

## Chapter 15

# A Catalogue of Fish Passes at Dams in Spain

BENIGNO ELVIRA<sup>1</sup>, GRACIELA G. NICOLA<sup>2</sup> and ANA ALMODÓVAR<sup>2</sup>

<sup>1</sup> Department of Animal Biology I, Faculty of Biology, University of Madrid, E-28040 Madrid, Spain

<sup>2</sup> Department of Ecology, Agricultural Research Service, Community of Madrid, PO Box 127, E-28800 Alcalá de Henares, Madrid, Spain

**ABSTRACT:** An inventory of fish passes at Spanish dams was made, and their effectiveness and level of maintenance were estimated. A total of 108 passes were catalogued, 31% of which were constructed after 1990. These passes are placed at weirs and dams of moderate height (1.5 to 25 m). Many of them are located in northern Spain and are mainly devoted to salmonid passage. Thus, 61% of the passes coincide with the occurrence of brown trout *Salmo trutta*, and 28% with the occurrence of both Atlantic salmon *Salmo salar* and brown trout. The most common fish pass design is the pool-and-weir (87%), followed by the Denil type (5%). With regard to effectiveness, it was estimated that 58% of surveyed facilities can be passed by target species. As for maintenance status, 61% of the passes are in good condition. A significant result of the survey is that a large majority of the approximate 1100 large dams built in Spain lack fish passes. Likewise, it was confirmed that alternative fish passage facilities, i.e. fish locks, fish lifts or bypass channels, are still absent from Spanish dams.

**Keywords:** conservation, dams, fish passes, freshwater fish, migratory fish, Spain.

## Introduction

Dams are considered one of the primary factors negatively affecting the indigenous fish fauna of Spain (Doadrio *et al.*, 1991; Elvira, 1996). The blockage of fish movements by dams without fish pass facilities has resulted in drastic range reductions of migratory species in Spanish rivers (Nicola *et al.*, 1996). In fact, all anadromous and catadromous species found in Spain are currently listed as threatened (Blanco & González, 1992; Elvira, 1996). Likewise, the existence of dams with ineffective fish passage devices has contributed significantly to the near extirpation of sturgeon *Acipenser sturio* in Spanish waters (Elvira *et al.*, 1991a, b).

For these reasons the State Conservation Service has funded a research project to catalogue and evaluate the fish passage facilities in Spanish rivers. Although similar reviews have been developed in other countries (Čada & Sale, 1993; Clay, 1995), it was the first attempt of this kind made in Spain. Conclusions of our research were presented in a report (Elvira *et al.*, 1995, unpubl. report), and the most relevant results are briefly summarised here.

## Methods

The field work was carried out between 1993 and 1995. Fish passes were visited once or twice and selected characteristics were recorded. Passes were grouped following the

classification of large river basins of Spain (Anon, 1992). Fish passes were further characterised by design following the classification proposed by Larinier (1992) and Clay (1995). The adopted categories were as follows: pool-and-weir (including, vertical slot, upper slot, and vertical slot and orifice designs), Denil, eel passes, and others (e.g. orifices, ramps and navigation locks). Some fish passes were found to be abandoned.

Effectiveness was evaluated by direct observation, taking into account different factors such as the location of the fish pass at the dam, the position of both fish pass entrance and exit, and their closeness to spillway gates or turbine intakes. Also, hydraulic conditions within the pass were considered, mainly evaluating if sufficient water was passing through. Additional data concerning fish pass design were noted, such as the length and slope, and the suitability of dimensions for target species and resting conditions, if required. Thus, each fish pass was included in one of the following categories:

- (1) High suitability
- (2) Adequate
- (3) Low
- (4) Impassable for fish.

Similarly, the condition of each device based on the deterioration of fish pass components and the obstruction of the entrance and exit with logs, leaves or other materials was characterised as being:

- (1) Good
- (2) Fair
- (3) Poor
- (4) Out-of-use.

## Results and Discussion

A total of 108 fish passes were catalogued. Many of them, 33 passes (30%), were built between 1990 and 1995. Distribution of passes among river basins is not uniform, since 87% of them are located within the two northernmost basins, North and Ebro (Fig. 15.1). Low proportions are found in central and southern basins: Douro, Tagus, Júcar, Guadiana and Guadalquivir. Many of the fish passage facilities were constructed in rivers where Atlantic salmon and brown trout (both resident and sea-run populations) occur (Fig. 15.2). Therefore, 61% of passes coincide with the occurrence of brown trout alone, and 28% with the occurrence of brown trout and Atlantic salmon.

