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Recaptures of salmon tagged as smolts in the
River Tay, Scotland, from 1967 to 1973

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SUMMARY

Smolt-tagging was carried out on the Rivers Almond and Tummel, two tributaries of the River Tay, from 1967 to 1973. Substantial numbers of recaptures were caught off West Greenland, the Tummel contributing proportionately more than the Almond. Fish from the latter were in their second sea-year, those from the Tummel in their second and third sea-years. Salmon from both rivers were recaptured off the south-east and north-west coasts of Ireland, off north-east England, and at various points around the Scottish coast. The recapture of a few salmon in rivers other than the Tay indicates occasional disturbance in their homing behaviour. Tummel fish recaptured in the Tay were caught as grilse and two- and three-sea-winter spring salmon, the two-sea-winter fish being most numerous; Almond fish were recaptured mainly as grilse, a few returning after 2+ or 3 years in the sea. The net-and-coble fishery in the river and estuary accounted for approximately 70% and 90% of the Tummel and Almond recaptures respectively. Results, particularly from the Tummel tagging, suggest that older fish (in terms of sea age) enter the river earlier in the year.

INTRODUCTION

Smolt-tagging experiments which have been carried out in Scotland since 1966 have provided useful information on the contribution, by the various rivers in which tagging has been conducted, to salmon catches in different areas. This paper presents some of the results from experiments carried out from 1967 to 1973 on the Rivers Almond and Tummel, tributaries of the River Tay (Fig 1), with particular reference to the migration and homing of salmon originating from these rivers.

TAGGING METHODS

In 1967, and for part of 1968, diamond-shaped silver tags were attached by silver wire at the anterior end of the base of the dorsal fin. Each tag was individually numbered and bore the code "Sc" on the reverse side. Subsequently, numbered green Canadian-type smolt tags, mounted on polyethylene filament and bearing the legend "Return - Fishlab, Pitlochry, Scotland - Reward", were used.

RIVER TUMMEL TAGGING EXPERIMENTS

Smolts were trapped in the fish-ladder at Clunie Dam, at the eastern end of Loch Tummel (Fig 1), from March to the end of May. These were tagged daily at the trapping site and were then transported downstream for a distance of approximately 5 km and released into the River Tummel below Pitlochry Dam, which impounds Loch Faskally and is the lowest dam on the River Tummel.

A total of 16,424 smolts was tagged and released during the seven years. Table 1 presents, for each year of tagging, numbers of recaptures in each area of recapture.

Recaptures outside Scotland

a) West Greenland

The regular recovery in the Greenland fishery of salmon tagged as smolts in the upper reaches of the Tummel indicates that the sea off West Greenland lies within the present migration route of at least some of the salmon from this river. Tummel salmon have been recaptured off Greenland from July to November, the period during which the fishery is pursued. Of the 144 recaptures, 85% were in their second sea-year, the remainder being in their third sea-year. While the one-sea-winter fish were recaptured throughout the general area of exploitation (60°N-70°N) 50% of the two-sea-winter salmon were caught between 69°N and 70°N.

b) Ireland

Of the 2 Tummel salmon recaptured in Irish waters, one was caught in Ardmore Bay, off south-east Ireland, in May, 1972, while the other was recaptured off the north-west coast, near Rossan Point, Co. Donegal, in June, 1974. Assuming that these fish had not previously spawned, both were caught as two-sea-winter salmon.

c) England

Tagged Tummel salmon have been taken off north-east England. In July, 1970, one was caught as a grilse approximately $\frac{1}{2}$ mile off Craster, Northumberland. In 1973, 2 two-sea-winter salmon were recaptured, one off the River Tyne during April, the other at the mouth of the River Esk in Yorkshire in June.

