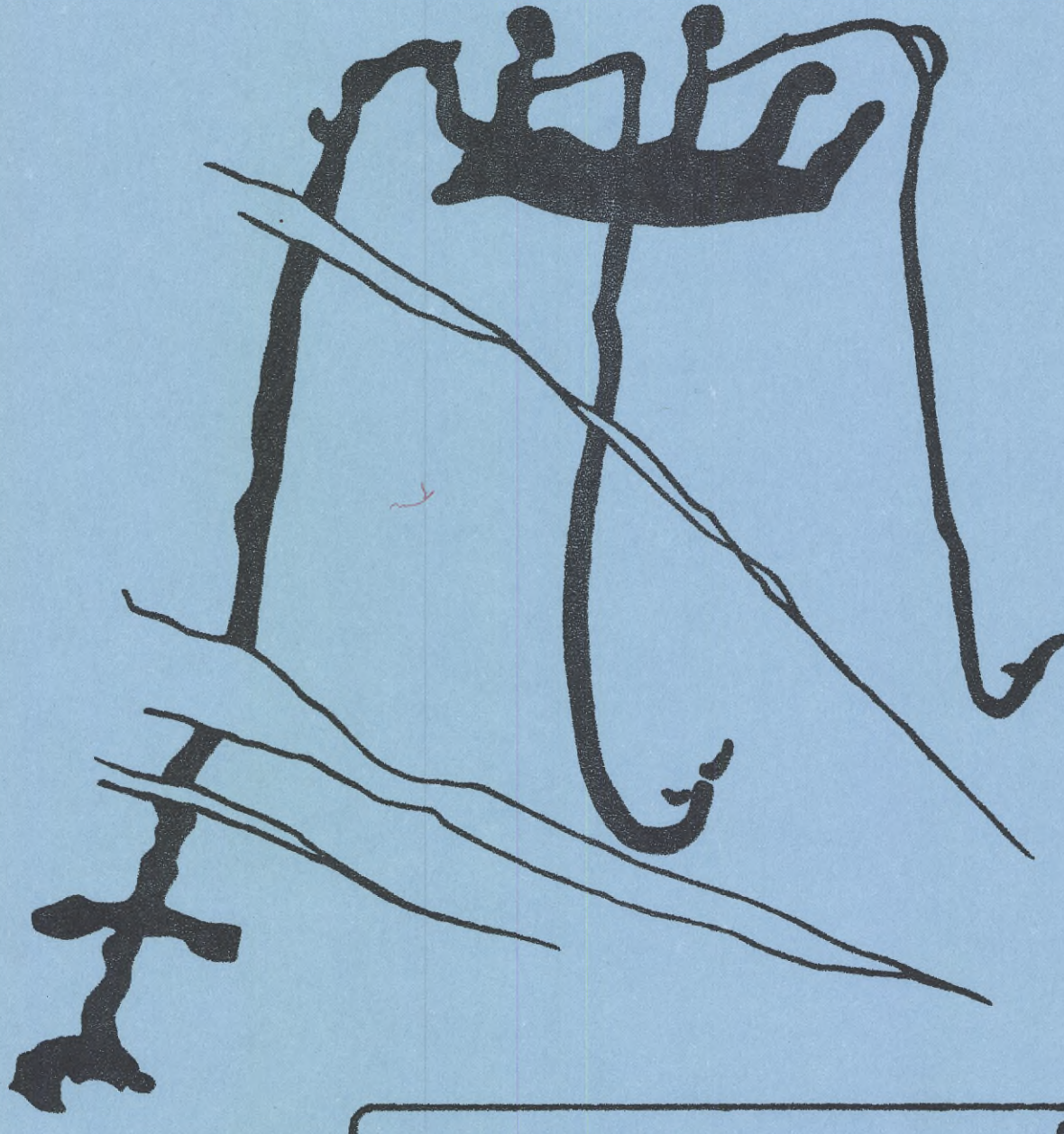

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SWEDISH HERRING TAGGING EXPERIMENTS, 1968-1970 IN THE KATTEGAT

by

Hans Ackefors

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ABSTRACT

The most important herring stock in the Kattegat nowadays is the Kattegat Spring Spawning stock. In 1968, 525 herrings of this stock were tagged off-shore in the northern Kattegat with Lea tags. The recovery was 3.8% within a period of two years. The majority of tag returns came from the Kattegat area. However, tag returns from the Rügen area indicate migration from the Kattegat to the Baltic. In 1970, 650 herrings of Skagerrak Spring Spawners were tagged in coastal waters with Lea tags. The recovery was 5.7% within a period of four years. The majority of tag returns came from coastal areas in the northern Kattegat and along the whole Swedish coast in the Skagerrak. A few tag returns also came from the southern Kattegat, the Sound and the Belt Sea indicating migration southwards. However, in both experiments the individual tags may derive from herrings from other stocks mixed with two tagged herring stocks in the northern Kattegat. In 1969, 550 herrings were tagged with internal tags in the northern Kattegat. The experiment was not successful.

INTRODUCTION

Tagging experiments on herring were started in 1968 in order to elucidate the migration of herring caught in the Kattegat area. The tagging continued in 1969 and in 1970. The herring in the area consist of many populations both spring and autumn spawners (Andersson, 1936; Ackefors, 1977a-d). Herring spawning in areas outside the Kattegat migrate to and through the Kattegat and probably constitute during certain parts of the year, an important fraction of the catches. Herring spawning in the North Sea and Skagerrak are caught in the Kattegat as well as herring spawning in the Baltic and the Belt Sea. The Kattegat area is thus a transition area for many herring populations.

Herring spawning in the Kattegat nowadays consists of at least three separate stocks, viz. Kattegat Winter Spawners (=Skagerrak Spring Spawners) (VS=56.7-57.3; K_2=14.2-14.7) Kattegat Coastal Spring Spawners (VS=55.5-56.1; K_2=13.7-14.2) and Kattegat Spring Spawners (VS=55.7-56.5; K_2=13.8-14.2) Ackefors, 1977a). The latter stock is the most important one (Ackefors, 1977a). At the end of 1960's the Kattegat Autumn Spawners (VS=56.1-56.4) (the Kobbergrund herring) were still an important spawning stock (Ackefors, 1977a, b).

