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Factors affecting the dispersal of coarse fish

Science Report – SC030215

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Science at the Environment Agency

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- **Delivering information, advice, tools and techniques**, by making appropriate products available to our policy and operations staff.



Steve Killeen

Head of Science

Executive summary

Habitats for fish in lowland rivers in England and Wales have been extensively modified for flow regulation purposes, including milling, navigation, land drainage and flood prevention. These modifications have degraded fish habitats and restricted the ability of fish to move between them, leading to changes in fish communities. These fish habitats will require mitigation and restoration in order to meet environmental objectives, notably the Good Ecological Status required under the European Commission's Water Framework Directive. Legislation also requires that new schemes avoid adverse effects on biota, including fish. However, our understanding of the factors causing these changes and how best to rehabilitate rivers remains poor. In addition, future challenges, notably climate change and the consequent changes in flow and temperature regimes, may exacerbate these problems.

Stocking of fish is one possible approach to rehabilitating fisheries, particularly after pollution events. However, the dispersal of stocked fish and how this dispersal relates to the physical habitat in the river is poorly understood. This project investigated the patterns of movement of stocked fish before, during and after flow events, in relation to physical habitat, temperature and season, and in comparison with wild fish.

Rehabilitating the physical environment in rivers is another measure advocated for restoring Good Ecological Status. Such rehabilitation requires an understanding of the responses of wild fish populations to floods and high flows. This project describes patterns of lateral and longitudinal movement and the utilisation of various habitats by fish in relation to flow, temperature and season. It also examines losses of fish as a result of their becoming stranded in floodplains following overtopping of floodbanks and the subsequent isolation.

Field studies were conducted on three English rivers: the River Ouse in Yorkshire; the River Trent near Nottingham; and the River Roding, a small tributary of the Thames in Essex. These field studies employed a variety of techniques, including some new technologies. There was therefore a need to demonstrate that the effects of these techniques on fish mortality and behaviour would not significantly influence the results. Trials of tagging methods on small coarse fish were thus undertaken under controlled conditions.

Both the benefits and the harmful consequences of high flows and floods for fish have been widely reported in the scientific literature. However, much of this work has been undertaken on large continental river systems with distinct seasonal flow regimes, and this is also the case with many documented lowland river rehabilitation projects. The aseasonal nature of the flow and flooding characteristics of UK rivers may present different challenges, which this study addresses.

On the Yorkshire Ouse, vast numbers of under-yearling coarse fish were found in temporary floodplain water-bodies following summer floods. Many fish became stranded in waterbodies created by over-topping of floodbanks, being unable to return to the main channel as floodwaters subsided. These young fish were mainly eurytopic species such as roach and bleak, but also included rheophilic species such as chub and dace. Very few fish were found in these habitats during the larger and more frequent winter floods. In summer and winter, backwaters also held large numbers of young fish and thus were also vital habitats for their survival.

Studies of the utilisation of man-made floodplain water bodies on the River Trent and a marina on the Yorkshire Ouse by adult and juvenile fish demonstrated that such water bodies are extensively used by a wide range of coarse fish species. The overall diversity of fish species using these water bodies was enhanced by the fact that they had varying degrees of connectivity to the main river channel according to flow stage.

The predicted effects of climate change on the frequency and magnitude of floods needs to be accounted for when designing and managing man-made waterbodies to ensure the optimum frequency and timing of connections to the river.

Studies conducted in controlled conditions showed that tagging and marking techniques for small coarse fish, employing full- and half-duplex PIT (Passive Internal Transponder) tags, had negligible effects on the survival of hatchery chub and roach and only limited and temporary impacts on their growth. The survival and growth of dace after PIT tagging was poorer, perhaps because of their smaller initial body size.

Studies of the movements of hatchery-reared and wild coarse fish on the River Roding demonstrated good survival of stocked fish: up to 70% of the fish remained after a five-month winter period with numerous high flow events. Movements of both wild and stocked fish were highly correlated with both flow and temperature, but varied between years. Generally, newly-stocked fish moved greater distances than wild fish and these movements were less clearly linked to the locations of favourable habitat. The movements diminished over time, suggesting an initial post-stocking exploratory phase followed by increasing site fidelity. This exploratory phase may bring greater danger of predation and displacement, and may explain the poor persistence of stocked fish observed in other studies.

