

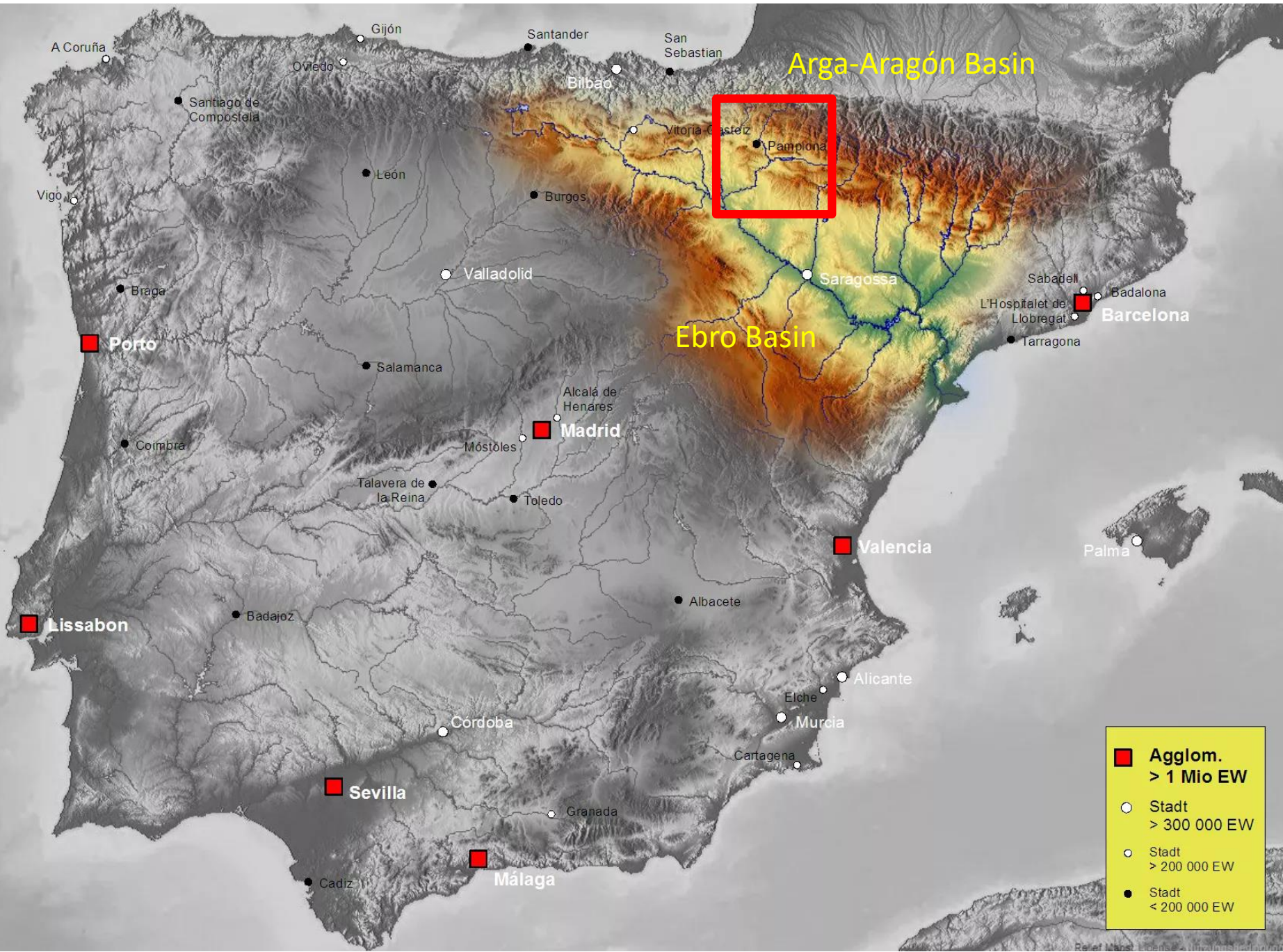
Can we reconnect rivers and provide multi-functional restoration in Med areas?

