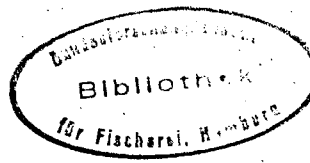


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The 1969 sole tagging experiments in German coastal waters

by

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A Introduction and Method

After the last German tagging experiments on adult soles carried out by KOTTHAUS (4) in 1961 around the waters of Helgoland, two further experiments have been conducted along the East-Frisian islands in June and August 1969.

The tagging of soles was carried out on board of small commercial shrimp boats of about 12 m length which had been equipped with light beamtrawls for catching soles during the summer months. Fishing took place around the German islands between Spiekeroog and Borkum in shallow waters during night (12 hour trips). Due to limitation of space and personal (two people were engaged in tagging) and the poor keeping facilities for soles on board the ship a proper classification of the soles concerning injuries or liveliness could not be performed.

The tagging was carried out by using a tagging gun and soft red plastic discs of 1.5 and 3.0 cm diameter reinforced by nylon

tissue (RAUCK,7). After the tagging the soles were released at the catching position without keeping them in tanks for further observations.

B Results

1) Return rate

Due to differences in the area, water depth and the size selection of fish, the length distribution of soles as given in Fig 1 varied accordingly.

Regarding the return rates the single experiments are treated seperately, for migration studies all the June experiments are put together and compared with those from August 1969.

Differences in the return rate have been observed varying from 41.0% to 12.3%.

The area of tagging, the number of soles tagged, the return rates and the type of tag used are given in Table 1.

Even though experiments a and b show the highest return rate, there is no evidence that tags with a smaller diameter yield better results. As a matter of fact the high return rate of 41.0% was due to the particular place of tagging (a) which differs considerably from the others (b, c, d).

Table 1

Area	Date	tagged sole	returns (%)	diameter of soft plastic discs
a) river mouth Ems (Easter-Ems)	24.6.69	210	41.0	1.5 cm
b) JE 8-Norderney	24.-26.6.69	409	17.1	1.5 cm
c) N off Norderney	26.-30.6.69	230	14.2	3.0 cm
d) Baltrum - Spiekeroog	17.-20.8.69	1000	12.3	3.0 cm

The tagging experiments b , c and d were carried out few miles off the East-Frisian islands Spiekeroog, Langeoog and Baltrum whereas experiment a was carried out in a branch of the river mouth of Ems called Easter-Ems (Fig 2). This particular part of the river Ems is characterised by a depth of up to 20 m (which is normally found only 8 - 10 nms off the East-Frisian islands) and flows through the shallow flats into the North Sea. The fishing vessel went at high tide over the shallow parts into the Easter Ems where the fishing and tagging tookplace for a period of about one tide.

Since a lot of the tagged soles stayed in this small tagging area 20 out of 210 soles were recaptured within ten days by German sole cutters.

The later migration of the tagged soles out of the Easter - Ems into the North Sea led to declining returns by the German cutters and to an increase of recovered soles by Dutch beam trawlers off the islands (Table 2).

Table 2: Number of recaptured soles caught within the tagging area (Easter-Ems) by German cutters and off the East-Frisian islands by Dutch beamtrawlers with in the first 120 days.

days after tagging	No of tagged soles caught	
	within the tagging area, German cutters	off the islands, Dutch cutters
10	20	
20	2	
30	4	1
40	1	-
50	3	1
60	1	2
70	1	-
90	1	2
90	1	1
100	-	3
110	1	2
120		9

This explains the high return rate of 41.0 % compared with the other experiments.

The total recapture figures (only those with full informations were counted) of the June and August experiment splitted up by quarters and nations from 1969 - 1973 are shown in Table 3.

Table 3: Number of recaptured soles by quarters and nations in the period 1969-1973 (June and August experiments combined)

1969 - 1973	Germany	Netherlands	Denmark
1. Quarter (June - March)	--	48	--
2. Quarter (April- June)	22	23	--
3. Quarter (July - Sept.)	62	66	3
4. Quarter (Oct. - Dec.)	3	95	--
total	87 (27.0%)	232 (72.0%)	3 (1.0%)

C Migration

In Fig 3 the number of recaptured soles of all the June experiments are given by statistical rectangles, quarters and nations.

In the second quarter Fig 3₁ the recoveries in the month of tagging are from the Easter-Ems mainly and solely caught by German cutters as described in chapter A. In the third quarter (Fig 3₂) the soles have spread further offshore to the NW, W and SW, the return rate of tagged soles in coastal waters by German cutters is still relatively high. However in the fourth quarter Fig 3₃ (Oct.-Dec.) the soles have migrated further offshore and are solely caught by Dutch beam trawlers. In the first quarter of 1970 (Fig 3₄) the tagged soles were caught in their hibernation quarters as described by KOTTHAUS 1961 (4).

Except two recoveries by German otterboard trawlers in the North of Fig 3₅ (April-June 1970) the migration pattern as well as

the distance from shore (Fig 3₅ and 3₆) are almost identical with those one year before (Fig 3₁ and 3₂). Even the results of the August-experiment fit extremely into the distribution pattern of the June experiment (compare eg. Fig 3₃ with Fig 4₂).

The various peaks in Fig 5 indicates that within 10 - 20 days, 40 - 60 days and 140 - 160 days after release larger numbers of soles have been caught. Fig 6 shows the area of distribution where the soles were caught in the respective time. This figure shows not only the migration pattern in relation to time but gives also an indication on the fishing effort in the different parts of the southern North Sea.

D Growth and shrinkage of tagged soles.

Fig 1a) - d) gives the number and length distribution of tagged soles as well as the number of returns at their tagging length. It is obvious as also found by KOTTHAUS (4) that the recaptured soles are distributed accordingly to the tagging length frequency and that e.g. no higher tagging or fishing mortality exists in smaller soles than in larger ones.

Since differences in growth for smaller and larger soles are to be expected after the tagging, the recovered soles were separated in 2 length groups, 17 - 27 cm and >27 cm (Fig 7, 8). Each point in the graph represents the difference in length measured between the time of release and the time of recapture. The achieved negative values for some soles are due to errors in measuring at the time of release or recapture as well as to shrinkage as well

known phenomenon in soles, KOTTHAUS (4). In both cases the June and August experiments (Fig 7, 8) sole > 27 cm show less growth over the given period of 600 days than the smaller ones.