In addition to those stocks adult herring from the Baltic proper, Rügen Spring Spawners, migrate into the Kattegat and Skagerrak areas, where many recaptures from tagging experiments in the Greifswalder Bodden have been made (Biester et al., 1976, 1977; Krüger et al., 1976). In the Sound and the Belt Sea other stocks of herring spawn which also to some extent migrate to the Kattegat area (Jensen, 1951; Anon, 1974; Weber, 1975). When tagging herring in the Kattegat it is therefore of the utmost importance that samples for populations analyses are taken simultaneously.

MATERIAL AND METHODS

In 1968 the tagging experiments were performed in the northern Kattegat from September 18 until September 26. A total of 525 herrings were tagged from the areas south of Groves Flak (N 56°59', E 11°39',5) and north of Groves Flak (N 57°12',3, E 11°31',2) (fig. 1).

The herrings were captured with bottom trawl. However, the tows were not longer than 10 minutes in order to avoid compressing the herrings. After the capture they were put carefully in tanks on deck. Only herrings which had not lost any scales were selected for tagging. Detailed information on the number of tagged herrings and average lenght is shown in table 1. Two parallel samples from the tagging localities were later analysed in the laboratory for stock identification purposes (table 2 The analyses showed that the main component consisted of Kattegat

Spring Spawners or Kattegat Coastal Spring Spawners (cf. Ackefors, 1977a).

In 1970 the tagging took place from October 22 until October 29 close to the coast in the northern Kattegat. A total of 650 herrings were tagged and released west of Hönö huvud (N 57° 41',8, E 11° 36'). In contrast to the 1968 tagging experiments, the herrings were captured in herring set net by ordinary fishermen. Detailed information on the number of tagged herring and average length is shown in table 3. One sample from the tagging locality was later analysed in the laboratory for stock identification purposes (table 4). The analyses showed that the herring consisted of Skagerrak Spring Spawners (cf. Ackefors 1977c).

The tagging technique was the same in 1968 and 1970. The herrings were tagged with Lea hydrostatic tags (Anon., 1953). They were attached to the back of the fish by a stainless steel wire hinge consisting of a U-shaped link articulating with a transverse rod. The whole operation took place in a "craddle" attached to running salt water. Each tagged herring was measured. A lenght measurement scale in the craddle made it possible to estimate the length, and a scale of each herring was taken for identification of age. The whole procedure did not take more than 30 seconds and afterwards the fishes were released without having been touched by hand. Thanks to the length measurement and the scale samples it was possible to establish, at least approximately, what kind of herring had been liberated. In some cases the recaptured herrings were sent back to the laboratory.