With regard to fish pass design, the pool-and-weir type is the most commonly used in Spain (87%), including vertical slot (51%), upper slot (11%) and vertical slot and orifice designs (3%). In addition, Denil type (5%), eel passes (1%) and other atypical designs (5%) have been installed at dams, but are not widely used. Also, 3% of passes are currently abandoned. It is worth noting that the most recently planned installations are pool-and-weir type passes.

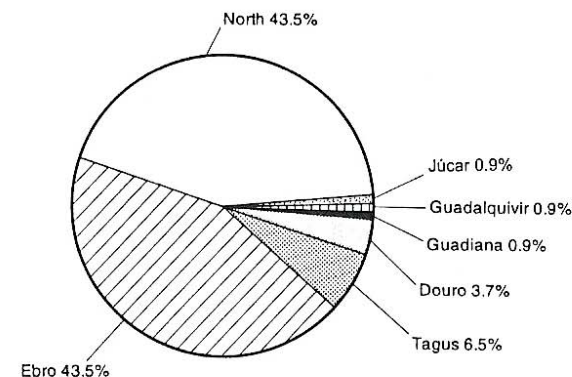


Fig. 15.1 Percentages of fish passes in each of the Spanish river basins (based on a total count of 108).

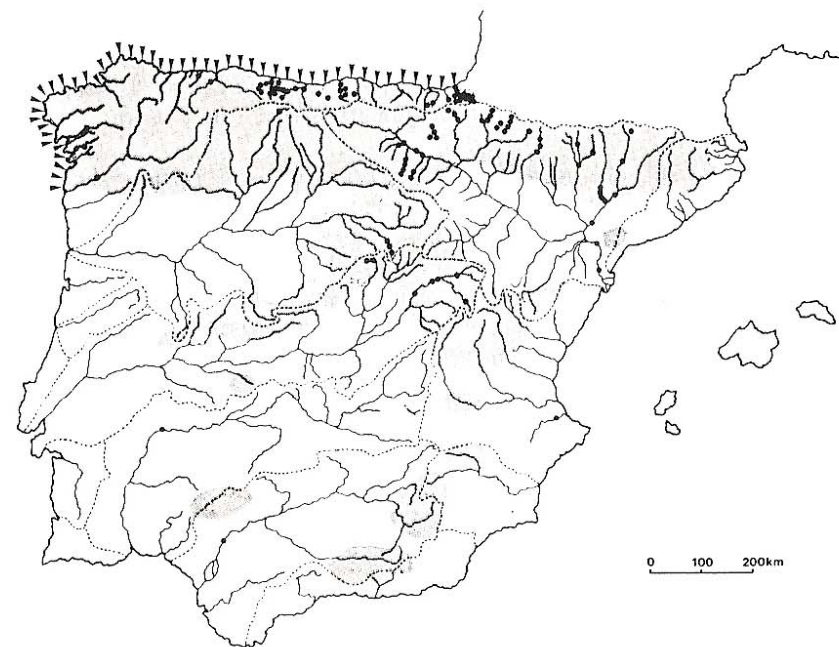


Fig. 15.2 Location of fish passes in Spain (black dots) and distribution range of brown trout *Salmo trutta* (shaded area) and sea-run brown trout and Atlantic salmon *Salmo salar* (arrows).

The effectiveness of passes was estimated as follows: 58% are highly suitable, 15% adequate, 19% low and 8% are considered impassable for fish (Fig. 15.3). Maintenance of these devices is quite variable: 61% are in good condition, 21% fair condition, 13% poor condition and 4% are out of use (Fig. 15.3).

Anon (1992) listed more than 1100 large dams placed in Spanish rivers. Nevertheless, the 108 fish passes are mainly located at weirs and dams of moderate height



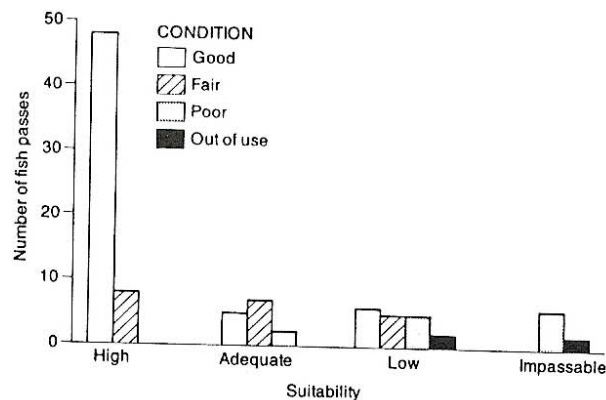


Fig. 15.3 Estimated effectiveness and condition of the Spanish fish passes.

