CENTRE FOR EVIDENCE-BASED CONSERVATION

SYSTEMATIC REVIEW NO. 12

WORKING TITLE: DOES IN-STREAM HABITAT IMPROVEMENT INCREASE THE ABUNDANCE OF TROUT AND SALMON?

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REVIEW PROTOCOL

1. BACKGROUND

In-stream habitat improvement devices may be used in an attempt to redress habitat degradation and enhance trout and salmon stocks in streams and rivers which have been detrimentally affected by anthropogenic influences. Interventions such as installment of flow deflectors and artificial riffles, and also the use of livestock fencing to reduce bankside erosion, aim to restore habitat to something approximating natural conditions.

An effect of installation of in-stream habitat devices is often the narrowing of over-wide streams with subsequent increased water velocities and turbulence resulting in beneficial impacts on water quality (Environment Agency 1996, Hendry *et al.* 2003, N.Milner pers.com 2005). Fencing and isolation of the river from livestock indirectly promotes beneficial salmon habitat reducing erosion and sediment inputs (Duff 1977, Platts *et al.* 1983, Platts & Nelson 1985). However the effectiveness of these devices is often not fully known as performance evaluations are rarely conducted (Harper & Quigly 2005). The Environmant Agency (EA) is interested in ascertaining the impact of flow deflectors, artificial riffles and livestock fencing on the abundance of trout and salmon stocks and also bullhead *Cottus gobio* (a UK BAP species of conservation concern).

The effectiveness of in-stream devices may be affected by local gradient and valley confinement (drivers of geomorphology), proportion of cobbles in substrate (driver of salmonid distribution, Armstrong *et al.* 2003), degree of existing modification (negatively related to salmonid abundance), and distance from source and water quality (effects carrying capacity, Armstrong *et al.* 2003). The impact of these potential effect modifiers also requires investigation.

A systematic review methodology will be used to retrieve data concerning the impact of in-stream habitat improvement devices. The review will limit bias through the use of a comprehensive literature search, specific inclusion criteria and formal assessment of the quality and reliability of the studies retrieved. Subsequent data synthesis will summarise empirical evidence, thereby assisting in the formulation of appropriate evidence-based management guidelines and highlighting gaps in research. The review should be of use to the EA and Rivers Trusts practitioners and also have wider international relevance.

2. OBJECTIVE OF THE REVIEW

2.1 Primary question

Does in-stream habitat improvement increase the abundance of trout and salmon?

Table 1: Definition of components of the primary systematic review question.

Subject (Population)	Intervention	Outcome		
		Primary	**Secondary**	**Tertiary**
Trout and salmon populations	Devices that aim to restore stream habitats i.e. anti-livestock fences, artificial riffles and flow deflectors Vs No instream devices	Change in abundance of trout and salmon	Changes in the abundance of other species including bullheads.	Any other outcomes

2.2 Secondary question

What influence does the local gradient and valley confinement, proportion of cobbles in substrate, degree of existing modification, distance from source, water quality, water flow, size of stream and canopy cover have on the impact of instream habitat devices?

3. METHODS

3.1 Search strategy

The following electronic databases will be searched:

1. ISI Web of Knowledge
2. Science Direct
3. Directory of Open Access Journals (DOAJ)
4. Copac
5. Scirus
6. Scopus
7. Index to Theses Online (1970-present)
8. Digital Dissertations Online
9. Agricola
10. Europa
11. English Nature's "Wildlink"
12. JSTOR
13. BIOSIS via EDINA
14. SIGLE via ARC2WebSPIRS

The following English language and latin search terms will be used:

1. Trout*
2. Salmo*
3. Bullhead*
4. Cottus gobio
5. River* and flow
6. Stream* and flow
7. flow deflector*
8. graz* and fish

