NRA North West Salmonid Microtagging Programme 1987-1994

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Summary

(1) The microtagging programme began in 1987 using hatchery reared salmon originating from the rivers Caldew and Hodder and subsequently included the Lune (1988) and Ribble (1989). Microtagging of sea trout began in 1991 for the Lune and in 1993 for the Hodder.

(2) The results to date show that the number of returning adults expressed as a percentage of the number stocked (approximately 10,000 were stocked in most cases) varied from 0.01% to 0.40%. The majority of returns have been grilse (1SW salmon). This compares with estimates of 0.05% and 3.4% recorded for the River Tees.

Further returns are expected in 1994 from stockings carried out in 1991 and 1992.

(3) The return rates were highest for the River Caldew (0.09% to 0.40%) due to better screening afforded by the use of a fish trap that intercepts all migratory fish when set in operation.

The screening process for the Lune, Ribble and Hodder need to be improved either through trapping and/or more extensive sampling of the rod and net fisheries.

(4) To date there have been no recaptures of microtagged sea trout.

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NRA North West Salmonid Microtagging Programme 1987-1994

1. Introduction

The International Council for the Exploration of the Seas (ICES) recommended that all European salmon producing countries should attempt to assess the extent of marine exploitation through a microtagging programme. This was duly organised in England and Wales by the Ministry of Agriculture Fisheries and Food (MAFF) (Russell and Potter, 1990).

The technique of microtagging was developed on the west coast of the USA in the early 1960's (Jefferts et al., 1963). Subsequently, millions of fish have been tagged each year in the USA. Microtagging offers several major advantages over the use of conventional external tags such as the high tagging rates that can be achieved, tag losses are lower, tagging has less effect on growth and survival, and it is possible to reduce or eliminate biases in tag returns (Isaksson and Bergman, 1977; Potter and Browne, 1985; Chart and Bergersen 1988; Bergman et al., 1968, 1992).

Microtagging studies in the North West of England began in 1987 for salmon and 1991 for sea trout, concentrating on the rivers Caldew, Lune, Ribble and Hodder. The objectives of the programme are as follows:

(1) Determine the pattern and level of exploitation of hatchery and wild stocks in

    (a) distant water fisheries
    (b) home water commercial fisheries
    (c) rod fisheries

(2) Determine the return rates and contribution to home water fisheries of hatchery stocks and the effect of

    (a) age of release
    (b) location of release
    (c) method of release
    (d) origin and rearing strategy

(3) To assess the performance of hatchery reared fish compared to wild fish

To assess exploitation in the distant water fisheries the scanning of landed catches in the high seas fisheries at Faroes and West Greenland have been coordinated by ICES. Home-water tag recovery programmes, with the exception of the English North East coast fishery (conducted MAFF), have been organised by regions of the NRA.

In the case of home waters, anglers and commercial netsmen are encouraged to submit adipose fin clipped fish for inspection. In the North West region of the NRA a £5 reward is payable on the production of an adipose fin clipped fish and a further £5 if a tag is present. The removal of the adipose fin serves to

identify the fish as having been microtagged. According to Isaksson and Bergman (1977) fin regeneration does not occur, but this seems to depend on the thoroughness of the removal. If the fin is poorly cut i.e. half way along the length of the fin, substantive regeneration can occur (Stuart, 1958). Anecdotal information suggests that there may be a minor hydrodynamic role for the adipose fin and it may act as a secondary sexual characteristic in male fish.

Microtags come in the form of a spool of coded wire which is cut to produce tags. A standard microtag is approximately 1mm long and 0.25mm in diameter. It carries 4 rows of binary code etched on to its surface. One row gives the master code from which the first data code, agency code (42 for England and Wales), and second data code can be determined. This constitutes the batch code (Fig. 1). A spool of microtag wire is usually sufficient for tagging 10,000-11,000 fish unless there are equipment malfunctions which can result in wire wastage. For general purposes a minimum fish length of 5cm is recommended when using standard tags. Half length tags can be used for fish of about 4cm. In practice, batch sizes in excess of 5,000 are desirable to ensure that sufficient adult fish are being intercepted since the lower the number of tag recoveries the higher the confidence limits associated with any recapture rate (Fig. 2). In order to obtain +/- 25% confidence limits 70 tag recoveries are required. If 25 tag recoveries are obtained the confidence limits will be +/- 40% of the estimate (Russell et al., 1992).

2. Methods

The tagging equipment consists of a tag injector (MK IV model) and quality control device (QCD) as shown in Fig. 3. A sample of fish (c. 200) must be measured to obtain a representative length frequency distribution of the batch to be tagged. This enables the correct head mold and needle penetration depth to be assessed from a look-up table. Having set these parameters the tagging process can begin on a test sample of about 200 adipose fin clipped fish.

When a fish is held against the head mold and the injector activated by the operator a tag is cut from the spool of wire, magnetised, and injected into the snout of the fish (Fig. 4). Fish are anaesthetised during the whole of this process (including fin clipping) using phenoxyethanol which also acts as a mild disinfectant. The fish is placed in the QCD which checks for the presence of a tag. If no tag is present the injector emits a warning sound and activates a warning light. At the same time the fish is directed by a water jet in the QCD to the reject exit from where it can be retrieved for retagging. After the tagging has been completed the tag retention rate of the sample must be determined to ensure that the tag placement depth is correct and the tag is not liable to be shed. Each fish is passed in front of a field sample detector which indicates whether a tag is present (Fig. 3). The length measurement of those fish that fail is recorded and examined to determine whether a relationship emerges with

Fig. 1 **BINARY CODED WIRE MICRO TAG**

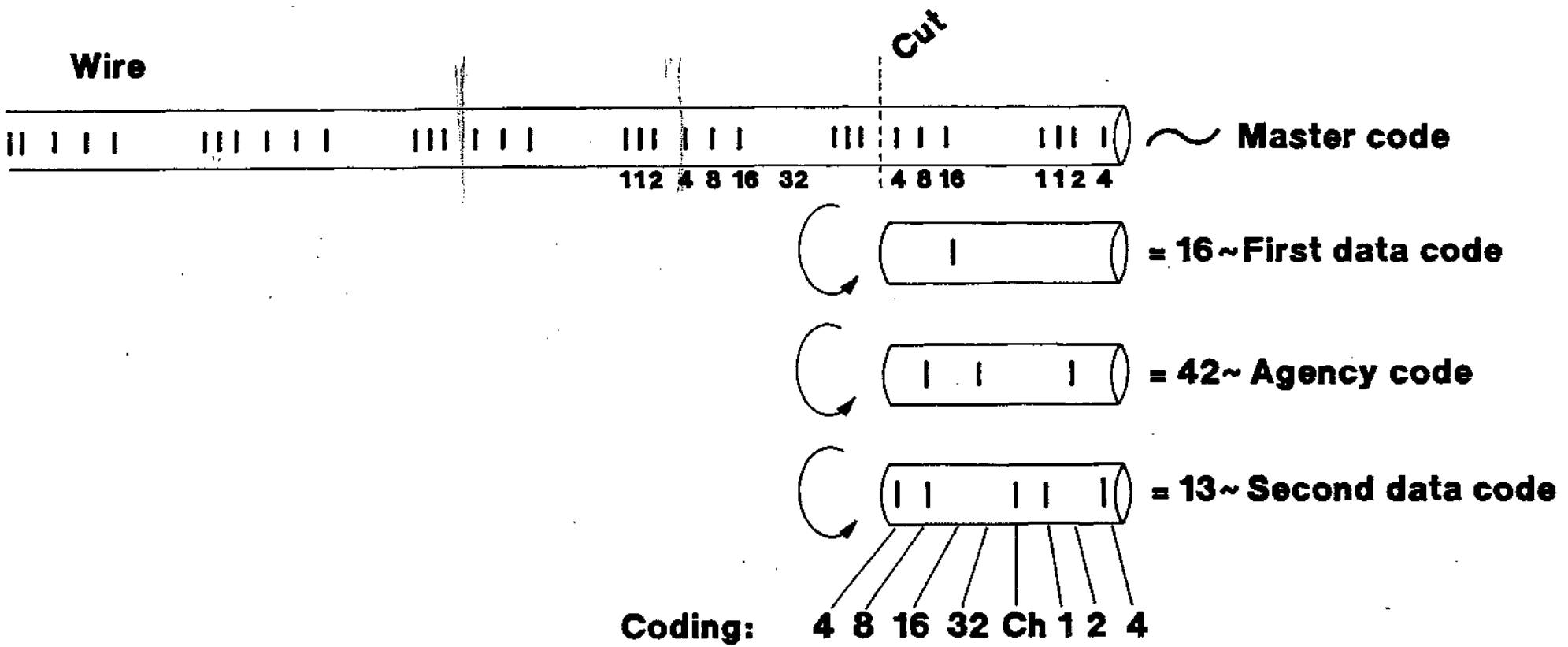


Fig. 2 Relationship between number of tags recovered and the confidence limits on the estimate of total tag recaptures

