ARGA and ARAGÓN RIVERS

Title		**LIFE + MINK TERRITORY (*Territorio visón*)**	
Organization		Gestión Ambiental de Navarra, Navarre Government, TRAGSA, Ministry of Ecological Transition, Ebro Water Agency	
Start	**End**	October 2010	March 2016
River typology		Meandering gravel river (wandering previously)	
Target species/habitat		European mink, Poplar and willow riparian woodlands, Otter, European, Pond turtle, Meanders	
Q mean		65 m^3/s	
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LOCATION AND CONTEXT

The LIFE + *Territorio Visón* (Mink territory) project comprises the restoration of the lower reaches of Arga and Aragón Rivers which are in the Aragón basin, a tributary of the left margin of Ebro River. The lower Arga and Aragón Rivers are located in the middle part of the Ebro Basin (NE Spain). The Aragón River is a 190-km-long tributary of the Ebro River that drains an 8,609 km^2 basin in the north of the Iberian Peninsula (Fig. 1). The Arga River is a 150 km long tributary of the Aragón River that confluences few kilometres upstream of the Ebro confluence.

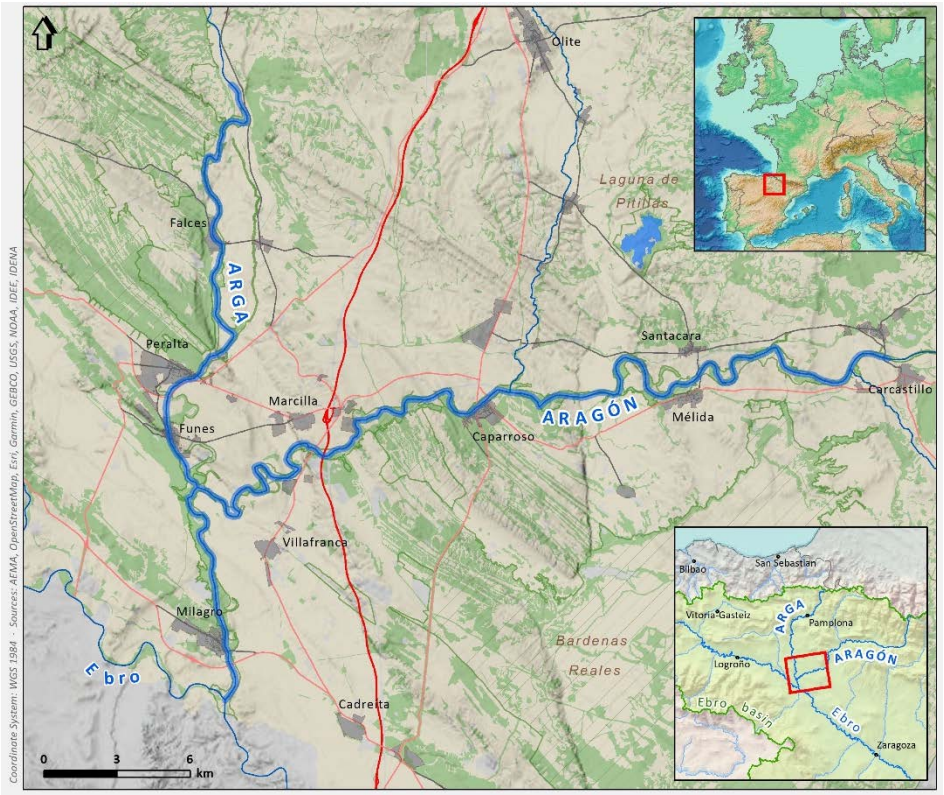

Figure 1. Location of the lower reaches of Arga and Aragón Rivers

The Arga and Aragón Rivers has been long affected by impacts both on the drainage basin and in the channel. Since the beginning of the twentieth century, many defences (groynes, riprap and bank structures) have been constructed along the river to reduce river space, channel mobility and bank erosion and to protect from floods and the lands. These infrastructures encouraged human activities, mainly agriculture and poplar plantations, in the floodplain. Additionally, the Aragón River has been affected by two reservoirs, Yesa (446.9 hm^3) built in 1959 and Itoiz (417 hm^3) built in 2004 on the Irati River, one of the main tributaries of the Aragón. The drainage area of Yesa is around 25% of the total of Aragón basin, whilst in Itoiz, it is 5.9%, and both reservoirs are used mainly for irrigation purposes. These reservoirs, especially Yesa which is older, have drastically altered the dynamics of the Aragón River as a result of reduced discharge and sediment trapping (Acín et al., 2011). The Arga River has a reservoir in its upper part, but without so much regulation effect on the river discharge. On the

