Habitat rehabilitation for inland fisheries

Global review of effectiveness and guidance for rehabilitation of freshwater ecosystems
Cover photos:
Left: excavation of new off-channel habitat (River Drau, Austria)
Top right: planting of riparian trees (River Drau, Austria)
Bottom right: lake habitat enhancement in North America
(Courtesy of Tennessee Wildlife Resources Agency)
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Global review of effectiveness and guidance for rehabilitation of freshwater ecosystems

by
Phil Roni, Karrie Hanson, Tim Beechie, George Pess, Michael Pollock
Watershed Program
Northwest Fisheries Science Center
National Oceanic and Atmospheric Administration (NOAA)
Seattle, United States of America

and

Devin M. Bartley
Inland Water Resources and Aquaculture Service
Fisheries Resources Division
FAO Fisheries Department
Rome, Italy

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This technical paper is part of the publication programme of the Inland Water Resources and Aquaculture Service (FIRI) of the Fisheries Department of the Food and Agriculture Organization of the United Nations. It provides a synthesis of information on the effectiveness of habitat rehabilitation for inland fisheries as well as recommendations for implementing, monitoring and evaluating habitat rehabilitation activities. The document is intended to assist managers, practitioners and scientists involved in the restoration of aquatic ecosystems. It draws on the more than 50 years of practical experience of the authors in the field of fisheries and riparian ecology, aquaculture and habitat restoration.

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The degradation of inland aquatic habitats through decades of human activities has lead to massive efforts to rehabilitate freshwater habitats for fisheries and aquatic resources in watersheds throughout the world. Many texts have been written on techniques for rehabilitation though no comprehensive worldwide review of the effectiveness of techniques has been undertaken. This paper reviews published evaluations of freshwater habitat rehabilitation projects, including studies on roads improvements and sediment reduction, riparian and floodplain rehabilitation, placement of habitat structures in lakes and streams, addition of nutrients to increase aquatic production and other less common techniques. In particular, the authors summarize what is known about the effects of various techniques for restoring natural processes, improving habitat, and increasing fish and biotic production. Recommendations on limitations of techniques, which techniques are effective, as well as information on planning, prioritizing and monitoring rehabilitation projects are also provided.

Despite locating more than 330 studies on effectiveness, as well as hundreds of other papers on rehabilitation, it was difficult to draw firm conclusions about many specific techniques because of the limited information provided on physical habitat, biota and costs, as well as the short duration and scope of most published evaluations. However, techniques such as reconnection of isolated habitats, rehabilitation of floodplains and placement of instream structures have proven effective for improving habitat and increasing local fish abundance under many circumstances. Techniques that restore processes, such as riparian rehabilitation, sediment reduction methods (road improvements), dam removal and restoration of floods, also show promise but may take years or decades before a change in fish or other biota is evident. Other techniques such as bank protection, beaver removal and bank debrushing can produce positive effects for some species but more often produce negative impacts on biota or disrupt natural processes.

Comparing the cost-effectiveness of different types of rehabilitation techniques was not possible because few evaluations reported various costs or economic benefits; however, estimates of average costs for various techniques are provided. Monitoring and evaluations clearly need to be designed as part of the rehabilitation action. The authors discuss the key steps to consider when designing monitoring and evaluation of rehabilitation actions at various scales.

Similar to less-comprehensive reviews of rehabilitation, this review demonstrates three key areas lacking in most rehabilitation projects: 1) adequate assessment of historic conditions, impaired ecosystem processes and factors limiting biotic production; 2) understanding upstream or watershed-scale factors that may influence effectiveness of reach or localized rehabilitation; and 3) well-designed and -funded monitoring and evaluation. These are the same factors that consistently limit the ability of published studies to determine the success of a given technique at improving habitat conditions or fisheries resources. Finally, this review suggests that many habitat rehabilitation techniques show promise, but most have not received adequate planning, monitoring or cost-benefit analysis.

Key words: habitat rehabilitation, restoration, fisheries, riparian, floodplain, monitoring and evaluation
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# Acronyms and abbreviations

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>BACI</td>
<td>Before-after control-impact</td>
</tr>
<tr>
<td>CICFRI</td>
<td>Central Indian Capture Fisheries Research Institute</td>
</tr>
<tr>
<td>DVWK</td>
<td>Deutscher Verband für Wasserwirtschaft und Kulturbau</td>
</tr>
<tr>
<td>FISRWG</td>
<td>Federal Interagency Stream Restoration Working Group (US)</td>
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<tr>
<td>LIFE</td>
<td>Financial Instrument for the Environment (European Union)</td>
</tr>
<tr>
<td>LWD</td>
<td>Large woody debris</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NRC</td>
<td>National Research Council (US)</td>
</tr>
<tr>
<td>NRRS</td>
<td>National River Restoration Synthesis Project</td>
</tr>
<tr>
<td>RSPB</td>
<td>Royal Society for Protection of Birds (United Kingdom)</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>USGAO</td>
<td>United Stated General Accounting Office</td>
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