(From Russell et al., 1992)

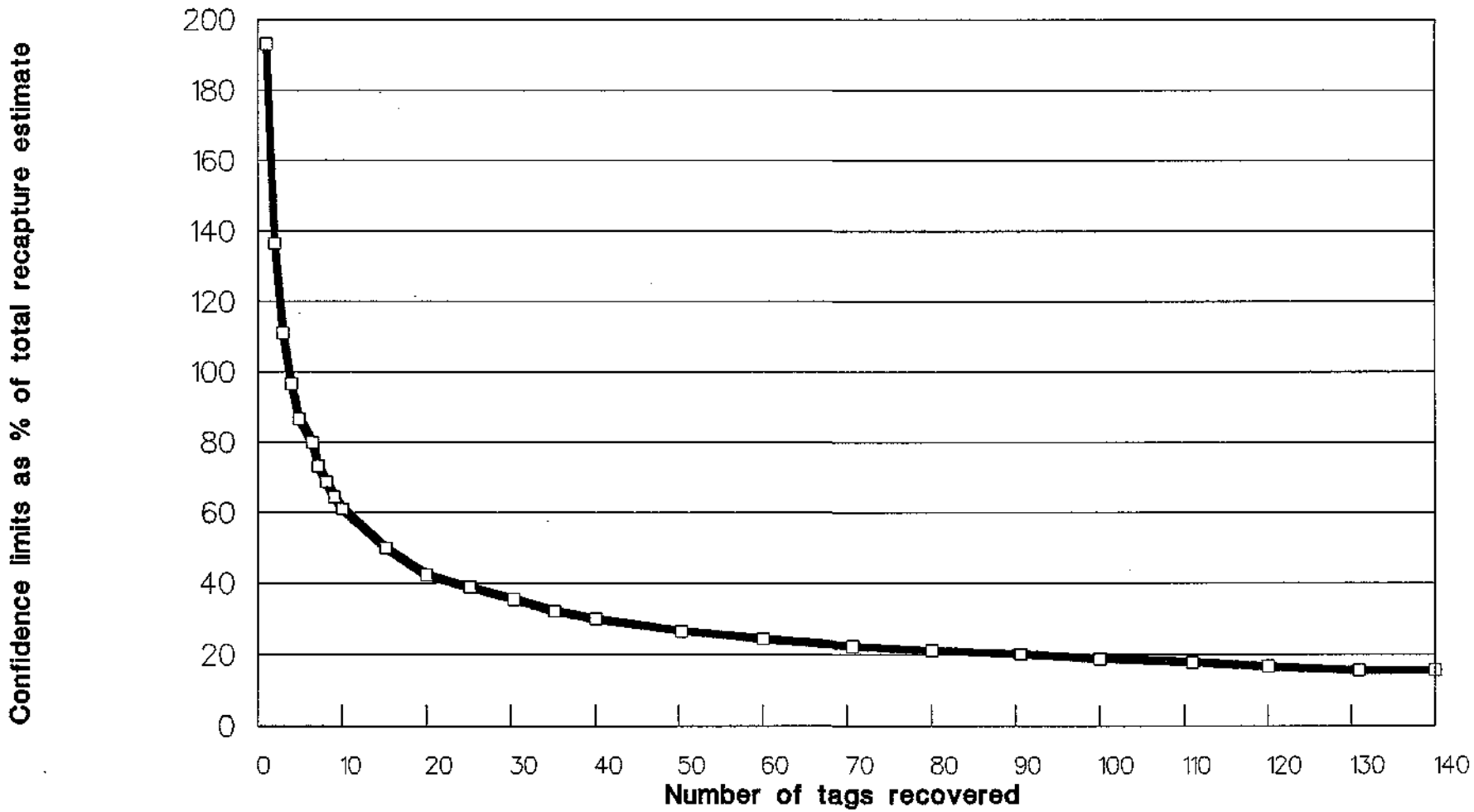
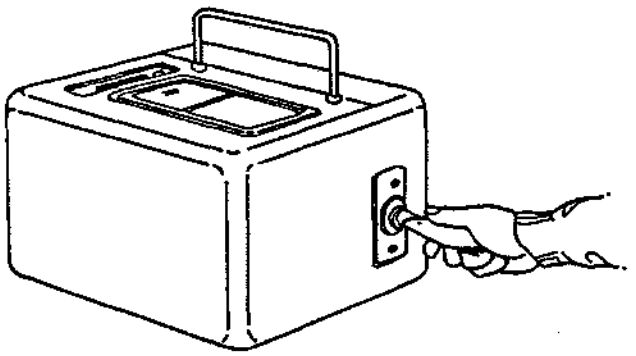
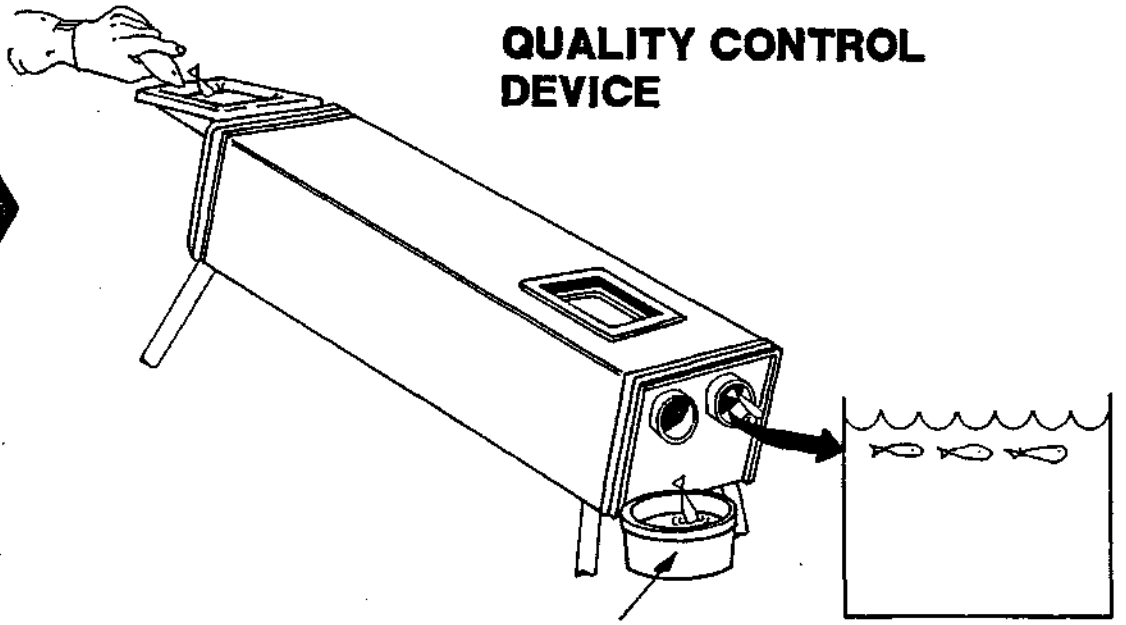