Fernando Magdaleno

CEDEX (Centre for Studies and Experimentation on Public Works, Spain)

CIREF (Iberian Centre for River Restoration) - WIEA





- **Agglom.**
> 1 Mio EW
- **Stadt**
> 300 000 EW
- **Stadt**
> 200 000 EW
- **Stadt**
< 200 000 EW



Arga-Aragón river system

Source: Navarra Government & MNC



Flood event, Ebro River

Flood event, Arga River



River channelized in the 80s, agro-urban matrix,
large conflicts between managers, end-users
and conservationists

Source: Navarra Government & MNC

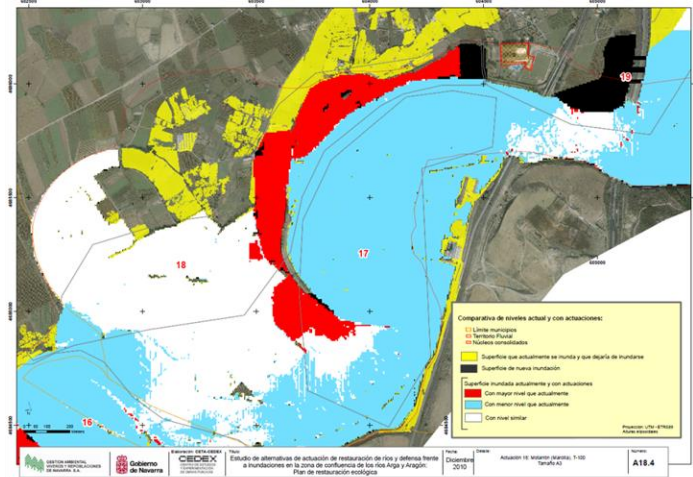
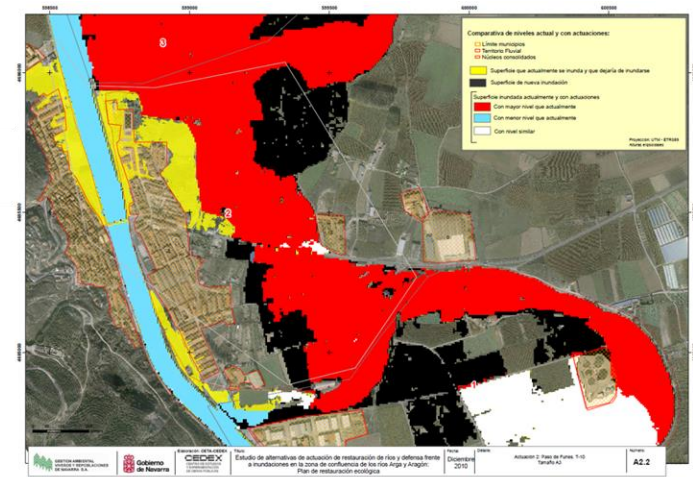
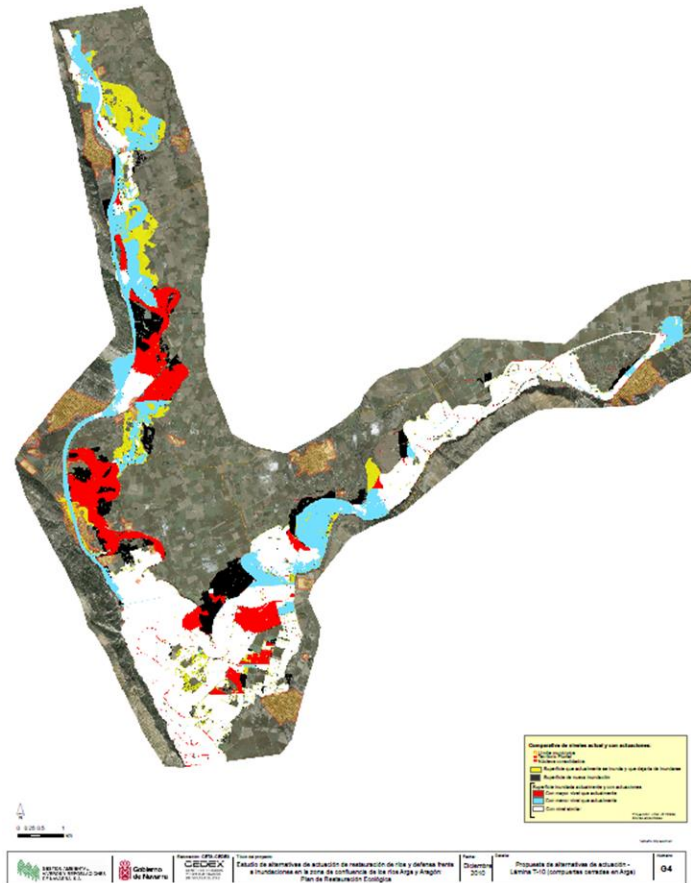


Land & river authorities reach an inflection point: dredging and new levees are no more seen as relevant solutions to face the situation

