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The results of tagging experiments in 1975
on Rügen spring spawning herring



by

BIESTER, E., JÖNSSON W. and G. KRÜGER
Wilhelm-Pieck-University of Rostock, GDR
Section of Biology, WB Fisherybiology

Summary

5004 Spring herring were marked in the Greifswalder Bodden from April 8th to May 26th, 1976. The recovery rate was 6.4 %. Migration took place in two directions: westwards into the Skagerrak in the case of large herring and eastwards to about 16° E in the case of the smaller fish which were marked later. The herring return to the Greifswalder Bodden for the next spawning season.

Résumé

Du 8 avril au 26 mai 1976, on a marqué 5004 harengs de printemps et l'indice de reprise en a été de 6.4 %. Deux directions d'émigration ont été constatées: une vers l'ouest jusqu'au Skagerrak pour les grands harengs, et l'autre vers l'est jusqu'au 16° de longitude est pour les harengs plus petits marqués plus tard. Les harengs retournent pour la prochaine saison de frai dans l'étang Greifswalder Bodden.

Introduction

The marking experiments begun on the Rügen spring herring in 1975 were continued in the Greifswalder Bodden with greater intensity during 1976 (BIESTER, JÖNSSON, KRÜGER 1975, 1976 a, b; KRÜGER, BIESTER, JÖNSSON, 1976).

Material and methods

The marking site selected at mouth between the bodden and the open sea during 1975 had proved to be satisfactory and was therefore retained. The marking technique was also subject to no major modification. In order to reduce the danger of injury to the herring, the fish were grasped by means of only thin surgical gloves. In order to permit the marking of a larger number of herring, time-consuming length measurements were omitted so that the time required for marking was reduced to about 10 seconds per fish.

Results

Due to the relatively long persistence of ice conditions, it was not necessary to start marking activities already in March.

A total of 5.004 herring were marked from April 8th to May 26th, 1976. Up to July, 1977, 320 (6.4 %) of these had been recovered, 21 (0.4 %) of them after one year.

Table 1: Number of markings 1976 and recoveries per marking day

Marking date	Number of fish marked	Recoveries	%	Recoveries after 1 year	%
8.04.	355	26	7,3	2	0,6
9.04.	269	45	16,7	2	0,7
14.04.	415	25	6,0	3	0,7
15.04.	311	22	7,1	3	1,0
20.04.	478	29	6,1	1	0,2
23.04.	390	39	10,0	3	0,8
29.04.	881	40	4,5	3	0,3
6.05.	464	25	5,4	1	0,2
7.05.	423	31	7,6	1	0,2
12.05.	383	17	4,4	-	-
26.05.	635	21	3,1	2	0,3
	5004	320	6,4 %	21	0,4 %

The majority of recoveries were reported after only a short time within the month of marking. The recovery of only isolated animals was reported during the subsequent months. Recoveries were recorded during 1977 for each of the marking dates during 1976 except for May 5th, 1976 (table 2).

Table 2: Number of monthly recovery reports for 1976/77

Marking date	Month of Recovery														
	1976					1977									
	IV	V	VI	VII	VIII	IX	X	XI	I	II	III	IV	V		
8.04.	16	2		1	2		1		2	1	1				
9.04.	33	2		2	1				5	1	1				
14.04.	13	3	1	1					4	1	1	1			
15.04.	5	3	1	1					7			2	1		
20.04.	16	7	2		1				2			1			
23.04.	15	7	3		1	1	1		8		2		1		
29.04.	11	20	2						4		1	2			
6.05.		19	1	1		1			2				1		
7.05.		17	4			2	1		6				1		
12.05.		13	1						3						
26.05.		16				1			2				2		
	109	111	15	6	5	5	2	1	45	2	1	6	6+6		

Table 3 shows the reported recoveries per recovery site (see also figure 1). A total of 137 recoveries were reported for the open sea (regions 0, 1, 2, 3, 4, 5 and 8), the number from the Greifswalder Bodden (region 7) being 183.