(1.5 to 25 m). Unfortunately, this means that the majority of dams lack fish passage facilities (Fig. 15.4). Moreover, large dams are still impassable barriers which stop the upstream movements of fish.

On the other hand, different devices (fish locks, lifts or bypass channels) have not yet been used in Spain as alternatives for passing fish over dams. For instance, fish bypass channels could be an adequate option for dams of moderate height instead of the traditional pool-and-weir design. Likewise, high dams would demand corrective measures different from the standard pool-and-weir design. In some of these locations, fish locks and fish lifts would be advisable. Eventually, trapping and trucking could be used to move fish upstream at the highest dams.

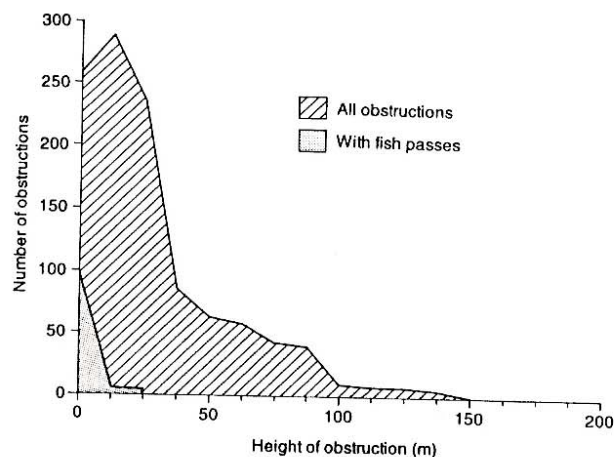


Fig. 15.4 Numbers of Spanish dams of various heights and the number of dams and weirs with fish passes.

## Conclusions

This evaluation provides the first baseline data illuminating the extent of river obstructions in Spanish rivers. Clearly, the conservation or rehabilitation of migratory fish populations in Spain depends on our ability to implement corrective measures at as many obstructions as possible. While the largest dams pose formidable obstacles, hundreds of low-head barriers could be mitigated with some form of fish passage device. We encourage the development of such facilities, or some other form of passage mitigation, and further recommend that any new dams be thoroughly assessed as to their potential effect on our remaining migratory as well as holobiotic fish populations.

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# **Fish Migration and Fish Bypasses**

**Edited by**

**MATHIAS JUNGWIRTH**

**STEFAN SCHMUTZ**

**STEVEN WEISS**

*Department of Hydrobiology, Fisheries and Aquaculture,  
University of Agricultural Sciences, Vienna, Austria*



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## Contents

<i>Preface</i>	vii
<b>PART 1 FISH MIGRATION AND RIVERS</b>	<b>1</b>
1 Migratory Behaviour of Fish and its Significance to Movement through Riverine Fish Passage Facilities <i>Tom G. Northcote</i>	3
2 River Continuum and Fish Migration – Going Beyond the Longitudinal River Corridor in Understanding Ecological Integrity <i>Mathias Jungwirth</i>	19
3 Behaviour of Upstream Migrating Whitefish, <i>Coregonus Lavaretus</i> , in the Kukkolankoski Rapids, Northern Finland <i>Anne Laine, Tuomo Ylinärä, Jaakko Heikkilä and Jussi Hooli</i>	33
4 Effects of Temperature and Flow on the Upstream Migration of Adult Atlantic Salmon in Two Norwegian Rivers <i>Arne J. Jensen, Nils Arne Hvidsten and Bjørn Ove Johnsen</i>	45
5 The Use of Radiotelemetry for Identifying Migratory Behaviour in Wild and Farmed Atlantic Salmon Ascending the Suldalslågen River in Southern Norway <i>Bjørn Ove Johnsen, Arne J. Jensen, Finn Økland, Anders Lamberg and Eva Bonsak Thorstad</i>	55
6 Biological and Environmental Characteristics of Fish Passage at the Tailfer Dam on the Meuse River, Belgium <i>C. Prignon, J.C. Micha and A. Gillet</i>	69
7 Fish Migration and Fish Passage Facilities in the Danube: Past and Present <i>Herwig G. Waidbacher and Gertrud Haidvogel</i>	85
8 Interruption of the River Continuum by Barriers and the Consequences for Migratory Fish <i>Armin Peter</i>	99
9 Effects of River Engineering on Genetic Structure of European Fish Populations <i>Günter Gollmann, Yvette Bouvet, Rui Miguel Brito, Maria Manuela Coelho, Maria João Collares-Pereira, Anastasia Imsiridou, Yiannis Karakousis, Eric Pattee and Costas Triantaphyllidis</i>	113