E Conclusion

The return rate of tagged soles has been generally described by several authors as not too satisfying. For comparison purposes the different types of tags as the Albrechtsen arrow tag (red or yellow) attached to different parts of the body, roll and anchor tags, flag tags and Petersen disc have been tried out and resulted in different return rates as described in the Report of the Working Group on Sole (1). The Petersen disc revealed to be the most successful typ for tagging soles.

Table 4: Return rates of several sole tagging experiments using the Petersen disc.

Ground and sole condition	lively				sluggish			
	MÖLLER CHRISTENSEN		KOTTHAUS		MÖLLER CHRISTENSEN		KOTTHAUS	
	tagged	returned	tagged	returned	tagged	returned	tagged	ret.
undamaged	699	35.8%	44	36.3%	14	28.6%	21	9.5%
scratched	524	31.9%	79	31.4%	25	10.0%	99	9.1%
rubbed	56	32.2%	10	--	2	--	23	3.6%

Based on these results the technique by using a tagging gun and soft plastic discs of different size has been tried out in 1969. In spite of the fact that no grade of ground and skin condition (MÖLLER CHRISTENSEN, 6) was determined and that due to the poor conditions on board the shrimp boats the tagged soles could not be kept in tanks for survival studies afterwards, the return rate of the June and August 1965 experiments are within the order of those of KOTTHAUS and MÖLLER CHRISTENSEN (Table 1). The return rates of a sole tagging experiment carried out by A.C. JOHANNSEN (5) 1916 in the Kattegatt yielded 19 - 33%.

The high return of the June experiment (41.0%) is due to the fishing activity of German vessels in this particular location of the tagging place in the enclosed part of the Easter-Ems. This deep part of the river mouth closed by a sand barrier is a well known area for young soles as described by EHRENBAUM (3) 1913 who states that soles > 15 cm live in this part and further up the river in muddy places. After about 3 - 4 years they leave for the North Sea.

During their stay in the Easter-Ems they were only fished by German cutters, when leaving into the North Sea, mainly by the Dutch beam trawlers (Table 2). This explains the exceptional high return rate (27.0%) by Germany compared to other years experiments. Even though the sole tagging experiments have all been carried out in the Southern North Sea and the distribution and migration pattern for all the experiments show the same trend, some of the countries like Denmark, England, France and Belgium show decreasing numbers of returns in relation to the rapidly expanding beam trawl fleet

Table 5

Returns of tagged soles by countries							
	KOTTHAUS	KOTTHAUS	de VEEN				RAUCK
	1959	1960	1959	1960	1959/60	1960/61	1969
Belg.	13.2	6.6	2.2-	5.5	4.2	0	0
Denm.	8.5	0	0	0	6.9	14.7	1.0
Engl.	9.4	6.6	3.2-	2.0	6.9	0	0
France	6.6	1.7	0 -	5.0	1.4	4.1	0
germ.	14.2	17.9	0	0	0	0	27.0
Netherl.	48.1	67.2	94.6	88.0	80.6	81.6	72.0

of the Netherlands during that period. (Compare also international fishing effort data ANON, (1) 1962).

Regarding the migration pattern of tagged soles all experiments of the southern North Sea show a movement of soles in spring to the coast and an opposite migration into the deeper parts of the North Sea in autumn. This pattern allows also to correlate the displacement of soles with the number of days after the tagging as described by KOTTHAUS (4) 1961. However it is not likely that soles arriving in spring at the different coastal parts of Netherland, Germany and Denmark keep also in separate parts of the southern North Sea during the rest of the year as assumed in the Report of the Working Group on Sole (1). The sole tagging experiment in 1969 however shows that after the soles have left the coastal zones they spread far over the whole southern North Sea in an area south of 55° and E of 2°E and are nearly equally distributed over all the squares in the period of Jan. - March. When migrating back from the hibernation quarters

to the shore they seem to show a certain "homing instinct" by returning in several cases to the place of tagging.

Even though it is difficult to obtain reliable estimates on the growth of soles by tagging (due to several possible errors) it is likely that the growth has increased slightly since the experiments by de VEEN (8) and the investigation by BÜCKMANN (2).

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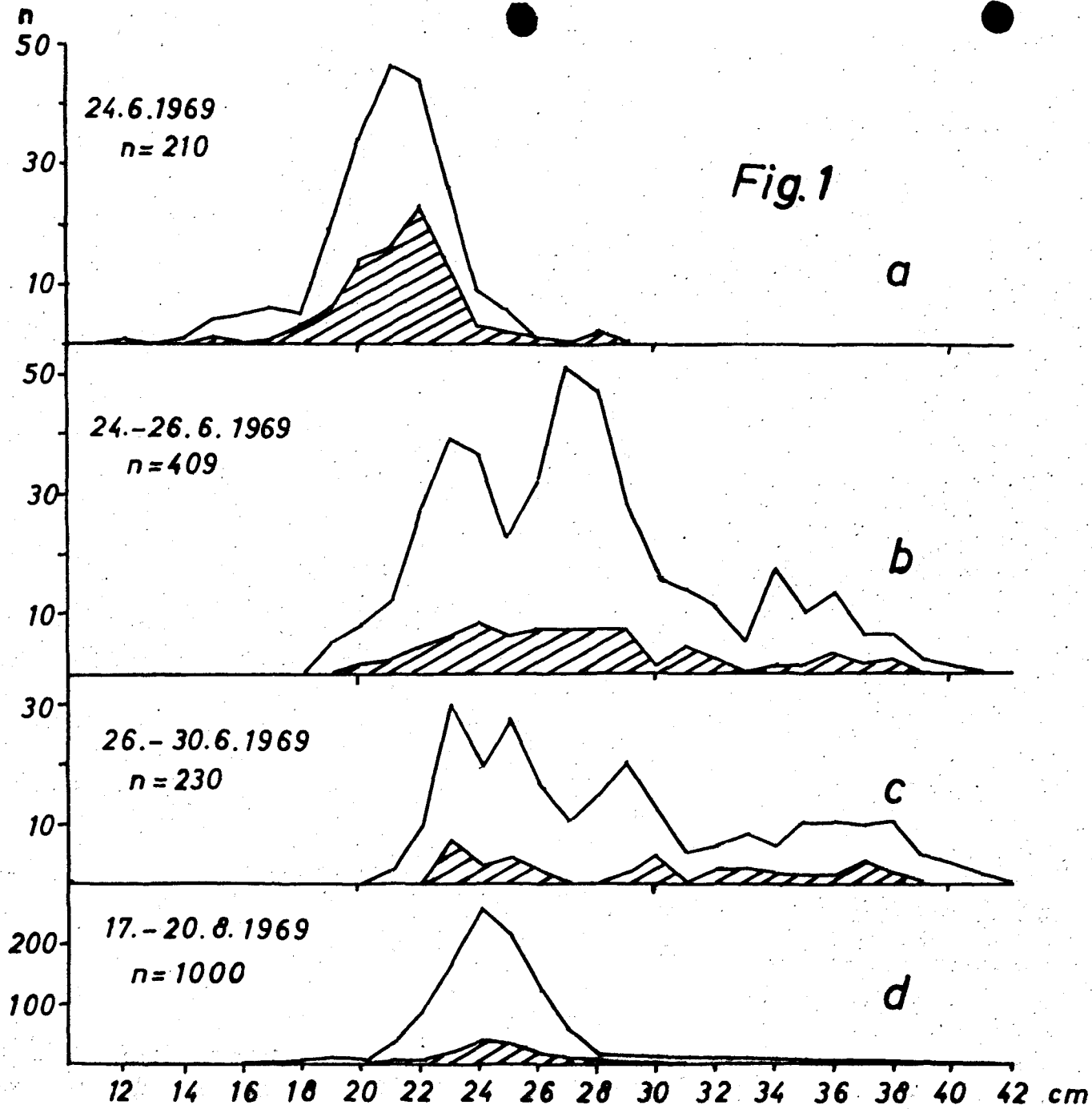


