The Influence of Genetics on Run Timing in Salmon: Implications for Fishery Managers

Stocking salmon fry in a River Braan tributary

Background

Differences in run timing among adult salmon returning to Scottish rivers extend the fishing season and lend variety to the fisheries. Tagging and tracking studies have shown that within each sea age group, the spawning destination of salmon is related to timing of river entry. Early-run fish penetrate further upstream and late-run fish remain lower down in the catchment. This diversity has important economic consequences for fisheries and everything possible should be done to maintain it.

Stocking is a common practice among fishery managers, and can involve moving eggs or fish within and between river catchments. It is therefore important to know if run timing is a genetic adaptation, or if differences in run-timing are controlled by the environment experienced by young fish. Information from tagging studies on the River Tay (Fig. 1) has shown that local genetic factors control the timing of both the smolt migration and the return of adults.

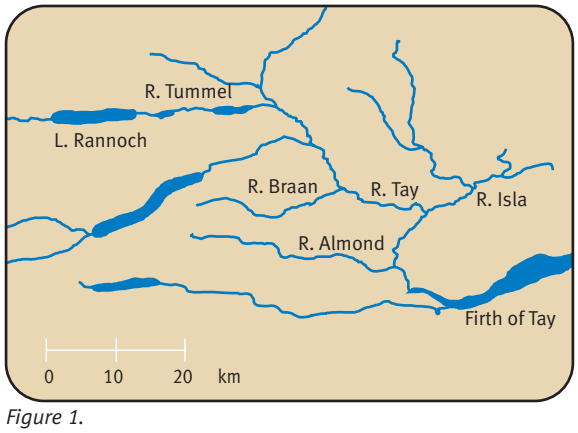

Figure 1.
River Tay catchment showing locations mentioned in the text.

Smolt run timing

Trapping of smolts from the Rivers Almond and Tummel in the 1960s and 1970s showed that both two and three-year-old smolts migrated from the upper catchment before smolts of the same age left the lower catchment. When smolts originating from an upper (Tummel) and lower (Isla) catchment stock were reared in a common environment above Loch Rannoch, this pattern of migration was retained, showing that the timing of smolt migration has a genetic component (Fig. 2).

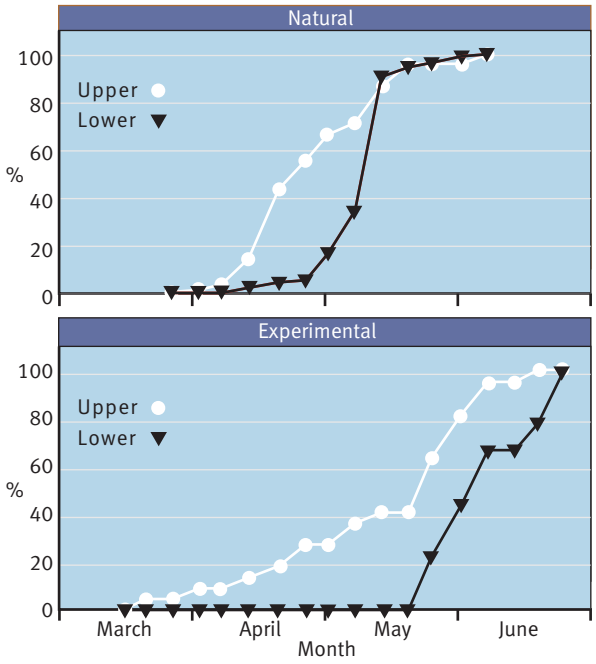

Figure 2.
Natural differences in the timing of migration of two-year-old smolts originating from upper and lower catchment (Natural) remained after fish were transferred and reared in a common location above Loch Rannoch (Experimental).

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Adult run timing

When recaptures of grilse (1 Sea Winter (1SW)) and salmon (2SW) from native smolts tagged in the Almond and Tummel were examined, fish originating in the Tummel (upper catchment) returned earlier than those destined for the Almond (lower catchment). In order to examine the nature of these differences, progeny of salmon collected from both tributaries were stocked into a common location (River Braan) and later tagged as smolts. On their return as adults, fish of Almond or Tummel origin, of both sea ages, retained the run timing characteristics of their parents (Fig. 3). These findings indicate that adult run timing, like smolt migration timing, is under genetic control.

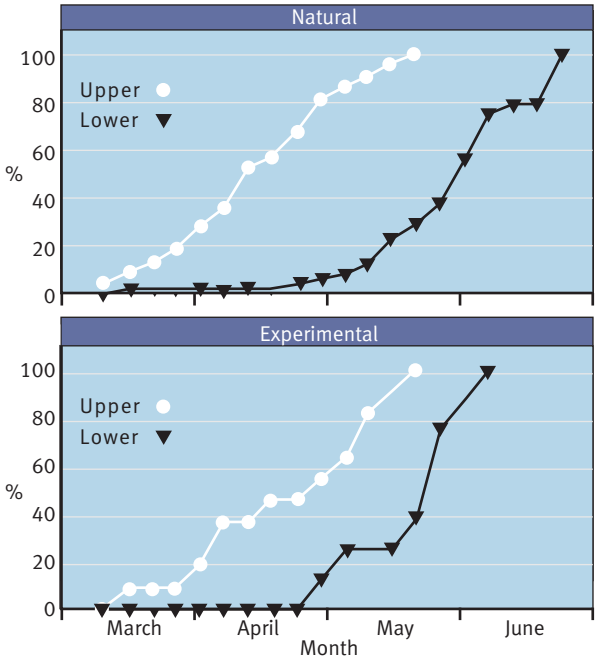

Figure 3.
Natural differences in run timing between fish returning to locations in the upper or lower catchment (Natural) were maintained following experimental stocking in the River Braan (Experimental). Tag recapture patterns shown are for 2SW fish.

Conclusions

Salmon from different parts of the same river catchment exhibit different behaviours that are probably due to adaptation to their local environment. The differences in behaviour arise from genetic differences, and are probably maintained by the homing of adults to natal streams, with selection against any fish which exhibit timings that are not appropriate to their particular location. The resulting patchwork of stocks may differ in many important ways; run timing differences may be only the most obvious sign that this patchwork exists. This genetic diversity is of great significance to fisheries as it results in fresh-run fish being spread out among the months that fisheries operate. When considered over the geographic range of Atlantic salmon, the Scottish fisheries are among the most unusual in this important respect.

The experiments described here show that local genetic factors are of direct importance to fisheries and fishery management. They add to a growing body of evidence that shows salmon to be genetically adapted to their local environment. This has important implications for fishery managers as inappropriate stocking may result in mismatches of stocked fish to local conditions and the possibility of unfavourable interactions between native and introduced stocks.

For further information see:

D.C. Stewart, G.W. Smith and A.F. Youngson (2002). Tributary-specific variation in the timing of adult Atlantic salmon to fresh water has a genetic component. Canadian Journal of Fisheries and Aquatic Sciences ***59****, 276-281.*

D.C. Stewart, S.J. Middlemas and A.F. Youngson (2006). Population structuring in Atlantic salmon: evidence of genetic influence on the timing of smolt migration in sub-catchment stocks. Ecology of Freshwater Fish ***15****, 552-558.*

'Harling' for spring salmon on the River Tay near Dunkeld

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