<b>PART 2 UPSTREAM PASSAGE: TECHNOLOGY AND REVIEW</b>	<b>125</b>
10 Upstream and Downstream Fish Passage Experience in France <i>Michel Larinier</i>	127
11 Performance of Four Fish Pass Installations Recently Built on Two Rivers in South-west France <i>Francois Travade, Michel Larinier, Sylvie Boyer-Bernard and Jean Dartiguelongue</i>	146
12 Environmental Factors Influencing the Passage of Alice Shad <i>Alosa alosa</i> at the Golfech Fish Lift on the Garonne River, France <i>Jean-Luc Bellariva and Alain Belaud</i>	171
13 Fish Passage in the Columbia River, USA and its Tributaries: Problems and Solutions <i>John G. Williams</i>	180
14 Upstream Passage of Juvenile Coho Salmon through Roughened Culverts <i>Ken Bates and Pat Powers</i>	192
15 A Catalogue of Fish Passes at Dams in Spain <i>Benigno Elvira, Graciela G. Nicola and Ana Almodóvar</i>	203
16 Fish Passage Mitigation at Hydroelectric Power Projects in the United States <i>Glenn F. Cada</i>	208
17 Fish Passage Facilities in the UK: Issues and Options for Future Development <i>Ian G. Cowx</i>	220
18 A New Type of Fishway in Norway: How a Regulated and Acidified River was Restored <i>Reidar Grande and Dag Matzow</i>	236
19 Monitoring of a Prototype Collection Gallery on the Lahn River <i>Beate Adam and Ulrich Schwevers</i>	246
20 Twenty-two years of Passing Shortnose Sturgeon in Fish Lifts on the Connecticut River: What Has Been Learned? <i>Boyd Kynard</i>	255
<b>PART 3 DOWNSTREAM PASSAGE: PROVISION AND DAMAGE ASSESSMENT</b>	<b>265</b>
21 Downstream Fish Passage Design Considerations and Developments at Hydroelectric Projects in the North-east USA <i>Mufeed Odeh and Curtis Orvis</i>	267
22 Surface-oriented Bypass Systems for Juvenile Salmonids on the Columbia River, USA <i>John W. Ferguson, Thomas P. Poe and Thomas J. Carlson</i>	281
23 Mechanisms of Fish Damage in Low-head Turbines: an Experimental Appraisal <i>Andrew W.H. Turnpenny</i>	300

24 Fish Mortality due to Passage through Hydroelectric Power Stations on the Meuse and Vecht Rivers <i>Rolph H. Hadderingh and H.D. Bakker</i>	315
<b>PART 4 NATURE-LIKE DESIGNS: CONCEPTS, APPLICATION AND EVALUATION</b>	<b>329</b>
25 Evaluation of Rock-Ramp Fishways in Australia <i>John H. Harris, Garry Thorncraft and Peter Wem</i>	331
26 Conceptual Guidelines for Nature-like Bypass Channels <i>Piotr Parasiewicz, Juergen Eberstaller, Steven Weiss and Stefan Schmutz</i>	348
27 The Effectiveness of Two Nature-like Bypass Channels in an Upland Austrian River <i>Juergen Eberstaller, Manuel Hinterhofer and Piotr Parasiewicz</i>	363
28 The Effectiveness of Nature-like Bypass Channels in a Lowland River, the Marchfeldkanal <i>Helmut Mader, Günther Unfer and Stefan Schmutz</i>	384
29 Examples of Near-natural Fish Passes in Germany: Drop Structure Conversions, Fish Ramps and Bypass Channels <i>Rolf-Jürgen Gebler</i>	403
30 Fish Passes at Run-of-river Hydropower Plants of the Verbund <i>Hubert A. Steiner</i>	420
<i>Index</i>	435