Further research is required on a number of aspects in order to confirm the details of these findings. The DIDSON methodology described in Chapter 5 shows particular promise for future studies of fish behaviour in relation to physical structures.

This project has demonstrated the links between flows and habitat in lowland rivers and both the lateral and longitudinal movements of coarse fish. It also makes a number of key recommendations for future research and for management action to support Good Ecological Status in English and Welsh lowland rivers.

The design of Flood Risk Management schemes, and habitat restoration and mitigation schemes should incorporate the provision of lateral and longitudinal connectivity between different fish habitats relevant to the species present and local conditions, along the following lines.

- Fish require shelter areas during periods of high flow, especially during summer when the swimming capabilities of small juveniles are limited. Wherever possible, flood levees should be set back as far as possible from the main river to allow connectivity between the river and the floodplain. Where high flow velocities result in fish being displaced over levees, outlet channels should be designed to allow water to drain back into the river smoothly as the floods recede, so that the fish can return to the river. Alternatively, permanent water bodies should be provided in the floodplain.
- Backwater areas are valuable for fish survival in high flows and should be constructed in channelised rivers as part of rehabilitation.
- Man-made floodplain waterbodies with variable connectivity to the main river channel at different discharge stages should be constructed where anthropogenic activities have reduced floodplain habitats.

Natural flow regimes and longitudinal connectivity should be protected and restored.

Restocking programmes can produce good results if account is taken of the availability of suitable habitats and the ability of stocked fish to move between them.

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Contents

Science at the Environment Agency	iii	
Executive summary	iv	
Acknowledgements	vi	
1	General introduction	1
2	Effects of floods on fish	4
2.1	Introduction	4
2.2	Flood concepts	5
2.3	Floods in upland streams	6
2.4	Floods in lowland rivers	10
2.5	Anthropogenic impacts on floods and floodplains	16
2.6	Rehabilitation of flow regimes and floodplains	18
2.7	Conclusions	21
3	Effects of floods on 0+ cyprinid fishes in a constrained lowland river: evidence for backwater and floodplain rehabilitation	22
3.1	Introduction	22
3.2	Materials and methods	23
3.3	Results	27
3.4	Discussion	31
4	Rehabilitation of lowland river-floodplain ecosystems: the importance of variable connectivity between man-made floodplain waterbodies and the River Trent	36
4.1	Introduction	36
4.2	Materials and methods	37
4.3	Results	42
4.4	Discussion	52
5	Imaging fish activity at a lowland river-backwater connection during elevated flow	55
5.1	Introduction	55
5.2	Materials and methods	56
5.3	Results	60
5.4	Discussion	66
6	Evaluation of visible implant elastomer marking and passive integrated transponder tagging protocols for juvenile cyprinid fishes	68
6.1	Introduction	68

6.2	Materials and methods	69
6.3	Results	72
6.4	Discussion	80
6.5	Conclusions and field study recommendations	83
7	Dispersal of stocked cyprinids in a small English river: comparison to wild fish using a multi-method approach	84
7.1	Introduction	84
7.2	Methods	85
7.3	Results	94
7.4	Discussion	103
7.5	Conclusions	108
8	General discussion	110
8.1	Introduction	110
8.2	Conclusions and recommendations	112
	References	116
	List of abbreviations	
	Glossary	