Scottish Recaptures

The distribution of Tummel salmon recaptured in Scottish waters is shown in Fig 2.

a) Recaptures from Scottish waters excluding the River Tay

The 9 recaptures outwith the River Tay included 7 grilse caught in June and July, 2 on the west coast, the others on the east coast; the 2 two-sea-winter salmon were caught at Newtonhill (8 miles S of Aberdeen) and at the mouth of the River Tweed in February and May respectively.

b) Recaptures in the River Tay

Of the 149 recaptures in the Tay watershed, 18 were caught in the River Tummel, including 6 from the upper Tummel, 4 from Loch Faskally and 8 from the lower Tummel (see Fig 1). All other recaptures were caught in the River Tay at various points from the Tay/Tummel confluence to the estuary.

The Tay net-and-coble fishery, which is mainly concentrated between the Almond/Tay junction and Newburgh (see Fig 1), a distance of some 20 km, accounted for 99 recaptures; 42 were caught by rod-and-line (including the 18 Tummel recaptures); 4 were found dead; the method of capture of the remaining 4 is unknown.

Table 1 River Tummel Smolt Tagging (1967-1973) - Numbers Recaptured/Each Area.

Year	Number Tagged	R. Tay	Numbers Recaptured ^a /Area					Overall			
			Scottish Waters			Other Waters					
Tagged	Tagged	Tagged	East Coast	Moray Firth	North Coast	West Coast	England	Ireland	Greenland	Unknown	Overall
1967	3,042	4 (1.3) ^b	-	-	-	-	-	-	5 (1.6)	-	9 (3.0)
1968	1,950	2 (1.0)	-	-	-	-	-	-	5 (2.6)	1 (0.5)	8 (4.1)
1969	2,338	15 (6.4)	-	-	-	-	1 (0.4)	-	12 (5.1)	-	28 (12.0)
1970	3,376	41 (12.1)	2 (0.6)	-	-	2 (0.6)	-	1 (0.3)	44 (13.0)	-	90 (26.6)
1971	1,467	48 (32.7)	2 (1.4)	-	-	-	2 (1.4)	-	33 (22.5)	1 (0.7)	86 (58.6)
1972	2,462	33 (13.4)	2 (0.8)	-	-	-	-	1 (0.4)	35 (14.2)	1 (0.4)	72 (29.2)
1973	1,789	6 (3.4)	1 (0.6)	-	-	-	-	-	10 (5.6)	-	17 (9.5)
16,424 149			7	-	-	2	3	2	144	3	310

a. Figs include recaptures to 31.12.74.

b. Figs in brackets = recaptures expressed per 1000 tagged.

These fish included 30% grilse, 47% two-sea-winter fish and 23% three-sea-winter salmon. Table 2 shows the numbers of each sea-age group caught by each fishing method in the Tay system, and the period during which each group was caught.

Table 2

<u>Sea-Age</u> <u>Group</u>	<u>Numbers and Period Recaptured</u>			
	<u>Net-and-coble^a</u>		<u>Rod</u>	
	<u>Number</u>	<u>Period</u>	<u>Number</u>	<u>Period</u>
Grilse	35	June, July	4	July-September
2 SW	53	February-June	13	January-August
3 SW	11	February-April	24	January-May

The statutory close season dates for salmon fishing in the River Tay are:-

- a) Net-Fishing : 21 August - 4 February
- b) Rod-Fishing : 16 October - 14 January

As the Tay net fishery is concentrated in the lower reaches of the river, the periods when the three sea-age groups have been caught probably give a reasonably reliable indication of their respective times of return into the home river. Of the grilse, 37% were caught in June and 63% in July; 79.2% of the two-sea-winter salmon were caught by the end of May; and 10 of the 11 three-sea-winter fish were recaptured by the end of March.

The recapture of both two-sea-winter and three-sea-winter salmon in the rod catches in January indicates that, in some years at least, a number of these salmon from the upper Tummel pass through the lower reaches of the Tay during the netting close-season.

RIVER ALMOND TAGGING EXPERIMENTS

Smolts were trapped each year at one of two sites on the lower Almond from 1968 to 1973. Although the trap was in operation from March to the end of May, the majority of smolts were caught during April and May. All tagged fish were released into the Almond at a point adjacent to the trapping site.

