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Tagging experiments on cod off the Belgian coast.

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INTRODUCTION.

Following a recommendation of the North Sea Roundfish Working Group on North Sea Cod (Anon., 1971) a tagging programme has been carried out on cod in the Southern Bight. As several gaps in the understanding of the migration routes in this area are still existing, the migration of cod especially along the Belgian coast was studied by means of successive tagging experiments.

MATERIAL AND METHODS.

Four experiments were carried out off the Belgian coast on board the R. V. "Hinders". Another experiment took place in the Clay Deep on board the R. V. "Tridens" and an additional experiment was set up with the same vessel along the Dutch coast. The detailed information concerning this programme is listed in tables 1 and 2.

The yellow flag system was used for the experiments 1, 2 and 3 whereas the others were executed with the Floy-tag system.

In accordance with the agreement of the North Sea Roundfish Working Group the parameters a^2 (mean square dispersion coefficient), φ (mean direction of dislocation), $\bar{V}$ (mean velocity in this direction), tn (mean days absent) and tn. $\bar{V}$ (mean distance) (Jones, 1965) were calculated. The data have also been grouped according to the period of recapture : January-April (winter), May-August (summer) and September-December (autumn).

The length frequency distribution of all cod tagged is shown in figure 1. All the tagging experiments were carried out on immature cod except for experiment 3 when a relatively large amount ($\pm$ 20 %) of mature cod were tagged.

RESULTS.

The migration parameters are listed in table 3. The location of recaptures as well as the mean distance and direction for all experiments per season are shown in figure 2 to 7.

It has been established that the highest concentrations of immature cod appear along the Belgian coast during the period October-January (Hovart and De Clerck, 1969). For this reason most of the experiments were carried out during this period of the year.

The main characteristic phenomenon after release was the fact that the immature cod stock started to migrate in the beginning of the year in two opposite directions. A major part (stock A) moved in a northeastern direction and the other part (stock B) moved in a southwestern direction. During the first summer the stock A concentrated near Terschelling on the Dutch coast and the stock B stayed in the Pas de Calais area. One year after release both stocks came again together off the Belgian coast mainly during the following autumn. During the next January-March period the separation occurred again into the same opposite directions.

On becoming mature the cod tends to remain in the area of the Dogger Bank even during the winter. This phenomenon was proved by the experiments 1 (second autumn), 4 (second autumn) and 6 (second winter).

From these results, indicating a temporary mixing of two immature cod populations in the autumn-winter period followed by a total different summer residence, it can be concluded that stock A belongs to the Southern Bight population and stock B to the Pas de Calais population. Moreover the results of French and Dutch tagging experiments on these populations are in agreement with the results of this study.

The results of the Frence tagging experiments (Lefranc, 1969) also led to the hypothesis of the splitting up of the population in the Channel area. One part of the stock moved in the direction of the Dogger Bank and the other remained during the whole year cycle in the release area. The former group consisted of mature cod and the latter of immature cod. Following these findings stock B can be identified as the Pas de Calais stock.

The Dutch tagging experiments (Daan, 1969) were carried out in January-February with a large number of mature cod and indicated a northward movement to the Doggerbank after June. The mature cod of stock A as described in this study had a similar movement hence it may be concluded that stock A belongs to the Southern Bight stock.

Experiment no 5 was set up in order to investigate wether there exists any relationship between the immature cod concentrations along the Dutch and the Belgian coastal waters. As figure 6 shows the young cods tended to move along both coast lines with a mean southwestern direction during the first and second autumn - even to the Belgian coast - and with a mean Northeastern direction in the spring. When growing up the adult cod tended to join the Dogger Bank area population as demonstrated in the first summer recaptures C.

Finally, the experiment 3 on the Clay Deep grounds was carried out on a large number of mature cod as illustrated in figure 1. The aim was to look at the relative importance of this stock to the so-called Southern Bight and Pas de Calais stocks. From the results in figure 3 no relation seems to exist with the Pas de Calais area. The cod migrated towards the Dutch coast in the autumn and rejoined the release point area during the summer.