Source: Navarra Government & MNC

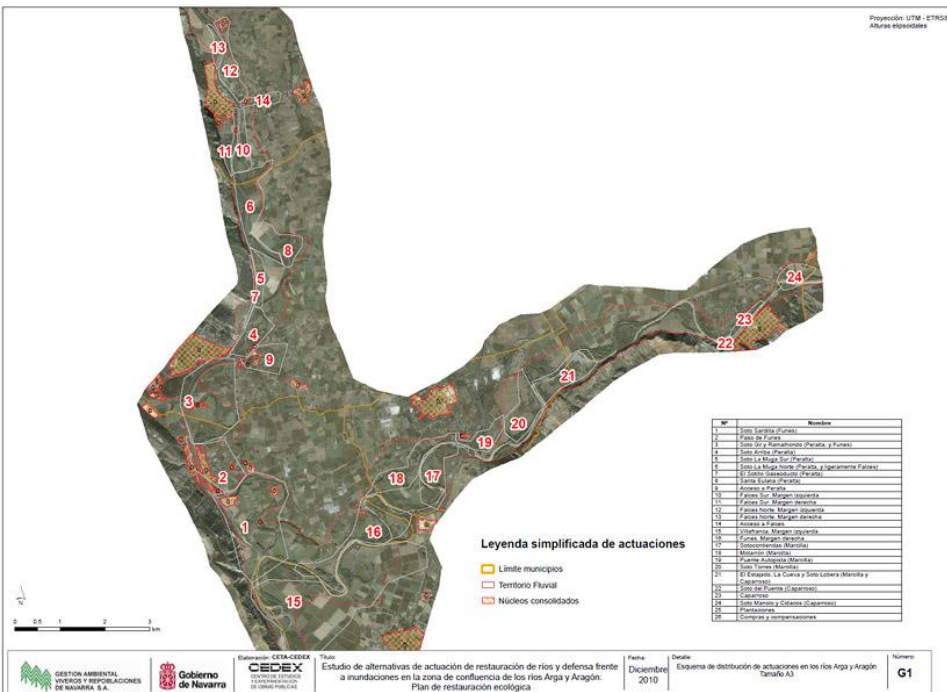
Key elements of the NBS approach undertaken:

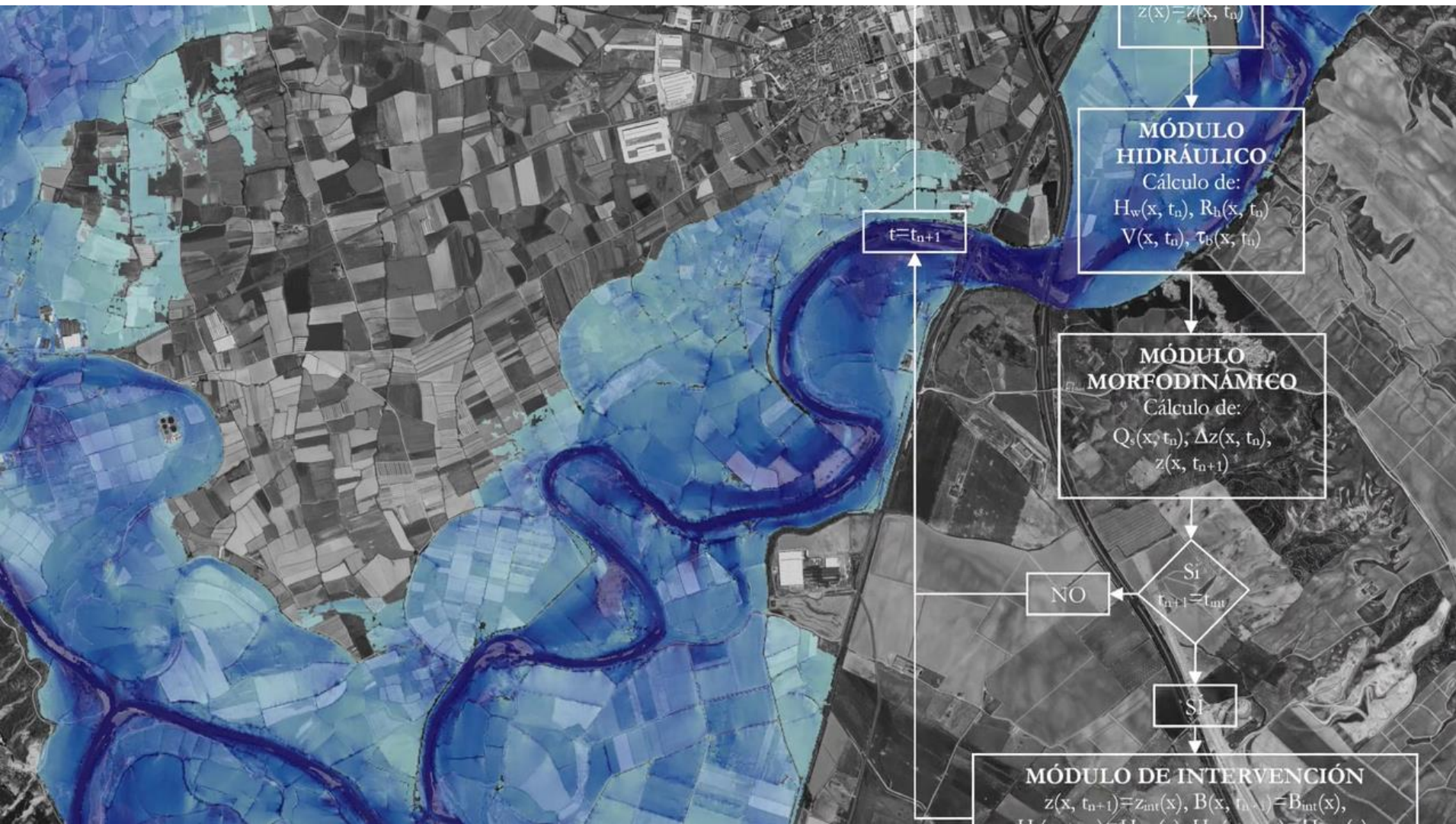
- Harmonization of **WFD, FRD and BHD**
- Improved protection for **T100 floods (no flooding of urban and critical areas)**
- Wide array of **protected habitats and species (e.g., European mink, *M. lutreola*)**
- Over a decade of **rehabilitation / restoration actions**
- National, and sp. Regional **funding (Navarre Govnt)**.
- **EU co-funding (Life+ and Interreg projects)**



