

Spanish River Restoration Practices: Duero Basin River Restoration

REFORM



**REstoring rivers FOR effective
catchment Management**

**STAKEHOLDER WORKSHOP
Pabellón de Méjico, SEVILLA
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Recap of the Spanish River Restoration Ideas and Practices

Highlights

2006:

- National Strategy of River Restoration:

http://www.magrama.gob.es/es/aqua/publicaciones/River_B_Restoration_tcm7-27571.pdf

2007:

- Floods Directive

2010

- River Basin Management Plans (RBMP)
- Green Infraestructure

2012

- Water Blueprint

2013

- Natural Water Retention Measures as part of Green Infraestructure

2013

- Flood risk and hazard maps

2014

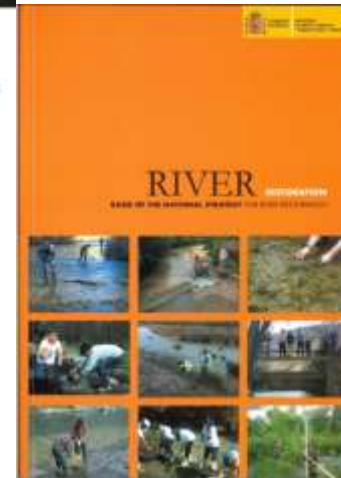
- Links between Floods Directive and WFD

2015

- Flood Risk Management Plans and RBMP could establish synergies through the Program of Measures



A Blueprint
to Safeguard Europe's
Water Resources



Main river restoration actions carry out in Spain

- **Cantabrico Basin Authority: demolition of 80 weirs and little dams**
- **Navarra Government: Arga-Aragón project and other interventions**
- **Pais Vasco Government: demolitions of weirs and dams**



Several river restoration measures have been carried out in the last 9 years in the Spanish part of the Duero Basin. There are two categories: recovery of the longitudinal continuity and improvement of the lateral connectivity.

These measures are part of the National Strategy of River Restoration and are integrated in the Program of Measures of the Duero Basin Management Plan.

These kind of actions are in accordance to an array of objectives which are integrated in Green Infrastructures Concept and Natural Water Retention Measures with several effects:

- Improvement of the hydromorphological and quality conditions in water bodies (Framework Directive)
- Control increase of flood risk (Flood Directive)
- Making bigger the water infiltration in alluvial areas (Groundwater Directive)
- Amelioration of the capacity of natural treatment processes in the receiving environment (Several Directives about Water Quality)
- Fluvial ecosystem recovery (Nature Network 2000: Habitats and Birds Directives)

Project Life MedWetRivers



First interventions in recovery of the longitudinal continuity after diagnosis shows us we have 3500 transversal obstacles in the Spanish part of the Duero Basin



Demolition of the La Concepción weir (Tormes river, Salamanca-Spain)



Demolition of the Villamorisca weir (Cea river, León-Spain)



**Demolition fo the La
Gotera weir
(Bernesga river,
León-Spain)**



**Before the building
works**



During the demolition works

Demolition fo the La Gotera weir (Bernesga river, León-Spain)



Final phases of the works



Demolition fo the La Gotera weir (Bernesga river, León-Spain)



Diferent phases of the demolition of the La Gotera weir (Bernesga river, León-Spain)



Trabajos de pesca eléctrica



Inicio de la demolición del muro



Detalle de la demolición del muro



Retirada de escombros



Inicio de la incisión en los acarreo



Finalización de los trabajos

Demolition fo the La Gotera weir (Bernesga river, León-Spain)



La Gotera weir, before and after the demolition.
We can see the high quantity of the sediment stored upstream the dam.