Tables

Table 3.1	Details of sites surveyed for 0+ fishes in the Yorkshire Ouse river (R), backwaters (B) and floodplains (F), including substratum, key aquatic macrophytes and number of times sampled (<i>n</i>)	26
Table 3.2	Frequency of occurrence and relative abundance of 0+ fish captured from the Yorkshire Ouse river (R), backwater (B) and floodplain (F)	28
Table 3.3	Comparison of bleak, chub and roach lengths (mean \pm CI, mm) between main river sites pre-flood and backwater sites during particular flood events	32
Table 3.4	Comparison of bleak, chub and roach lengths (mean \pm CI, mm) between main river sites pre-flood and floodplain sites during the August 2004 flood event	32
Table 3.5	Comparison of fish lengths (mean \pm CI, mm) before and after particular winter flood events (growth assumed to be zero)	34
Table 4.1	Details of sites surveyed for 0+ fishes in the River Trent (R) and floodplain waterbodies (F), including river width (<i>W</i> , m), floodplain waterbody area (<i>A</i> , ha), maximum depth (Max. <i>D</i> , m), dimensions of connectivity channel (<i>W</i> = width, <i>D</i> = depth and <i>L</i> = length, m) or river level rise required for connection (m), connectivity rank (see text for details), substratum and key aquatic macrophytes	40
Table 4.2	Relative abundance of 0+ fish captured from five main river sites (R1–R5) and ten floodplain waterbodies (F1–F10) on the River Trent	43
Table 4.3	Shannon-Wiener diversity index (<i>H'</i>), species richness and Pielou's measure of evenness (<i>J</i>) for all samples from five main river sites (R1–R5) and 10 floodplain waterbodies (F1–F10), and beta diversity (βW) between floodplain waterbodies and local river sampling sites on the River Trent	49
Table 5.1	Mean density (fish $m^{-2} \pm$ SD (%)) at start of each minute processed (<i>n</i> , no. of fish (%)) during day and night sampling periods for all length classes (cm)	62
Table 5.2	Mean (\pm SD (%)) number of fish moving towards the marina per minute during day and night sampling periods for all length classes (cm)	63
Table 5.3	Mean (\pm SD, (%)) number of fish moving away from the marina per minute, during day and night sampling periods for all length classes (cm)	64
Table 6.1	Summary of treatment, species of fish, initial sizes (mm, g) and ratio (%) of PIT tag weight to initial fish mass for each treatment	70
Table 6.2	Survival (% (<i>n</i> , no. of fish)), length (mean \pm SD, mm), mass (mean \pm SD, g), SGR and mark site condition for small chub treatments and control at 29 days, 89 days and 182 days post marking	74
Table 6.3	Survival (% (<i>n</i> , no. of fish)), length (mean \pm SD, mm), mass (mean \pm SD, g), SGR and mark site condition for large chub treatments and control at 29 days, 89 days and 182 days post marking	75
Table 6.4	Survival (% (<i>n</i> , no. of fish)), length (mean \pm SD, mm), mass (mean \pm SD, g), SGR and mark site condition for roach treatments and control at 29 days, 89 days and 182 days post marking	76
Table 6.5	Survival (% (<i>n</i> , no. of fish)), length (mean \pm SD, mm), mass (mean \pm SD, g), SGR and mark site condition for dace treatments and control at 29 days, 89 days and 182 days post marking	77
Table 7.1	Summary of electric fishing surveys for tagging wild fish, including the date sampled, number of sites fished, total length of river fished (m), mean site length (m \pm SD) and the number of fish (all species) tagged	87
Table 7.2	Number (<i>n</i>), length (mean \pm SD (range), mm), mass (mean \pm SD (range), g) and ratio (%) of tag weight of wild and stocked chub	88
Table 7.3	Number (<i>n</i>), length (mean \pm SD (range), mm), mass (mean \pm SD (range), g) and ratio (%) of PIT tag weight of wild and stocked dace	88
Table 7.4	Number (<i>n</i>), length (mean \pm SD (range), mm), mass (mean \pm SD (range), g) and ratio (%) of PIT tag weight of wild and stocked roach	89
Table 7.5	Total population (<i>n</i> \pm SE) and probability of capture (<i>P</i> \pm SE) for chub, dace and roach as determined by the Maximum Likelihood Methods (Carle and Strub 1978) for the three sites sampled quantitatively	90
Table 7.6	PIT antenna operational details, downstream, upstream and milling fish movements recorded and missed, and the proportion of movements missed during 2005–06 sampling	92
Table 7.7	PIT antenna operational details, downstream, upstream and milling fish movements recorded and missed, and the proportion of movements missed during 2006–07 sampling	93
Table 7.8	Number of chub, dace and roach tagged (<i>n</i>) during each sampling occasion and the proportion recaptured (% (<i>n</i>)) in March 2007	96