Fig. 1

Number and length distribution of tagged soles and the return (hatched part). Returns given at tagging length.

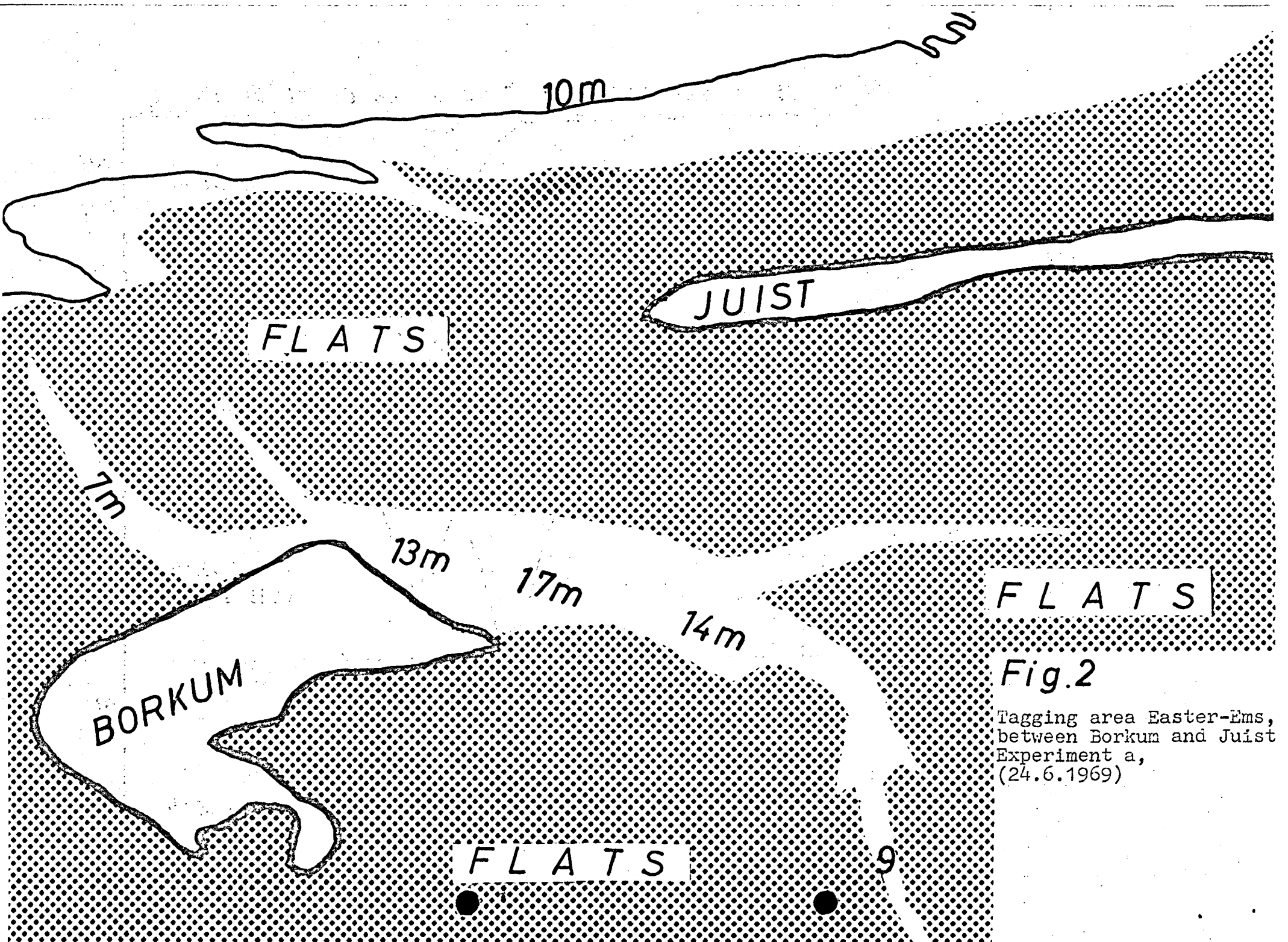
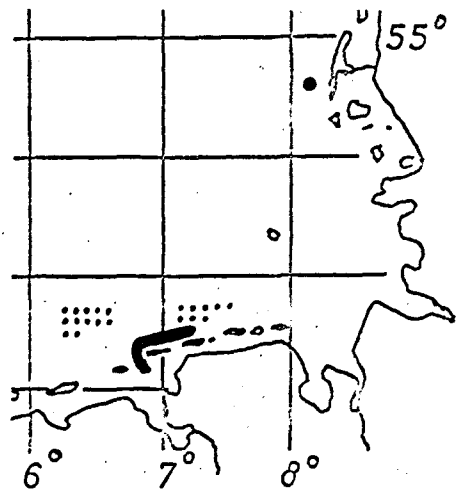


Fig.2
Tagging area Easter-Ems,
between Borkum and Juist
Experiment a,
(24.6.1969)

