

To be or not to be...removed

— International Seminar on dam removal | 24-26 September, 2018 —

Dam removal vs. invasive species report

Gustavo González - Iberian Center of River Restoration (Spain)







CONSERVATION STATUS OF EUROPEAN FRESHWATER FISHES



Europe

Figure 9. Major threats to freshwater fishes in Europe



Freyhof, J. & Brooks, E. 2011 European Red List of Freshwater fish

BENEFITS OF ELIMINATING UNNECESSARY DAMS

- Recovery of the river's natural flow regime
- Recovery of floodplain and adjacent wetlands
- Improvement of water quality
- Redistribution of sediments, improvement of fluvial dynamics and renewal of habitats
- Recovery of longitudinal connectivity



MAINTAINING OR RESTORING CONNECTIVITY CAN



- Enhance migratory fish populations
- Maintain genetic diversity in small, isolated populations
- Allow organisms to access complementary habitats to meet life-history needs
- Facilitate recolonization after local extirpations.



DAMAGES OF DAM OR WEIR REMOVAL

- Can mobilize toxics or cause sediment problems
- Facilitate the dispersion of parasites and diseases
- Facilitate the dispersion of invasive species
- Enable the hybridization of isolated populations with repopulation stocks

INTENTIONAL FRAGMENTATION MAY BE BENEFICIAL WHEN IT PREVENTS TO

- Spread of alien species or exotic diseases,
- Eliminate hybridization between hatchery and wild stocks
- Stop individuals from entering ecological traps



Percentage of non-native species per basin (i.e., the ratio of non-native species richness/total species richness)



Non-native species richness per basin.

Leprieur F, Beauchard O, Blanchet S, Oberdorff T, Brosse S (2008) Fish Invasions in the World's River Systems: When Natural Processes Are Blurred by Human Activities. PLOS Biology 6(2): e28. https://doi.org/10.1371/journal.pbio.0060028 http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.0060028

Invasion hotspots are defined as areas where more than a quarter of the species are non-native



(From sea to source. Internatinonal guidance for the restoration of fish migration higways. 2012)

Directive 92/73/EEC on the conservation of natural habitats and of wild fauna and flora

Article 10

Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence af the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora.

Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species.

Article 22

In implementing the provisions of this Directive, Member States shall:

- (a) study the desirability of re-introducing species in Annex IV that are native to their territory where this might contribute to their conservation, provided that an investigation, also taking into account experience in other Member States or elsewhere, has established that such re-introduction contributes effectively to re-establishing these species at a favourable conservation status and that it takes place only after proper consultation of the public concerned;
- (b) ensure that the deliberate introduction into the wild of any species which is not native to their territory is regulated so as not to prejudice natural habitats within their natural range or the wild native fauna and flora and, if they consider it necessary, prohibit such introduction. The results of the assessment undertaken shall be forwarded to the committee for information;
- (c) promote education and general information on the need to protect species of wild fauna and flora and to conserve their habitats and natural habitats.

Water Framework Directive (2000/60 / EC)

Hydromorphological quality elements

Element	High status	Good status	Moderate status
Hydrological regime	The quantity and dynamics of flow, and the resultant connection to groundwaters, reflect totally, or nearly totally, undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
River continuity	The continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms and sediment transport.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Morphological conditions	Channel patterns, width and depth variations, flow velocities, substrate conditions and both the structure and condition of the riparian zones correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

Biological quality elements

Element	High status	Good status	Moderate status
Fish fauna	Species composition and abundance correspond totally or nearly totally to undisturbed conditions. All the type-specific sensitive species are present. The age structures of the fish communities show little sign of anthropogenic disturbance and are not indicative of a failure in the reproduction or development of a particular species.	There are slight changes in species composition and abundance from the type-specific communities attributable to anthropogenic impacts on physico- chemical or hydromorphological quality elements. The age structures of the fish communities show signs of disturbance attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements, and, in a few instances, are indicative of a failure in the reproduction or development of a particular species, to the extent that some age classes may be missing.	The composition and abundance of fish species differ moderately from the type-specific communities attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements. The age structure of the fish communities shows major signs of disturbance, attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements, to the extent that a moderate proportion of the type specific species are absent or of very low abundance.

Regulation 1143/2014 on the prevention and management of the introduction and spread of invasive alien species

(26) Invasive alien species generally cause damage to ecosystems and reduce the resilience of those ecosystems. Therefore proportionate restoration measures should be undertaken to strengthen the ecosystems' resilience towards invasions, to repair the damage caused and to enhance the conservation status of species and their habitats in accordance with Directives 92/43/EEC and 2009/147/EC, the ecological status of inland surface waters, transitional waters, coastal waters and groundwater in accordance with Directive 2000/60/EC, and the environmental status of marine waters in accordance with Directive 2008/56/EC. The costs of such restoration measures should be recovered in accordance with the polluter pays principle.