CONCLUSIONS.

The stock of immature cod which has a temporary residence along the Belgian coast is constituted by two different cod populations, namely the Southern Bight and the Pas de Calais populations. Both sub-populations move during summer time in an opposite direction and rejoin the following year as long as they are immature. When maturity is reached both populations join the Dogger Bank stock.

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Jones, R. FAO/UN, FAO/GFCM seminar on sardine tagging. Split, Yugoslavia, 2-14, November 1964.

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Table 1 - Details per experiment of the area, the season and the recoveries.

Experiment	1	2	3	4	5	6
Area	Belgian coast	Belgian coast	Clay Deep	Belgian coast	Dutch coast	Belgian coast
Period	winter 1970	summer 1970	summer 1970	autumn 1970	autumn 1970	autumn 1971
Numbers released	121	49	328	500	345	500
% recaptures	17	10	13	8	19	8

Table 2 - Information concerning the nationality of the recaptures.

Nationality of recaptures	Experiments 1	2	3	4	5	6	total
Belgium	5	2	1	8	1	10	27
Netherlands	10	2	17	3	42	9	83
France	3	1	2	10	4	18	38
Denmark	-	-	8	1	1	-	10
Germany	1	-	6	-	-	-	7
U.K.	1	-	10	9	9	3	32
Unknown	-	-	-	7	8	2	17

Table 3 - Migration parameters (a).

Experiment	Season of recapture	V	a^2	ψ	tn	tn.V	n
1	first winter A	0.567	0.000	7°45'	67	38	1
	first winter B	0.382	0.000	245°	110	42	1
1	first summer A	0.600	14.203	12°22'	160	96	5
1	first summer B	0.922	101.943	244°53'	180	166	2
1	first autumn A	0.197	8.337	20°04'	279	55	5
1	first autumn B	0.453	0.000	219°	234	106	1
1	second winter	0.141	1.400	30°38'	396	56	3
1	second summer	0.178	0.000	16°01'	511	91	1
1	second autumn	0.405	0.000	46°01'	630	255	1
2	first summer	1.000	0.000	1°	109	109	1
2	first autumn	0.200	15.443	354°	190	38	3
3	first summer A	1.855	72.593	102°50'	14	26	10
3	first summer B	1.912	142.689	334°33'	54	54	3
3	first autumn A	0.986	38.307	158°36'	62	61	14
3	first autumn B	3.100	0.000	279°	30	93	1
3	first winter A	0.486	17.282	159°	183	89	4
3	first winter B	0.646	0.000	35°	263	170	1
3	second summer	0.071	0.000	137°	354	25	1
3	second autumn	0.315	0.000	180°	492	155	1
4	first autumn	1.450	11.330	233°25'	20	29	3
4	first winter A	0.056	3.717	35°27'	103	6	8
4	first winter B	0.690	0.000	224°	89	61	1
4	first summer A	0.692	8.425	6°	220	152	7
4	first summer B	0.666	110.639	255°54'	204	136	2
4	second autumn	0.224	105.4	6°	317	71	7
5	first autumn	0.705	16.188	168°	23	16	11
5	first winter A	0.162	8.886	221°30'	101	16	12
5	first winter B	0.247	6.103	314°36'	93	23	5
5	first summer A	0.610	0.8	51°07'	186	113	2
5	first summer B	0.424	2.456	325°07'	225	95	4

Table 3 - continued

Experiment	Season of recapture	V	a^2	ψ	tn	tn.V	n
5	first summer C	0.155	2.747	223°21'	178	28	4
5	second autumn A	0.029	7.486	359°32'	371	11	5
5	second autumn B	0.405	0.000	223°	296	120	1
5	third autumn	0.019	0.000	31°	726	14	1
6	first autumn A	0.340	1.483	77°37'	14	5	5
6	first autumn B	1.502	12.300	244°25'	13	20	3
6	first winter	0.480	34.047	350°34'	95	46	11
6	first summer A	0.345	16.260	0°41'	188	65	8
6	first summer B	0.407	1.034	238°40'	151	61	2
6	second autumn A	0.036	0.000	15°	333	12	1
6	second autumn B	0.127	10.473	252°28'	296	38	3
6	second winter	0.252	0.075	19°24'	440	111	2

(a) When clear differences in the direction were noticed a separation has been made in the calculations, viz. A, B and C.