In the six years in which tagging has taken place, 18,080 smolts were tagged and released. Summarised data, in terms of numbers per area of recapture, are shown in Table 3.

Recaptures outside Scotland

a) West Greenland

Salmon from each year of tagging, except 1968, have been recaptured in the Greenland fishery. Although the recapture rate is much lower per unit number of smolts tagged compared with that from Tummel smolts, the appreciable number of returns indicates a definite, rather than chance, migration of a proportion of Almond salmon into Greenland waters. All recaptures were made during the autumn (August to October) of their second year at sea. Although Almond fish were taken throughout the fishery, from 60°N-70°N, a higher proportion (85%) were caught in the south (60°N-66°N) compared with that (67%) for Tummel one-sea-winter recaptures.

Table 3 River Almond Smolt Tagging (1968-1973) - Numbers Recaptured/Each Area

Year Tagged	Number Tagged	Numbers Recaptured ^a /Area									Overall
		R. Tay	Scottish Waters			Other Waters		Unknown			
			East Coast	Moray Firth	North Coast	West Coast	England	Ireland	Greenland		
1968	2,726	15 (5.5) ^b	2 (0.7)	-	-	-	-	-	-	17 (6.2)	
1969	1,749	67 (38.3)	1 (0.6)	-	-	-	4 (2.3)	-	6 (3.4)	82 (46.9)	
1970	6,703	200 (29.8)	7 (1.0)	3 (0.4)	3 (0.4)	3 (0.4)	6 (0.9)	-	17 (2.5)	242 (36.1)	
1971	2,685	141 (52.5)	11 (4.1)	1 (0.4)	1 (0.4)	1 (0.4)	7 (2.6)	2 (0.7)	13 (4.8)	186 (69.3)	
1972	1,759	83 (47.2)	9 (5.1)	2 (1.1)	2 (1.1)	1 (0.6)	3 (1.7)	-	4 (2.3)	107 (60.8)	
1973	2,458	83 (33.8)	7 (2.8)	-	-	2 (0.8)	3 (1.2)	-	2 (0.8)	103 (41.9)	
18,080		589	37	6	6	7	23	2	42	25	737

a Figs include recaptures to 31.12.74

b Figs in brackets = recaptures expressed per 1000 tagged.

b) Ireland

The first evidence that Almond salmon might contribute to the Irish fishery was the report of a grilse, tagged in 1969, in a consignment of salmon sent from Ireland to England. A further 2 recaptures, also grilse, have since been reported from the Donegal fishery. Both were caught in July, 1972, one near Malin Head, the other off Aranmore Island.

c) England

In each year since 1970, Almond salmon have been recaptured off the north-east of England, particularly off Northumberland by the drift-net fishery. These fish were caught as grilse during July and, to a lesser extent, August.

Scottish Recaptures

Fig 2 shows the distribution of Almond salmon recaptured in Scotland.

a) Recaptures from Scottish waters excluding the River Tay

Although Fig 2 demonstrates a scattering of Almond recaptures around the Scottish coastline, the combined non-Tay returns account for only 8.7% of the Scottish recaptures.

Over 90% of these fish were grilse, of which approximately two-thirds were caught in July, the remainder being taken in August with one other recapture caught by rod in Loch Lomond (W Scotland) in September. Grilse were taken in all the main areas but the available information provides no distinct evidence of earlier seasonal occurrence in any particular area. Of the 4 fish recaptured as two-sea-winter salmon, 2 were caught in May on the north coast, while the remaining 2 were caught in July, one in the Moray Firth and one on the east coast.

