



## Results of the stocking of Ettrick-origin juvenile Salmon reared at the Kielder hatchery into various Tweed tributaries

1. In the late 1980's, eggs were stripped from Salmon in the Upper Ettrick and reared on in the Kielder hatchery, Northumberland, for stocking into the R. Tyne. The aim of this was to introduce a Spring Salmon strain there. A proportion of the juveniles reared were also sent back to the Tweed in return for the donation of these eggs.
2. At this time, three tributaries of the Tweed, the Jed, Slitrig and Leithen had only recently been opened up to Salmon, having previously been blocked by caulds – a juveniles survey by the Freshwater Fisheries Laboratory, Pitlochry, in 1988 had shown them to have only low numbers of Salmon juveniles.
3. The Kielder-reared juveniles were therefore stocked into these previously blocked tributaries and also into the Glensax burn, which was not opened up till later (and is now a research tributary with a trap that catches all fish entering and leaving it). Reared juveniles were also stocked into the Ettrick and Tima Water, back in the zone where they had come from.
4. These fish were micro-tagged in the hatchery, so it could be seen when they returned to the river and what they returned as. The aim of taking fish from the upper Ettrick was to produce fish of a Spring stock that would return as such and could lead to the setting up of Spring stocks in the Jed, Slitrig and Leithen.
5. The data and results from these stockings are shown in the table below:

### Release details

Date	Place	Life stage			cms
1986	Ettrick	Summer Fry	1989.07.10	Irish Drift Nets (Waterford)	2.4kg
October (1)	Leithen Glensax (6335 tagged)		1990.03.19	Mertoun, by rod	64
			1990.05.01	N.E. England Drift nets ( N. Shields)	57
			1990.06.12	Ushan (Irish Drift Nets)	66
			1990.07.09	N.E. England Drift nets (Amble)	74
			1990.08.07	N.E. England Drift nets (Saltburn)	73
1989 February	Tima W & Glensax B (6,000 each site Released )	1+ Parr	1990.06.29	Malin Head (Irish Drift Nets)	57
			1990.07.03	Venture Netting Station, R. Tay	50
			1992	Estuary net (found in freezer)	na
1990 March	Jed & Slitrig (10,167 tagged)	1+ Parr	1991.07.03	N.E. England Drift Nets	60
			1991.07.11	Irish Drift Nets (Foyle)	62
			1991.07.17	N.E. England Drift Nets (Saltburn)	59
			1991.07.24	N.E. England Drift Nets (Whitby)	60
			1991.07.29	N.E. England Drift Nets (Whitby)	62
			1991.07.30	N.E. England Drift Nets (Sunderland)	67
			1991.07.30	N.E. England Drift Nets (Sunderland)	61
			1991.08.05	N.E. England Drift Nets ( N. Shields)	52
			1992.05.01	Middle Mertoun, by rod	



6. The first point of significance is the number of recaptures from the Northumbrian and Irish drift nets. At this time there was a specific programme to look for micro-tagged fish in the Northumbrian drift nets (the adipose fin was clipped off when fish were micro-tagged, so they could be recognised later) as well as a publicity programme along the Tweed. Also at this time, the Northumbrian drift net season started in March and was therefore much longer than it is at present. The result of this information was that the reduction in drift netting became a priority for the RTC.
7. The second point of significance was the age at which the fish stocked as one year old parr (in 1989 and 1990) were recaptured – most of them were taken at sea the year immediately after stocking. This means that they must have left their stocking sites within a month or two. As smolts start leaving around late March/early April, those stocked in March 1990 must have started leaving almost immediately (or, perhaps, did not stay in their stocking sites at all, but started leaving as soon as they were put into the river).
8. These fish were supposed to be of Ettrick Spring Salmon stock, which typically smolt after two winters in the river and return after two winters in the sea. These stocked fish, however, migrated as one year old smolts and were returning after just one year in the sea. Whilst 1.1 Grilse are found in the Tweed naturally, they are a later running form, not a type associated with the upper Ettrick.
9. The evidence is therefore that the effect of hatchery rearing had been to significantly alter the life history of these fish, turning them from slower growing smolts and multi-sea-winter Spring Salmon into Grilse that would have returned in August. Early Grilse are part of the Spring Salmon population (typically the males), but these are usually 3.1 fish returning in June.
10. The effects of hatchery rearing on Salmon have now been well researched and it has been conclusively shown that the assumption that fish reared under the artificial conditions of a hatchery are no different from fish of the same stock reared in the wild is wrong. Traditional hatchery rearing actually produces great differences in physiology, metabolism, shape and behaviour compared to a wild reared fish. These differences make it much more difficult for a hatchery fish to survive in the wild than a naturally reared fish, so the return rates for hatchery reared smolts are typically around a tenth of those of wild smolts. Therefore, though mortality is much less in a hatchery than in the wild, it is only delayed and catches up with the fish once they are put back into the wild.
11. Only one full tag return, a fish caught by rod at Mertoun in May 1st 1992 was the sort of Spring Salmon that was expected from this stocking. This had spent two winters at sea, which would be typical of an Ettrick Spring Salmon, but it must also have migrated as a one year old smolt, which is less typical of an upper Ettrick fish.
12. However, this fish was caught at Middle Mertoun, though supposedly stocked into a tributary of the Teviot. If the tag recording and reading were accurate, then it had missed its turning at the Junction.
13. This raises the question of how well these one year old parr that smolted immediately after stocking were “imprinted” with the odours of their home areas. There has been a considerable amount of research on this with a strong, general, conclusion that Salmon learn the smell of their home areas and then the sequence of smells as they migrate downriver as smolts, which later allows them to “play back” a route map to get them home. However, the details of this process are less clear: - “The imprinting process, even at the smolt stage, seems to involve more than mere exposure to odours of a river or hatchery, as the date of release affects homing performance” (*Hansen and Jonsson 1991*).
14. It may well be therefore that these one year old parr stocked in 1989 and 1990 as well as having their life cycle altered to being small, quick-growing, 1.1 Summer Grilse from their multi-sea-winter Spring Salmon origin by the effects of hatchery rearing, were also stocked at the wrong time to properly imprint with the smell of their home area and so would not have been able to find their way back to where they had been stocked. This would have effectively prevented any chance of Ettrick-origin fish becoming established elsewhere in the Tweed system from such fish.
15. The stocking in 1986 was with Summer fry (fish at the end of their first summer of life) and was back into the zone where they had come from, the Ettrick and Tima. Two of the six tag returns were from Spring Salmon back in the rivers, the others were from the drift nets and were of fish that would have been back