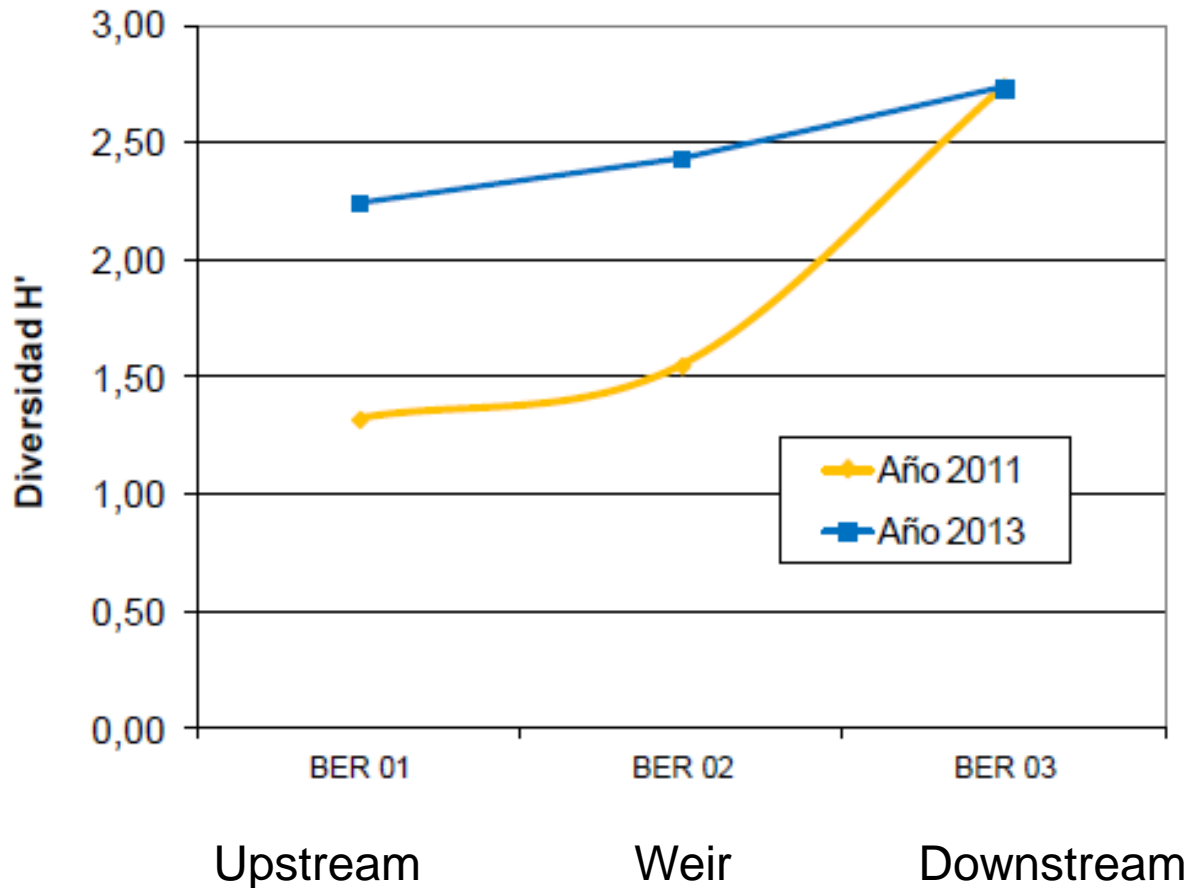


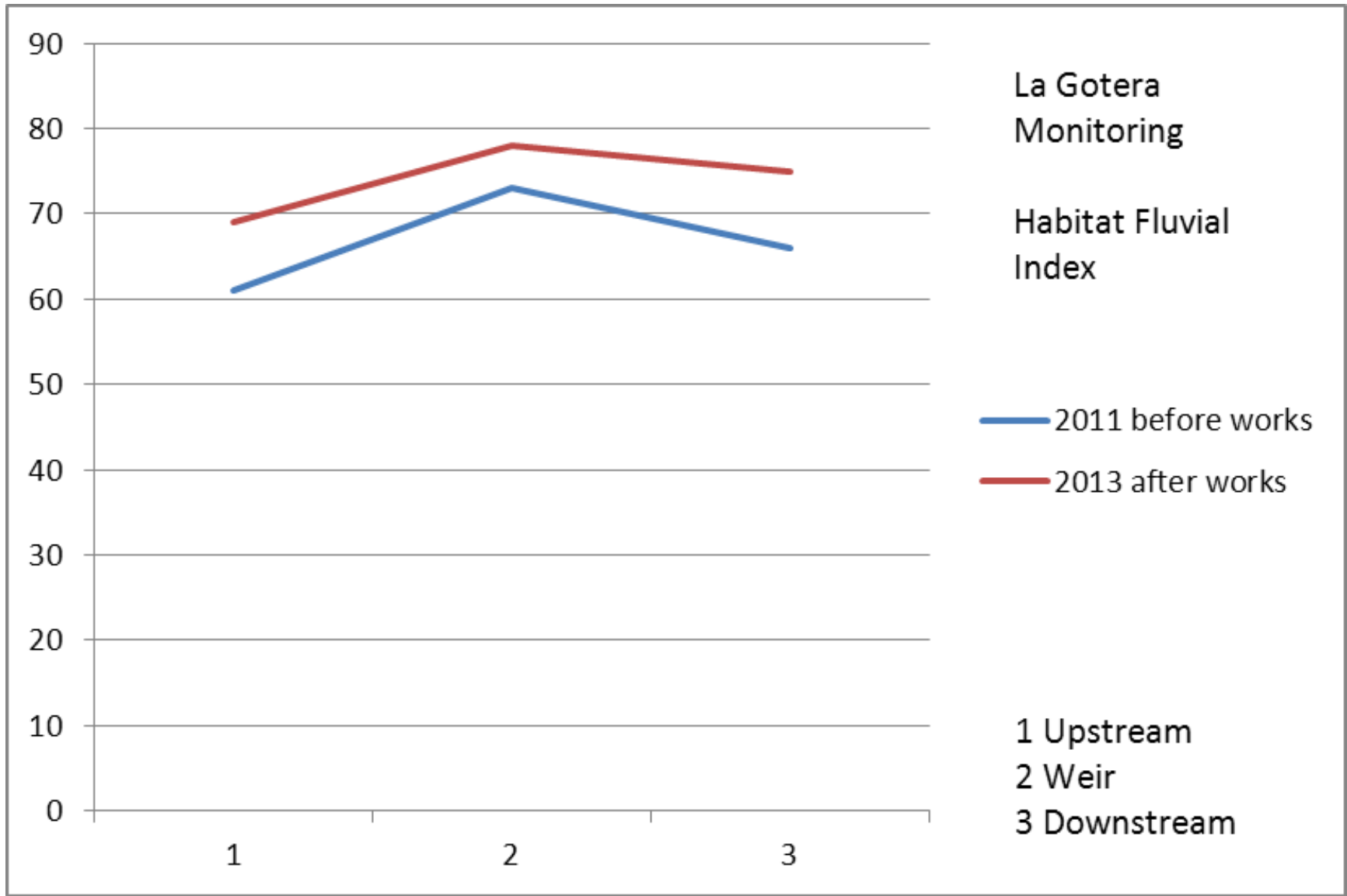
**Demolition fo the La Gotera weir
(Bernesga river, León-Spain**

**A flow peak about 22 m³/s
moved away
20.000 m³ of sediment
load stored upstream the
dam**



La Gotera Monitoring macroinvertebrates

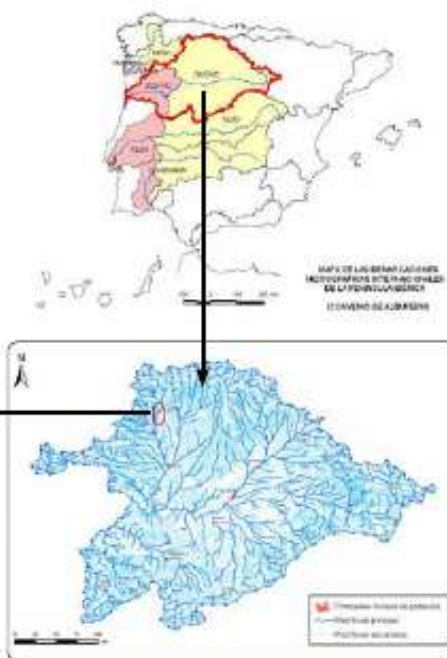




Demolition of the La Gotera Dam

Ignacio Rodríguez Muñoz, José Ignacio Santillán Ibáñez and Rosa Huertas González. Office of the Water Commissioner, Duero River Basin Authority. Luis Ortega Regato, Infraestructura y Ecología, S.L.

Map showing the location of the Duero River Basin District (International) and the Spanish portion of the Duero basin. Location of the demolition project of the La Gotera dam or weir.