The recapture by rod of 2 grilse, one in the River South Esk, the other in Loch Lomond, suggests that some of the Almond fish stray into fresh waters other than their home river. The Loch Lomond rod recapture is particularly interesting in that it was taken in a west coast river system at least 15 km from the sea and presumably at a rather late stage of maturity.

b) Recaptures in the River Tay

Of the total of 712 recaptures for which capture sites have been established, 589 (82.7%) were taken in the Tay watershed. The net-and-coble fishery accounted for 494; 65 were caught by rod, including 61 in the main river of which 72% were taken upstream from the Almond/Tay junction (most were caught between Almondmouth and Islamouth although one was recaptured approximately 25 km above Almondmouth); 3 recaptures were caught by rod in the Almond itself, a river subject to negligible fishing effort; and one was caught in the River Earn, some 12 km upstream from its confluence with the Tay. A further 12 recaptures were taken in the main river, but the method of capture was not reported; and, in the Almond, 13 were found dead during and shortly after the spawning season, 4 were caught during electro-fishing operations in late autumn and the method of recapture of the remaining fish was not established.

Recaptures in the Tay included 537 grilse (91.2%), 50 two-sea-winter salmon (8.5%) and 2 three-sea-winter salmon (0.3%). Details of numbers caught by each method, and the periods of capture for each sea-age group, are given in Table 4.

Table 4

<u>Sea-Age</u> <u>Group</u>	<u>Numbers and Period Recaptured</u>			
	<u>Net-and-Coble</u>		<u>Number</u>	<u>Rod</u>
	<u>Number</u>	<u>Period</u>		<u>Period</u>
Grilse	459	June - August	51	July - October
2 SW	35	June - August	11	June - October
3 SW	-	-	2	April, September

Over 99% of the grilse recaptured by net were caught in July and August. From 1969 to 1973, 77.0 - 80.5% were taken from mid-July to mid-August. However, there has been a progressive increase in the proportion of grilse caught before mid-July and, in 1974, this amounted to 27.1%. The proportion from mid-July to mid-August fell to 55.7% in that year.

Of two-sea-winter salmon caught in the Tay nets, 28.6% were taken in June, 51.4% in July and 20.0% in August. These data indicate a marked tendency for these small summer salmon to return rather earlier than the grilse.

Rod catches provide evidence that the Almond produces a few three-sea-winter salmon.

CONCLUSIONS

These results from smolt-tagging experiments indicate distinct differences in the time and stage of homing to the Tay by salmon from the Almond and upper Tummel. This may be due to complex genetic/environmental inter-relationships, e.g. the Almond rises 40 km from the upper tidal limit on the Tay while the upper Tummel smolts are the progeny of salmon which migrate upstream from 65 km to over 100 km above that limit. The lower tributary produces a higher proportion of grilse, but in both tributaries there is a tendency for the oldest (sea-age) fish to return before the grilse.

While results have substantiated, in general, the accurate homing to the main river, the recapture of substantial numbers of Almond salmon upstream from the Almond/Tay confluence suggests that homing may not be so accurate within the river system.