Fig. 3 **MICROTAGGING SYSTEM – OVERVIEW**

TAG INJECTOR

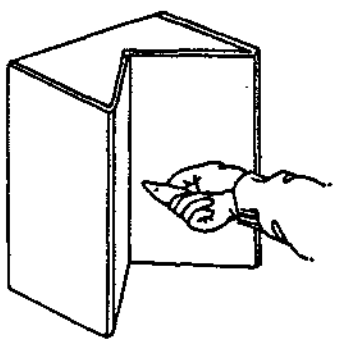


QUALITY CONTROL DEVICE



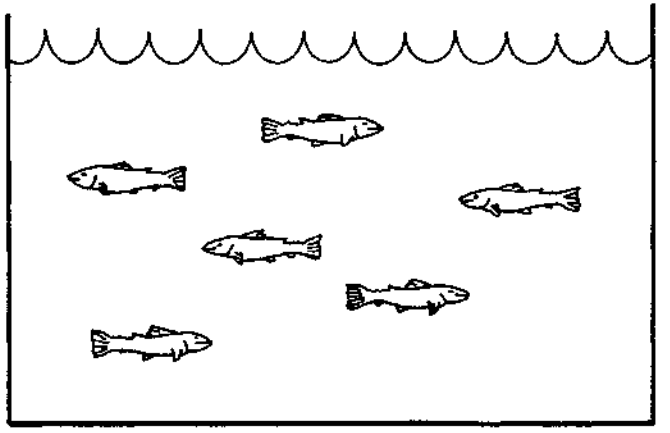
Rejects

FIELD SAMPLING DETECTOR



For tag retention tests

HATCHERY HOLDING TANK



STOCKING

Typical tag placement area for salmonids

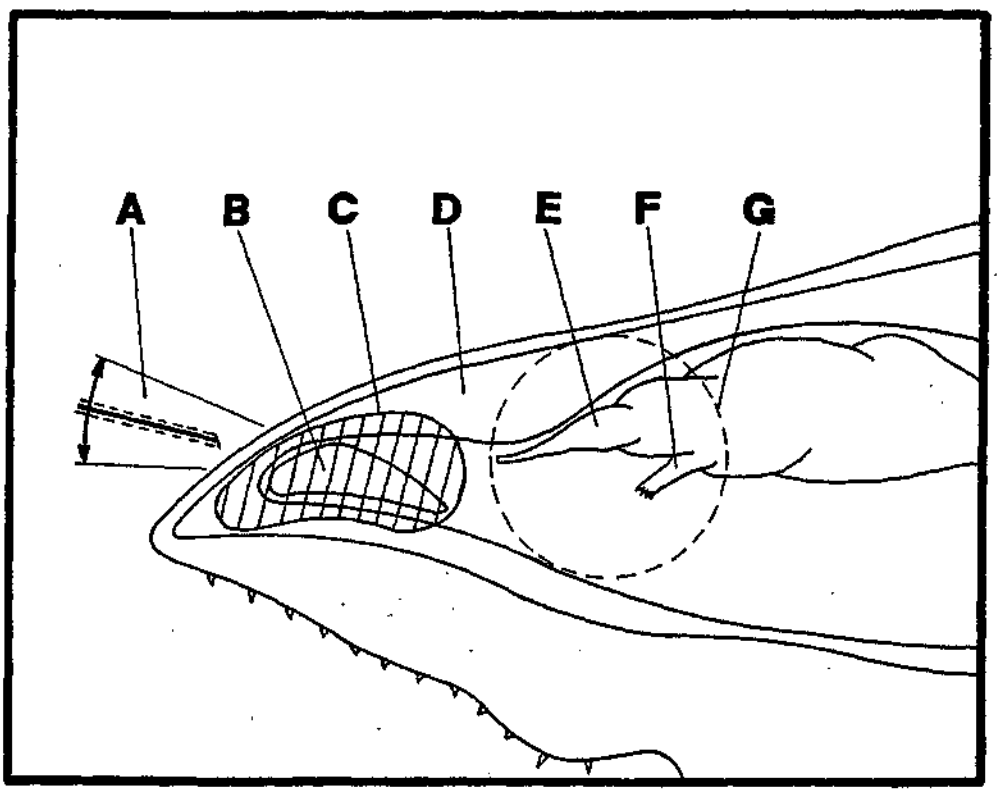


Fig. 4

A – Usual range of tagging needle angles.
B – Muscle, adipose and fibrous tissue.
C – Tag target area.
D – Cartilage.
E – Olfactory lobe and nerve.
F – Optic Nerve.
G – Position of eye.

regard to tag loss. If the tag retention rate is acceptable then the whole batch can be processed, otherwise adjustments are required (usually the needle penetration depth) and the tag retention test repeated until an acceptable tag retention rate is obtained. A tag retention test and length frequency measurements must also be determined prior to stocking.

It has been reported that on occasion, adipose fin clipped fish have failed to elicit a response from the tag detector due to demagnetisation of the tag (Bill Riley pers. comm.). This can be rectified by exposing the fishes head to a magnetic field (remagnetising the tag) and retesting with the field sample detector. However, such occurrences are rare.

A tag that has been extracted from an adult salmonid can be read with the aid of a microscope (20-30 x magnification) and tag holding pencil and jig.

3. Results

The number of juvenile salmonids tagged from 1987 to March 1994 are shown in Appendices 1-5.

Adipose fin clipped salmon recapture data are summarised in Table 1 and shown in detail in Appendix 6. To date there have been no recaptures of microtagged sea trout. The current data includes all returns from home-water and high-seas fisheries recorded since the tagging programme began in 1987. The majority of recaptures have been located in inland waters. The data set is incomplete at present and further returns are expected from the 1991 and 1992 stockings. Where age data are available it shows that the majority of fish caught in home-water fisheries are grilse (1 SW). The returns from the Caldew salmon released in September 1991 (tag code 17/42/52) show that all 30 (n=38) of those for which age data are available were found to be grilse which had spent 1 year in fresh water. The 17/42/20 batch of Caldew salmon were stocked in September 1990. Age data were obtained for 9 (n=12) of these and all were found to be grilse which had spent 2 years in freshwater. The separation point between grilse and multi-sea-winter fish has been estimated to be at a weight of about 9lbs (Fig. 5). Using this information combined with the known release and recapture dates, inferred ages have been attributed to fish for which scales were not submitted for age determination. Nearly all of these fish were identified as grilse. The inferred ages are presented in parenthesis in Appendix 6.

The geographical distribution of the recaptures is presented in Fig. 6 for home-water fisheries and Fig. 7 for the high-seas and Ireland. 98.6% (n=71) of the microtagged Caldew salmon caught in home waters since 1987 were those returning to their natal river. One Caldew fish was caught in the River Lune in 1993. Of the 71 fin clipped Caldew fish caught between July 1993 and January 1994 12 did not possess a tag (17%) while tags from two fish were lost during the extraction process.

Table 1. Salmon Microtag Recoveries 1988/94

River of Origin	Tag Code	Date Released	Inland waters	Coastal	Ireland	Faroes	Greenland
Caldew	16/42/52	Mar-87	1		1	1	
Caldew	17/42/02	Oct-87	4				
Caldew	21/42/49	Sep-89	12		2		
Caldew	17/42/19	Sep-90	7		2		
Caldew	17/42/20	Sep-90	12				
Caldew	17/42/52	Sep-91	35	2	1		
Ribble	21/42/50	Sep-89	5		2		
Ribble	22/42/49	Sep-90	4			1	
Ribble	17/42/57	Oct-91	2				
Ribble	17/42/56	Mar-92	3		2		
Hodder	16/42/53	May-87	2				1
Hodder	19/42/44	Oct-88	3		4		
Hodder	21/42/57	Sep-89			1		
Hodder	17/42/54	Oct-91	4				
Hodder	17/42/55	Oct-91	1		1		
Lune	21/42/52	Sep-89	1				
Lune	17/42/21	Sep-90	5		2		
Lune	17/42/53	Oct-91	2				
Lune	17/42/58	Mar-92	2				

Inland Waters - refers to numbers caught irrespective of river of capture.