The La Gotera dam or weir was located on the upper Bemesga River, with UTM coordinates 30T-283688,4755462, between the towns of Villasimpliz and Villamanín. It was used for a small hydropower plant developed in the 1920s; this use ended after the concession period of 75 years expired. Once no longer in use, it was demolished in order to recover the longitudinal continuity of the river in that stretch, thereby reconnecting about 15 km. As well as recovering the longitudinal connectivity, the project resulted in the recovery of the river's natural state in a stretch of river of singular beauty, as the river runs through a canyon formed by Ordovician quartzite of the La Gotera mountain, which lends its name to the dam. The demolition was difficult because the river runs through a narrow canyon in that stretch and access of heavy machinery to the area is difficult. The data corresponding to the demolished dam are as follows:

- Type: gravity, with a diversion channel in the left abutment.
- Maximum height: 8 m
- Average height: 7.1 m
- Length: 24.5 m

Volume of rubble material: 1,068 m3: the sediments accumulated upstream as a result of the obstruction have not been removed since they are part of the sediment flow of the river; therefore,

they have been left to be redistributed by the river current itself.

- Cost: 120,000 euros

This type of projects are part of the River Channel Conservation and Maintenance Programme of the Duero basin, within the National Strategy for River Restoration, and specifically Sub-programme 3 on the Improvement of the longitudinal continuity of rivers in the Duero basin. They consist primarily of eliminating transverse obstacles which are no longer in use (to date 79 demolition projects have been carried out) and the construction of fish passage structures in those that are still in use (105 in total in the basin; 25 of them built by the Duero River Basin Authority and 70 built or under construction by users as a result of a review of concession rights).

Brief summary of the project:

Preliminary work phase:

1. Processing and resolution of the administrative proceedings to extinguish the right to the hydropower development (18 months)
2. Preparation of a valued report (1 month)
3. Public information and environmental evaluation process (3 months)



Demolition of the Umbrías dam (Aravalle river, Ávila-Spain)

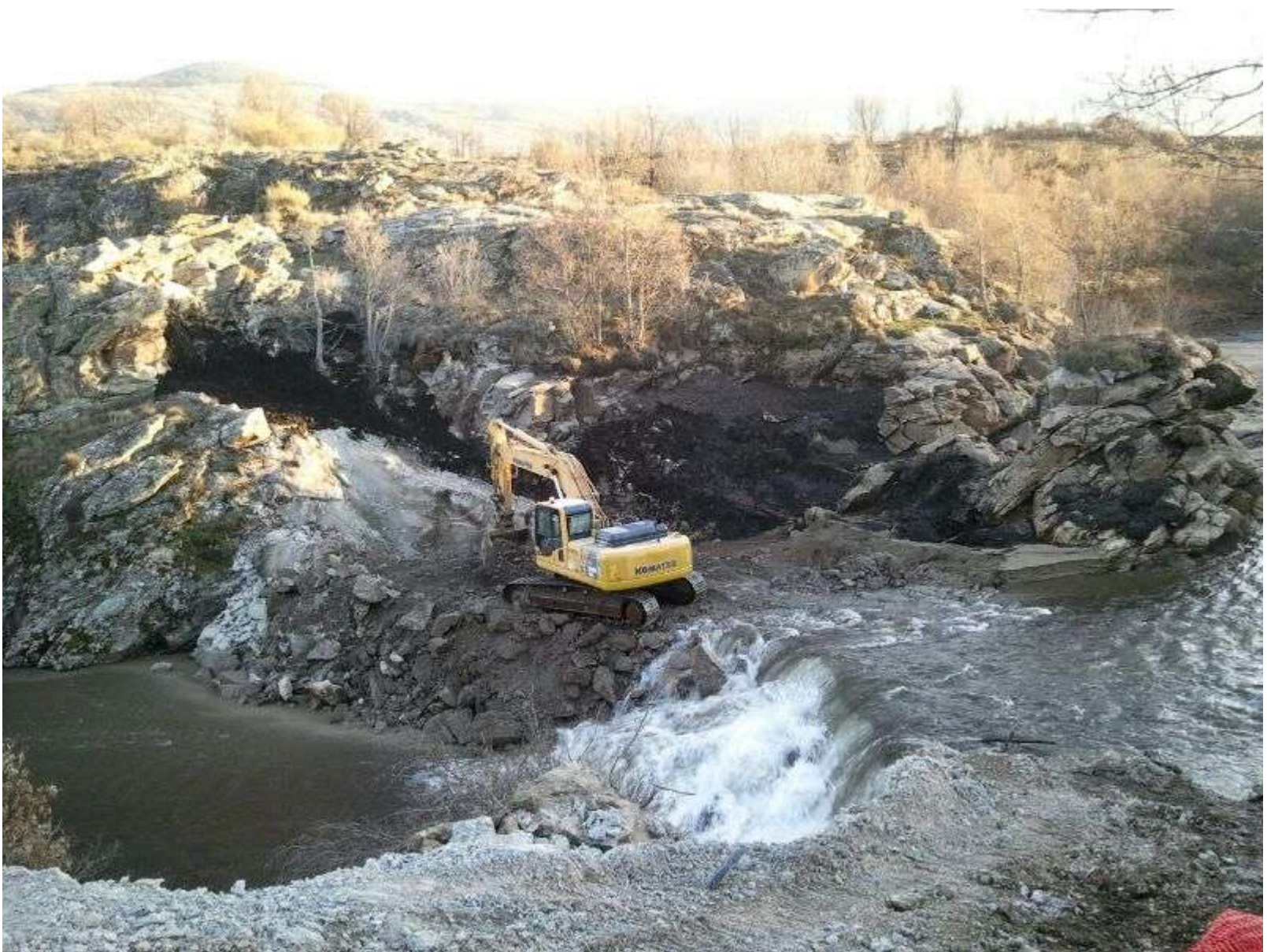




Demolition of the Umbrías dam (Aravalle river, Ávila-Spain)



Demolition of the Umbrías dam (Aravalle river, Ávila-Spain)



**Demolition of the Umbrías dam (Aravalle river, Ávila-Spain)
two months later**



Aravalle river one and a half year after works





Partial demolition of the San Marcos weir (Bernesga river, León-Spain)