In 1969 a tagging experiment was performed with internal steel tags. Altogether 550 herrings were tagged in the northern Kattegat. The experiment was not successful, probably because most of the adult herring were caught for human consumption in 1969. Only 2 recaptures were reported from fish meal industries in Denmark.

RESULTS

Most of the recaptures from the experiments in 1968 were taken in the same area as the tagging localities (fig. 1). However, two recaptures were reported from the Baltic proper, near Rügen and one from the Egersund area on the borderline between the outer Skagerrak and the North Sea. A total of 20 tagged herrings, of which 14 with known positions of the recapture, were reported in the experiments. This means a recapture of 3.8%. The recaptures were reported during a period of 21 months (fig. 1 and table 5). They consisted of six 2-ringers, two 3-ringers, one 4-ringer, one 5-ringer and seven 7-ringers. Two of the recaptures were not age determined due to obscure scales.

The herring tagged in 1970 were mainly recaptured close to the Swedish coast in the northern Kattegat and in the Skagerrak (fig. 2). Tagged herring were also reported from the southern Kattegat, the Sound and from the Kieler Förde in the Belt Sea. Altogether 37 tagged herrings, of which 26 with known positions of the recapture, were reported in the experiments in 1970. This means a recapture of 5.7%. The recaptures were reported during a period of 42 months (fig. 2, table 6). The age composition of the recaptures were one 2-ringer, ten 3-ringers,

seventeen 4-ringers, five 5-ringers, one 6-ringer and thre 7-ringers.

DISCUSSION

In the experiments in 1968 the tagged herrings consisted of Kattegat Spring Spawners or Kattegat Coastal Spring Spawners. Single herrings might have consisted of Rügen Spring Spawners from the Baltic. The meristic characters are similar or overlapping for these three stocks, making it impossible to distinguish the individual herrings (cf. Ackefors, 1977a; Biester & Hering, 1977). In any case, the results show the connection between the herring in the Kattegat and the Baltic, which has also been demonstrated by Biester et al. (1977) and earlier papers by those authors.

The tagged herring in 1970 consisted of another stock of herring in the Kattegat, viz. Skagerrak Spring Spawners (cf. Ackefors, 1977c). Consequently, the results were quite different from those in 1968. Most of the herrings was recaptured from the Swedish coast from Varberg up to the Norwegian border. Single recaptures from the southern Kattegat, the Sound and the Belt Sea, indicate that there are herring migrating between those areas. This has also been reported by Jensen (1951), Anon. (1974) and Weber (1975).

Tagging experiments with spring spawners and autumn spawners in Northern Bohuslän (the inner Skagerrak) in 1951 and 1953 showed that the main part of the recaptures came from the Skagerrak

and the Kattegat. But there were also herring which were later caught in the North Sea and the outer Skagerrak (Höglund, 1955). A few spring spawners (probably Skagerrak Spring Spawners) were caught in the outer Skagerrak or the North Sea just outside the the southwestern part of Norway. Those results and results in this paper, as well as other experiments, indicate that Skagerrak Spring Spawners occur mainly within the Skagerrak and Kattegat areas although some individuals migrate even farther to areas west and south of the Skagerrak-Kattegat area.

The poor recovery rate tags may be attributed to the condition of the caught herring, tagging mortality, natural mortality, low detection rate of tagged herring and the small reward paid for the return of tags.

The recovery was 50% better in 1970 than in 1968. This may be accounted for by the different ways of catching the herring. In 1968 the herring were caught by bottom trawl and in 1970 by herring set net. We were well aware that bottom trawled herring might be in a less satisfactory condition for tagging. But we tried this method as no commercial purse seiners could help us at that time. In 1970 we tagged herring bought from local fishermen close to the coast. They had been instructed before the catch how to handle the herring. The higher return rate of tags in the experiments of 1970 may have been due more to the condition of the herring than to other factors, such as natural mortality, detection rate etc., which ought to be the same in both experiments.

tion rate etc. which ought to be the same in both experiments.