Article 20

Restoration of the damaged ecosystems

1. Member States shall carry out appropriate restoration measures to assist the recovery of an ecosystem that has been degraded, damaged, or destroyed by invasive alien species of Union concern unless a cost-benefit analysis demonstrates, on the basis of the available data and with reasonable certainty, that the costs of those measures will be high and disproportionate to the benefits of restoration.

- 2. The restoration measures referred to in paragraph 1 shall include at least the following:
- (a) measures to increase the ability of an ecosystem exposed to disturbance caused by the presence of invasive alien species of Union concern to resist, absorb, accommodate to and recover from the effects of disturbance;
- (b) measures to support the prevention of reinvasion following an eradication campaign.

Article 10.3

Competent authorities will require promoters of works in river courses to inform about the presence of species in the catalog in those waters that will be the source of water transfers or temporary or permanent deviations. In case of presence of these species, the project will be reviewed to study alternatives and preventive measures that do not imply dispersal of these species, or the **suspension of the project will be assessed**. Similarly, if work is carried out in river courses affected by species in the catalog, preventive protocols for the dispersion of species to non-affected

courses should be applied.



Criteria for decision-making towards the improvement of river connectivity and dam removal considering the impacts of invasive fish species in the Iberian Peninsula

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At the request of:

Centro Ibérico de Restauración Fluvial (CIREF)

Wetlands International European Association



To show the current **situation** of the problem of the **river connectivity vs. dispersion of invasive species** and the current solutions through a compilation of recent scientific knowledge

To analyze the **management actions** and the studies taken in the Iberian Peninsula and others countries

To **highlight guidelines** addressed to inform different European institutions about advisable improvements in the national and European legal regulations

To serve as a **best practices guide** to make decisions



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'Biodiversity hotspots' for European riverine fish

61 species are present

Important area of endemisms

47 species are Iberian endemics80% of the continental ichthyofauna

Iberian freshwater ichthyofauna are very threatened

85% continental fish species are included in some category of threat IUCN

Barriers and fluvial connectivity

Iberian Peninsula is one of the areas with the largest number of dams in the world

ugal

1,200 large dams 256 large dams

Inventory of barriers still remains heterogeneous and incomplete

Are estimated about 50,000 obstacles







Iberian Peninsula is one of the areas with the largest number of dams in the world



Source: CIREF (2016)



Habitat Directive and Water Framework Directive are already reflected in **Spanish and Portuguese legislation**

In Spain, the implementation of the **National Strategy of River Restoration** has been a strong stimulus in the process of barrier connectivity improvement and dam removal.

During the years 2006-2014:

- 200 weirs were removed
- 100 fish passage were built

Weirs removed by demarcation during the Spanish National Strategy of River Restoration



Permeabilization actions by year



Ciref 2016. An analysis of river fragmentation in the Spanish basins



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In Spain and Portugal, the **acclimatization of exotic fish** is also among the main threat factors that negatively affect the survival and conservation of native freshwater fish species, many them are invasive and predators of the local ichthyofauna

The **exotic fish constitutes 55%** of all the continental ichthyofauna in the Iberian Peninsula

Spain and Portugal have the **largest number of exotic species** in Europe

- **Spanish Catalogue of invasive alien species** (Royal Decree 630/2013)
- Portuguese non-indigenous species (Decree-Law No. 565/99)

Studies: connectivity vs. Invasive species



FISH and FISHERIES

Unintended consequences and trade-offs of fish passage

Robert L McLaughlin^{1*†}, Eric R B Smyth^{1†}, Theodore Castro-San Thomas C Pratt^{5‡} & Luis-Antonio Vélez-Espino^{6‡}

Isolation Management with Artificial Barriers as a Conservation Strategy for Cutthroat Trout in Headwater Streams

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Restoration Ecology

THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION INTERNATION

RESEARCH ARTICLE

Effects of Flow Restoration and Exotic Species Removal on Recovery of Native Fish: Lessons from a Dam Decommissioning

Jane C. Marks,^{1,2} George A. Haden,^{1,3} Matthew O'Neill,¹ and Cinnamon Pace¹

Proyecto cipríber

LIFE13 NAT / ES / 000772 "ACTUACIONES PARA LA PROTECCIÓN Y CONSERVACIÓN DE CIPRÍNIDOS IBÉRICOS DE INTERÉS COMUNITARIO."