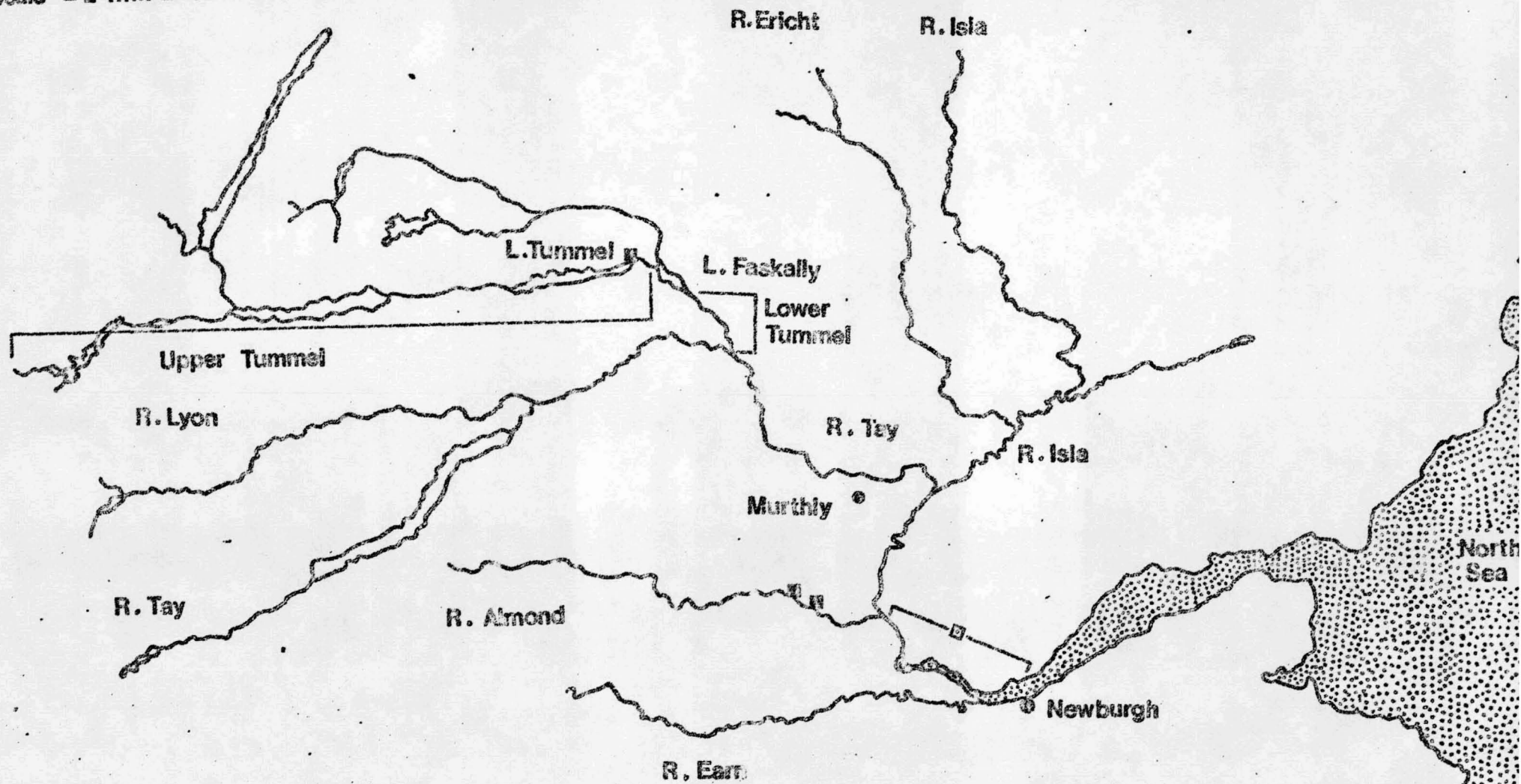
The recaptures along the Irish, Northumberland and Scottish coasts of Almond and Tummel salmon, at a time when they are probably making their return to freshwater, suggest that some of these may enter coastal waters at appreciable distances from the outfall of the home river. The low number of these returns may indicate that salmon from these rivers are widely dispersed in the North Atlantic and North Sea, the majority of those which survive travelling to the home river outside the coastal areas of exploitation. However, the efficiency with which tags are returned is probably lower outside the areas where the catches are under close investigation.

The incidence of recaptures off West Greenland is convincing evidence that this area is within the present marine migratory route of salmon from both rivers. As the Almond and Tummel appear to be essentially grilse and salmon (two- and three-sea-winter) rivers respectively, this probably accounts for the proportionately lower contribution by the former to the Greenland population from which fish return to Scotland as two-sea-winter and older fish.