Fig. 5 Weight Frequency Distribution Of Salmon

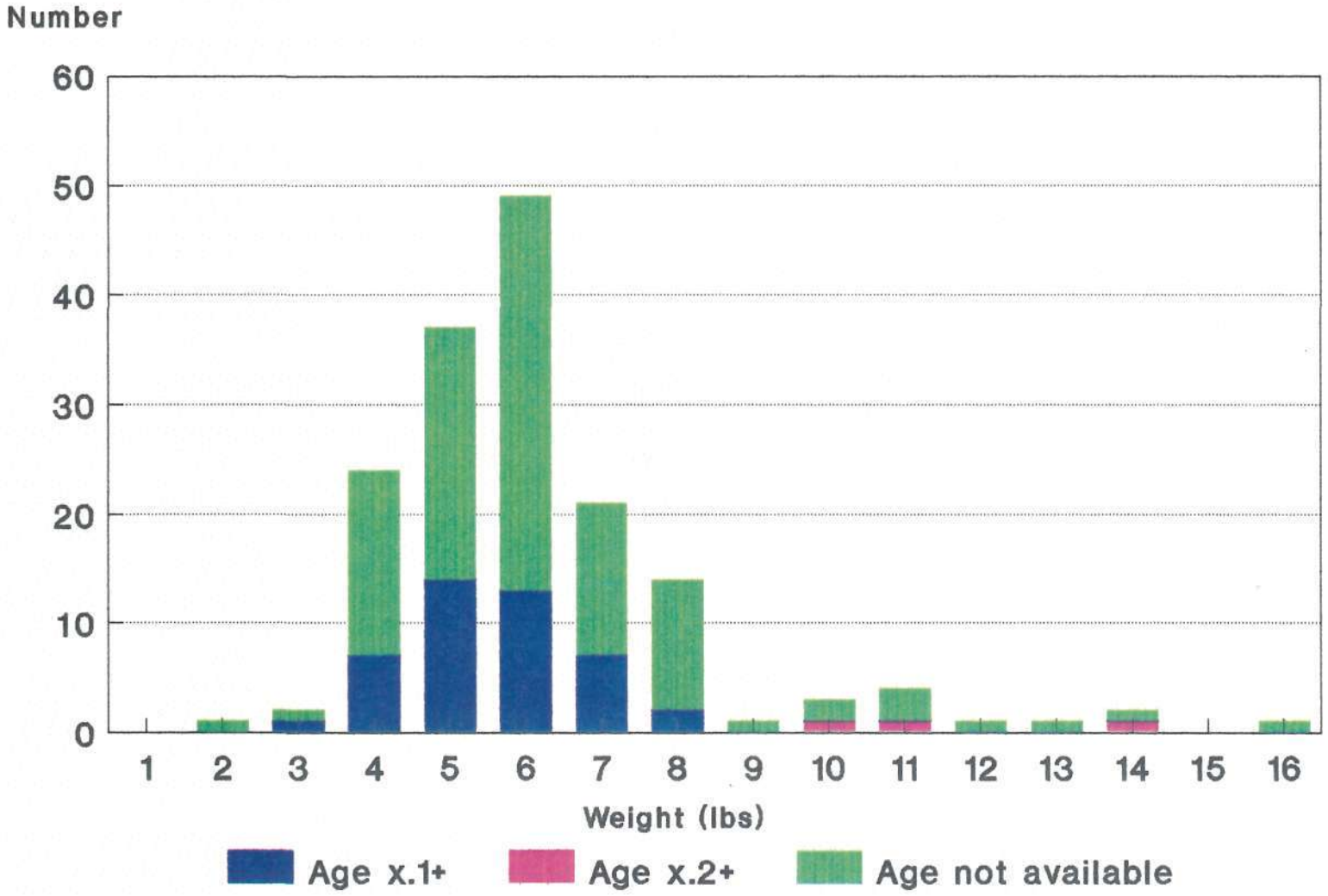


Fig. 6

SALMON MICROTAG RECOVERIES, 1988-93
HOME WATERS

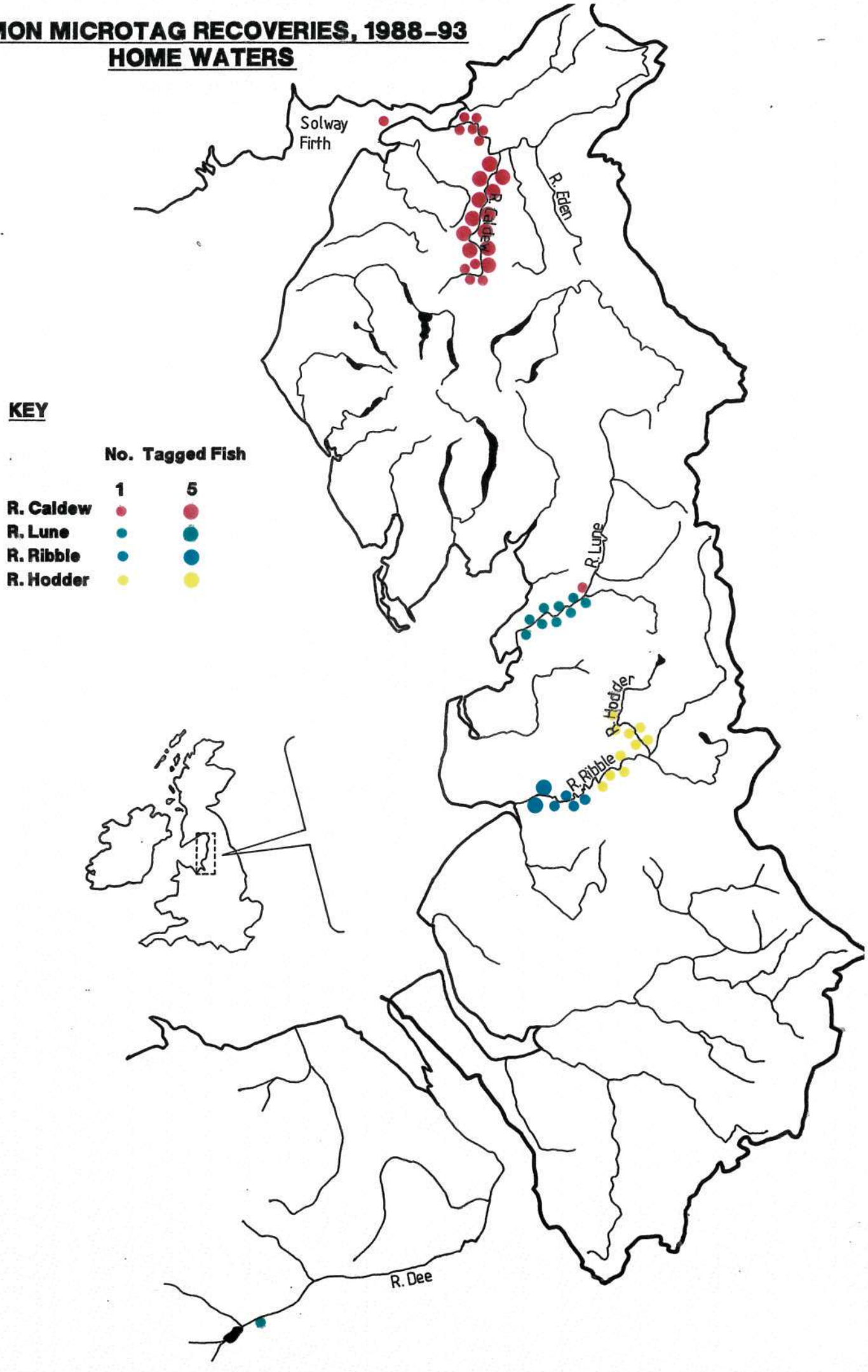
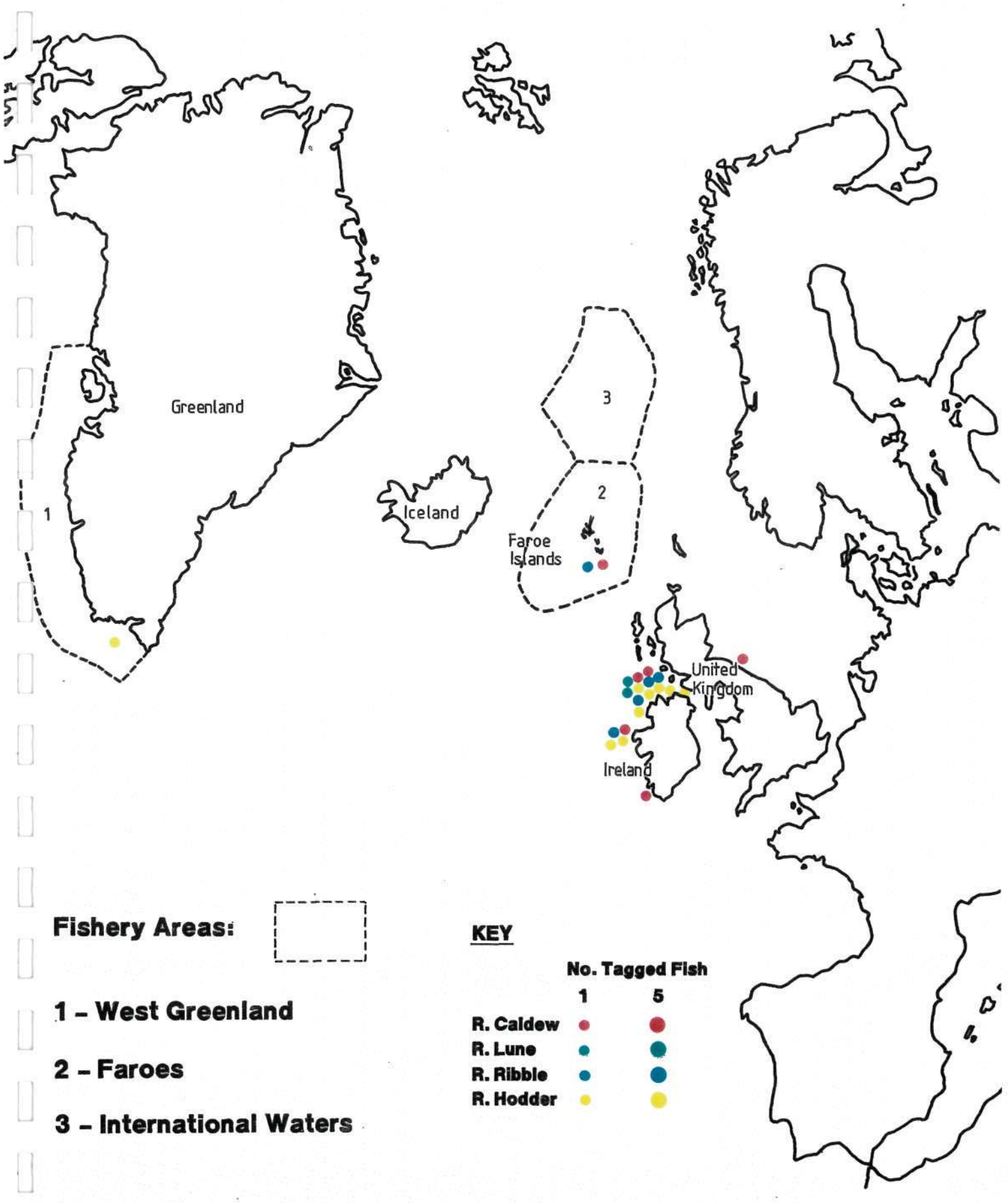