Further terms may be added as the search progresses involving combination of the existing terms and the use of taxa-specific terms if necessary. Publication searches will be undertaken on conservation and statutory organisation websites (Countryside Council of Wales, Department of Agriculture and Rural Development, Department of Environment, Food and Rural Affairs, English Nature, EA, Freshwater Fisheries Lab, Joint Nature Conservancy Council, National Parks and Wildlife Service, Scottish Natural Heritage) and using the meta-search engines Dogpile, Alltheweb and Google Scholar. Fishbase.org. will also be searched. The first 100 word document or PDF hits from each data source will be examined for appropriate data. Additional foreign language searches will be undertaken on Google to capture information from the following non-English speaking countries with significant managed salmonid fisheries: Denmark, Finland, France, Norway, Spain and Sweden. In addition bibliographies of articles viewed at full text will be searched. Authors, recognised experts and practioners will also be contacted for further recommendations and for provision of any unpublished material or missing data that may be relevant. The EA will be asked for access to information retrieved from the Research and Development Project 603 which produced R&D Technical Report W18, Restoration of Riverine Trout Habitats: A Guidance Manual. Participants in the pan-European FAME project (Development, Evaluation and Implementation of a Standardised Fish-based

Assessment Method for the Ecological Status of European Rivers) will be asked to provide access to data. Questionnaires will be circulated to practioners in order to collate experience.

3.2 Study inclusion criteria

- **Relevant subjects:** Rivers and streams containing trout and salmon populations.
- **Type of Intervention:** Devices that aim to restore stream habitat e.g. anti-livestock fences, artificial riffles and flow deflectors vs no treatment.
- **Types of Outcome:** The primary outcome is change in abundance of trout and salmon. However studies will not be rejected on the basis of outcome and outcomes other than change in fish abundance will be catalogued. Adverse outcomes have been defined by the EA as a reduction in abundance of bullheads by 50% or more.
- **Types of Study:** Type of study will not be used to define inclusion or exclusion criteria. It is envisaged that all information regarding the primary outcome will be collated qualitatively or within a Bayesian framework. Appropriate spatial or temporal controls are a prerequisite for studies to be included in inferential meta-analysis.

Where there is insufficient information to make a decision regarding study inclusion when viewing titles and abstracts, then relevance to the next stage of the review process will be assumed. Reviewers will consider articles viewed at full text for relevance excluding or admitting them to different categories of relevance and quality. At least two reviewers will independently assess a random subset of 25% of articles viewed at full text. Disagreement will be resolved by consensus, or following assessment by a third reviewer.

3.3 Study quality assessment

Reviewers will consider articles viewed at full text excluding or admitting them to different categories of information quality. At least two reviewers will independently assess a random subset of 25% of articles viewed at full text. Disagreement will be resolved by consensus, or following assessment by a third reviewer.

3.4 Data extraction strategy

Data regarding study characteristics, quality and results will be recorded on a specially designed data extraction form. These forms may be amended after consultation with statisticians and piloting of the data extraction process.

3.5 Data synthesis

It is envisaged that all information will be collated qualitatively or within a Bayesian framework. This will incorporate meta-analysis where appropriate data exists. Reasons for heterogeneity in results including local gradient and valley confinement, proportion of cobbles in substrate, degree of existing modification, distance from source, water quality, water flow, size of stream and canopy cover will be investigated by meta-regression where appropriate data exists.

3.6 Reasons for heterogeneity

The following potential reasons for heterogeneity have been formally identified *a priori* in order of importance by the EA.

1. Local gradient and valley confinement
2. Proportion of cobbles in substrate
3. Degree of existing modification
4. Distance from source
5. Water quality
6. Water flow
7. Size of stream
8. Canopy cover

4. POTENTIAL CONFLICTS OF INTEREST AND SOURCES OF SUPPORT

No conflicts of interest to be declared. This systematic review is funded by NERC.

5. REFERENCES

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6. APPENDIX

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Stakeholders: Environment Agency fisheries staff, Fisheries staff in other public bodies in Scotland and Ireland, Fisheries Trusts, The Association of Fisheries Trusts and other angling organisations.

Experts (researchers): Nick Giles, Terry Langford, David Cragg-Hine, David Solomon, Bill Riley (CEFAS), Martin O'Grady.