in the river in July and August. Their year of recapture also shows that they were returning as 2.2 fish, which is typical of natural Ettrick fish.

16. Whether this greater success was due to less time being spent in the hatchery or to some of them growing up in their natural home zone cannot be disentangled. The less time spent in the hatchery, the better for fish if they are to survive in the wild (see para. 10).
17. Salmon breed very effectively in the wild, if there are no problems caused by humans such as barriers, siltation, acidification, pollution, habitat degradation, etc. If there are, stocking will not stop these problems and if there are not, then natural recolonisation will fill up any gaps and reach capacity. Two hundred average, eight-pound, females, will produce around a million eggs, so even if numbers of adults falls very low, numbers of juveniles produced can still be very large, quickly repairing damage or recolonising new areas.
18. Shortly after the Jed, Slitrig and Leithen were opened up, the Whiteadder Water was fully opened to Salmon. This had been blocked from the 1860's and was well known to be without Salmon for around a century. When Salmon started to recolonise is unknown, but it could have been after the major flood of 1948 which destroyed or altered many caulds on the Tweed system. There were still a number of difficult or impassable obstacles on the Whiteadder system but these were dealt with by the mid 1990's. The subsequent recovery in terms of the distribution of Salmon parr within the Whiteadder catchment is shown below:

1988	7 sites, average Salmon Parr density of	1.3 per 100 m <sup>2</sup>	(at 2 sites out of 7)
1996	same 7 sites, average Salmon Parr density of	15.9 per 100 m <sup>2</sup>	(at 6 sites out of 7)
2000	same 7 sites, average Salmon Parr density of	65.0 per 100 m <sup>2</sup>	(at 7 sites out of 7)

(One of these sites then became unusable. Later samplings have shown continued good levels of juvenile Salmon in the Whiteadder. The Blackadder was opened up later and is still recolonising.)

19. The Gala Water was blocked from 1821 to 1948 and the Leader Water from the 1840's to 1959. Both were naturally recolonised without stocking and now have very good populations of juvenile Salmon. Genetics work on the Gala fish has shown that its original colonists came from the Ettrick and the middle Tweed, the nearest sources.
20. The examples of the Gala, Leader and Whiteadder show that stocking is unnecessary in a catchment like the Tweed, even for tributaries that have been blocked for years. Once opened up, they recolonise naturally and quickly from neighbouring areas. The Jed and Leithen now have good juvenile populations – the Slitrig still has access problems.
21. The attempt made in the late 1980's to spread the Ettrick Spring Salmon stock to other parts of the catchment would have failed, regardless of the quality of any hatchery reared fish, because of this strong, natural, effect. As soon as the Leithen and Jed were opened up fish started to recolonise them, as shown by the 1988 electro-fishing results (while the homing instinct in Salmon is very strong, it is not 100% and there is always an advantage to being first into a new area). Even if the stocking with Ettrick fish had continued, they would have been in competition with the locals spreading in naturally, and the evidence is that the locals always win in such situations.
22. It is also known now that hybrids between different stocks of Salmon are less fit than pure bred fish, so the effect of continued stocking with Ettrick fish into other parts of the catchment would actually have been to slow down their recolonisation by producing hybrids with less chance of survival and return, what is called "out-breeding depression". No such thing as "hybrid vigour" has been shown for Salmon.
23. There is also the point that run-timing, whilst having a strong genetic basis, can also be modified by the environment in which fish are reared, so while upper Ettrick fish would have a genetic bias towards returning as Spring Salmon, the degree to which this would be expressed when they were stocked into a different area of the catchment could be affected by the environment there. For example, when Spring Salmon from the River Tummel were stocked into the R. Braan, further down the Tay system, the typical time of return from the sea was significantly later than for Tummel fish reared in their native river (Stewart et al. 2002). This result was only for the first generation's return and if a breeding stock had been



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established in the Braan, then it could be expected that the timing of return would further alter over the years to suit the new environment.

**REFERENCES:**

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