contrary, in the 80's the lower reach of Arga River suffered a channelization that cut several meanders to protect downstream settlements against flooding and which disconnected the river and led to a severe incision of the river. Both rivers have had also a long history of gravel mining and the in the beginning of the 21st century some small hydropower stations were installed cutting some meanders of the river (Ibisate et al., 2013).

These defence infrastructures considerably reduced the dynamics of these two rivers, leading to the decline of the conservation status of the natural habitats (by aging and area reduction), which in turn limits the biological diversity of the area, but also the geomorphological diversity and the availability of sediments on a river with reduced availability due to reservoirs and gravel mining. The European mink is particularly affected by the degradation of the riverine ecosystem, since it is a semi-aquatic mammal whose preferred habitat is the margins of the middle sections of rivers and ponds such as lagoons and oxbow lakes, with abundant vegetation of cattails (*Typha*) and reeds (*Phragmites*). This area is home to 20% of the population of this species in Navarre and 2/3 of the Iberian population, giving an idea of the importance of restoring the riverine ecosystems in the lower basin of these two rivers as part of the overall strategy for the conservation of species.

PRESSURES & IMPACTS
1) Lateral defences and embankments
2) Agricultural use (poplar plantations) and irrigation
3) Reservoirs
4) Weirs
5) Small hydropower plants
6) Narrowing
7) Incision

Prior to the Territorio Visón project, there was a background of studies and projects and restorations that laid the groundwork for the realization of this project. In the Management Plan for the Site of Community Importance, "Lower Aragón and Arga Rivers," fluvial continuum space, predecessor of "Fluvial Territory," was a key element of biodiversity conservation planning in this Natura 2000 space. In subsequent EU-funded projects, some of the proposed actions in the Management Plan established Fluvial Territory restoration as a means for conserving biodiversity while managing flood risk and human land uses, as SUDEAU and LIFE GERVE – Ecosystemic Management of Rivers with European Mink – which was awarded with the Best of LIFE prize, included the recovery of part of the floodplain, removing dykes which helped to reduce flooding risk downstream.

One of the actions of the Mink territory LIFE+ project was also finalist of the European River Prize in 2016.

The European mink (*Mustela lutreola*), as one of the most endangered species on the planet, is particularly affected by the degradation of the river ecosystems. This is due to the fact that is a species that needs the natural woodlands and wetlands alongside the rivers during the different stages of its life. The LIFE + MINK TERRITORY project was directed at restoring the river habitats along the lower reaches of the Aragón and Arga rivers in Navarre and at increasing the mink population and its conservation status.

The project is expected to achieve an integral improvement of the fluvial ecosystem that will lead to the recovery and increase in population of the European mink, together with a decrease in its main threats. Oxbow lakes, wetlands, floodplains, river forests and river beds were restored as part of the objective of improving the carrying capacity of the area for the target species.

The project also sought to promote a more positive public attitude to nature, the fluvial territory and biodiversity conservation.