Main barriers

- **Complex territory** in physical, environmental, social and political terms
- Negative **inertial** attitudes between managers and end-users: strong **dredging** and **channelization** supporters
- Limited **experience** on restoration actions at such scales, and in dryland areas
- Administrative permissions, dense **bureacracy**
- **Coupling** of social-political “windows” with available funding and scientific-technical knowledge





Source: Navarra Government & MNC

**Natural
reference**



Rehabilitation of >100 ha of
territory for river dynamics

**Project area before
restoration**



Improved lateral connectivity for river habitats, flood risk mitigation, better W/D ratio, infiltration, reduction of erosion and vegetation encroachment



Source: Navarra Government & MNC



Flooding after restoration works

Source: Navarra Government & MNC

Reintroduction of sediments in the river channel (ca. 100.000 m³, gravels)



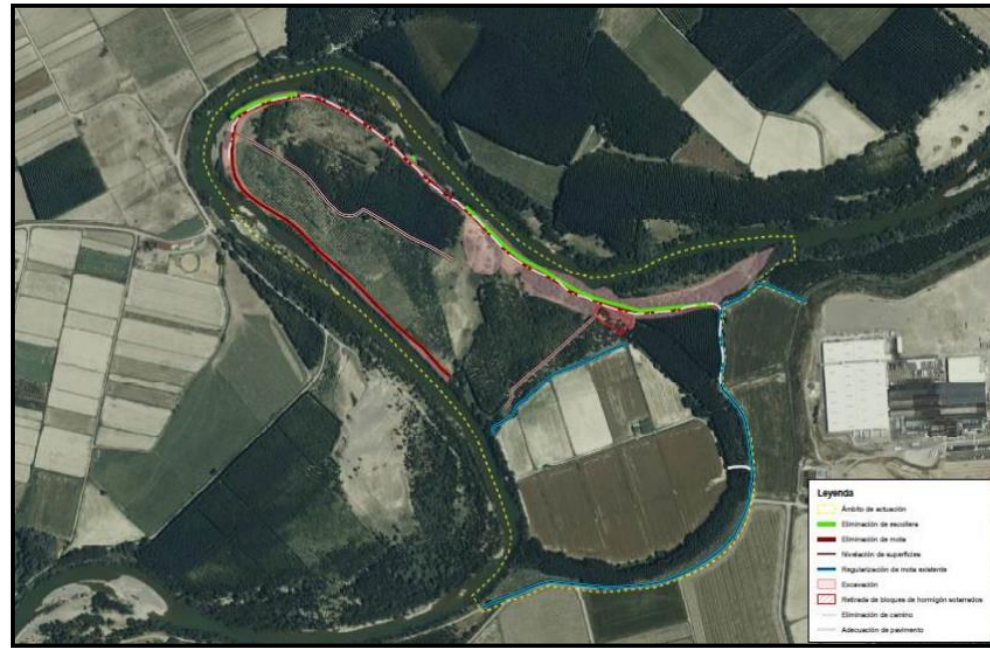
Source: Navarra Government & MNC

Reintroduction of sediments in the river channel



Source: Navarra Government & MNC

Removal or relocation of >6km of artificial levees



Improved ecohydrological connectivity for river habitats, flood amelioration, better W/D ratio, infiltration, reduction of erosion and encroachment



**Natural
reference**

Restoration of >10 ha of river habitats

Created



Construction of **wetlands** as suitable habitat for endangered species and amelioration of degraded water processes (retention, infiltration, etc.)