**Parcial
demolition
of the San
Marcos
weir
(Bernesga
river,
León-
Spain)**

**Pictures
taken by
drone**

Before



After



14 Marzo 2014. Puente de San Marcos. León



**Fish passes are due
but they aren't in
any case the best
solution**

**They are temporary
measures that allow
the partial
reconnection for fish
and they must be
monitored**

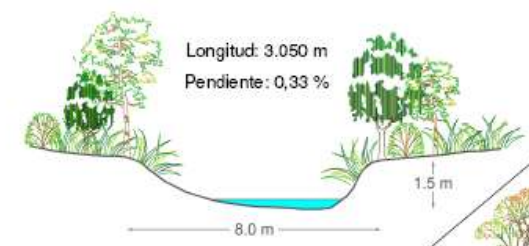
Lateral connectivity



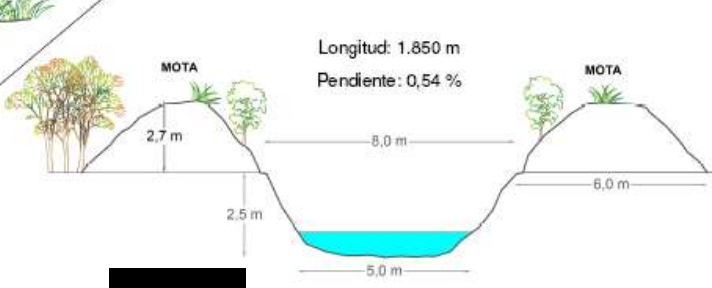
RESTAURACIÓN DEL RÍO CASTRÓN EN FERRERAS DE ABAJO, ZAMORA

El río Castrón en Ferreras de Abajo se canaliza en el año 1980. El río abandona su cauce original y circula por un canal en tierra desconectado de su llanura de inundación natural. Una parte del cauce abandonado se llena de maleza y vertidos sólidos de carácter antropogénico pero conserva en cierta medida su forma. Otra parte del cauce original se tapa por completo al ser nivelado el terreno en las tareas de acondicionamiento para la plantación de una chopera de producción. Nos encontramos por lo tanto con dos tramos diferenciados a la hora de seleccionar los trabajos para la restauración. En el tramo inicial, donde se puede ver o intuir el trazado original, se retiran los vertidos, se elimina la vegetación que invade el cauce y con tratamientos selvícolas se refuerza la presencia de las especies de ribera allí donde todavía se conservan. Este es el tramo que se describe como "cauce recuperado". En el segundo tramo, el cauce ha desaparecido, no hay vegetación de ribera y únicamente se observan algunas zonas húmedas ocasionadas por el vertido de fosas sépticas que rebosan al ser insuficientes para la población de Ferreras de Abajo. Este segundo tramo es el que se describe como "cauce restaurado" y ha sido excavado según el trazado que el río tenía en el año 1956. Los términos "restauración" y "recuperación" aquí utilizados sólo pretenden diferenciar las actuaciones necesarias para llevar el río a su estado original desde dos tramos inicialmente distintos. En su conjunto se trata de una obra de "Restauración fluvial".

CAUCE ORIGINAL



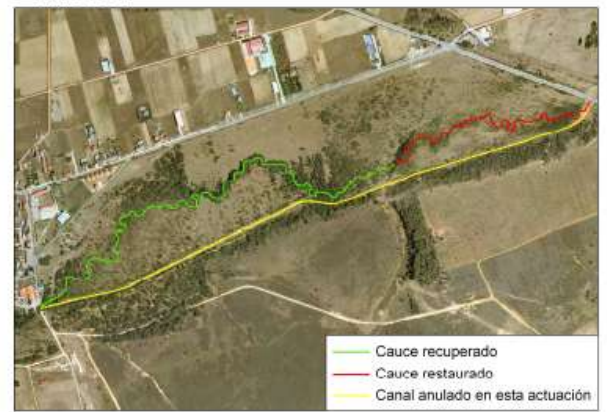
CAUCE CANALIZADO



Trazado del río Castrón sobre la fotografía aérea de 1956.



Año 2006.





Castrón river in summer, in low water level



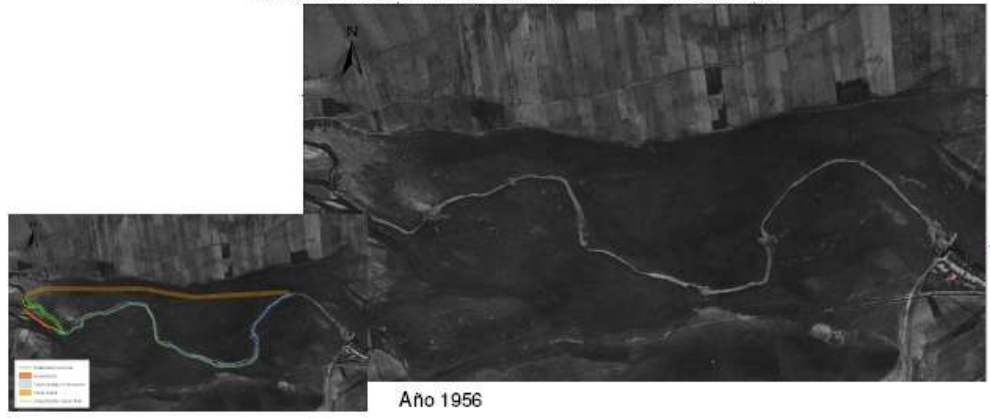
Castrón river, Ferreras de Abajo (Zamora-Spain) Bankfull stage after works

RESTAURACIÓN DEL TRAZADO ORIGINAL DEL RÍO SEQUILLO EN BELVER DE LOS MONTES, ZAMORA

Los planes de colonización agraria realizados en el pasado trataban de proporcionar una mayor superficie cultivable en terrenos fértiles para mejorar así la productividad y producción agrícola. Hoy en día, apoyados por la virtud de la perspectiva temporal, hemos podido observar los grandes perjuicios que se generan en el medio y los grandes riesgos que conlleva la canalización de nuestros cauces. Hecho que acarrea la pérdida de conexión de los mismos con sus diferentes dimensiones hidromorfológicas alejándolos de su estado natural y alterando su dinámica funcional exponiendo a los mismos y a sus áreas de influencia a consecuencias impredecibles.

El río Sequillo, como muchos de los ríos mineralizados de la meseta norte, fue objeto de una de estas canalizaciones. La Confederación Hidrográfica del Duero actúa de oficio tomando la determinación de restaurar el trazado natural del río Sequillo que se puede observar en las fotos aéreas tomadas por el ejército americano en el año 1956. En el paraje de la Dehesa de Belver de los Montes, además de recuperar la funcionalidad de la dinámica fluvial, potencialmente se recuperarán 91ha de Zonas Inundables dentro de la ZEPA "Tierra del Pan" (Cod. Es0000209) lo cual podría formar humedales estacionales muy favorables para las poblaciones orníticas de la zona.