OBJECTIVES
The project has the objectives: ➢ **Restore the floodplain and river habitats, recover the fluvial territory in the area with the highest density of European mink in western Europe** ➢ **Healthier and more diverse nature** ➢ **Promote people awareness to the fluvial territory and biodiversity conservation**

Target species/habitats	European mink, alluvial forest, Hydromorphology

RESTORATION ACTIONS

The restored reaches, located downstream from the reservoirs, have 43.7 km in the Aragón River before the confluence, 19.1 km in the Arga River, and 10.1 km in the Aragón River once their confluence until the Ebro River. Both rivers present a gravel-bed meandering channel

1) GIVING BACK FLUVIAL TERRITORY: SET BACK OF RIPRAPS

The use of the Spanish term “Territorio Fluvial” (Fluvial Territory) was established by the participants in the working session on geomorphological disturbances of rivers in

the National Strategy for River Restoration (Ollero, 2007). The project will implement the 'Fluvial Territory' concept as a way of preserving biodiversity, recover the fluvial dynamics and obtaining good ecological status, while also promoting public interest, awareness and flood protection.

To recover fluvial space, Fluvial Territory, municipal lands were purchased or agreements were reached with the municipalities for its land use change and lateral dykes and ripraps were set back to give more space to the river. The project focused on less productive areas or already cut poplar plantations to facilitate the agreements with local authorities.

These are complex actions. On the one hand, it implies a change in the river management models used up to now, in accordance with the Water Framework Directive (2000/60) and the Floods Directive (2007/60). On the other hand, socially it implies a mentality change of the local population, who fear that the actions will affect their safety and productive land. For this reason, actions have focused on eliminating the first lines of defense in areas of lower productivity, and restoring a second line of defense to maintain the degree of protection in productive areas. This requires hydraulic studies to ensure the effectiveness of the actions and to determine how they should be implemented. This is important to favor the credibility and acceptance of the new river management models. It also entails important participatory processes, but thanks to them, the local population and municipalities are familiarized, sensitized and understand the need for a change in river management models, so that production, protection and conservation objectives can be compatible. The initial forecasts for the elimination of dykes was significantly increased (Goikoetxea, 2015).

Flood protection is a key element for local population and authorities. Lateral defenses removal, set back of defenses to protect more external areas against flooding and increase of floodplain surface was done in 7 municipalities.


0
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Figure 2. Example of 8.65 ha fluvial territory recovery in Soto Manolo and wetlands creation. From the top to down: 1957; late 90'; before restoration in 2012 (yellow line set back of riprap, red line improvement of a path protection); after restoration (2013) and in 2022.

- In Mélida and Sotocontiendas 582 m and 1425 m of lateral dykes were set back, reconstructing or heightening existing structures and guaranteeing that the same protection degree is kept behind the setback defences.
- In other cases buying the lands for restoration and conservation does not require more protection, facilitating the recovery of functional floodplains and decreasing flood risk areas downstream. This has been implemented in Caparroso (Figure 2), Carcastillo and Soto Montecillo where 800 m, 1450 m and 400 m of dykes and riprap were removed, respectively.
- Finally, old dykes in external areas without any function were removed.

2) RECONNECTION OF MEANDERS

In the 80's the channelization of the lower Arga River cut several meanders. This led to the hydraulic disconnection of these meanders and the incision of the Arga River. The disconnection supposed the deterioration, lack of renovation, siltation and desiccation of associated riparian forests.

The reconnection is only given during ordinary floods due to the elevation differences as consequence of incision, but enough for the project objectives of recovery the natural dynamics of these spaces relevant for the European mink. The hydraulic reconnection of the meanders during flooding make possible to remove the fine sediment from the former river bed whilst the target habitats are flooded, thereby ensuring their natural conservation and regeneration. The reconnection was made by excavating 54,776 m^3 at the entrance of the former river bed (previously blocked off) and by clearing the infrastructures preventing the water circulation: earth embankments, cross pathways, etc.

The work has been carried out on the following remnant meanders: Soto de La Muga (Peralta) and Soto de Santa Eulalia (Peralta). A third one initially contemplated was not completed under this project but it has been done in a subsequent project led by the Ministry of Environment.