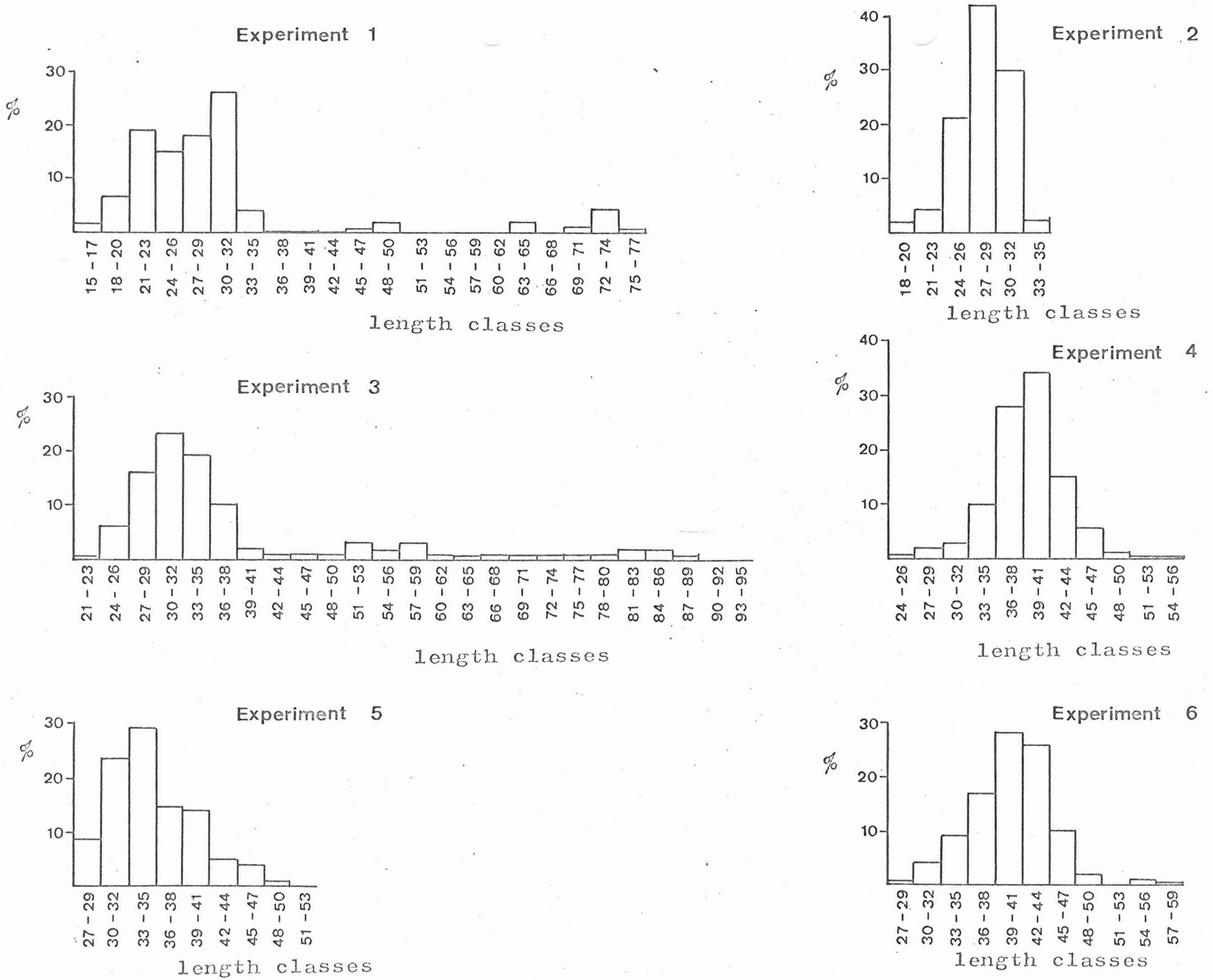


Figure 1 - Length frequency distribution of the tagged cod for each experiment.

