

Introduction

- An understanding of habitat use, particularly at critical life history stages, is important for the effective conservation and management of freshwater fish stocks.
- Previous studies have utilised a number of different techniques that have varying levels of intrusiveness and spatial & temporal resolution (Greenberg & Giller 2000).
- Collection of meaningful data requires that fish are not disturbed during long term sampling in order to describe habitat shifts and intra/inter-specific interactions.
- This can now be achieved using a newly developed portable monitoring system.

Methods

The portable PIT multi-point decoder (MPD) detection system (Riley et al. 2003)

- The system is constructed from one, or more, MPD units.
- Units consist of one 24V MPD (16-channel), two 12V lead-acid batteries, and 16 circular panel antennae (E. Collinson & Co. Ltd; approx. total cost £4000).
- Antennae operate at 134 kHz and have a typical detection range of 90 mm.
- The MPD sequentially interrogates all 16 antennae within 3.2 s (read time of 200 ms per antenna).
- An on-board clock and memory enables the logging of 6000 time- and date-stamped events.
- The MPD has an adjustable data repetition filter and performs an error detection process.

System deployment and study area

- The system was field tested on the Brandy stream (Riley et al. 2002), a carrier of the River Itchen, in southern England (Fig. 1a).
- Antennae were positioned in four lines across the stream, two lines per unit (Fig. 1b), initially at the upstream end of the study site.
- Lines (Plate 1) were installed at 5 m intervals and were left in position for 46 h.
- Lines were moved every second day to cover the next 20 m downstream (installation time of approx. 2 h), until exit 3 was reached.
- Details of the habitat at all 350 antenna locations were recorded before removal.

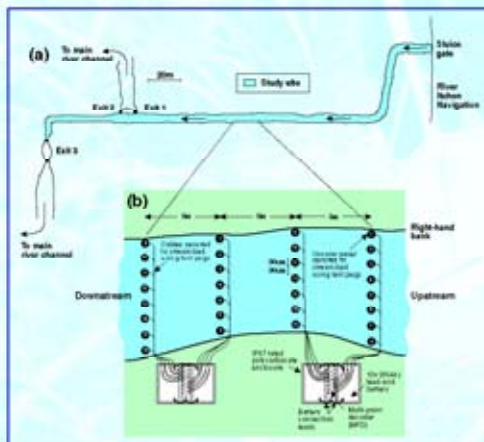


Figure 1: (a) Scale diagram of Brandy carrier stream, showing the extent of the study site and (b) schematic representation of the PIT multi-point decoder (MPD) detection system in an example 46 h deployment

Results

- Between 18 September and 16 October 2001 20,769 detections were successfully logged from 186 individual fish (89 Atlantic salmon *Salmo salar* L., 62 trout *Salmo trutta* L., 31 grayling *Thymallus thymallus* L., three roach *Rutilus rutilus* (L.) and one pike *Esox lucius* L.).
- Overall, 56% of the wild fish PIT tagged (Plate 2) on 29 August 2001 were detected (45% salmon, 73% trout, 72% grayling, 75% roach and 50% pike).
- 38 (0.18%) detections contained unallocated tag codes. Further examination of the records left only three (0.01%) unidentifiable.
- Chi-squared tests compared the expected number of fish detections in each habitat type with the actual number of fish detections.
- The chi-squared statistic was used to judge the strength of preference for a particular habitat type (e.g. Fig. 2 and Fig. 3).
- A repeat deployment between 16 January and 13 February 2002 recorded 10,349 detections from 90 fish (73 of which had been detected the previous autumn).
- In a separate investigation, the system was deployed in a 20 m section of Brandy stream and left in position for 10 days before & 35 days after the stocking of hatchery reared salmon parr. During this period 338,852 detections were logged from 33 wild salmon parr, 16 wild trout, 20 wild grayling and 110 hatchery salmon parr.



Plate 1: One line of antennae in situ. Insert shows the multi-point decoder with two antennae attached



Plate 2: Fish were caught for PIT tagging using Electric Fishing

References

- Greenberg L.A. & Giller P.S. (2000) The potential of flat-bed passive integrated transponder antennae for studying habitat use by stream fishes. *Ecology of Freshwater Fish* 9, 74-80.
- Riley W.D., Eagle M.O. & Ives S.J. (2002) The onset of downstream movement of juvenile Atlantic salmon, *Salmo salar* L., in a chalk stream. *Fisheries Management and Ecology* 9, 87-94.
- Riley W.D., Eagle M.O., Ives M.J., Rycroft P. & Wilkinson A. (2003) A portable passive integrated transponder multi-point decoder system for monitoring habitat use and behaviour of freshwater fish in small streams. *Fisheries Management and Ecology* 10, 265-268.

Acknowledgements

This research was funded by the Department for Environment, Food and Rural Affairs (Defra) UK under contract SF0229. The authors thank Winchester College and its river keeper, Mr Mark Sankey, for the use of the study site. The Environment Agency, in particular Messrs Richard Redsell and David Hunter, for help with the electric fishing surveys.

Figure 2: Graphical representation of substrate preference, by ecological group, September/October 2001 Days

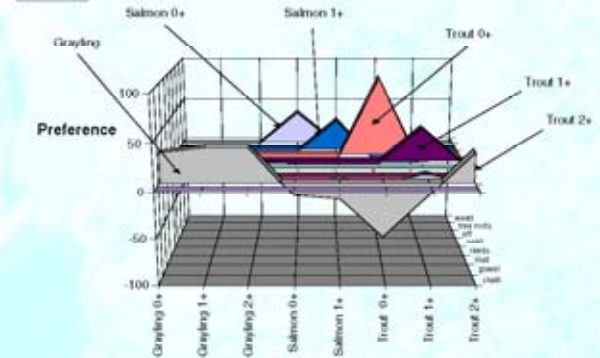
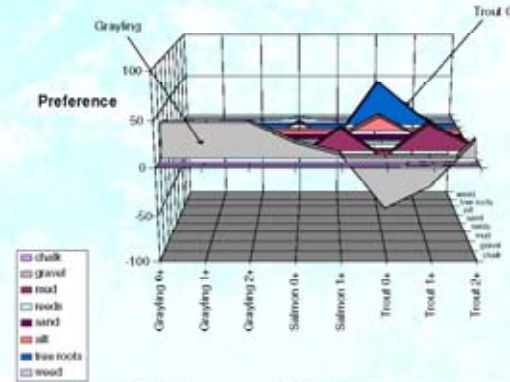


Figure 3: Graphical representation of substrate preference, by ecological group, September/October 2001 Nights

Conclusions

Advantages of the new system include:

- Continuous remote monitoring of numerous individual fish with high spatial and temporal resolution;
- Consistent sampling even under difficult conditions such as shallow, fast flowing, turbid water at night;
- Small antennae that allow targeting of specific microhabitats;
- Sequential polling of antennae that permits close positioning without interference.

Limitations include a:

- Change in streambed composition at antenna locations. However, custom made open frame tubular antenna and cobble shaped or indented panel antenna could be manufactured;
- Small detection range that will, in some cases, introduce a bias, as the efficiency of detection will vary with species behaviour; and could also be influenced by stream depth. However, the system can operate with larger PIT tags that would improve the reading range.

Methods currently available could not have produced the data collected by this novel system. Development of alternative antennae will permit its wider usage for other ecological and behavioural experiments in both aquatic and terrestrial environments.