Ecology of Freshwater Fish 2000: 9: 90–91
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ECOLOGY OF
FRESHWATER FISH
ISSN 0906-6691

Life-history evolution, biology and conservation of stream fish: introductory note

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The central problems of ecology at the end of the twentieth century are posed in an acute form by stream fishes (Matthews 1998, Wootton 1998). The presentations at the Symposium on the Ecology of Stream Fish: State of the Art and Future Prospects held at Luarca, Spain, in April 1998 illustrated the many facets of these problems. In the sessions on Stream Management, Conservation and Endangered Species, and Life History Evolution and General Biology, several themes emerged (Appendix A).

The first theme was the importance of defining the relevant scale for the studies. Species diversity of stream fishes at a locality will reflect the effects of processes acting over different geographical areas and temporal periods ranging from the consequences of allopatric speciation on the size of the species pool, species dispersal, abiotic conditions, and environmental productivity to the intensity of biotic interactions occurring at a particular locality (Oberdorff et al.). An understanding of the effect of scale on population traits such as birth, death, emigration and immigration is required for the design of refuges for threatened stream fish populations (Steward) and to predict the consequences of the introduction of exotic species (Mellado et al.).

Modern techniques of molecular ecology provide effective tools for defining the effect of scale on the genetic composition of stream populations and for designing stocking programmes that maximize the match between the genotypes of the fish stocked and the environmental conditions of the streams. The possibility of excessive inbreeding can also be effectively monitored given the genetic detail provided by these molecular techniques (Letcher & King). The introgression caused by hybridization between closely related species may represent a danger if one of the parental species is at risk of extinction, as seems to be case for *Salmo marmoratus* in Slovenia (Ocvirk). Molecular techniques offer means of monitoring the progress of introgression in such examples and so will provide a check on the effectiveness of procedures to conserve the endangered species.

A second theme was that, despite a long history of study, predicting and assessing the impact of anthropogenic activities on stream fish communities is still difficult. Here, too, it will be necessary to consider the effects of scale. Anthropogenic disturbances may result from the processes involved in the exploitation of natural resources such as timber and minerals. These types of disturbances may occur as point-source impacts, or they may act more generally across entire watersheds, with different resulting effects on stream fish communities. An example may be found in attempts to control forest fires, where there are changes both in the intensity and spatial pattern of such fires. Stream fauna that are adapted to natural patterns of fire may not be well adapted to the new patterns characteristic of managed forests, together with other disturbances associated with timber extraction such as road construction (Rieman & Clayton). The impact of impoundments on spawning migrations and other movements of stream fishes also emphasizes the importance of using an appropriate scale for evaluating the effects of anthropogenic disturbances (Penczak & Kruk 2000). In assessing the likely impact of disturbances such as impoundments and other river engineering projects it is also necessary to ascertain just what information is required on the life history traits of stream fishes and the environmental characteristics of their habitats (Formigo et al.).

The quantitative effects of activities of such as recreational fisheries need to be defined in the context of the life history patterns of stream fishes. What are the effects on mortality rates of returning fish compared with mortality rates if fish are not returned (Whoriskey et al. 2000)? How do spatial and temporal scales of a recreational fishery influence the population dynamics of the stream fish? Do populations subjected to such fisheries show adaptive changes to the fishery impact?

A third theme of discussion was environmental variability. All environments are subjected to some degree of stochastic variation, but streams, with their histories of variations in flow, temperature and oxygen, probably show more stochastic variation than most. How effectively can fish buffer the effects of these variations? How sensitive are components of fitness, growth, mortality and reproduction, to such variation (Ali & Wootton 2000)? The life history traits of species will determine which species persist in a given habitat. Under the prevailing environmental conditions, the traits must generate sufficient recruitment for populations to persist (Baker). Studies on salmonids illustrate the variation that life-history traits show in relation to food availability and other environmental variables (Pirhonen et al.; Lobón-Cerviá 2000). The relative importance of genetic variation and phenotypic plasticity in the observed variations have to be clarified by appropriate "common-garden" experiments.

Last but not least, a fourth theme of discussion emerged during the sessions. Despite the intensive research on the ecological themes above, several participants pointed out the need of further research to increase knowledge on the life history of stream-dwelling fishes. The lack of information on these fishes, particularly populations or species either exploited or threatened constrain the design and implementation of appropriate management actions and programs (Elvira).

Field observations, field experiments and laboratory experiments of stream fishes will contribute not only to understanding of their ecology but also contribute to the development of ecological theory in general.

We wish to thank all the authors and reviewers of manuscripts submitted from the sessions on Stream Management, Conservation and Endangered Species, and Life History Evolution and General Biology. The Symposium and the publication of these proceedings were possible thanks to many people, but mainly to the personal effort of the convener, Dr. Javier Lobón-Cerviá.

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Appendix A

Presentations at the sessions Stream Management, Conservation and Endangered Species, and Life History Evolution and General Biology within the Symposium Ecology of Stream Fish: State of the Art and Future Prospects, held at Luarca, Spain, in April, 1998.

Ali, M. & Wootton, R.J. Variation in rates of food consumption and possible compensatory responses in freshwater fish.

Baker, J.A. Life-history studies of stream-fishes: relationships with assemblages-level studies and suggestions for future research avenues.

Elvira, B. The fishes of Spanish streams: what do we know to preserve these species?

Formigo, N., Santos, P., Jesús, T., Figueiredo, C., Tavares, G. & Ribeiro, F. The fish community of River Sabor (Douro Basin, Portugal).

Letcher, B. & King, T. Tools for stream fish restoration: Atlantic salmon genetics, broodstock management and fry-marking.

Lobón-Cerviá, J. Factors regulating the size and growth of trout *Salmo trutta*. A field assessment, 1987–1997.

Lobón-Cerviá, J. Determinants of parr size variations within a population of brown trout.

Mellado, E., Escot, C., Rodríguez-Ruiz, A. & Granado-Lorencio, C. Patterns of native and exotic fishes in the Guadalquivir River basin: are there limits to exotic fish distribution?

Oberdorff, T., Hugueny, B. & Guègan, J.-F. Role of scale in regulation of riverine fish species richness.

Ocvirk, J. Marble trout (*Salmo marmoratus* Cuvier, 1817) repopulation program in Slovenia.

Penczak, T. & Kruk, A. Threatened obligatory riverine Cyprinidae in modified by man Polish rivers.

Pirhonen, J., Forsman, L., Thorpe, J.E. & Soivio, A. Is brown trout smolting similar to that of salmon: theory and its experimental testing.

Rieman, B. & Clayton, J. Wildfire, forest management and conservation of native fishes.

Steward, C.R. III. Salmon refuges-guidelines for establishing a network of protected areas in the Pacific Northwest.

Whoriskey, F. Jr. Ponoi River catch-and-release studies.