Table 3: Number of reported recoveries during 1976 and 1977 (+1 etc.) per recovery site

Marking date	Recovery sites								Name of recovery site	ICES Nr. I
	0	1	2	3	4	5	7	8		
8.04.	2	1+1		1	9		8+1	3	0=Skagerrak	101,102
9.04.	3				7+2		31	2	1=Kattegat	21
14.04.	1				9+2		10+1	2	2=Baltsee	22
15.04.	1				4+2		14	0+1	3=Sund	23
20.04.	1				7+1		19	1	4=Arkonasee	24
23.04.			1		11	1	20+3	3	5=Bornholmsee	25
29.04.					17+1		19+2	1	7=Greifswalder Bodden	24
6.05.					13+1	2	8	1		24
7.05.				1	8	1	18+1	2	8=Rügenküste	24
12.05.					6		11		(see figs. 1 and 2)	
26.05.					1+2	1	17			
	8	2	1	2	103	5	183	16		

Reports of the most distant recoveries (8) were obtained, as during 1975, from the Skagerrak (regions 0 - 3, 6 and 9). The fish were caught there in June (1), July (5) and August (2). Two recoveries were reported from the Kattegat (region 1), one for August and the other for February, 1977. The latter was obviously on the return Journey to the spawning grounds. This assumption is corroborated by two recoveries from the sound (region 3) towards the end of October and the middle of November. A total of 8 recoveries were reported from the region west of the Darss Sill (Darsser Ort, Wustrow, Neuhaus, Warnemünde, Kadetrinne, Gedser Ref). The fact that, as in 1975, no recoveries were reported for the Belt Sea (region 2) except for a single animal north of Kuehlungsborn.

The eastern migration component is represented by 20 recoveries. Of these, 9 were reported from region 4; 12 were caught on the Oder Bank and 3 were recovered near Usedom coast off Zinnowitz-Koserow. Five recoveries were reported from the Bornholm Sea and 4 (July - September) from region 5. The most eastern recovery was reported for region 5.5.

Examination of table 3 shows that only the fish marked at the beginning of the fishing season (April) migrate towards the west (regions 0 to 3). In contrast, the recoveries of fish marked later were received from the eastern Baltic (region 5), none coming from western regions.

As was expected, the majority of recoveries (183 = 57 %) were reported from the Greifswalder Bodden (region 7), the Arkona Sea (region 4) (103 = 32 %) and the coastal regions (region 8) immediately off the isle of Ruegen (16). In Region 8, the herring are caught in trap and set nets (up to 3 nm from the coast) in contrast to the methods used from cutters on the open sea. Table 4 (see also figures 1 and 2) shows the recovery reports for region 3 in greater detail.

Year	Month	Region	Number of fish	Percentage	Remarks
1975	June	0-3, 6, 9	8	2.4%	Skagerrak
1977	February	1	1	0.3%	Kattegat
1977	August	1	1	0.3%	Kattegat
1975	October	3	2	0.6%	Sound
1975	November	3	1	0.3%	Sound
1975	July	4	12	3.6%	Oder Bank
1975	August	4	12	3.6%	Oder Bank
1975	September	4	12	3.6%	Oder Bank
1975	July	5	4	1.2%	Bornholm Sea
1975	August	5	4	1.2%	Bornholm Sea
1975	September	5	4	1.2%	Bornholm Sea
1975	July	5.5	1	0.3%	Eastern Baltic
1975	August	7	183	57%	Greifswalder Bodden
1975	September	7	183	57%	Greifswalder Bodden
1975	October	7	183	57%	Greifswalder Bodden
1975	November	7	183	57%	Greifswalder Bodden
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1975					

Table 4: Reported recoveries for 1976 and 1977 (+1 etc.) for the Greifswalder Bodden (7), the Rugen coast (8) and the Arkona Sea (4).

Marking date	Recover site																		
	7.2	7.3	7.4	7.5	7.6	7.8	7.9	7.2	8.2	8.3	8.4	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9
8.04.		3	2				1	2+1			3				7			2	
9.04.	1	4	22				2	2			2				6+1			1	0+1
14.04.		3	6		0+1	1					2	1		1	2+1		1	4+1	
15.04.		2	7			1	1	3	0+1					1+1	0+1		2	1	
20.04.	1	4	5	1		2	2	4		1		1	1		1	0+1	2	1	1
23.04.	1	2+2	12				0+1	5	1	1	1				7			3	1
29.04.	1	5+1	11				1	1+1		1					8			3+1	6
6.05.		2	4				2			1			1		7+1			3	2
7.05.	3	4	9+1				1	1			2		1		1			1	2
12.05.	1	2	5				2	1							2			2	2
26.05.	1	6	6					4							0+2				1
	9	37+3	89+1	1	0+1	4	12+1	23+2	1+1	4	10	2	3	2+1	44+6	0+1	5	21+2	15+1

