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LIFE+ Segura-Riverlink: a green infrastructure approach to restore the longitudinal connectivity

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Habitat connectivity is a central factor in shaping fish assemblages and populations, however, few tools are developed to maintain and restore this attribute at a large scale in fluvial Mediterranean systems. The Segura-Riverlink is a LIFE Programme project which aims to promote and support the environmental recovery of a fluvial sector of the Segura River Basin, more than 50 km long in its main river (Period of actions: from September 2013 to July 2017) (Oliva-Paterna *et al.*, 2016). The main purpose is to demonstrate and validate management measures for the development of a Green Infrastructure (GI) approach into the context of Mediterranean river basins characterized by a high impact in their connectivity. The project will restore the longitudinal connectivity removing a significant number of small artificial barriers to re-establish fish movement and will also support other best practices of riverine restoration. In this line of action, our project is similar to Cipriber (www.cipriber.eu), Irekibai (www.irekibai.eu) and Migratoebre (www.migratoebre.eu) as LIFE type actions or to the project Habitat Restoration for Diadromous Fish in the River Mondego (www.rhpdm.uevora.pt).

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The restoration actions have included the removal of a small weir and the construction of effective fish passage systems. Moreover, a monitoring programme is assessing the performance of these actions with the hope of validating the GI approach to river basin management and its possible extension to the official management programmes. The project will also develop a Land Custody Network to integrate private owners in the river management and in agreeing good practices.

In January 2014 a small weir (1.3 m high and 3.2 m wide) was removed in the Moratalla stream. Since September 2015, six fish passes [Natural-like fishways (bypass and rocky-ramp) and Technical fishways (vertical-slot fishway)] have been implemented according to characteristics of each action site (Fig. 1). The knowledge of the biological needs of target species has influenced the final parameters in the fishway structure and a restoration of riverine vegetation at weir sections was also implemented. Experience has shown that the most effective means to develop successful solutions has occurred when engineers and biologists worked together systematically to design passage structures. This was the case in the development of the fish passage structures implemented in the context of the LIFE+ Segura Riverlink. Our fishway design process for upstream migrating fish has provided an opportunity to develop safe, timely, and effective fish passage structures.

The fish-based assessment at the river sector of the project area was initiated in autumn of 2013 with significant baseline data showing a worrying conservation status of the Southern Iberian barbel (*Luciobarbus sclateri*), the target species of the project. In addition to this native species, we have selected, as sentinel species, three other Cyprinids, Pyrenean gudgeon (*Gobio lozanoi*), Iberian nase (*Pseudochondrostoma polylepis*) and Bleak (*Alburnus alburnus*) to assess changes during the period of the project. The updated distribution of those fishes in the fluvial sector of the action project reflects a marked degradation compared to the previous data. In fact, the number of species has significantly increased due to species introduction and the turnover rate in species composition has been extremely high (Oliva-Paterna *et al.* 2014).

Since Autumn 2014, two main fish-based assessment programs have been developed (see Sánchez-Pérez *et al.* 2016 in the present FiSHMED issue). The first one focused on the fish assemblage and populations, and the second is a specified mark-recapture program only with target species. The aims of the mark-recapture program are (1) to obtain information about fish movements and (2) to develop an informative campaign on sport fishing anglers. Today we have recapture data in some fluvial sectors next to the barriers and the analysis of fish movement was initiated in 2016. We have confirmed that the target species have been using the passage structures (see Sánchez-Pérez *et al.* 2016). During the next two migration periods we are going to evaluate the effectiveness of each fishway using several complementary methodologies (like in Pereira *et al.* 2017) and we hope that these structures will be appropriate for each specific obstacle.

The comprehensive approach summary is that its main result will be to demonstrate and validate that a GI on a regional scale is an adequate conservation tool for the ecological recovering, as well as to rise the environmental value of a fluvial sector of a Mediterranean river. By which we expect to raise awareness about the ecosystem services, the fluvial biodiversity and to increase the social respect of the nearby users. The project will protect local aquatic and riverine habitats, allow fish reproductive movements along an important fluvial sector, improve ecosystem services, and build a framework of scientific and social knowledge to improve river management quality and to help the implementation and enforcement of EU Water Framework Directive and EU biodiversity Strategy to 2020.