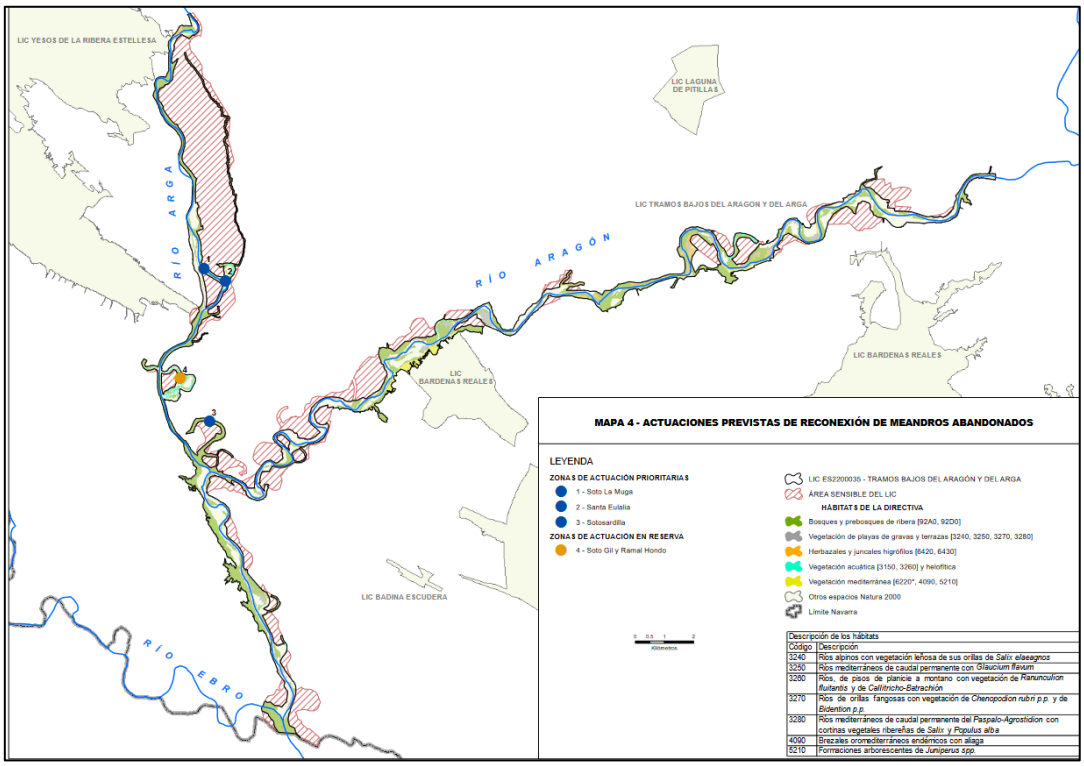

Figure 3. Location of the reconnection meanders actions along the Arga River.

The project has been carried out taking into account physical, infrastructural, protection and public use constraints public use, which have been incorporated after a process of participation with the Peralta City Council.

3) GRAVEL ADDITION

The lack of sediment due to the upstream reservoirs, lateral defences, weirs, gravel extraction and river narrowing led to important incision processes on the Aragón River with a decrease of the water table and problems with the stability of infrastructures which became a serious agronomic and environmental problem.

Gravel addition was done in Sotocontiendas, a meander or Aragón River in Marcilla upstream from the confluence of Arga River. This river reach was selected based on social, legal and political feasibility. A geomorphological, morphometric and granulometrical analysis were previously done, as well as hydraulic and morphodinamic validations that were used to explain people the lack of risk of introducing sediments to the riverbed and reactivating erosive and lateral flooding processes (Pérez et al., 2015).

As Perez et al. (2015) explain: The morphological and ecological model chosen proposes the naturalisation of the forms as a means of (I) recovering riverbed-forming processes, (II) restoring the lateral dynamics of overflow and the processes they

depend upon, (III) reversing sedimentary levels by promoting natural deposition, (IV) increasing the availability of sediments and (V) increasing the heterogeneity of habitats and biological diversity, favoring the formation of lateral backwaters (wetlands). Eventually the provision of longitudinal profile control structures as a way of stabilising the incision was ruled out.