Caracterización del cauce



CANALIZACIÓN

La canalización conlleva modificaciones en la dinámica fluvial, que generan problemas de incisión, erosión y alteraciones en el nivel freático.

DEGRADACIÓN de la DINÁMICA FLUVIAL

Es necesario en todo proyecto de restauración fluvial, conocer el estado previo a la perturbación para poder revertir los efectos de la misma, y prever con mayor exactitud el resultado de las actuaciones proyectadas. Para ello se hace necesaria documentación como las fotos del vuelo americano de 1956, fotos antiguas de la zona y testimonios de personas que vivieron en aquellos tiempos. También se hace útil el estudio comparativo de tramos del mismo cauce, o de cauces con las mismas características del que va a ser objeto de la actuación.



Old Sequillo river in Belver de los Montes (Zamora-Spain): picture taken from the levee of the realignment channel



**Recovery of the old
river. Sequillo river,
Belver de los Montes
(Zamora-Spain)**



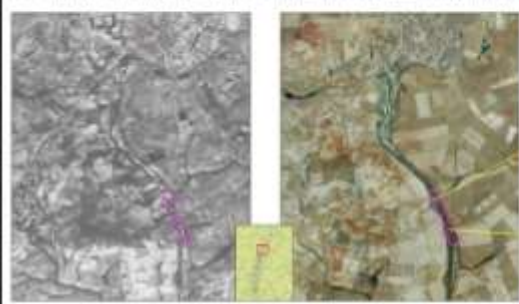
**Realigned channel of
the Sequillo river
mantained as
backwater**

**Recovery of the old river.
Sequillo river, Belver de los
Montes (zamora-Spain)**



RENATURALIZACIÓN Y RESTAURACIÓN DEL RÍO SALADO EN VILLARRÍN DE CAMPOS, ZAMORA

En el año 1972 con el fin de producir la desecación total de la superficie lagunar de la zona de Villarrín, el Arroyo Salado fue convertido en un verdadero canal, dotado de sus márgenes, conformados por el material entrado en la excavación, dejando un trazado prácticamente rectilíneo. La situación está dentro de la Reserva Regional de Caza "Lagunas de Villarrín", que a la vez está delimitada como ZEPA por su riqueza ornitológica y LSI por su riqueza botánica. Con los trabajos realizados, se pretende recuperar el cauce antiguo de Arroyo, eliminando los márgenes, y volver material fértil al canal, con el fin de devolver al río su función de inundación regular y dote de agua a las zonas de prado antiguo (Pastizales Salinos Mediterráneos, Juncofita Marces y Prados Húmedos Mediterráneos de marces altas del Mioceno-Astocotermoy y la principal asociación presente en la zona que es Estepas Salinas Mediterráneas (Limonada).



Zonas de los trabajos sobre la fotografía aérea de 1956 y satélite de 2006.



Zona de los dos tramos antiguos, se observa el canal rectilíneo en oscuro y a su izquierda el antiguo cauce meandrosito recuperado.



Antes de los trabajos Después de los trabajos



Antes de los trabajos Después de los trabajos



Paradigma de la zona ya recuperada, produciéndose visiblemente el aumento de la fauna de inundación y la conectividad lateral.

Las limícolas, como en este caso la cigüeñuela no lo tenían fácil con el canal, ahora con la disminución de la profundidad pueden alimentarse en el lecho del cauce recuperado.



El cambio va produciendo ya sus frutos

Dechannelization of the Salado river in Villarrín de Campos (Zamora-Spain)

18.000 m Levee removal, Arroyo de la Vega (León)



18.000 m Levee removal, Arroyo de la Vega (León)



Levee removal 18.000 m Arroyo de la Vega (León)



Some indicators of the National Strategy of River Restoration in Duero Basin

Longitudinal connectivity

Transversal obstacles removal: 99 (600 km river length re-connecting)

Fish passes: 80 (420 km partially re-connecting)

Lateral connectivity

Levee removal: 62.125 m.l.

Levee setback: 8.200 m.l.

De-channelization: 12.300 m.l.



The Órbigo River Restoration Project:

http://www.riverfoundation.org.au/articles/2013_IRF_European_Riverprize_Finalists



Órbigo river before the works



Works recently completed



After six months

2013 IRF European Riverprize Finalists

PUBLISHED: 11 JULY 2013

ORBIGO RIVER, SPAIN

The Órbigo River is located within the Duero Basin, a trans-national shared between Spain and Portugal. Here, water management strategies have evolved historically from a view of the hydrologic cycle as a resource to a more integrated and focused approach encompassing ecological functioning. This approach fits under the European Union legislation on water, particularly the Water Framework Directive and Floods Directive. From this context, the National Strategy for River Restoration emerged in two thousand and six with the ultimate goal to improve the ecological status of all Spanish water courses. In order to develop this Strategy, the Ministry asked its agencies for demonstrative actions of change in the management of river systems, promoting integration with land use following sustainability criteria, while encouraging engagement and civil participation, and technical training in this new approach. Órbigo River Restoration Project was designed for this purpose: it is an example of integration of both water management and land use policies. It covers a variety of actions including recovering "room for the river", improving lateral connectivity and the recovery of secondary channels and other para-river structures which reduced ecological functioning because of channelization. The integrated approach ensures that public participation processes, education and training and a volunteering program underpin the implementation of the project.

RIVER RHINE, ALL COUNTRIES IN RHINE BASIN

Following half a century of river degradation and a nineteen-eight-six chemical accident near Basel resulting in hundreds of kilometres of river being polluted and the mass death of fish, eels and other aquatic organisms, those responsible for the River Rhine realised that a fundamental shift in thinking was required for the management of this major transnational river.

Following investments by the states, municipalities and industry, more than ninety-six per cent of the fifty-eight million inhabitants of the Rhine catchment are today connected to urban wastewater treatment plants and many industrial sites now dispose of waste via modern treatment plants. As a result, water quality has improved considerably and oxygen

Alcoba weir before works

Órbigo River

Framework



Directive 2007/60/ of the European Parliament and the Council of 23 october 2007, on the assesment and management of flodd risks

Whereas, number 14:

Flood risk management plans should focus on prevention, proteccion and preparedness. With a view to given rivers more espace, they should consider where possible the maintenance and/or the restoration of floodplains,...