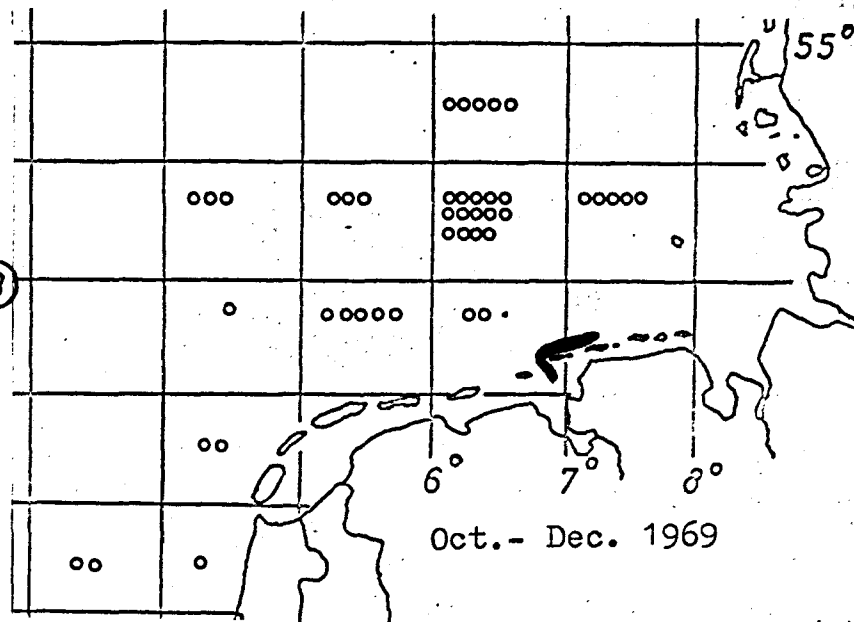
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June 1969

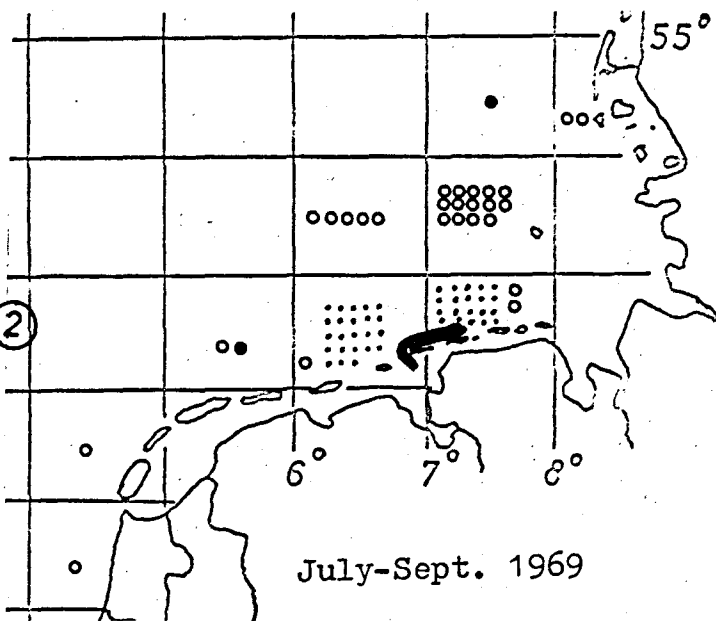
- Germany
- Netherlands
- Denmark
- Soles caught and released