The handling of bigger catches which are partly aimed for industrial fish will cause a lower detection rate nowadays than earlier when the whole catch of adult herring in Kattegat was aimed for human consumption. On the other hand the recovery of 5.7% in the experiments of 1970 is only slightly less good than the recovery rate of 6.4% in a recent performed experiment in the Rügen area (Biester et al., 1977).

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Table 1. The number of tagged herring, the average length, and range of the herring tagged in the experiments of 1968 and released in the northern Kattegat.

Date	n	average length (cm)	Range (cm)
Sept. 18	50	30.3	26.0-35.2
" 19	171	32.5	26.9-36.0
" 20	14	30.0	26.7-33.3
" 23	57	32.1	24.6-35.3
" 24	117	29.1	24.7-35.2
" 25	56	29.1	25.2-34.1
" 26	60	29.2	25.4-35.5
Total	525	30.6	24.6-36.0

Table 2. Samples taken for stock identification purposes in the experiments of 1968.

Date	W.r.	Year-class	%	V.S.	Length cm	Weigth g	Maturity stages
Sept. 19	1	1967	0.7	57.00	23.0	90.0	I
	2	1966	42.7	56.31	25.7	166.4	I,II,III,IV,V,VI
	3	1965	36.0	55.85	28.2	227.3	III,IV,V,VI,VII,VIII
	4	1964	1.5	56.00	29.5	280.0	IV,V
	5	1963	2.2	56.33	32.0	316.7	IV,V,VII
	6	1962	1.5	56.50	31.0	295.0	V,VII
	7	1961	12.5	56.37	32.1	352.9	IV,V,VII,VIII
	8	1960	0.7	56.00	31.0	300.0	V
	9	1959	2.2	56.00	33.0	376.7	IV,V
		Mean value:		56.14	27.9	223.6	
Sept. 23	2	1966	20.3	56.18	26.7	185.9	I,II,IV,V
	3	1965	18.8	55.92	29.2	257.2	II,III,IV,V,VI
	4	1964	7.5	56.00	29.7	278.0	II,IV,V,VII
	5	1963	6.8	56.22	30.4	272.2	III,IV,V,VII
	6	1962	7.5	56.50	31.7	327.0	IV,V,VIII
	7	1961	30.8	56.33	32.0	318.8	IV,V,VII,VIII
	8	1960	0.7	56.00	31.0	310.0	V
	9	1959	0.7	56.00	34.0	430.0	IV
	10	1958	1.5	57.00	32.5	370.0	IV
	>10		5.2	56.00	32.5	378.3	IV,V,VIII
		Mean value:		56.20	30.1	279.0	

Table 3. The number of tagged herring, the average length and range of the herring tagged in the experiments of 1970 and released in the northern Kattegat.

Date	n	average length (cm)	Range (cm)
Oct. 22	90	31.0	27.8-35.0
" 23	150	30.9	27.5-35.0
" 27	129 (+1)	31.2	27.0-35.0
" 28	90	29.9	26.7-34.7
" 29	190	30.1	27.2-34.8
Total	650	30.6	

Table 4. Samples taken for stock identification purposes in the experiments of 1970.

Date	W.r.	Year-class	%	V.S.	K_2	Length cm	Weight g	Maturity stages
Oct. 22	2	1968	3.2	57.00	14.50	30.00	260.0	II/III,IV
	3	1967	27.4	56.71	14.37	29.90	255.3	II/III,III,IV, IV/V,VII/II
	4	1966	32.0	56.68	14.63	30.65	283.5	IV,IV/V
	5	1965	22.4	56.93	14.43	32.11	332.1	IV,IV/V,V
	6	1964	3.2	57.50	16.50	33.00	340.0	IV
	7	1963	14.4	56.78	14.44	33.08	367.8	III,IV,IV/V
	Mean value:			56.79	14.55	31.16	299.5	

Table 5. Recaptures (with known position) from tagging experiments in September, 1968. The herring were released in the northern Kattegat.

Distance naut. miles / Days at liberty	0- 10	11- 20	21- 50	51-100	101-150	151-200	201-250	Total
0 - 10	4	2	1					7
10 - 20		1						1
21 - 30			1					1
31 - 50								0
51 - 100		1						1
101 - 150								0
151 - 200								0
201 - 250						2	1	3
≷								
251 - 500								0
501 - 1000	1							1
Total	4	5	1	1	-	2	1	14

Table 6. Recaptures (with known position) from tagging experiments in October, 1970. The herrings were released close to the Swedish coast in the northern Kattegat.