Chapter IV, Flood Risk Management Plans

Article 7, 3: ...Flood risk management plans shall take into account relevant aspects such as costs and beneficts, flood extent and flood conveyance routes and areas which have the potencial to retain flood water, such as natural floodplains, the environmental objetives of Article 4 Water Framework Directive, soil and water manegement, spatial planning, land use, nature conservation,...

The Órbigo River Restoration Project

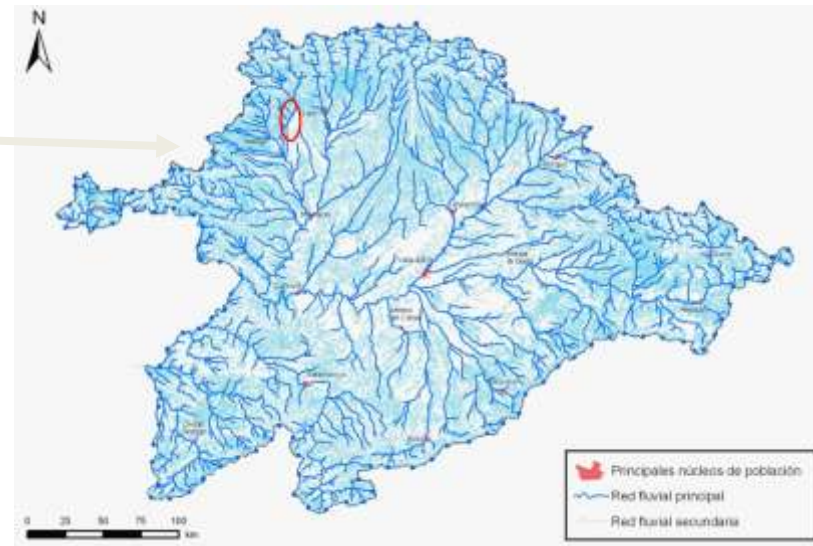
Phases of the project

1. Preliminary flood risk assesment
2. Draft project
3. Public participation and information
4. Environmental assessment
5. Final project
6. Construction work (started in October 2011, finish in November 2012)
7. Monitoring



The Órbigo River Restoration Project

Maps showing the location of the Duero International River Basin District and the Spanish portion of it.



River length: 108 km , from its source in the province of León as a result of the confluence of the Luna fork and Omañas fork, to the point where it flows into the Esla River on its right margin, in the province of Zamora

Stretch I: 23.5 km, in order to undertake the project with greater ease, the river has been divided into three stretches, with work currently underway in the upper stretch or I, and with a budget of 3.1 million euros.

The Órbigo River Restoration Project

Hydrographical and hydrological characteristics of the Órbigo River:

Basin surface: 4,990 km²

Maximum altitude: 2,411 m.a.s.l.

Minimum altitude: 827 m.a.s.l.

Altitude range: 1,584 m

Regime: rainfall-snowfall

Average discharge under the natural regime: 40 m³/s

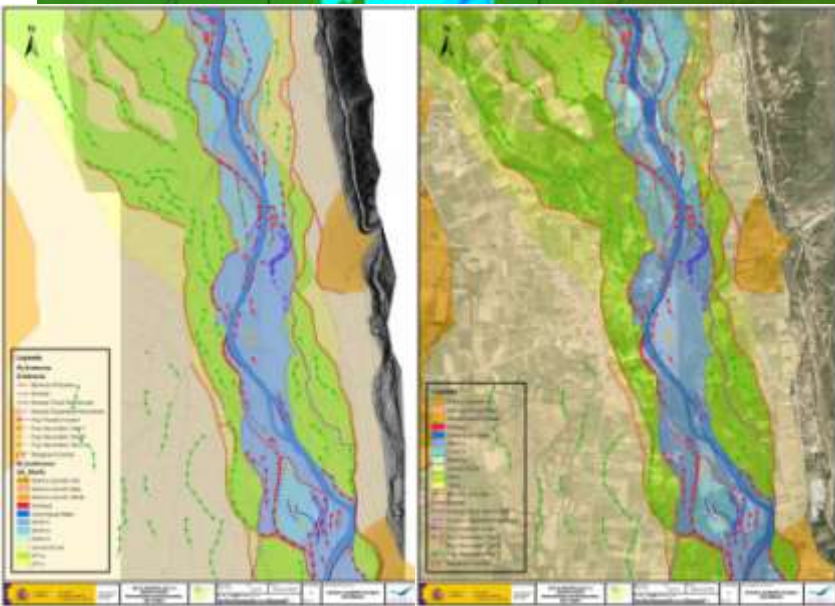
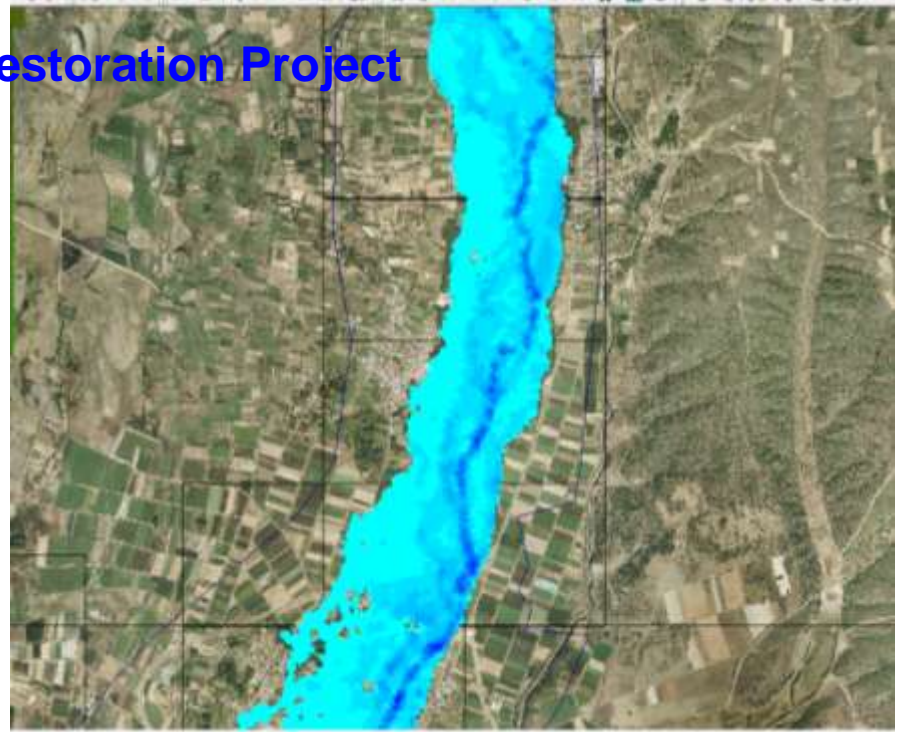
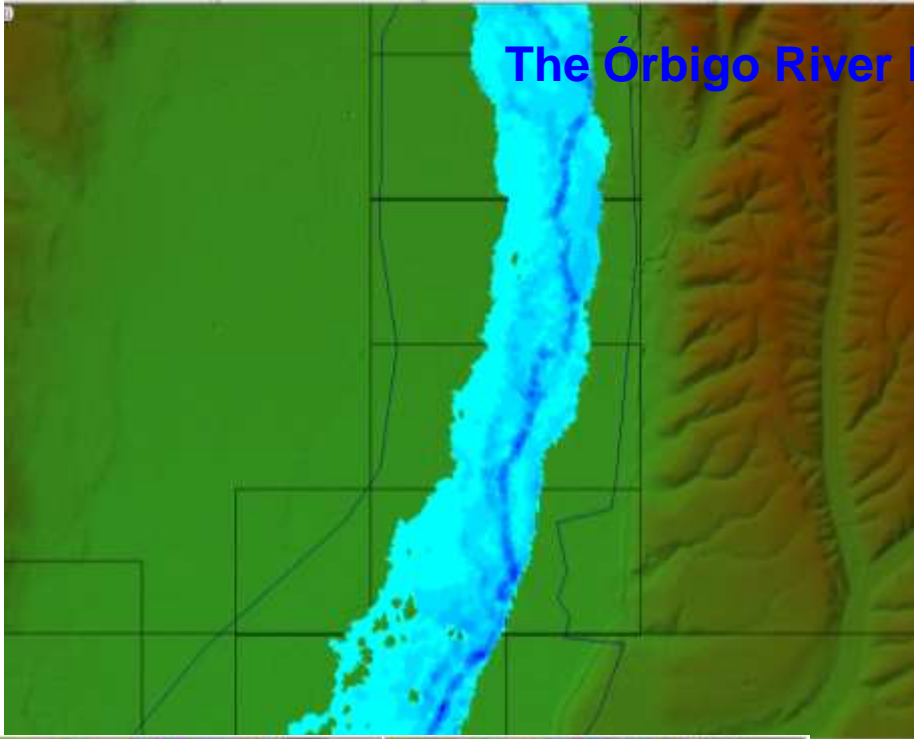
Base discharge under the natural regime: 15 m³/s