③



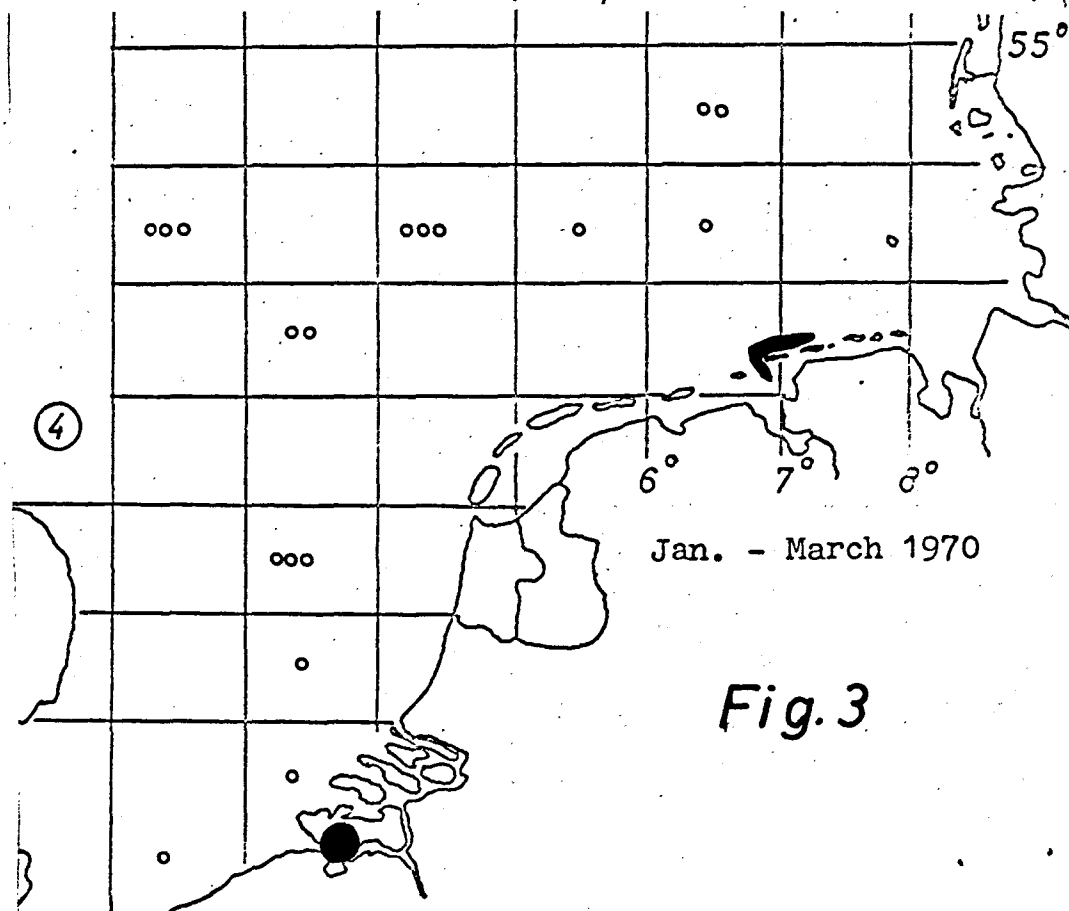
Oct. - Dec. 1969

②



July-Sept. 1969

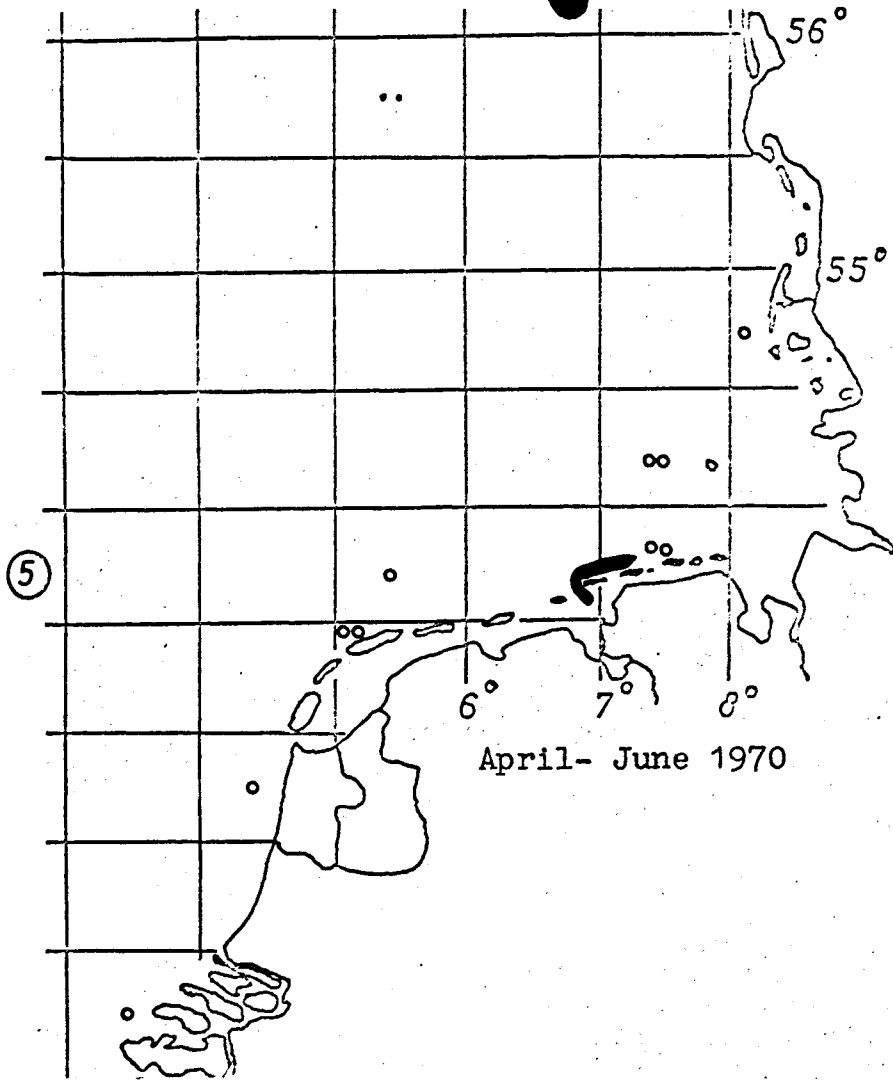
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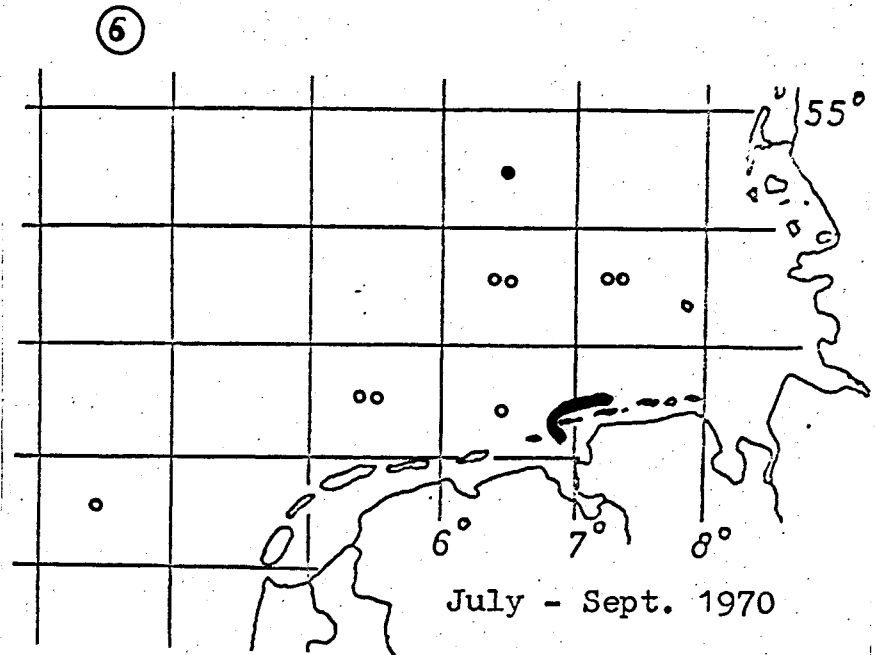
Jan. - March 1970