Figure 2 - Experiment 1.

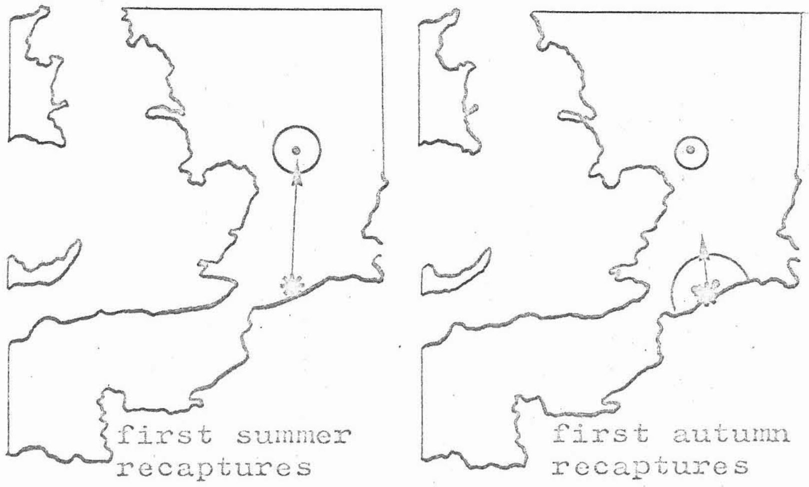
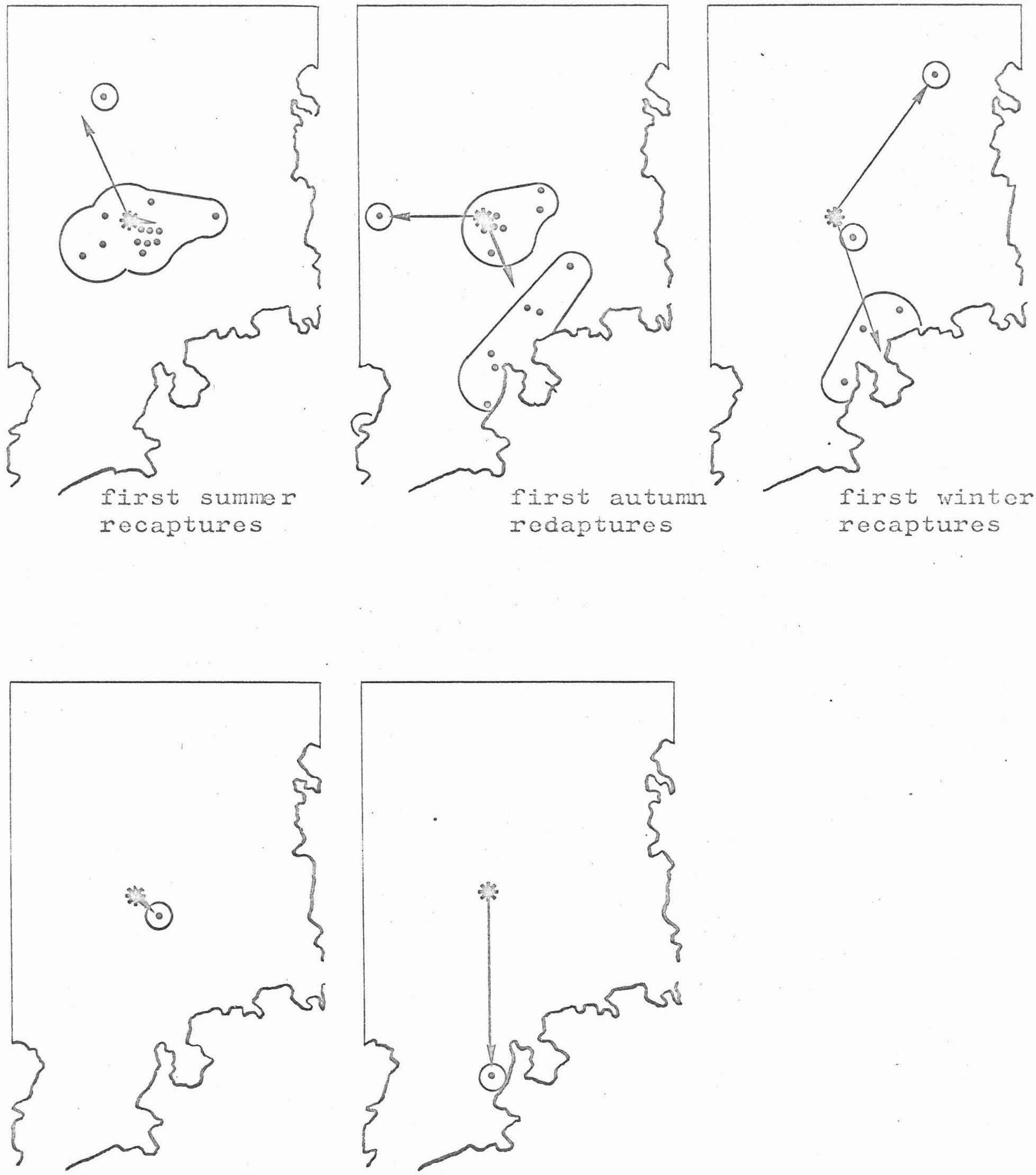