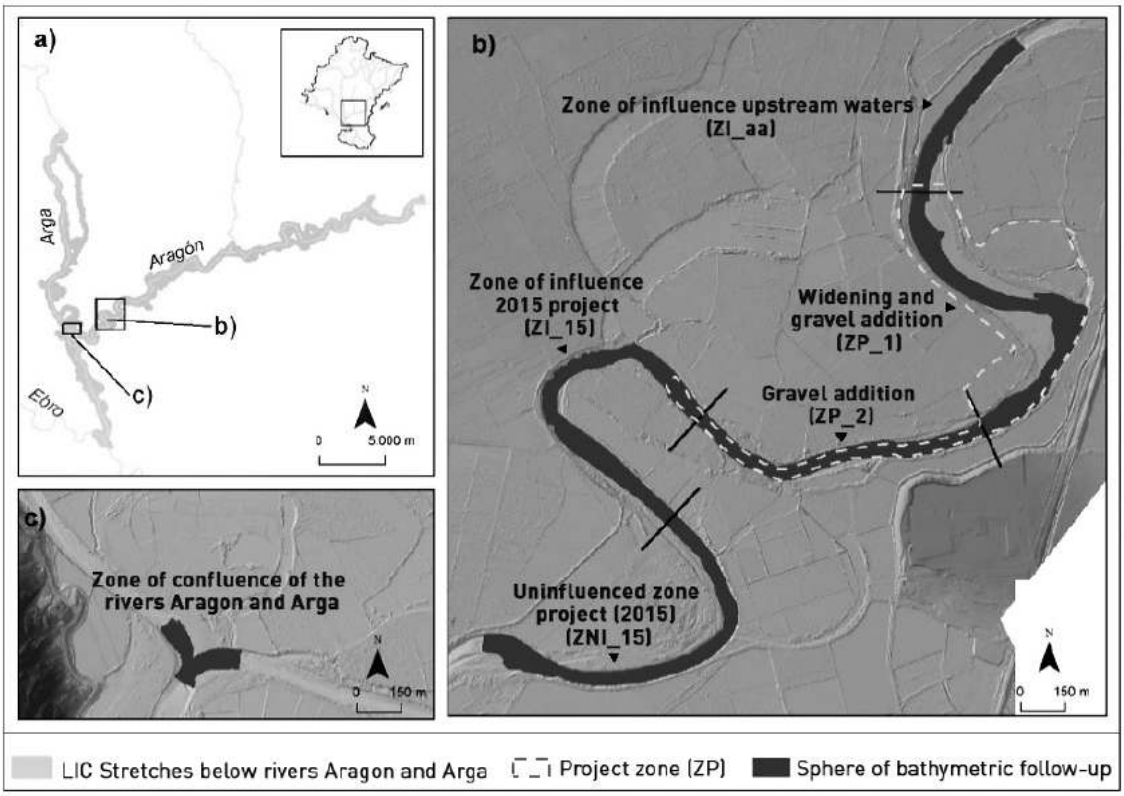

Figure 4. Location of the gravel addition river reach (Pérez et al., 2015)

The project was carried out between February and November 2014. River restoration activities took place on a total of 32 ha and along 2.5 km of river. The restoration actions were (Pérez et al., 2015):

(I) Recovering the geo-morphodynamic process of lateral adjustment by suppressing 985 lineal meters of riprap and similar structures.

(II) Reactivating overflow processes following the elimination of containing structures, which involved the removal of 1,342 linear meters of dyke.

(III) Restoring the original reliefs and forms in accordance with the morphometric studies. 4.6 ha were re-sectioned, generating a land excavation volume of 200,000 m^3, of which 101,115 m^3 was gravel and 98,885 m^3 silt.

(IV) Returning the excavated sediments (mainly dredged material that constituted the borders and constructed the dykes). 90,485 m^3 of silt was reintroduced back into the river during episodes of swelling, and gravel was spread evenly along the 2.5 km, creating an average regrowth of 0.65 m.

(V) The reconstruction of the former lagoon that was filled in for forestry purposes. It constitutes a hugely important habitat for the European mink.

Restoration process: Removal of dykes (B); suppression of ripraps (A); recovering riparian space (C, D); recovering space for beds and widening the main channel (E, F, G); returning to the river the sediments dredged during the past (H, I, J).