Sole tagging experiment June 1969 and recaptures by countries

Fig. 3



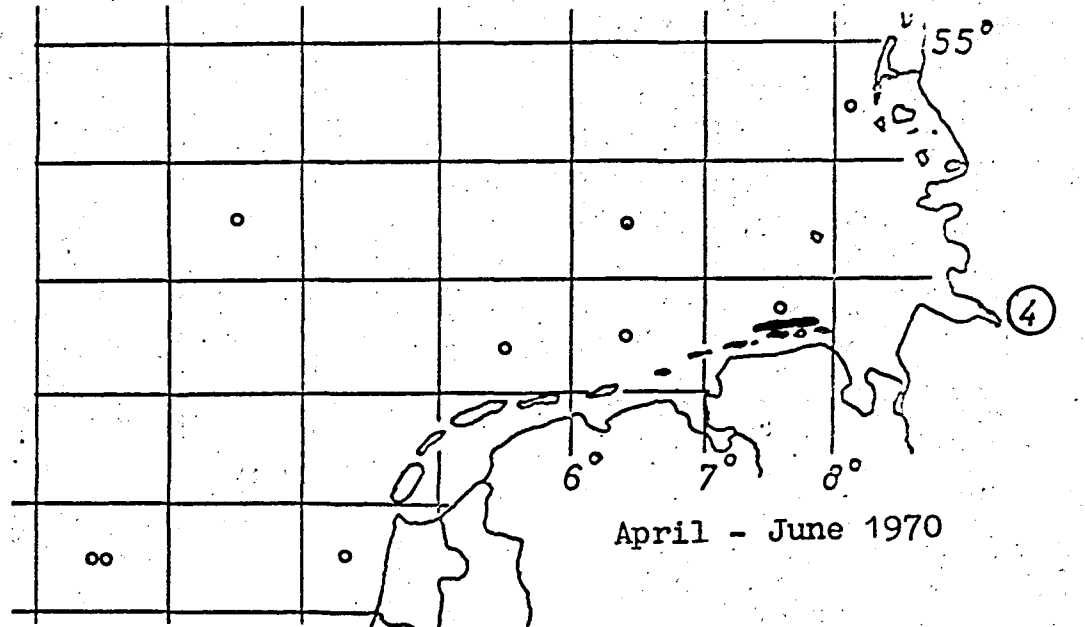
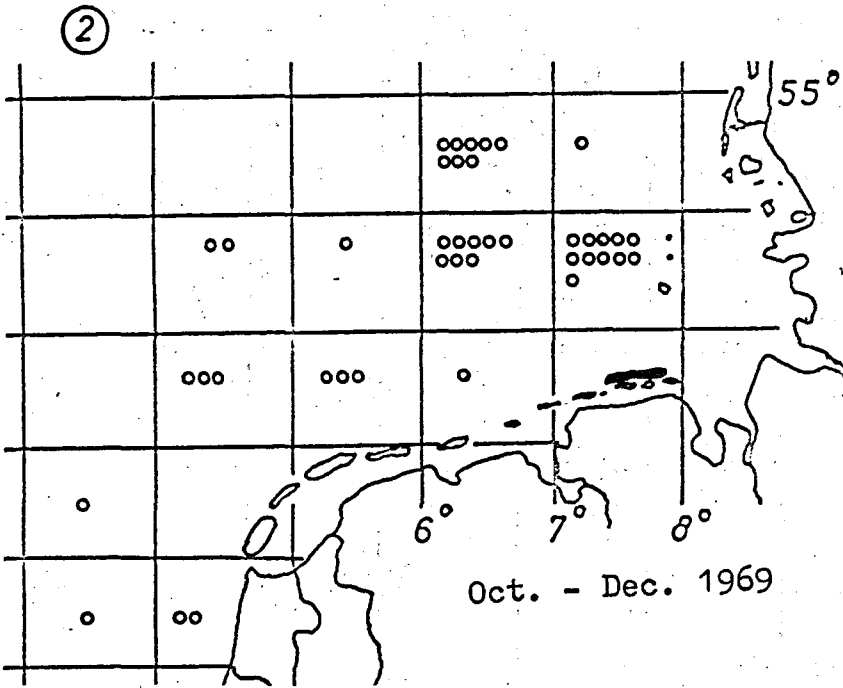
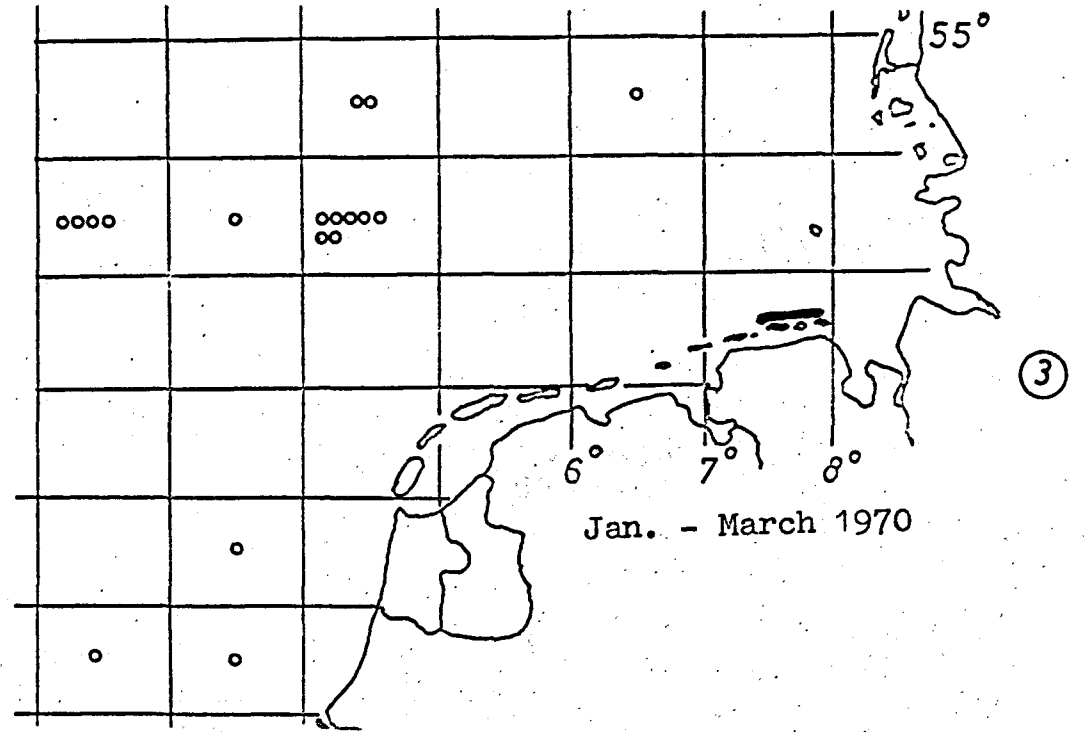
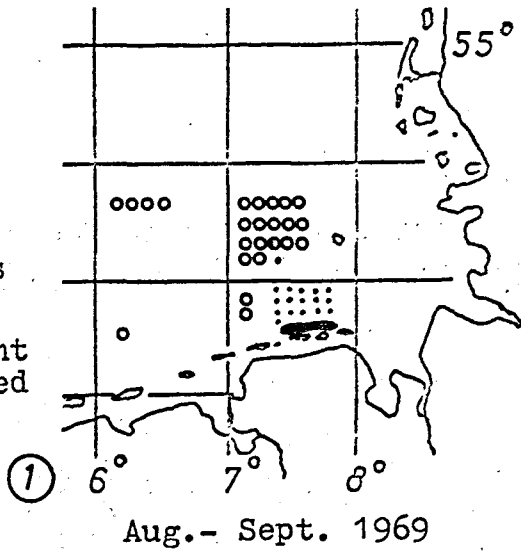
Sole tagging experiment June 1969
and recaptures by countries