Distance naut. miles / Days at liberty	0- 10	11- 20	21- 50	51-100	101-150	151-200	201-250	Total
0 - 10	2	1	1					4
11 - 20			2					2
21 - 30	1							1
31 - 50			1					1
51 - 100			1					1
101 - 150	2	2	1	1				6
151 - 200	1			1	1		1	4
201 - 250				1				1
251 - 300								0
301 - 350								0
351 - 400	1	2	1					4
401 - 450								0
451 - 500		1						1
⋮								
501 - 1000								0
1001 - 1500				1				1
Total	6	4	9	5	1	0	1	26

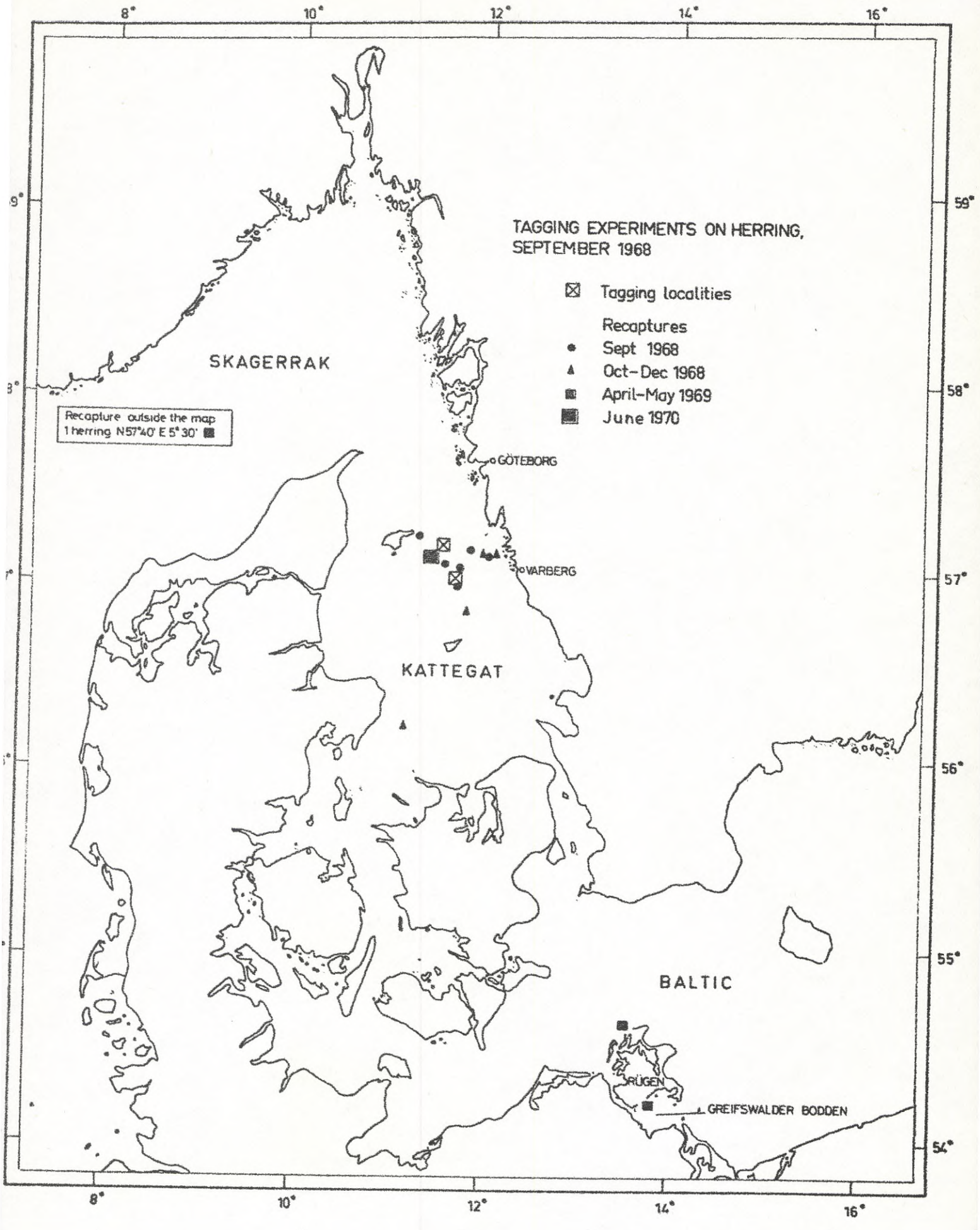

Fig. 1. In 1968 tagging experiments with herring were performed south and north of Groves Flak in the northern Kattegat. The figure shows tagging localities and recaptures with known positions.