Figure 3 - Experiment 2.



first summer recaptures

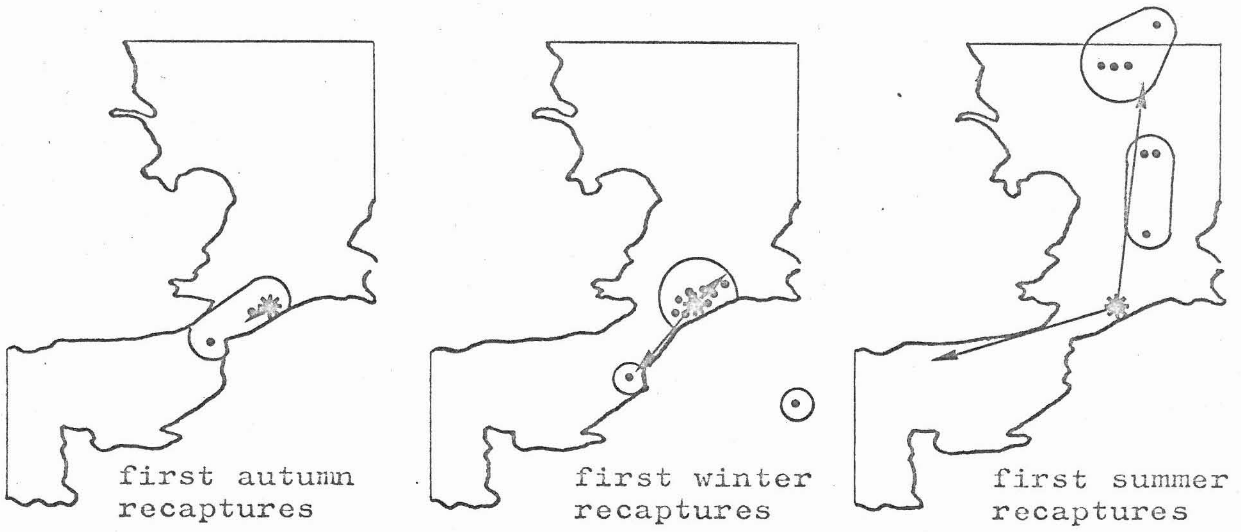
first autumn redaptures

first winter recaptures

second summer recaptures

second autumn recaptures

Figure 4 - Experiment 3.