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Human effects on ecological connectivity in aquatic ecosystems: Integrating scientific approaches to support management and mitigation

David A. Crook ^{a,*}, Winsor H. Lowe ^b, Frederick W. Allendorf ^b, Tibor Erős ^c, Debra S. Finn ^{d,e}, Bronwyn M. Gillanders ^f, Wade L. Hadwen ^g, Chris Harrod ^h, Virgilio Hermoso ^g, Simon Jennings ^{ij}, Raouf W. Kilada ^k, Ivan Nagelkerken ^f, Michael M. Hansen ¹, Timothy J. Page ^g, Cynthia Riginos ^m, Brian Fry ^g, Jane M. Hughes ^g





Most of them only refer the problem but don't analyze consequences or measures to be taken Most of them are carried out with salmonid



At facing the decision to maintain river fragmentation or restoring connectivity, four elements or issues can be considered as determining factors:

State of conservation of native species

Adaptation of invasive species to lentic or lotic water

Type of feeding of invasive species

Migratory needs of native species and invasive species

Determining actions based on the invasion-isolation trade-off



Question?	Check	Remove the dam	Keep the dam	Check
What is the degree of threat of the native species?	✓	Natives little threatened upstream or highly threatened downstream	Natives highly threatened upstream or little threa- tened downstream	
What are the migratory requirements of native species	✓	High migratory requirements	Low or no migration requirements	
What is the importance of metapopulations of native species?		High isolation. High need of contact or genetic flow.	Low isolation. Low need of contact or genetic flow.	~
Where are the invasive fish species?	7	Upstream	Downstream	3
What are the migratory requirements of invasive species?		Low migratory requirements	High migratory requirements	
What kind of trophic interactions exist between invasive and native species?		Low competition for food resources, space and/or refuge between native and invasive species	High competition for food resources, space and/or refuge between native and invasive species	
What kind of predation interactions exist between invasive and native species?		Invaders low or no predation on eggs, juveniles and/or adults of native fish species	Invaders high predation on eggs, juveniles and/or adults of native fish species	
What kind of reproductive interactions exist between invasive and native species?		Invaders with low hybridization capacity or genetic contamination	Invaders with high capacity for hybridization or genetic contamination	
		Invaders with low sexual competence	Invaders with high sexual competence	
Are invasive species carriers of diseases or parasites?		No diseases or parasites associated with invasive species	Presence of diseases and/or parasites associated with invasive species	
How does the recovery of natural conditions affect invasive species?		Invaders not adapted to natural flows	Invaders adapted to natural flows	
		Invaders not adapted to natural conditions of water temperature and oxygen	Invaders adapted to natural conditions of water temperature and oxygen	
Are there toxic substances in the reservoir? or Do invasive species present bioaccumulable toxic substances?		No toxic substances in the reservoir neither Invaders transport bioaccumulated toxic substances	Toxic substances in the reservoir or invaders transport bioaccumulated toxic substances	
Does the reservoir have a potential ecological value as a refuge for native species under drought conditions?		The lentic waters of the reservoir cannot preserve populations of threatened endemic fish against climate change	Reservoir can preserve populations of threatened endemic fish against to climate change	
Does the removal of the dam significantly increase connectivity in the basin?		The obstacle causes a high synergic effect and its elimination would be very beneficial for the entire basin	There are no synergistic effects or obvious benefits	
Faced with the impossibility of removing the obstacle, what options to recover connectivity and/or restoration of natural flow exist?		No possibility of improvements in the passage of the obstacle	It is possible to improve connectivity and to safeguard a necessary isolation	
Faced with the impossibility of removing the obstacle, what options to recover connectivity and/or restoration of natural flow exist?		No possibility of improvements in the passage of the obstacle	It is possible to improve connectivity and to safeguard a necessary isolation	
Are other, non-fish, invasive species present?		No risk of expansion of other, non-fish, invasive species	Risk of expansion of other invasive species.	
Are other, non-fish, threatened species affected?		It favours other highly threatened, non-fish, native aquatic species	It harms other highly threatened native aquatic species	
What other complementary measures are going to be adopted?		Habitat restoration, control of invaders, translocations between isolated native metapopulations, etc.	None	
Is the reservoir a focus of attraction for new introductions?		Yes	No	
Total checks		Checks in favour to remove	Checks in favour to keep	

Removal of man-made fluvial barriers considering invasive alien species

Guidelines for decision-making



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http://www.cirefluvial.com/biblioteca.php