Figure 5. Process of removal of defences and giving sediments back to the river

The project development has been accompanied by an exemplary process of social awareness-raising and social concertation process in a territory where the omnipresence of the hydraulic risk had led to political and popular positions that had been demanded the provision of control structures and river dredging.

4) OTHER ACTIONS

Other restoration and conservations actions related to the recovery of specific habitats of the European mink, to recover riparian vegetation habitats and removal of alien and invasive species (Goikoetxea, 2015):

- Actions directly related to the recovery of disappeared specific habitats of the European mink due to the homogenization of river ecosystems. It requires calm waters, associated with the main riverbed, in reproductive stages breeding to raise and feed offspring. The actions targeted the recovery of wetlands:
  - Irregular soil excavation with different depths to create a diversity of environments, also of interest for other species,
  - Irregular, lobulated and stretched banks, gentle slopes, islands.
  - Creation of mink refuges, thorny corridors, recovery of riverbanks
  - Wetlands associated to irrigation leftover returns
  - Wetlands connected with the water table
- Actions to recover and conservation of other fluvial habitats of interest. The recovery of the 92A0 (*Populus nigra* and *Populus alba* riparian forests) or 92D0 (*Tamarix gallica* forests), 3270 (nitrophilous vegetation colonizing gravel pits) or 3280 (herbaceous nitrophilous annual and perennial herbaceous formations).
  - 115 ha of poplar plantations transformations.
  - Agreements with the municipalities and financial compensations.
  - Active restoration and plantations with local vegetation.
  - Passive restoration associated with the enhancement of the fluvial territory in order to favour natural regeneration of the areas and the removal of poplar groves and mechanical and biological tree stump removal.
  - Other complementary actions: chiropterans, picidae, European sapper, European pond turtle...
- Removal of alien and invasive species:
  - Growing environmental problem.
  - Floridian pond turtle (*Trachemys scripta*).
  - Cane (*Arundo donax*), Ailanthus (*Ailanthus altissima*), False Acacia (*Robinia pseudoacacia*).
  - Sampling and captures are carried out to diagnose the species and demonstrative and demonstrative actions have been carried out for the species eradication.

MONITORING

A monitoring program was developed to assess ecological and geomorphological results of different restoration actions.

The monitoring of dykes and ripraps removal and sediment addition was done through a couple of bathymetrical surveys, one before the works began and another once they were finished, in March 2015, to provide an approximation of the morpho-sedimentary behaviour of the river reach.

As Perez et al. (2015) explained the preliminary data available (Figure 6 and 7) indicates that the morpho-functional behaviour of the stretch is extremely similar to that envisaged. The results of the hydro and morphodynamic studies of model validation (prior to the works), concluded that the effect on the likelihood of flooding in the stretch were imperceptible, and that the filling would remain in the widened stretch, whilst in the rest of the stretch the material would not accumulate but circulated to lower waters. Following the envisaged addition, the bed of the river Aragon would balance out after around 100 days, understood as equivalent days of water flow (calculated at approximately 21% del Q2.33). For its part, the river would maintain waters at the lower part of the widened stretch, and the initial slope.