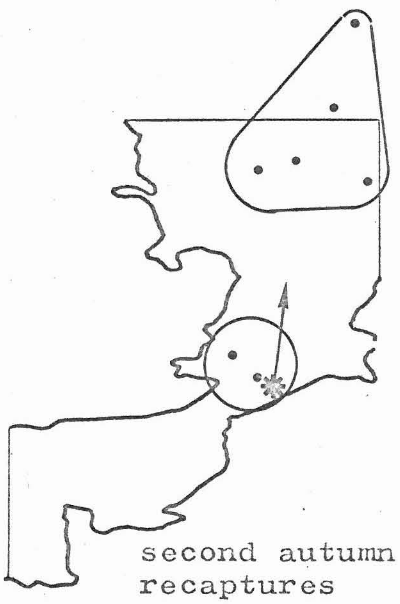
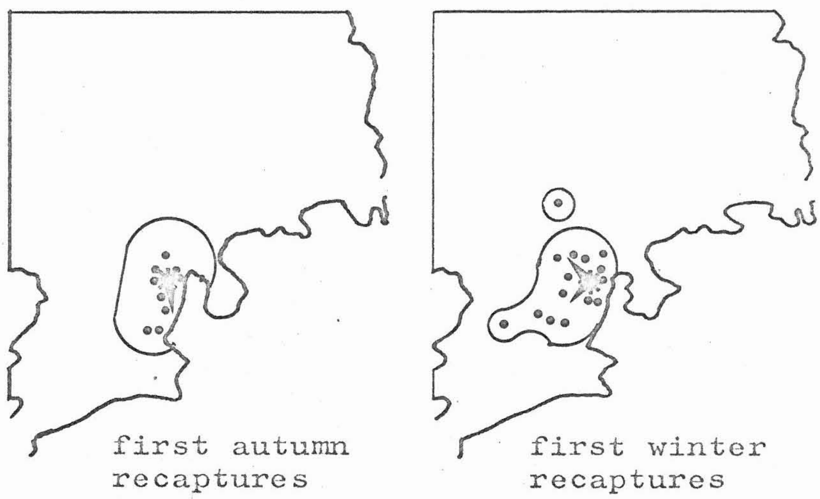


Figure 5 - Experiment 4.



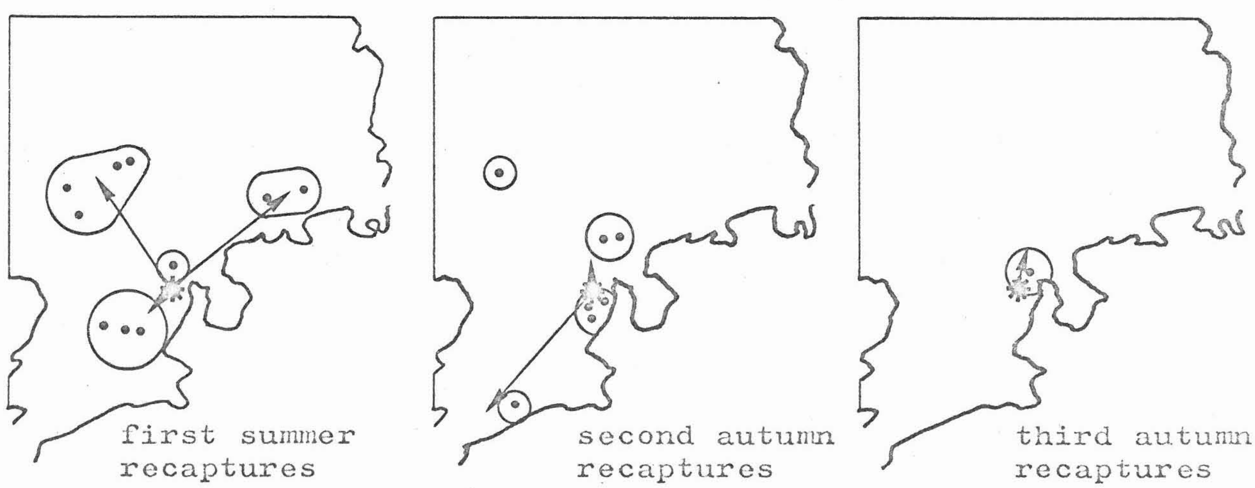


Figure 6 - Experiment 5.

Figure 7 - Experiment 6.