THERMAL HABITAT UTILISATION IN UPSTREAM MIGRATING ADULT SALMONIDS

by A. M. Walker, R. A. Bush, M. Pawson and A. Moore

Introduction

During the freshwater spawning migration, Atlantic salmon and sea trout generally cease to feed and are quiescent for long periods. Final growth and maturation of gonads continues during this period and the fish must rely on stored energy reserves for successful reproduction. Little is known regarding the habitat requirements of adult salmonids during this period and, in particular, how modifications to the thermal regimes within the river may affect survival and subsequent reproductive success.

Changes in the thermal regime of a river may result from:

- climate change (warming; changes in precipitation);
- modification to flow regime (abstraction; changes to land management practices);
- salmonid enhancement practices (stream engineering for juvenile production; canopy removal).

This preliminary study used Data Storage Tags and radio transmitters to investigate the thermal environments occupied by adult salmonids during the freshwater spawning migration.

Methodology

During June and July 2002, five Atlantic salmon and two sea trout were trapped and tagged in the River Kent in the North West of England (see Plates 1 & 2). DST (Star-Oddi milli; temperature sensor accuracy = ± 0.1°C, sampling interval 30 min) and radio transmitters (Biotrack TW5, 174 MHz) were surgically implanted into the peritoneal cavity of the fish.

Plate 1: The river as it flows through the town of Kendal has been considerably modified for the purposes of flood prevention works and is characterised by a wide, shallow channel and numerous weirs.

Plate 2: The upper reaches of the catchment are characterised by steep-sided valleys with rough grazing for livestock.

A laboratory-based study indicated that the temperature recorded by the tag inside the fish corresponded to the ambient water temperature (Figure 1).

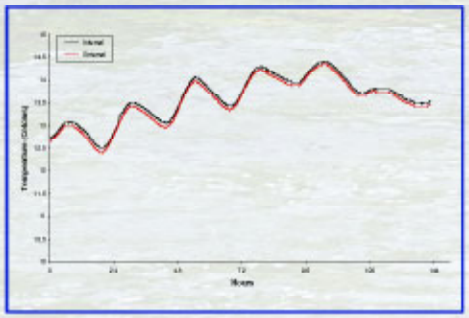

Figure 1: Comparison of the temperatures recorded by DSTs in the peritoneal cavity of a salmon and the surrounding water.

The gross movements of tagged fish were monitored using automatic receivers (CEFAS) whilst greater spatial resolution of habitat use was provided by active tracking at 2-4 week intervals. The thermal characteristics of the river were monitored using strategically placed temperature loggers (Gemini Tinytag Plus; temperature sensor accuracy = ± 0.2°C, sampling interval 30 min).

Progress

DSTs were recovered from one sea trout (female, 1.75 kg) caught 100 days after release, and from one salmon (female, 5.5 kg) recovered after it had spawned in the main river 167 days after release.

The sea trout and salmon occupied the same holding pool (750 m long) for 56 days (July to Sept), during which time they were repeatedly located by active tracking to be <50 m apart. The sea trout lay under cover of overhanging vegetation whilst the salmon occupied deeper water near the middle of the channel (Plate 3).

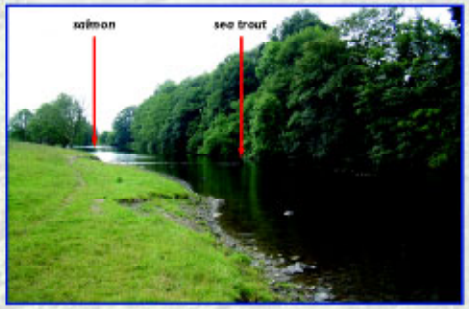

Plate 3: Lower section of holding pool used by both fish during the quiescent phase of their migrations. Arrows indicate the areas where each fish was always located by active tracking at various times during daylight hours.

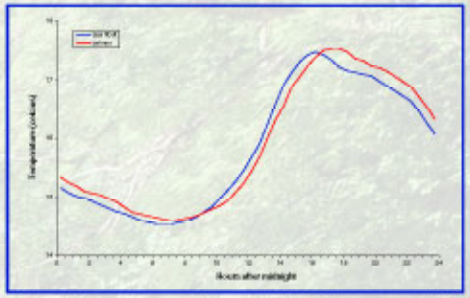

Figure 2: Temperatures recorded by DSTs in both fish over a typical 24h period (15 July) when the fish occupied the same pool. Note the time lag in temperature change of the DST in the salmon.

The difference between the cumulative thermal regimes experienced by the two fish during this period was slight (7.2°D; see Figure 2). However, there were differences in both the diurnal thermal regime and the depths occupied by the salmon and sea trout:

- During the day fish typically stayed close to the bottom and moved nearer the surface during the night (Figure 3).
- The sea trout often resided in cooler water than the salmon (Figure 4).

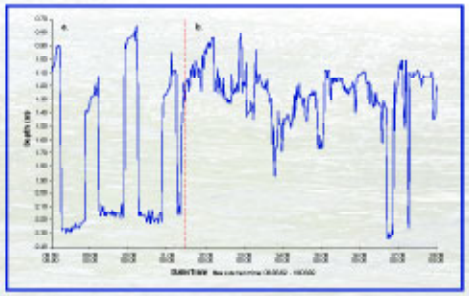

Figure 3: Depth record for the sea trout showing the day/night pattern of movements typical of both fish during the early (a), and later parts of the quiescent phase (b).

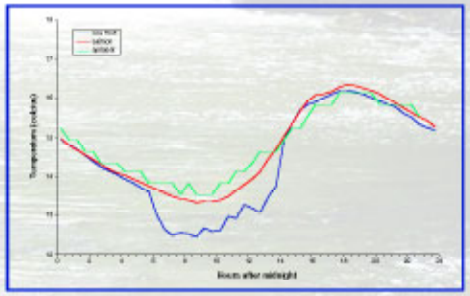

Figure 4: Temperatures recorded by DSTs in both fish, and by a temperature logger 500 m downstream, during one of the 24 h periods (22 Aug) when the sea trout experienced temperatures >1°C cooler than the salmon or the temperature logger.

Future Work

Future work will investigate differences in the thermal habitats occupied by MSW salmon and grilse. The field based studies will be complemented by laboratory based studies on the impact of thermal regimes on migratory metabolism and reproductive success.

Acknowledgments

This research is funded by the Department for Environment, Food and Rural Affairs (Defra) UK under contract SFO231. We are grateful for the assistance of the Environment Agency and for the support of riparian owners and fishing interests on the River Kent.

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk NR33 0HT, UK. E-mail: a.m.walker@cefas.co.uk http://www.cefas.co.uk