The low number of recoveries reported from inside the Greifswalder is, as in the previous year, remarkably low (figure 2). The most western of the reported recoveries were made south of the Isle of Vilm (region 7.2 and north of the Kees Oeninsula (region 7.4). The latter together with a recovery reported in March, 1977, for region 7.6 lead to the conclusion that there is some, if only slight, migratory activity out of the Bodden and towards the west through the Strelasund. The majority of recoveries were reported after only a short period from the immediate vicinity of the marking site (regions 7.4, 7.3 and 7.9). The migration route obviously passes through regions 7.9, 4.8 and 8.4 more or less near the coast along the eastern side of Rügen. Recoveries were reported from regions 4.8 and 4.5 (figure 1) between 1 and 4 weeks after marking. These fish were caught by cutters fishing with trawls at depths between 15 and 20 m.

The reported recoveries for 1977 are shown in table 5. The 8 recoveries from region 6 prove that the herring marked in the Greifswalder Bodden return to their spawning grounds after a year. Recoveries reported from the regions 4.4 and 8 document the migration into and out of the spawning grounds.

Table 5: Monthly recovery reports for 1977 per recovery site.

Month of recovery	Recovery site											
	1	4.4.	4.5	4.6	4.8	4.9	7.3	7.4	7.6	7.9	7.7	8.2
I			2									
II	1											
III					1	1	2		1		1	
IV		1		1	1		1				1	1
V			4					1		1		

Discussion

The recovery rate of 6.5 % for the 1976 season was higher than that of the 1975 marking action (3 %).

Some 59 % of the recoveries were reported from the Greifswalder Bodden, the majority being received within one week of marking. This leads to the conclusion that the herring remain in the spawning grounds for only a short period and then, after spawning, leave the Greifswalder Bodden in a north-eastern direction on their migration into the Baltic.

As stated by ANWAND (1963), direct migration towards the west, i.e. out of the bodden through the Strelasund, is possible but only of subordinate importance.

As the recovery reports from regions 4.8 and 4.5 on the one hand and 8.2, 8.3 and 8.4 on the other (figures 1 and 2, table 4) show, the spring herring migrate into the Baltic mainly more or less near the coast along the eastern side of Ruegen.