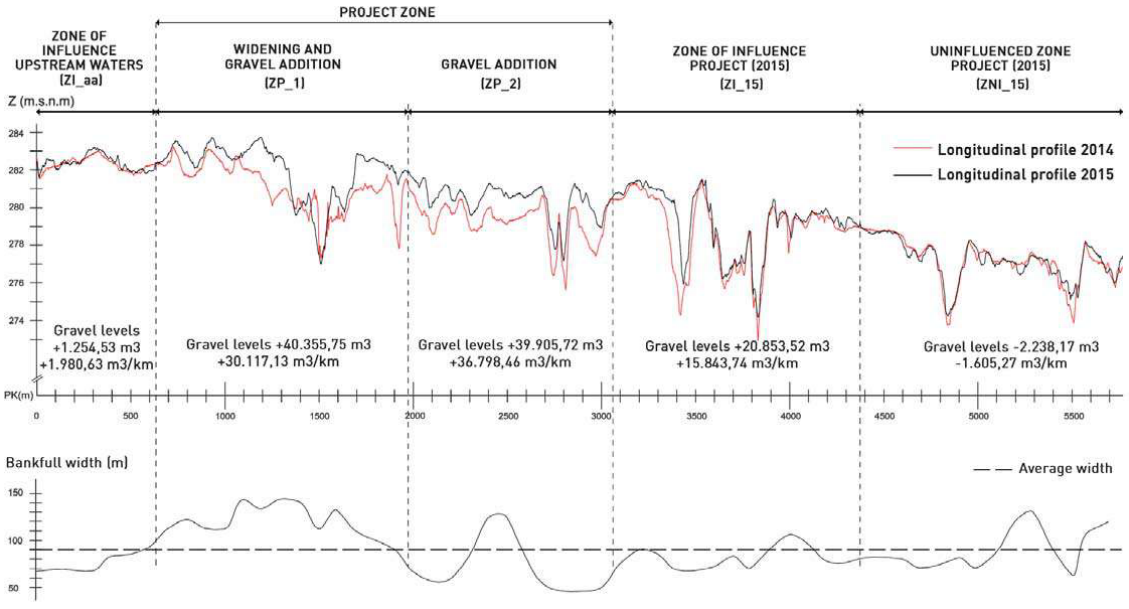

Figure 6. Longitudinal profile before and after sediment addition and changes on bankfull width (Perez et al, 2015)

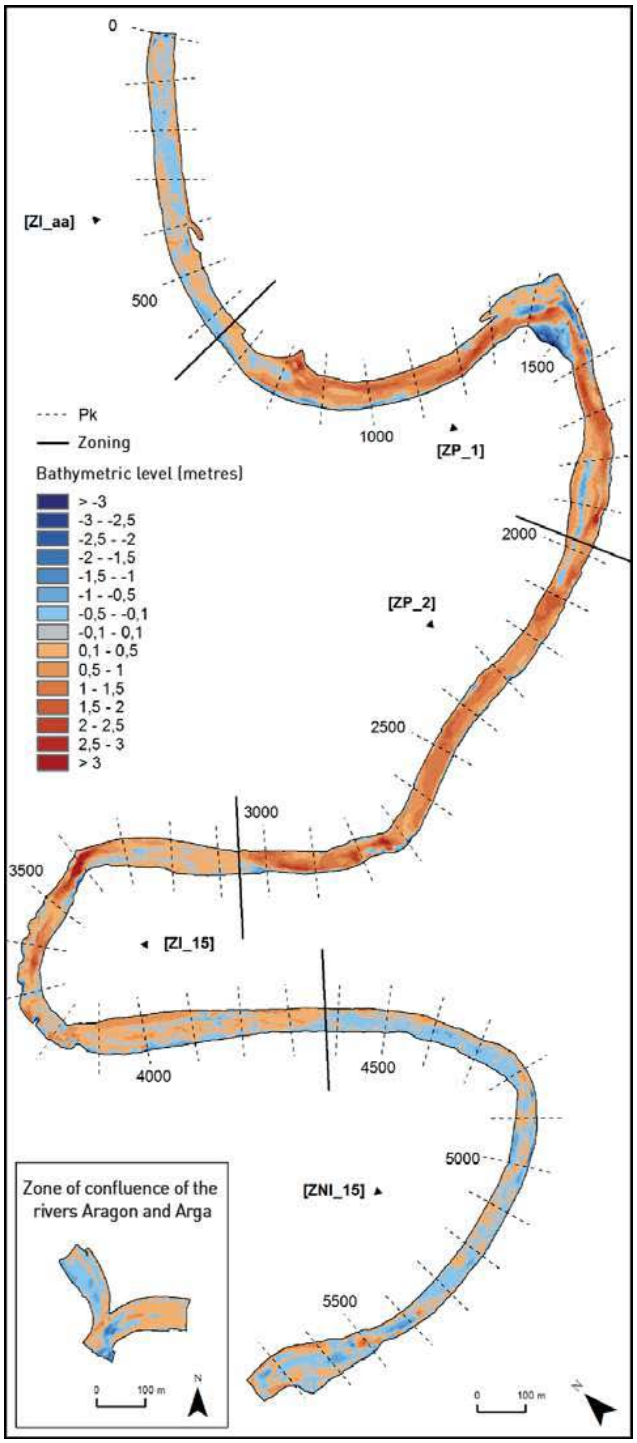

Figure 7. Bathymetric level differences between before (March 2014) restoration and after (March 2015).