- Germanv
- Netherlands
- Denmark
- Soles caught and released

Fig. 3

- Germany
- Netherlands
- Denmark
- Soles caught and released



Sole tagging experiment August 1969
and recaptures by countries

Fig. 4

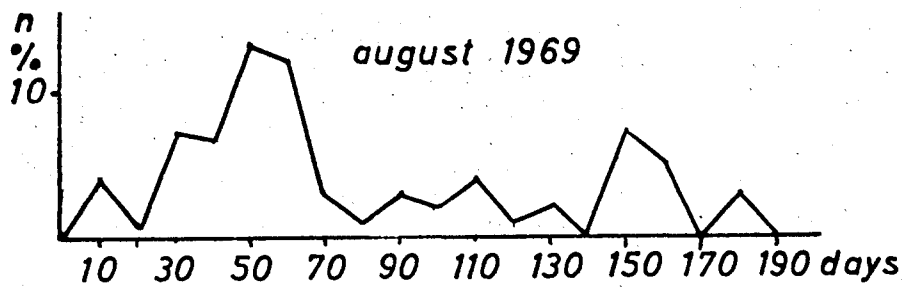
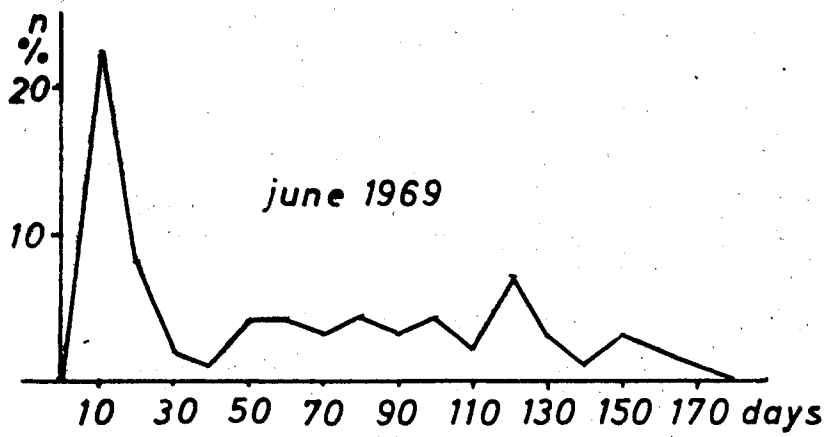


Fig. 5

Number of returned soles after the tagging

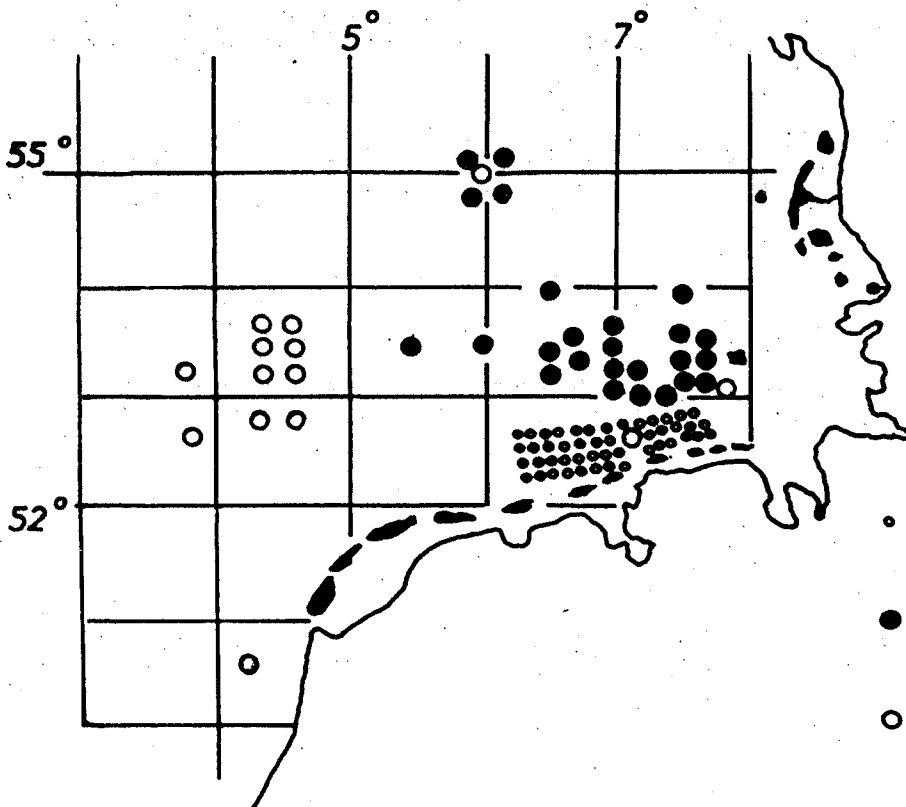


Fig. 6

- Recaptured soles
- = 10-20 days after release (June 1969)
 - = 40-60 days after release (Aug. 1969)
 - = 140-160 days after release (Aug. 1969)