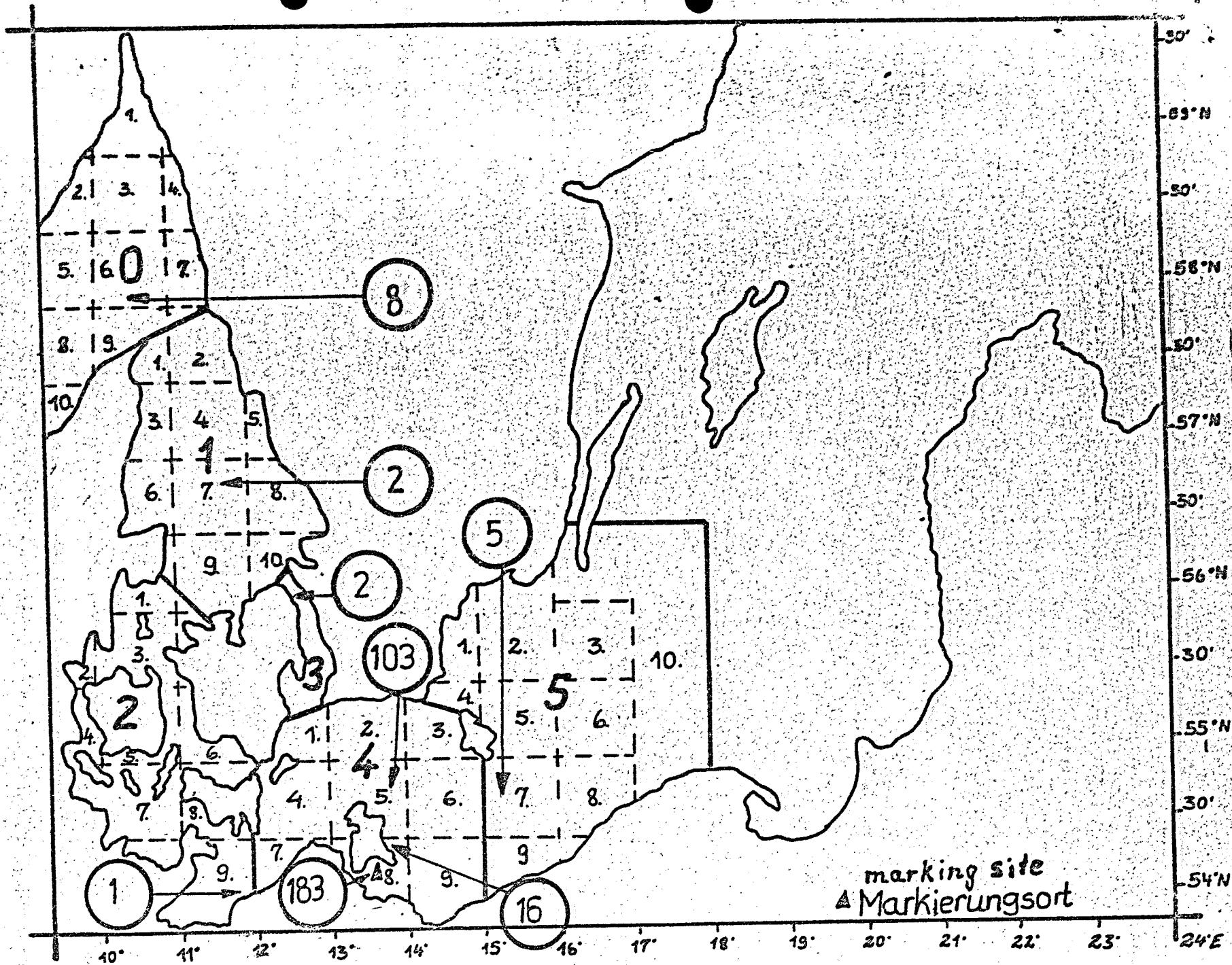
The marking experiments have shown, and this has been corroborated by studies on the length distribution (KRÜGER, BIESTER, JÖNSSON, 1976), the large herring which are marked earlier in the year migrate towards the west, whereas the smaller herring marked later migrate into the north-eastern and eastern regions. The westward migration obviously follows the south coast of Sweden (reported recoveries from Ystad and Trelleborg) and the eastern coast of Seeland (reported recoveries east of the Isle of Møn), through the Sound and into the feeding grounds in the Kattegat and Skagerrak. Different herring stocks from the north and south mix here during the feeding period (JENSEN, 1951). This is also confirmed by marking Experiments performed by WEBER (1975) on the spring herring from the Kiel Bight. The fact that no recoveries have been reported from the Belt Sea except for one north Kuehlungsborn (region 2.9) since 1975 is of some interest. If this is assumed to be one of the western migration routes for the Ruegen spring Herring, a larger number of recoveries should have been reported on account of the intensive spring fisheries in this region. Since this is not the case, it supports the above assumption that migration takes place through the Sound. According to the recoveries reported so far, the migration region for the smaller herring which migrate later in the year is restricted to the area from the Hanö Bay (South Sweden) - eastern Bornholm (16° E) - Kolobrz (People's Republic of Poland).

It must be left to later studies to clarify the question of whether the herring spawning in the Greifswalder Bodden involve different biological groups or whether the smaller herring migrating to the east have spawned for the first time and do not yet undertake such extensive migrations.

Recoveries reported after 1 year in the Greifswalder Bodden prove that the herring return to their spawning grounds. Migration again follows the east coast of Ruegen. We are unable, on the basis of our results, to confirm ANWAND's (1963) conjecture that the spawning grounds are entered predominantly through the Strelasund from the west.

References

- ANWAND, K., (1963): Markierungen am Rügenschon Frühjahrshering im Jahre 1961.
Int.Revue ges.Hydrobiol. 48, 315-323
- BIESTER, E., N.JÖNSSON, G. KRÜGER (1975): Preliminary report on marking of spring herring in the Rügen Bodden 1975.
ICES, C.M.1975/P:11
- BIESTER, E., N.JÖNSSON, G.KRÜGER (1976): The result of marking experiments in 1975 on the Rügen spring herring
ICES, C.M. 1976/P:15
- BIESTER, E., N.JÖNSSON, G. KRÜGER (1976): Ergebnisse der Markierungen 1975 am Rügenschon Frühjahrshering
Fischerei-Forschung 14, 19-21
- JENSEN, A.J.C. (1951): Migrations of the herring in the waters round Denmark.
Rapp.P.-V.Réun. Cons.perm.int.Explor.Mer 128, 29.
- KRÜGER, G., E.BIESTER, N. JÖNSSON (1976): Preliminary results of the Herring marking action in the Greifswalder Bodde in 1976.
ICES, C.M.1976/P:16
- WEBER, W. (1975): A tagging experiment on spring spawning herring of the Kiel Bay.
Ber.dt.wiss.Komm.Meeresforsch.24, 184-188