Fig. 7 **SALMON MICROTAG RECOVERIES, 1988-93**
HIGH SEAS AND IRELAND



10 microtagged fish of Lune origin have been caught in home waters since 1988, 9 of these were captured in the Lune itself while one was recorded in the Welsh Dee. 2 microtagged fish were captured by the Irish fishery.

19 microtagged Ribble salmon have been captured in home and distant fisheries since 1989. 14 of these have been caught in the Ribble. The Hodder is a tributary of the Ribble and as such it becomes difficult to assess the degree of stream specificity exhibited by returning migrants which can be intercepted in the Ribble. A total of 17 microtagged Hodder salmon have been recovered in home and distant fisheries since 1987, 6 in the Hodder and 4 in the Ribble. Of the 18 adipose fin clipped salmon caught in the Ribble/Hodder system in 1993, 6 did not possess a tag, an unusually high proportion.

767 fish were caught in the Caldew trap from July 1993 to January 1994, 7.7% of these were fin clipped, 6.3% possessing a tag. The composition of monthly catch data during this period is shown in Fig. 8. In general, the pattern for fin clipped returnees follows that for wild fish.

The proportion of adults recaptured in relation to the numbers stocked as parr varied from 0.01% to 0.40% (Table 2). The percentages of fish recaptured in the Lune, Ribble and Hodder are relatively the same as that of the Caldew pre-1989. However, post-1989 the returns in the Caldew have increased and this coincides with the introduction of the salmonid trap. The duration of the trapping period has varied over the years as shown in Table 3. The higher return rate obtained in 1993/94 is due in part to the more intensive screening period (10% of the run having been caught in September 1993, Fig. 8) and operational modifications.

Table 3 Caldew trap operating season 1988-94

November	1988	-	December 1988
October	1989	-	January 1990
November	1990	-	December 1990
October	1991	-	January 1992
October	1992	-	January 1993
July	1993	-	February 1994

The majority of microtagged fish referred to in this study have been released in the autumn (Table 2). There have been 4 spring batches: (1) in the Caldew, 1987 (16/42/52); (2) in the Hodder, 1987 (16/42/53); (3) in the Ribble, 1992 (17/42/56); and (4) in the Lune, 1992 (17/42/58). Return rates have ranged from 0.02% to 0.05% and are comparable with fish released in the autumn (0.01% to 0.40%).

Fig. 8 Caldew Trap Salmon Data For 1993/94

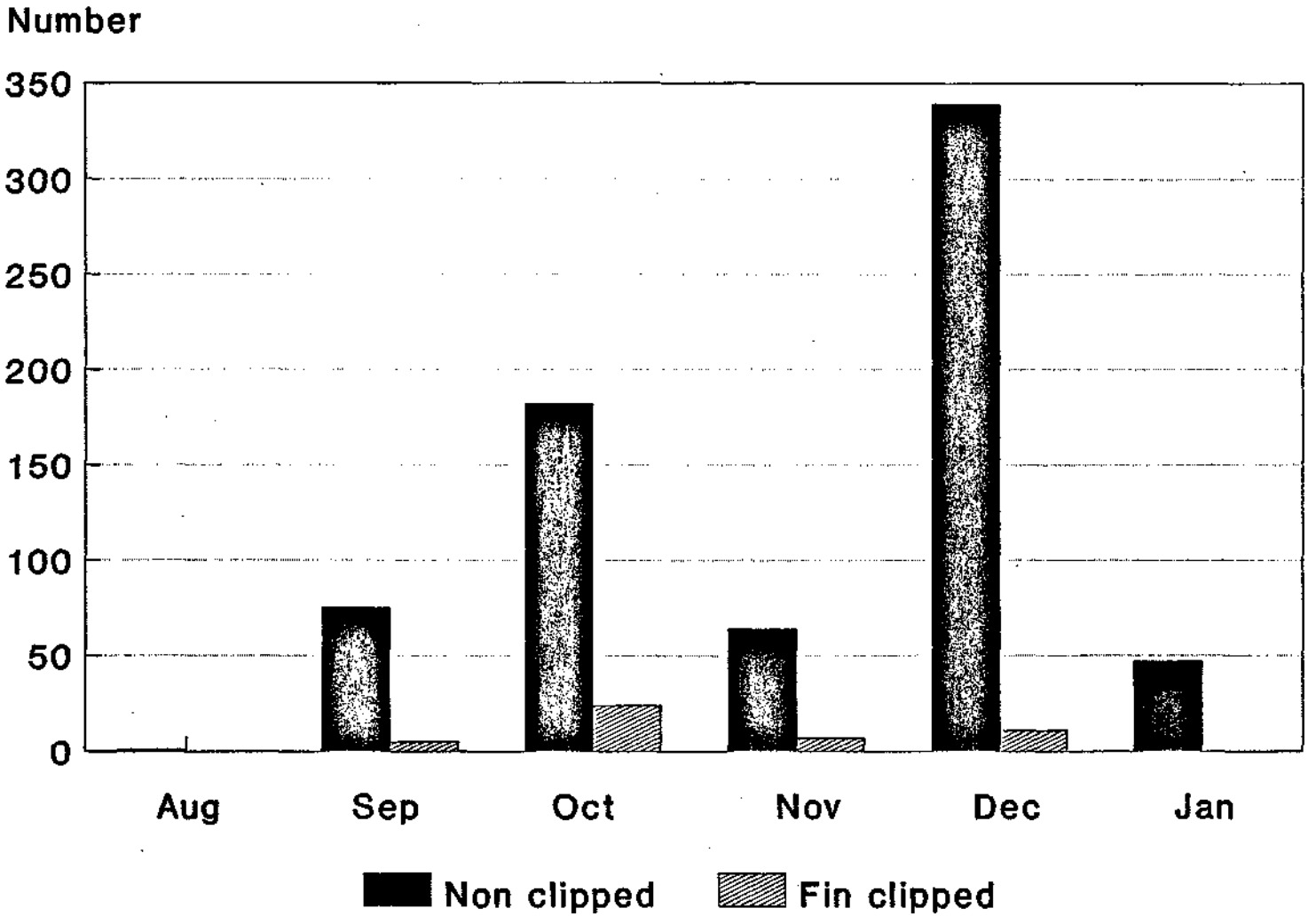


Table 2 Adult Salmon Returns (Total)

River Of Origin	Date Released	Tag Code	Number Tagged	Tagged Returnees	% Return	Fin Clipped Returnees	Total Returnees	Total % Return
Caldew	Mar 1987	16/42/52	9191	3	0.03			
Caldew	Oct 1987	17/42/02	10753	4	0.04			
Caldew	Sep 1989	21/42/49	10761	14	0.13			
Caldew	Sep 1990	17/42/19	10202	9	0.09			
Caldew	Sep 1990	17/42/20	10147	12	0.12			
Caldew	Sep 1991	17/42/52	9393	38	0.40			
		Caldew	60447	80	0.13	14	94	0.16
Ribble	Sep 1989	21/42/50	10485	7	0.07			
Ribble	Sep 1990	22/42/49	10686	5	0.05			
Ribble	Oct 1991	17/42/57	9326	2	0.02			
Ribble	Mar 1992	17/42/56	9570	5	0.05			
		Ribble	40067	19	0.05	4	23	0.06
Hodder	May 1987	16/42/53	6957	3	0.04			
Hodder	Oct 1988	19/42/44	11235	7	0.06			
Hodder	Sep 1989	21/42/47	10735	1	0.01			
Hodder	Oct 1991	17/42/54	9319	4	0.04			
Hodder	Oct 1991	17/42/55	9004	2	0.02			
		Hodder	47250	17	0.04	2	19	0.04
	Ribble and Hodder		87317	36	0.04	6	42	0.05
Lune	Sep 1989	21/42/52	10743	1	0.01			
Lune	Sep 1990	17/42/21	10573	7	0.07			
Lune	Oct 1991	17/42/53	9817	2	0.02			
Lune	Mar 1992	17/42/58	9781	2	0.02			
		Lune	40914	12	0.03	0	12	0.03

4. Discussion

The Caldew trap can be operated continually during the whole migratory period and as such will intercept all the fish entering the Caldew system. Returns from the Lune, Ribble and Hodder are dependent on the cooperation of anglers and commercial netsmen. It is evident at this initial stage of the analysis from comparisons with the returns from the Caldew with those from the Lune, Ribble, and Hodder, that the higher degree of screening in the Caldew is responsible for the greater recovery rates observed since 1989. These findings are comparable to estimated tag recovery rates for the River Tees of 0.05% and 3.4% (Russell, 1994).