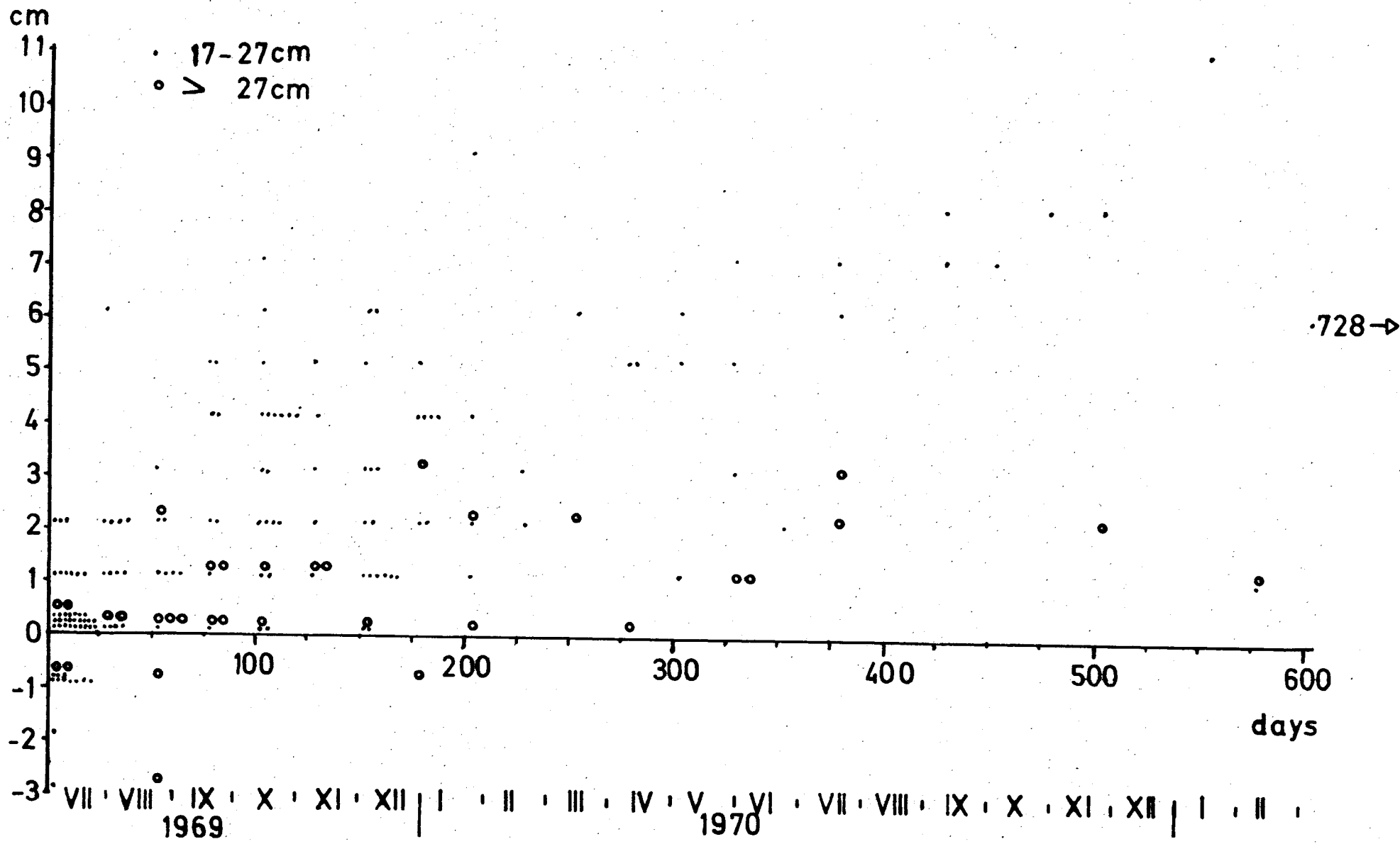


Fig. 7 Growth, difference between length at release and recovery (June 1969).

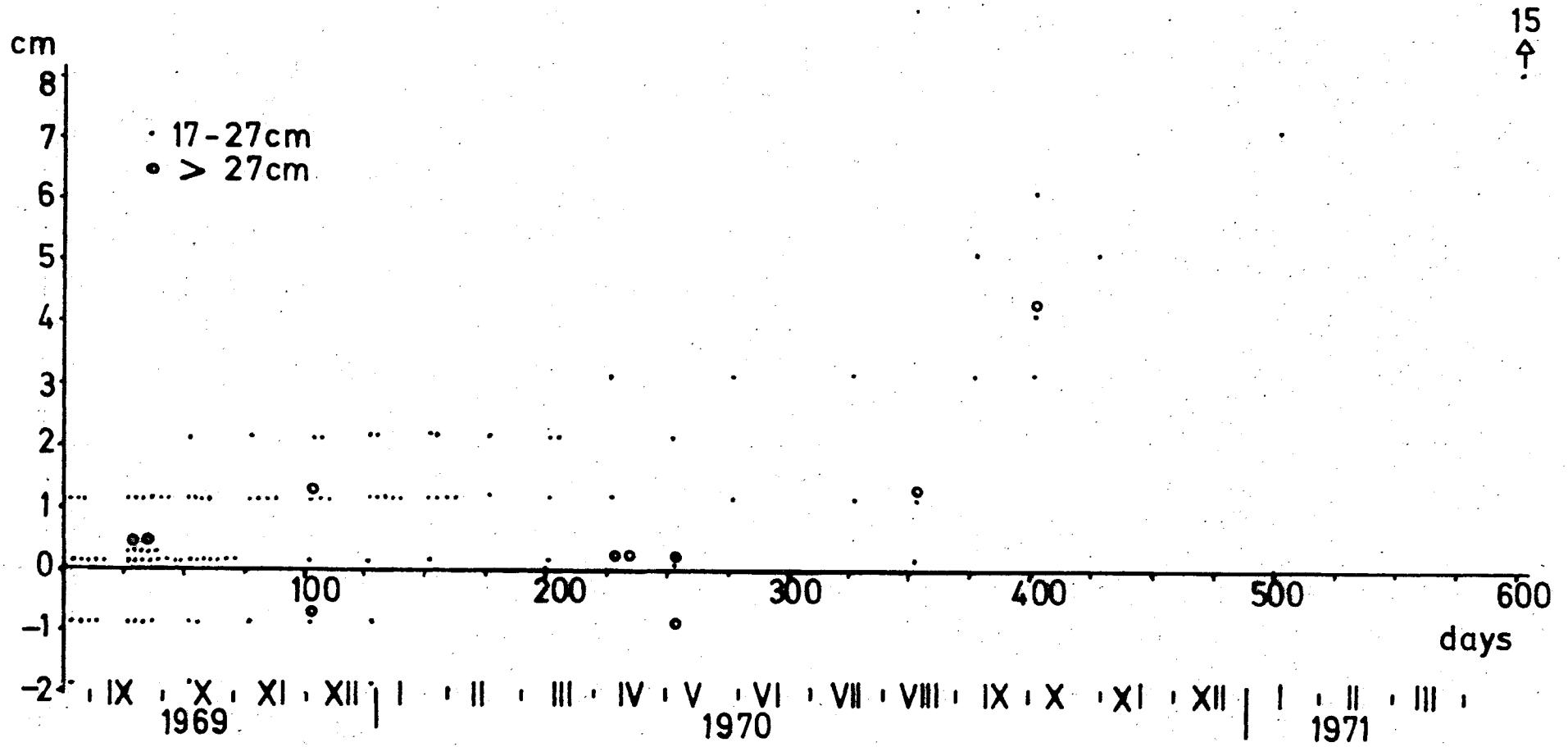


Fig. 8

Growth, difference between length at
release and recovery (Aug. 1969)