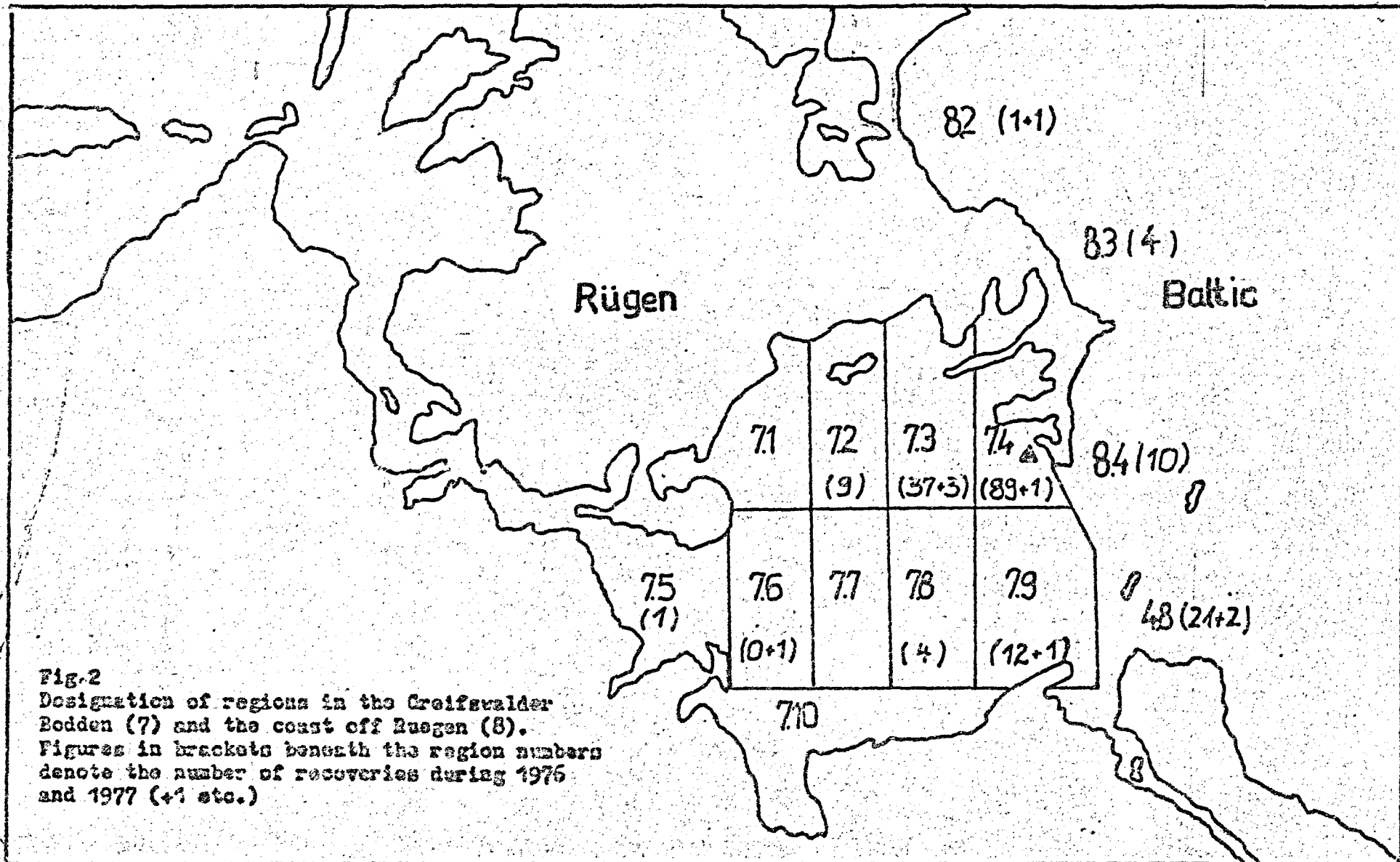


Fig. 2
 Designation of regions in the Greifswalder Bodden (7) and the coast off Rügen (8).
 Figures in brackets beneath the region numbers denote the number of recoveries during 1976 and 1977 (+1 etc.)

▲ Markierungs-
 ort
 marking site