River Tay Catchment Area

FIG 1

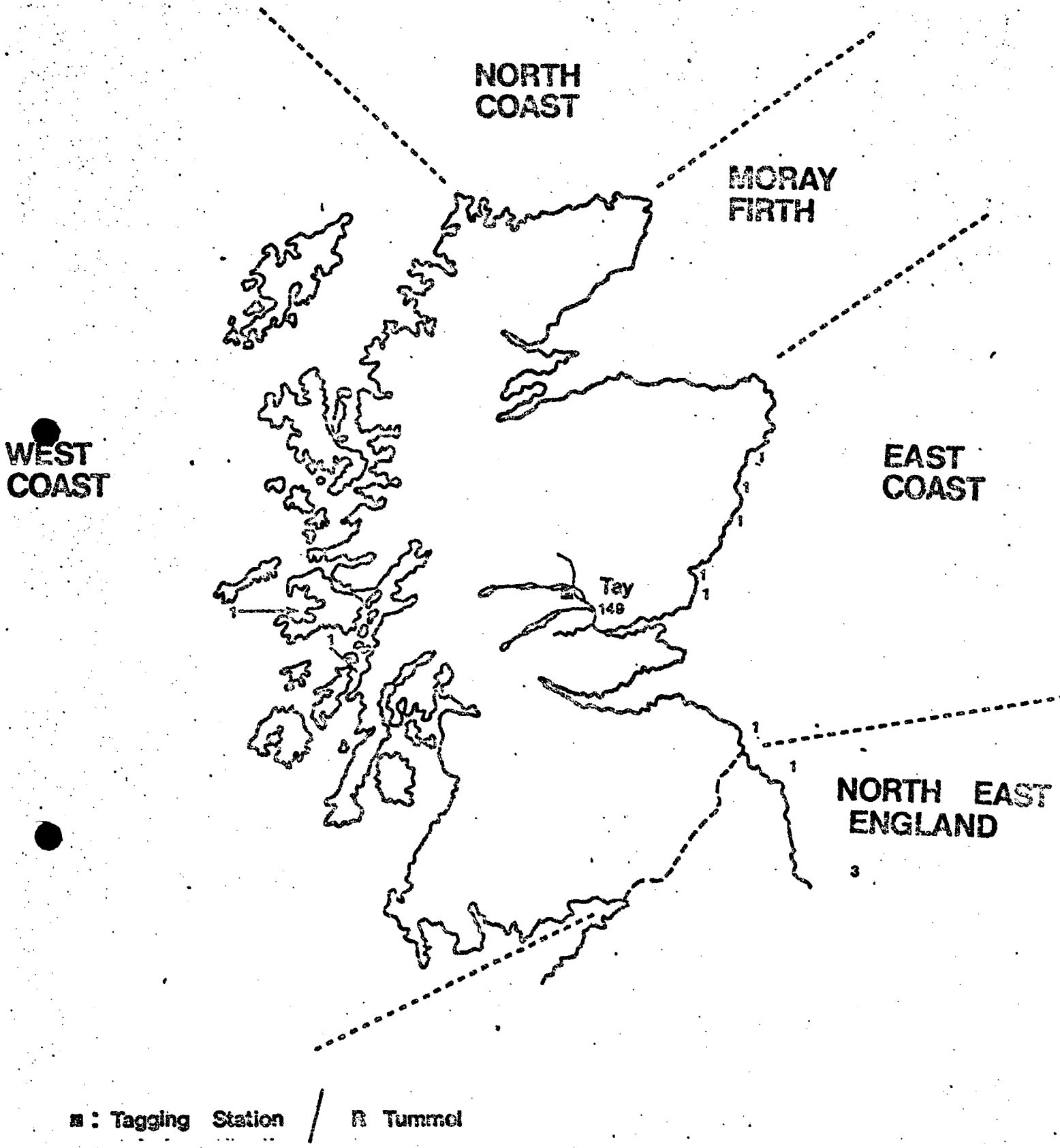
Approx Scale = 2 mm = 1 km



■ : Tagging Stations

—■— : Net/Coble Fishery

FIG 2 Recaptures of Tummel Salmon in Scottish Waters



■ : Tagging Station / R Tummel

Recaptures of Almond Salmon in Scottish Waters

FIG 3

