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Recaptures of salmon tagged as smolts in the  
 River North Esk, Scotland, from 1961 to 1970

by

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**INTRODUCTION**

The work described in this paper is part of a long-term experiment designed to measure the smolt and adult production of a salmon river, with the object of finding the optimum level at which its stock can be cropped. The River North Esk discharges into the North Sea some 5 km north of Montrose, Angus. Its length from source to mouth is approximately 56 km and it drains an area of 586 sq km.

On the basis of the numbers of salmon and grilse caught annually within the North Esk Fishery District, with a coastal length of 12 km, this is one of the six most productive districts in Scotland. During the period of this report, the catch was obtained at six netting stations (four north and two south of the mouth of the river), and by net and coble and rod fisheries within estuarial limits. The intensity of netting in this area was probably greater than in most other areas in Scotland. No measure of angling effort was available, but each year the nets caught the larger proportion of the total catch.

Although the dates for the fishing season are not uniform throughout Scotland, commercial fishing within the North Esk Fishery District, in common with a number of others, commenced on 16 February and terminated on 31 August, while rod-fishing started on the same date and continued until 31 October.

**METHODS**

Each spring from 1961 to 1970 wild smolts, caught in traps situated just above the head of tide in the North Esk, were tagged and released. The numbers caught at this location in 1968, 1969 and 1970 were augmented by fish caught in a trap sited in a tributary almost 14 km further upstream. In 1970, in addition to the smolts caught in traps, some smolts caught by sweep-netting in the estuary were also tagged and released.

In 1961 and 1962 three types of tags were used, plain annealed steel wire, coloured plastic tubing threaded on silver wire and the standard Carlin tag. The following year the number of tag types was limited to two, a small red porcelain bead threaded on silver wire and a silver disc also attached by silver wire. From 1964 until 1966 all fish were tagged with silver plates attached by silver wire, and in 1967 approximately half the fish were tagged by this method and half by Canadian-type Carlin tags attached by polyethylene thread. A tag similar to the Canadian-type Carlin tag, also attached with polythene thread, was used from 1968 to 1970. Apart from the Carlin and Carlin-type tags which were attached below the dorsal fin, all tag types were fixed in front of this fin.

The plain steel wire and coloured plastic tubing, the red bead and the silver disc tags carried no indication of their place of origin while the silver plate tags bore the internationally recognised letters Sc indicating Scotland. The Carlin and Carlin-type tags, with the exception of the Canadian type used in 1967, carried the message "Return to Fishlab, Pitlochry, Scotland, Reward". The message on the Canadian-type Carlin tag used in 1967 was "Return to F.R.B.C. St Andrews N.B. Canada Reward". The tag reward was raised during the course of the experiment from 25 pence to 50 pence, but this alteration was not thought to have had any significant effect on the return of tags.

As success in tagging and recapture techniques depends largely on the captor of a tagged fish returning the tag with details of the fish and capture, much publicity was given to the tagging experiments, both by displaying notices and making personal visits to netting stations. Since a large proportion of all the salmon caught on the coast between Aberdeen and just south of Montrose, and also the total catch of the net and coble fishery in the North Esk, were brought to one fish-house in Montrose they were examined for any tags which the fishermen might have missed and the presence of a research worker in the fish house encouraged the fish packers to examine each fish more closely.

## RESULTS

Table 1 summarises the number of smolts tagged annually and the number of tagged fish recaptured from each batch of fish released. All the recaptures on the Scottish coast were divided into groups according to the areas in which they were caught (Fig 1).

The majority of the recapture sites were either fixed-engine salmon fishing stations on the Scottish coast or pools within the North Esk where the net and coble fishing operated. The remaining recaptures, apart from those caught off the coasts of Greenland (4.1% overall), were in other Scottish rivers, principally the South Esk, or off the Northumbrian coast, but single fish were recaptured off the coast of Ireland and Norway and in the estuary of the River Foyle, Northern Ireland.

More than half the tagged fish recaptured from all the releases of smolts (except these in 1967 and 1969) were taken in the nets operated in Montrose Bay (Group 2). In seven out of the ten years 1961 to 1970, these fish, together with those caught by sweep-net in the North Esk, accounted for between 85.0% and 93.8% of the total number of recaptures from each release of tagged smolts. The corresponding figures for the remaining three years, 1967, 1969 and 1970 were 67.4%, 69.7% and 67.2% respectively. The difference was mainly due to an increase in the proportion caught in those years in other coastal areas of Scotland, and in Scottish rivers apart from the North Esk.

The recapture sites of grilse and salmon in home waters from the same smolt release were generally spread over the same geographical range, but in some instances the grilse tended to be recaptured over a wider range.

Apart from the tagged fish caught in the South Esk the majority caught in rivers other than the North Esk were taken by anglers fishing the middle and lower reaches of those rivers. One of the fish caught in the River Spey was reported to have been spent, presumably having spawned the previous autumn.

In two of the three years (1961 and 1962) when more than one type of tag was used the geographical range of recapture sites was not influenced by the presence or absence of forwarding instructions on the tags. However in 1967, when approximately half of the fish tagged that year bore tags bearing the

instruction to send them to F.R.B.C., fish bearing this tag were recorded during the following three years from seven Scottish coastal areas and eight Scottish rivers, compared with three Scottish coastal areas and two Scottish rivers for the fish bearing silver plate tags marked Sc. Six Canadian-type Carlin tags and 2 silver plate tags were returned from Greenland waters.