Peak discharge registered: 600 m³/s

Original geomorphology: braided (wandering) and meandering

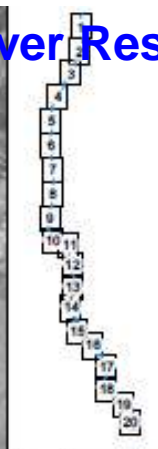


The Órbigo River Restoration Project



Maps showing geomorphic and hydraulic aspects (flood area T 500 years) of a portion of stretch I in the upper Órbigo River, extracted from the studies about Flood Risk and Hazard Maps

The Órbigo River Restoration Project



Comparison between orthophotos of a 5 km segment in the Stretch I of the Órbigo River taken in 1956 and 2006. They show perfectly the encroachment on the original channels (braided), the channelization and the drastic morphological changes occurred in 50 years.

The Órbigo River Restoration Project

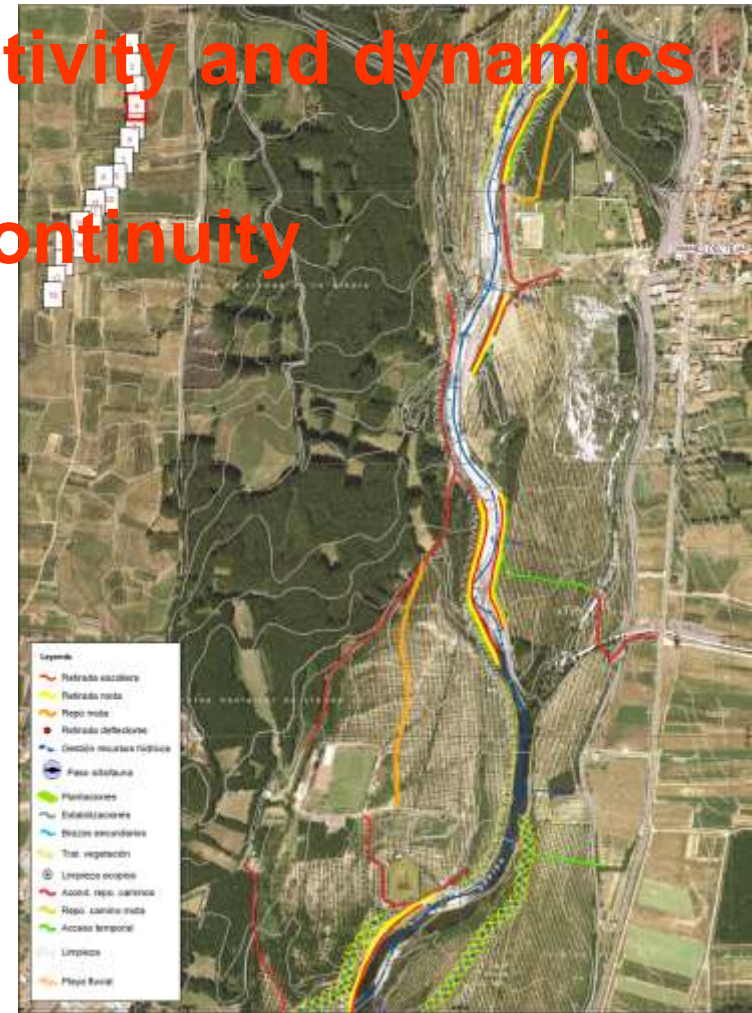
Main actions undertaken along the length of stretch I (23,500 m):

Works to improve lateral connectivity and dynamics

Works to improve longitudinal continuity

Forest actions

Orthophoto of a portion of the stretch I showing the earth embankments that are eliminated and/or moved away from the channel