In theory, delaying the time of release until the spring would be expected to give better adult returns as the parr would have been subjected to a lower mortality rate post stocking and prior to smoltification than fish stocked in the autumn. However, any evaluation of the effect of time of release on return rates is limited because of the small number of recaptures. There is a need to reevaluate the findings once the returns from the present stockings can be assessed, especially those from the Caldew where the rate of screening is much higher when compared with other rivers. The return rates of 0.02 - 0.05% are on the low side when compared with spring released parr in the Tees of 0.05% and 3.4% (Russell, 1994) though the degree of screening is likely to be higher than in the present study.

In order to compare tag recovery rates the number of tags must be scaled up to the whole catch for that fishery by means of raising factors. These are calculated by dividing the whole catch by the number of fish scanned. Scanning of catches in the high seas fisheries (West Greenland and Faroes) and in large home water net fisheries (Ireland and North East England) has proved relatively straight forward (Russell and Potter, 1990). For many home water fisheries it is often not possible to derive raising factors with any degree of precision because it is difficult to establish what proportion of the catch has been effectively scanned. Since the Caldew trap intercepts all the fish entering the Caldew then the raising factor will be 1 assuming the trap is operated continuously during the migratory period. In the case of the Ribble and the Lune raising factors can be calculated from data obtainable from the resistivity fish counter at Waddow and Forge Weir respectively to give total 'catch', and by operating the traps to screen for microtagged fish. Sampling the net and rod fisheries will further improve the screening process. In addition, anglers are being asked to identify on fish scale packets whether the fish has been fin clipped or not.

With regard to the extent to which microtagging induces mortalities in juvenile fish, Potter and Browne (1985) and Russell (1994) refer to hatchery microtagging experiments in England and Ireland where fish were held for several weeks after tagging. There was little or no mortalities associated with the tagging. In a North American study (Anon.) a 2%

mortality rate was observed after tagging 68,297 hatchery reared pink salmon from which it was concluded that microtagging appeared to have no significant effect on mortality.

A problem that is intrinsic in studies attempting to assess the effect of tagging on adult returns is how to identify the control fish i.e unmarked fish. Hansen (1988) found that adipose fin clipping of migratory wild Atlantic salmon smolts under MS 222 anaesthesia reduced the survival rate of returning adults compared to unmarked fish. However, the author acknowledges the fact that the number of unmarked returnees may have been increased by the presence of strays and by the contribution made by smolts which were below the smolt trap and therefore could not be taken account of when enumerating unclipped smolts in relation to clipped smolts prior to release. Hansen concluded that smolts are sensitive to handling and anaesthesia and this was probably the main reason for the increased mortality of clipped fish compared to unmarked fish. In contrast, Vincent-Lang (1993) found that fish that had received adipose fin clips and microtags did not exhibit significantly higher mortality than unmarked fish.

It has been suggested that the Earth's magnetic field provides some directional information to guide fish during the marine phase of the homing process (Legget, 1977; Quinn, 1981; Taylor, 1987). Whether the magnetised microtag has any effect on the homing capabilities of salmonids is not known for certain, however, studies comparing microtagged fish returns with returns from other non magnetic marking techniques as well as unmarked fish have demonstrated no significant deleterious effects on return rates (Bergman et al., 1968; Isaksson and Bergman, 1977; Vincent-Lang, 1993).

5. Conclusion

Compared to the results from the River Caldew, fewer adipose fin clipped fish were caught in the Ribble, Hodder and Lune in 1993. This is undoubtedly related to the degree of screening involved in these systems. The only way to ensure that meaningful data is obtained from the Lune, Ribble and Hodder is to increase the screening process for these fisheries and/or increase the number of microtagged fish stocked so that returns in excess of 25 fish can be achieved (giving confidence limits of +/- 40%).

6. Recommendations

(1) To use the fish counter and associated trapping facilities at Forge Weir and Waddow to get more accurate estimates of return rates by determining raising factors for the Lune and Ribble fisheries. Consideration should be given to increasing the number of microtagged fish stocked.

(2) Coordinate tagging and release of batches of salmon parr in spring and autumn to determine the most effective release strategy for maximising return rates.

(3) To investigate the feasibility of tagging batches of wild salmon smolts to compare the return rates with hatchery reared fish, and through run reconstruction modelling (Potter and Dunkley, 1993) determine exploitation in the distant water fisheries.

(4) A smolt tapping facility may be useful on the River Caldew to screen for microtagged fish and thus provide an indication of mortality rates for juveniles. This in turn would lead to a better understanding of adult return rates, complementing recommendations (2) and (3).

7. Acknowledgments

The authors would like to thank all those MAFF and NRA personnel who were involved in the microtagging of juvenile salmonids, and those involved in providing age data, the retrieval of tags and the decoding of tags from adult returnees. In this respect the data from the Caldew trap, the high seas, and Ireland is much appreciated.

MAFF, NRA Welsh region and NRA South Western region kindly loaned microtagging equipment.

Lex Pearce and Iain Crabb persevered with numerous technical problems associated with the tag injector during the 1993 season.

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Appendix 1. Salmon Microtagging Data, 1987-1990

River of Origin	Tag code	Number Tagged	Age	Date Released
Caldew	16/42/52	9191	1+	Mar-87
Hodder	16/42/53	6957	1+	May-87
Caldew	17/42/02	10753	0+	Oct-87
Hodder	19/42/44	11235	0+	Oct-88
Lune	19/42/47	10910	0+	Oct-88
Hodder	21/42/47	10735	0+	Sep-89
Caldew	21/42/49	10761	0+	Sep-89
Ribble	21/42/50	10485	0+	Sep-89
Lune	21/42/52	10743	0+	Sep-89
Caldew	17/42/19	10202	0+	Sep-90
Caldew	17/42/20	10147	0+	Sep-90
Lune	17/42/21	10573	0+	Sep-90
Ribble	22/42/49	10686	0+	Sep-90
Hodder	22/42/50	10440	0+	Sep-90

Appendix 2. Salmon and Sea Trout Microtagging Data, 1991

	Sea Trout		Salmon							
	R. Lune		R. Lune	R. Ribble		R. Hodder		Caldew	R. Lune	
Tag Code	17/40	17/39	17/53	17/56	17/57	17/54	17/55	17/52	17/58	
Number Tagged	11060	11245	9817	9570	9326	9319	9004	9393	9781	
Length Range (mm)	70-92	65-82	88-127	69-165	50-127	64-129	50-80	66-126	80-156	
Mean Length (mm)	79	73	106	104	83	98	68	104	113	
Batch Retention	99.5%	100%	96.8%	96.5%	95.8%	99.06%	95.57%	95.3%	96.7%	
	n=11116	n=11245	n=10142	n=9913	n=9735	n=9407	n=9421	n=9857	n=10115	
Release Date	Aug-91	Aug-91	Oct-91	Mar-92	Oct-91	Oct-91	Oct-91	Sep-91	Mar-92	

Appendix 3. Salmon Microtagging Data, 1992

	River Ribble				River Hodder			Caldew
Tag Code	18/54	18/55	18/56	18/57	18/58	18/59	18/60	18/53
Number Tagged	4466	10356	2611	1422	8047	9915	1317	4332
Length Range (mm)	57-104	57-104	58-89	63-95	63-97	61-99	50-80	62-133
Mean Length (mm)	73	78	72	75	77	75	68	100
Batch Retention	94.7%				94.5%			92.2%
	n=4716	n=10936	n=2757	n=1502	n=8515	n=10492	n=1394	n=4697
Release Date	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	Sep-92