ACHIEVEMENTS

The project had a positive impact on land planning, ecological restoration and flood-risk management (mitigation) and recovery of the river dynamics, morphology and hydraulic capacity of the channel. The project has meant a paradigm shift on how to treat rivers and the problems that affect them.

- 7,350 meters of lateral defences removal
- 94,7 ha of fluvial territory recovery
- Reconnection of two abandoned meanders
- 14 areas and 13,61 ha of habitats recover for the European mink
- Public participation and awareness. Thanks to the participatory processes, there is more technical knowledge among stakeholders (farmers, irrigators, ecologists) and more reluctant sectors such as farmers are becoming convinced that the current river management is not the right one and are becoming "convincers".

GOVERNMENT AND SOCIAL IMPACT

All the administrations with duties on river system environmental management participate on the project. The Government of Navarre (with authority for environmental matters), the Ministry of the Environment for Spain and the Ebro River Water Board (with authority for water-related matters) are working together on this project through their public companies: GAVRN (public company of the Government of Navarre, now called GAN-NIK); TRAGSA (public company of the Spanish State). The local authorities (12 municipalities) area also supported the project (Goikoetxea, 2015b).

Important effort on management and coordination to solve the dispersion of competences of the biodiversity management on fluvial ecosystems: hydraulic management competence of Water Agencies, environmental management of regional governments and land properties mainly of the municipalities (in that area).

The availability of the lands is a limiting factor. The project achieved agreements with the 12 municipalities that form part of the “Mink Territory” buying or with the financial compensations for loss of profit of plantations incomes coming from their lands, from 5,400 €/ha to 20,000 €/ha (Goikoetxea, 2015b).

Hydraulic studies gave security, credibility and acceptance to the people, as well as the social participation with sensitization, familiarity and comprehension.

Communication and participation program aimed social changes for sensitization, awareness and change of mentality on river management philosophy.

At this moment, the Ebro Resilience LIFE project (https://www.ebroresilience.com/en/) is following similar strategies in its actions along the mainstream of Ebro River with other different type of actions but very linked to this project too.

Based on the experience of this project the reconnection of the Sotosardilla meander (Funes) has been developed in the last years by the Ministry of Environment, in collaboration with the Navarre government.

The Aragón River Restoration Project was finalist in the 2016 IRF European Riverprize (https://www.youtube.com/watch?v=D2qeKr92p3Y).

The Ministry for the Ecological Transition (MITECO) has chosen the reconnection of the meanders of the Arga River (Soto Sardilla) as one of the cases that exemplifies adaptation to climate change in the new portal of the AdapteCCa platform on Adaptation to Climate Change in Spain:

https://adaptecca.es/casos-practicos/conexion-hidrologica-y-mejora-de-habitats-en-los-meandros-del-tramo-bajo-del-rio

BUDGET

The total budget of the LIFE project was 10,463,490 € where the EU Contribution was of 3,877,164 € co-financed by the Government of Navarra and the Water Direction of the Ministry of Environment through the Ebro Water Agency.
Project coordinated by a public company, Gestión Ambiental de Navarra, S.A. (GAN) and executed by TRAGSA, as well under the direction of the Government of Navarre and the Ebro Water Agency.

WEBSITES

https://territoriovison.eu/

https://territoriovison.eu/wp-content/uploads/2019/12/Informe-Layman.pdf

http://contratoderiomatarranya.org/documentos/BP-restauracion/BP2.pdf

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1. Mink Territory Project presentation and 4. River habitat restoration works: https://vimeo.com/showcase/3673433