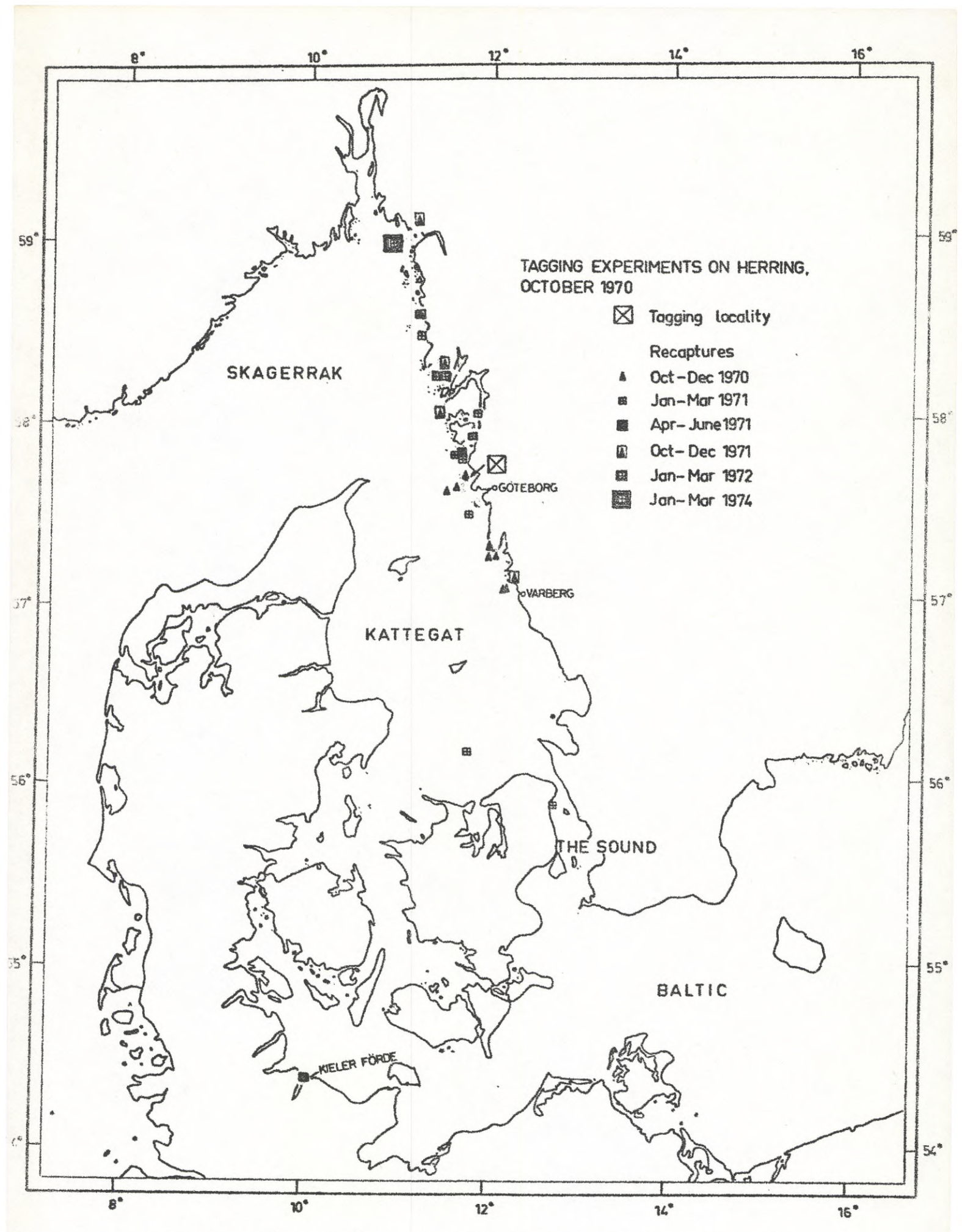

Fig. 2. In 1970 tagging experiments with herring were performed close to the coast in the northern Kattegat. The figure shows tagging locality and recaptures with known positions.