Appendix 4. Salmon and Sea Trout Microtagging Data, 1993

	Sea Trout					Salmon			
	Lune		Hodder			Caldew	Lune	Lune	Caldew
Tag Code	18/62	18/61	19/29	19/30	19/27	19/24	19/23	19/54	19/57
Number Tagged	6809	4485	9411	9732	7971	9027	9027	7772	10800
Length Range (mm)	54-92	54-92	70-111	70-111	70-111	55-110	53-116	55-129	55-121
Mean Length (mm)	75	75	84	84	84	86	85	96	94
Batch Retention	83%		83%			97%	86%	100%	98%
	n=8204	n=5403	n=11338	n=11725	n=9604	n=9306	n=10496	n=7772	n=11020
Release Date	Aug-93	Aug-93	Oct-93	Oct-93	Oct-93	Sep-93	Sep-93	Mar-94	Mar-94

Appendix 5. Salmon Microtagging Data, March 1994

	Hodder	Ribble
Tag Code	19/58	19/58
Number Tagged	5124	4958
Length Range (mm)	110-164	101-176
Mean Length (mm)	137	137
Batch Retention	94.3% n=5434	94.6% n=4958
Release Date	Mar-94	Mar-94

Appendix 6. Salmon Microtag Returns 1988-94 (Inferred age in parenthesis)

River of Origin	Number Tagged	Date Released	Place of Capture	Date Captured	Ref	Tag Code	Weight (lbs)	Length (cm)	Age
Caldew	9191	Mar-87	Ireland	12/07/88		16/42/52	6.0	63	(1+.1+)
Caldew		Mar-87	Eden	27/08/88		16/42/52	4.5	56	(1+.1+)
Caldew		Mar-87	Faroes	30/11/88		16/42/52	7.0	67	(1+.1+)
Caldew	10753	Oct-87	Caldew	08/11/89		17/42/02			1+.1+
Caldew		Oct-87	Caldew	08/01/90		17/42/02			1+.1+
Caldew		Oct-87	Caldew	10/11/91		17/42/02	11.4	94	(2+.2+)
Caldew		Oct-87	Caldew	25/11/91		17/42/02	10.0	86	(2+.2+)
Caldew	10761	Sep-89	Ireland	28/06/91		21/42/49			(1+.1+)
Caldew		Sep-89	Ireland	15/07/91		21/42/49	6.0	63	(1+.1+)
Caldew		Sep-89	Caldew	07/11/91		21/42/49			(1+.1+)
Caldew		Sep-89	Caldew	08/11/91		21/42/49	4.4	63	(1+.1+)
Caldew		Sep-89	Caldew	03/12/91		21/42/49		57	(1+.1+)
Caldew		Sep-89	Caldew	03/12/91		21/42/49	4.4	72	(1+.1+)
Caldew		Sep-89	Caldew	06/12/91		21/42/49	4.0	58	(1+.1+)
Caldew		Sep-89	Caldew	06/12/91		21/42/49	6.0	64	(1+.1+)
Caldew		Sep-89	Caldew	06/12/91		21/42/49	6.2	65	(1+.1+)
Caldew		Sep-89	Caldew	06/12/91		21/42/49	5.7	68	(1+.1+)
Caldew		Sep-89	Caldew	06/12/91		21/42/49	7.5	71	(1+.1+)
Caldew		Sep-89	Caldew	08/12/92	0104	21/42/49	5.3	60	(2+.1+)
Caldew		Sep-89	Caldew	17/12/92	0105	21/42/49	5.7	59	(2+.1+)
Caldew		Sep-89	Caldew	03/12/93	0209	21/42/49	10.0	80	2.2+
Caldew	10202	Sep-90	Caldew	06/11/92	0103	17/42/19	5.7	70	(1+.1+)
Caldew		Sep-90	Ireland	06/07/93		17/42/19	7.0	66	(2+.1+)
Caldew		Sep-90	Ireland	13/07/93		17/42/19	5.7	64	(2+.1+)
Caldew		Sep-90	Caldew	22/09/93	0112	17/42/19	4.25	60	2+.1+
Caldew		Sep-90	Caldew	23/09/93	0113	17/42/19	14.0	85	1+.2+
Caldew		Sep-90	Caldew	07/10/93	0129	17/42/19	4.4	59	2.1+

Appendix 6. Salmon Microtag Returns

River of Origin	Number Tagged	Date Released	Place of Capture	Date Captured	Ref	Tag Code	Weight (lbs)	Length (cm)	Age
Caldew	10202	Sep-90	Caldew	07/10/93	0124	17/42/19	4.8	61	2+.1+
Caldew		Sep-90	Caldew	08/12/93	0211	17/42/19	5.5	65	2.1+
Caldew		Sep-90	Caldew	20/12/93	0213	17/42/19	7.7	74	(2+.1+)
Caldew	10147	Sep-90	Caldew	28/07/93	0106	17/42/20			(2+.1+)
Caldew		Sep-90	Eden	10/09/93	0101	17/42/20	8.0	43	(2+.1+)
Caldew		Sep-90	Caldew	06/10/93	0119	17/42/20	4.0	56	2+.1+
Caldew		Sep-90	Caldew	06/10/93	0123	17/42/20	5.5	70	2.1+
Caldew		Sep-90	Caldew	07/10/93	0128	17/42/20	5.3	60	2.1+
Caldew		Sep-90	Caldew	09/10/93	0142	17/42/20	2.5	47	2+.1+
Caldew		Sep-90	Caldew	11/11/93	0148	17/42/20	4.8	63	2+.1+
Caldew		Sep-90	Caldew	16/11/93	0202	17/42/20	5.1	59	2.1+
Caldew		Sep-90	Caldew	02/12/93	0205	17/42/20	5.1	62	2+.1+
Caldew		Sep-90	Caldew	02/12/93	0206	17/42/20	7.3	72	2.1+
Caldew		Sep-90	Caldew	03/12/93	0210	17/42/20	6.8	71	2.1+
Caldew		Sep-90	Caldew	20/12/93	0214	17/42/20	7.9	71	(2+.1+)
Caldew	9393	Sep-91	Ireland	12/07/93		17/42/52	4.4	55	(1+.1+)
Caldew		Sep-91	Eden	30/07/93		17/42/52	5.5	67	(1+.1+)
Caldew		Sep-91	N. Sea	24/08/93		17/42/52			1+.1+
Caldew		Sep-91	Lune	27/08/93		17/42/52	5.5		1.1+
Caldew		Sep-91	Solway	30/08/93	0005	17/42/52	6.0	46	(1+.1+)
Caldew		Sep-91	Caldew	17/09/93	0109	17/42/52	7.0	63	1+.1+

Appendix 6. Salmon Microtag Returns

River of Origin	Number Tagged	Date Released	Place of Capture	Date Captured	Ref	Tag Code	Weight (lbs)	Length (cm)	Age
Caldew	9393	Sep-91	Eden	19/09/93	0118	17/42/52			(1+.1+)
Caldew		Sep-91	Caldew	22/09/93	0111	17/42/52	7.0	65	1+.1+
Caldew		Sep-91	Caldew	22/09/93	0110	17/42/52	4.3	58	1+.1+
Caldew		Sep-91	Eden	26/09/93	0007	17/42/52	6.1	76	(1+.1+)
Caldew		Sep-91	Eden	29/09/93	0116	17/42/52			(1+.1+)
Caldew		Sep-91	Caldew	06/10/93	0120	17/42/52	4.5	60	1+.1+
Caldew		Sep-91	Caldew	06/10/93	0121	17/42/52	4.75	60	1+.1+
Caldew		Sep-91	Caldew	06/10/93	0122	17/42/52	7.0	65	1.1+
Caldew		Sep-91	Caldew	07/10/93	0138	17/42/52	6.2	64	1+.1+
Caldew		Sep-91	Caldew	07/10/93	0137	17/42/52	4.6	60	1+.1+
Caldew		Sep-91	Caldew	07/10/93	0135	17/42/52	4.4	58	1+.1+
Caldew		Sep-91	Caldew	07/10/93	0134	17/42/52	5.1	61	1+.1+
Caldew		Sep-91	Caldew	07/10/93	0130	17/42/52	4.4	58	1+.1
Caldew		Sep-91	Caldew	07/10/93	0131	17/42/52	5.5	64	1+.1+
Caldew		Sep-91	Caldew	07/10/93	0126	17/42/52	5.7	63	1.1+
Caldew		Sep-91	Caldew	07/10/93	0125	17/42/52	4.6	58	1+.1
Caldew		Sep-91	Caldew	09/10/93	0139	17/42/52	5.5	65	1+.1+
Caldew		Sep-91	Caldew	09/10/93	0140	17/42/52	7.0	72	1+.1+
Caldew		Sep-91	Caldew	09/10/93	0141	17/42/52	5.5	68	1.1+
Caldew		Sep-91	Caldew	10/10/93	0143	17/42/52	4.0	62	1+.1+
Caldew		Sep-91	Caldew	10/10/93	0144	17/42/52	4.5	62	1+.1+
Caldew		Sep-91	Caldew	10/10/93	0145	17/42/52	5.0	65	1+.1+
Caldew		Sep-91	Caldew	11/10/93	0146	17/42/52	5.9	67	1+.1+
Caldew		Sep-91	Caldew	11/11/93	0147	17/42/52	5.5	66	1+.1+
Caldew		Sep-91	Caldew	11/11/93	0149	17/42/52	4.6	60	1+.1+
Caldew		Sep-91	Caldew	14/11/93	0150	17/42/52	5.7	67	1+.1+
Caldew		Sep-91	Caldew	16/11/93	0201	17/42/52	7.7	69	1+.1+
Caldew		Sep-91	Caldew	01/12/93	0203	17/42/52	7.9	74	1+.1+