The Órbigo River Restoration Project

Works to improve lateral connectivity and dynamics:

Elimination of rock armour (rip-rap): 4,720 m

Elimination of levees: 8,710 m

Setback of levees: 3,130 m

Recovery of secondary channels: 10,063 m

Recovery of flood prone areas: 300 ha



Works to eliminate earth embankments in stretch I of the ecological improvement project in the Órbigo River



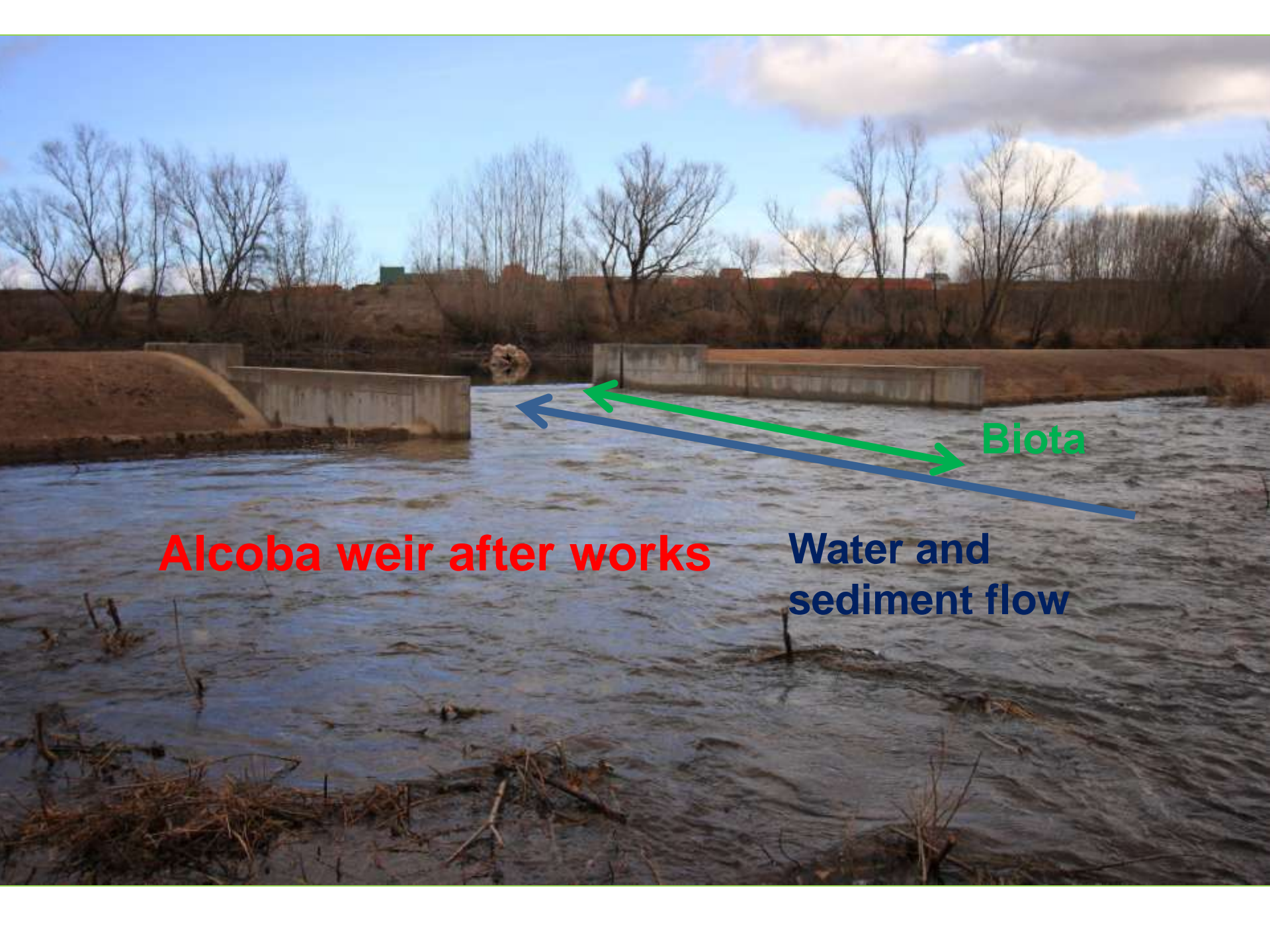
The Órbigo River Restoration Project

Works to improve longitudinal continuity:

Modification of transversal obstacles to allow the passage of fauna and sediment flow: 1 unit



Alcoba weir before and during the works to allow the passage of fauna and sediment flows



Alcoba weir after works

**Water and
sediment flow**

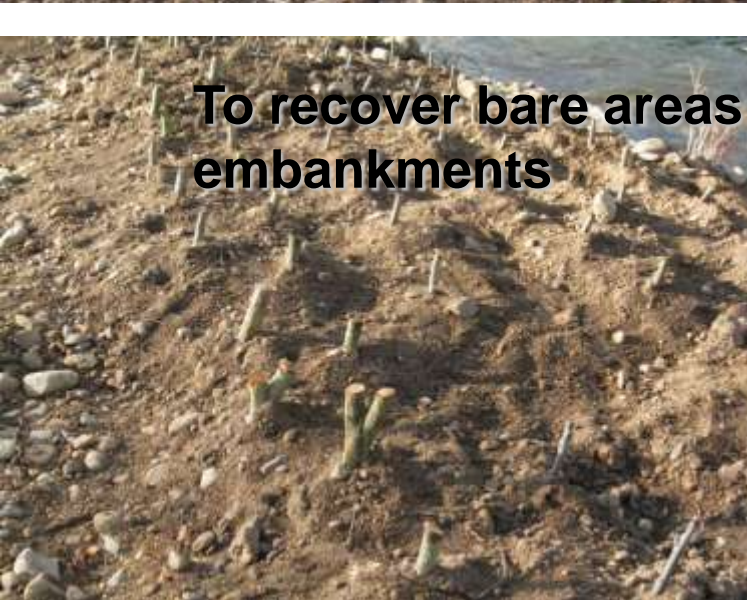
Biota

The Órbigo River Restoration Project

Forest actions:

Revegetation with riparian vegetation: 7.2 ha

To recover bare areas after the elimination or relocation of earth embankments



Órbigo river monitoring by drone





Thanks

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