For more information: www.segurariverlink.eu; www.facebook.com/segurariverlink

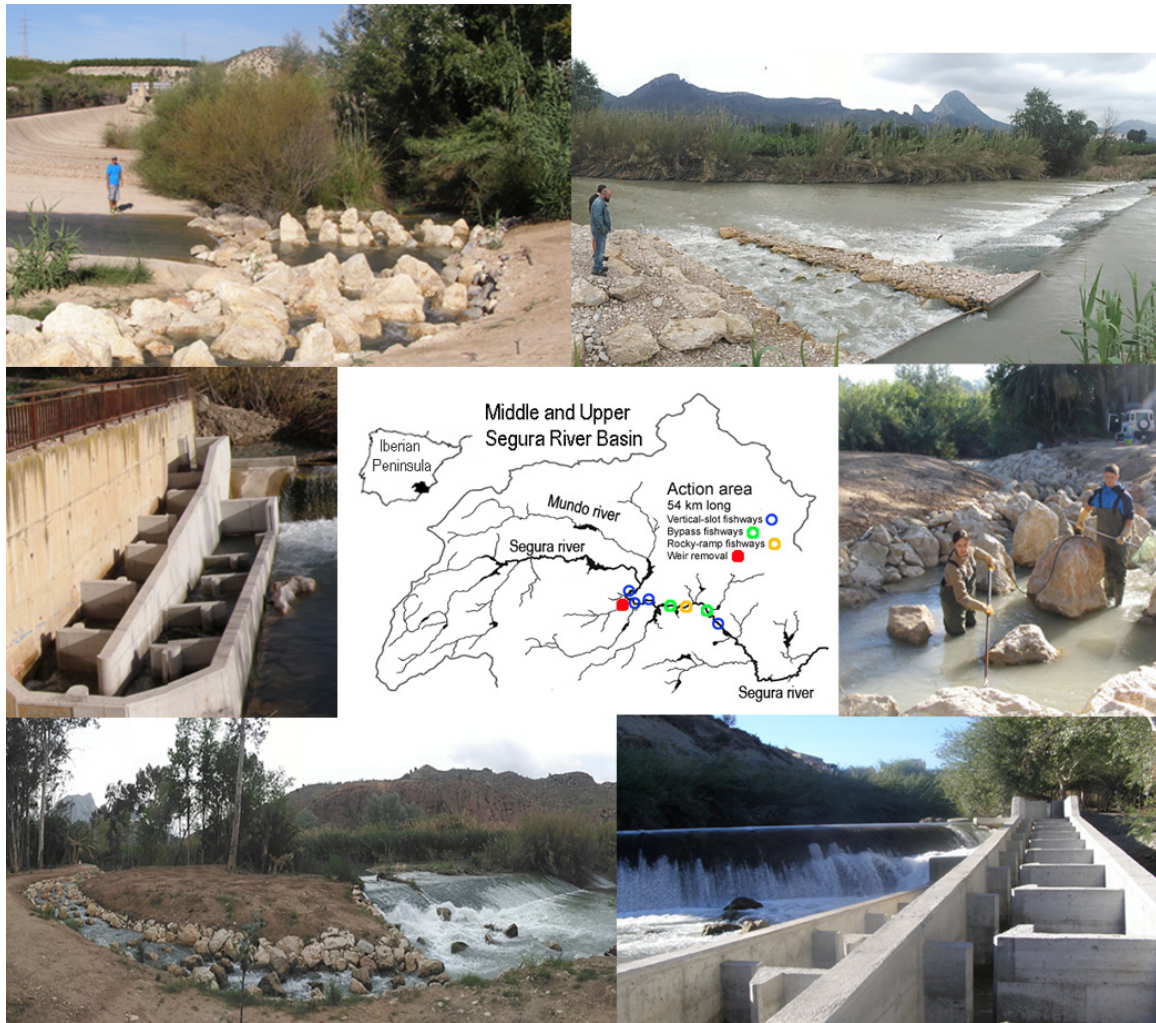


FIGURE 1. Fish passage structures implemented in the LIFE+ SEGURA RIVER-LINK. Views of the nature-like fishways, bypass fishways and fish samplings into the passes. Location of the fish passes in the middle part of the Segura River Basin is showed.

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