#### DISCUSSION

The results obtained from experiments such as those described in this paper are dependent on the co-operation of the netmen and anglers to such an extent that non-reporting of tagged fish can influence the results obtained and any conclusions drawn. The netmen and anglers in and around the North Esk area are particularly co-operative, and efficient in detecting and reporting tags in their catch, although it is not suggested that this is the primary reason for the concentration of recapture sites in the area. The results were also dependent on the proportion of the stock of salmon which was catchable, since substantial quantities of fish migrate from their sea feeding grounds to freshwater and beyond the area of the nets during the periods when the regulations governing the Weekly and Annual Close Times are in force. In addition a proportion of the stock evades capture during the Open Season.

The majority of the tagged fish caught outside the North Esk were immature, and could have been on passage to their native river while maturing. However there were two exceptions, both caught by rod and line, one being described as ripe and running in a spawning tributary of the South Esk and the other as a kelt in the River Spey. It was shown by Shearer (1958) that a proportion of the salmon caught in fixed-engines, even those sited in the vicinity of a major salmon river, will not necessarily enter the nearest river but may travel considerable distances in a northerly or southerly direction before entering the river in which they were released. Furthermore, some salmon caught in the lower reaches of a river may not necessarily belong to that river. A proportion of the adult salmon tagged in the estuary of the North Esk over a number of years returned to the sea after release and ascended another river (Shearer 1973). Thus fish found in other rivers might be on passage to the North Esk.

Although it was suggested that the possible reason for the wider geographical spread of recapture sites of fish tagged in 1967 with the Canadian-type Carlin tag could be a greater efficiency in reporting recaptures with this tag, compared with those bearing the more conventional silver plate tag, the difference between the two sets of results could also be due to a considerably greater survival, as indicated by the higher recapture rate, of fish tagged with the Canadian-type Carlin tag.

#### REFERENCES

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- SHEARER, W.M. 1973. A Study of the Atlantic Salmon Population of the North Esk 1961-1970. M.Sc. Thesis University of Edinburgh.

#### SUMMARY

1. Salmon smolts were tagged each spring between 1961 and 1970.
2. Usually more than 80% of the fish subsequently recaptured were caught on the adjacent coast and in the North Esk.
3. A small proportion (less than 2% overall) of the total number of tagged fish recaptured were caught in other rivers, mainly the South Esk.

Table 1 Number of Smolts Tagged and Adults Recaptured at Different Sites

Year	No. of Fish	Type of Tag	North Esk	Other Scottish Rivers	Scottish Coastal Sites									Greenland	Elsewhere	Unknown	Total
					1	2	3	4	5	6	7	8	9				
1961	2,500	Steel Wire	31 (28.7)		7 (6.5)	69 (63.7)	1 (0.8)										108
	1,250	Plastic Tube	15 (31.9)		5 (0.6)	27 (57.4)											47
	1,300	Carlin	17 (25.8)	3 (4.5)	1 (1.5)	36 (54.5)	6 (9.1)							2 (3.0)		2 (1.5)	66
1962	2,500	Steel Wire	22 (34.4)		2 (3.1)	38 (59.4)	2 (3.1)										64
	1,250	Plastic Tube	9 (18.8)			38 (79.2)	1 (2.1)										48
	1,250	Carlin	7 (43.8)			6 (37.5)	1 (6.3)					1 (6.3)			1 (6.3)		16
1963	6,360	Red Bead	42 (23.2)	1 (0.6)	3 (1.7)	123 (68.0)	7 (3.9)							5 (2.8)			181
	1,287	Silver Disc	12 (23.1)		5 (9.6)	29 (55.8)	4 (7.7)							2 (3.8)			52
1964	9,020	Silver Plate	59 (33.0)	3 (1.7)	11 (6.1)	98 (54.7)	3 (1.7)					1 (0.6)		4 (2.2)			179
1965	9,474	Silver Plate	32 (26.9)	1 (0.8)	6 (5.0)	68 (57.1)	2 (0.8)		1 (0.8)					9 (7.6)			119
1966	5,783	Silver Plate	24 (22.2)	1 (0.9)	5 (4.6)	66 (61.1)	4 (3.7)			1 (0.9)				6 (5.6)	1 (0.9)		108
	4,468	Silver Plate	12 (24.5)	1 (2.0)	5 (10.2)	24 (49.0)	5 (10.2)							2 (4.1)			49
1967	4,357	Caradian Carlin	20 (20.4)	11 (11.2)	2 (2.0)	43 (43.9)	4 (4.1)	3 (3.1)	3 (3.1)			2 (2.0)	1 (1.0)	6 (6.1)	2 (2.0)	1 (1.0)	98
	5,322	Modified Carlin	33 (29.2)	2 (1.8)	4 (3.5)	63 (55.8)	3 (2.7)							6 (5.3)		2 (1.8)	113
1969	1,312	Modified Carlin	7 (21.2)		4 (12.1)	16 (48.5)								3 (9.1)	3 (9.1)		33
1970	11,539	Modified Carlin	58 (16.0)	6 (1.7)	16 (4.4)	186 (51.2)	13 (3.6)		5 (1.4)		2 (0.6)	5 (1.4)	1 (0.3)	59 (16.3)	4 (1.1)	8 (2.2)	363

Figures in brackets are percentages of total recaptures.

FIG 1

RECAPTURE AREAS OF TAGGED SALMON