Appendix 6. Salmon Microtag Returns

River of Origin	Number Tagged	Date Released	Place of Capture	Date Captured	Ref	Tag Code	Weight (lbs)	Length (cm)	Age
Caldew		Sep-91	Caldew	02/12/93	0204	17/42/52	6.2	67	1+.1+
Caldew		Sep-91	Caldew	03/12/93	0207	17/42/52	4.2	58	(1+.1+)
Caldew		Sep-91	Caldew	03/12/93	0208	17/42/52	5.1	64	1+.1+
Caldew		Sep-91	Caldew	11/01/94	0216	17/42/52	5.7	69	(2+.1+)
	Salmon M		Caldew	17/09/93	0108	NO TAG	8.0	70	
	Salmon		Eden	19/09/93	0102	NO TAG	7.0		
	Salmon H		Caldew	24/09/93	0115	LOST TAG	4.5	62	
	Salmon M		Caldew	24/09/93	0114	NO TAG	5.5	63	
	Salmon F		Caldew	06/10/93	0127	NO TAG	3.9	54	
	Salmon F		Caldew	07/10/93	0136	NO TAG	3.7	56	
	Salmon F		Caldew	07/10/93	0133	NO TAG	6.6	65	
	Salmon F		Caldew	07/10/93	0132	NO TAG	5.5	62	
	Salmon M		Caldew	08/10/93		NO TAG	6.0	70	
	Salmon M		Caldew	11/11/93		NO TAG	7.5	73	
	Salmon M		Caldew	09/12/93		NO TAG	16.0	93	
	Salmon F		Caldew	20/12/93	0212	NO TAG	5.0	66	
	Salmon F		Caldew	10/01/94	0215	LOST TAG	4.7	62	
	Salmon F		Caldew	15/09/93	0107	NO TAG			

Appendix 6. Salmon Microtag Returns

River of Origin	Number Tagged	Date Released	Place of Capture	Date Captured	Ref	Tag Code	Weight (lbs)	Length (cm)	Age
Ribble	10485	Sep-89	Ribble	30/10/91		21/42/50	5.0		(1+.1+)
Ribble		Sep-89	Ribble	??/??/91		21/42/50	6.0	57	(1+.1+)
Ribble		Sep-89	Ribble	Late/91		21/42/50		57	(1+.1+)
Ribble		Sep-89	Ribble	Late/91		21/42/50		67	(1+.1+)
Ribble		Sep-89	Ireland	18/06/92		21/42/50	13.0	78	(1+.2+)
Ribble		Sep-89	Ireland	10/07/92		21/42/50	12.1	80	(1+.2+)
Ribble		Sep-89	Ribble	14/12/92		21/42/50	4.2	61	(2+.1+)
Ribble	10686	Sep-90	Ribble	10/10/92		22/42/49	4.3	65	(1+.1+)
Ribble		Sep-90	Ribble	??/11/92		22/42/49			(1+.1+)
Ribble		Sep-90	Faroes	15/12/92		22/42/49	4.6	60	(1+.1+)
Ribble		Sep-90	Ribble	July-93		22/42/49	7.0		(2+.1+)
Ribble		Sep-90	Ribble	93		22/42/49		61	(2+.1+)
Ribble	9326	Oct-91	Ribble	93		17/42/57		58	(1+.1+)
Ribble		Oct-91	Ribble	93		17/42/57		62	(1+.1+)
Ribble	9570	Mar-92	Ireland	02/07/93		17/42/56	4.8	55	(1+.1+)
Ribble		Mar-92	Ireland	23/07/93		17/42/56			(1+.1+)
Ribble		Mar-92	Ribble	28/08/93		17/42/56	8.0		(1+.1+)
Ribble		Mar-92	Ribble	93		17/42/56			(1+.1+)
Ribble		Mar-92	Ribble	Aug-93		17/42/56	7.0		(1+.1+)

Appendix 6. Salmon Microtag Returns

River of Origin	Number Tagged	Date Released	Place of Capture	Date Captured	Ref	Tag Code	Weight (lbs)	Length (cm)	Age
Hodder	6957	May-87	Greenland	21/08/89		16/42/53	6.0	70	(2+.1+)
Hodder		May-87	Hodder	12/12/90		16/42/53	11.0	88	(2+.2+)
Hodder		May-87	Hodder	03/01/91		16/42/53		80	
Hodder	11235	Oct-88	Ireland	06/07/91		19/42/44	6.6	63	(2+.1+)
Hodder		Oct-88	Ireland	24/07/91		19/42/44	8.0	66	(2+.1+)
Hodder		Oct-88	N.Ireland	30/07/91		19/42/44	6.0	63	(2+.1+)
Hodder		Oct-88	Hodder	09/11/91		19/42/44	6.0	65	(2+.1+)
Hodder		Oct-88	Hodder	30/12/91		19/42/44			(2+.1+)
Hodder		Oct-88	Ireland	25/06/92		19/42/44	7.5	68	(3+.1+)
Hodder		Oct-88	Ribble	Nov/92		19/42/44			(3+.1+)
Hodder	10735	Sep-89	Ireland	20/07/91		21/42/47	5.7	60	(1+.1+)
Hodder	9319	Oct-91	Ribble	09/07/93		17/42/54	6.0		(1+.1+)
Hodder		Oct-91	Ribble	23/10/93		17/42/54	4.0		(1+.1+)
Hodder		Oct-91	Ribble	93		17/42/54		38	(1+.1+)
Hodder		Oct-91	Hodder	26/11/93		17/42/54		59	(1+.1+)
Hodder	9004	Oct-91	Ireland	23/06/93		17/42/55			(1+.1+)
Hodder		Oct-91	Hodder	21/07/93		17/42/55	6.0		(1+.1+)
	Salmon F		Ribble	93		NO TAG		85	1.2
	Salmon F		Ribble	93		NO TAG		64	1.1+
	Salmon F		Ribble	93		NO TAG		67	1.1+
	Salmon F		Ribble	93		NO TAG		68	r.1+
	Salmon M		Hodder	93		NO TAG		81	1.2
	Salmon F		Hodder	93		NO TAG		58	1.1

Appendix 6. Salmon Microtag Returns

River of Origin	Number Tagged	Date Released	Place of Capture	Date Captured	Ref	Tag Code	Weight (lbs)	Length (cm)	Age
Lune	10743	Sep-89	Lune	15/10/91		21/42/52	3.7	59	(1+.1+)
Lune	10573	Sep-90	Lune	19/08/92		17/42/21	5.5		(1+.1+)
Lune		Sep-90	Lune	24/09/92		17/42/21	2.2	50	(1+.1+)
Lune		Sep-90	Ireland	29/06/93		17/42/21	8.58	70	(2+.1+)
Lune		Sep-90	Ireland	14/07/93		17/42/21	10.78	70	(1+.2+)
Lune		Sep-90	Lune	22/07/93		17/42/21	6.75		2.1+
Lune		Sep-90	Lune	02/08/93		17/42/21	11.0		1+.2+
Lune		Sep-90	Lune	13/08/93		17/42/21	5.5		2.1+
Lune	9817	Oct-91	Lune	26/07/93		17/42/53	5.0		(1+.1+)
Lune		Oct-91	Dee	04/08/93	0008	17/42/53	8.25	68	(1+.1+)
Lune	9781	Mar-92	Lune			17/42/58	5.0		(1+.1+)
Lune		Mar-92	Lune	08/10/93		17/42/58	9.0		(1+.1+)