Created wetlands in the river floodplain



**Natural
reference**

Restoration of >10 ha of river habitats

Created



Reintroduction/maintenance of **LWD** for habitat, water and sediment trap, improved trophic connections, etc.

Restoration of 230 ha of priority habitats

**Natural
reference**

Created



New approaches to the revegetation of riparian areas: lower density, patches plantation, self-maintenance and regeneration, high species diversity, and roles of vegetation to contribute to optimized ESS

**Natural
reference**



Snags (Standing dead trees) for riparian habitat, improved hydromorphology, refuge, etc.

Created

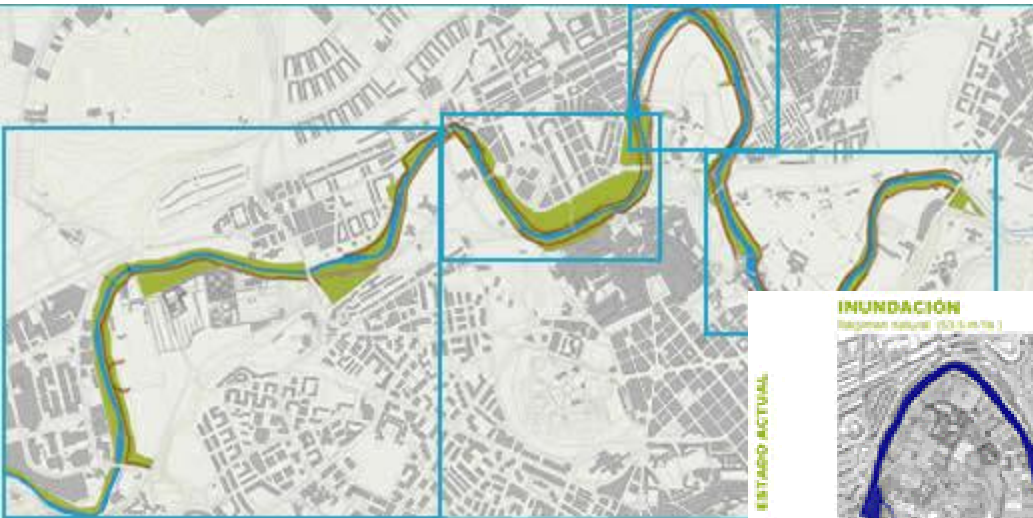


Created



Biological (fungal) removal of poplar stumps to avoid loss of quality of riparian soils (and infiltration), enhance trophic network...and also for social interest!

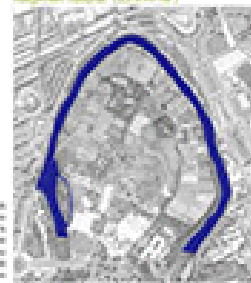
Flood abatement and ESS in cityscapes: Arga River in Pamplona



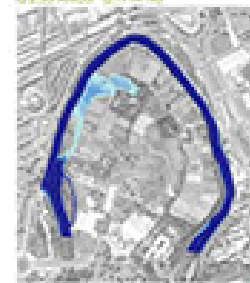
INUNDACIÓN

Regimen natural (Q1 4 m³/s)

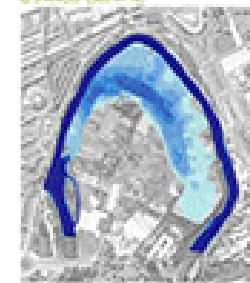
ESTADO ACTUAL



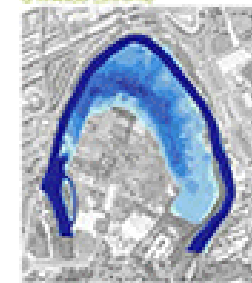
Q 2.33 AÑOS (217 m³/s)



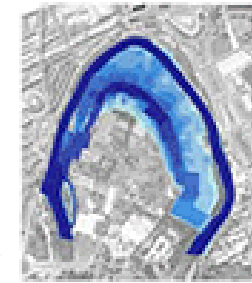
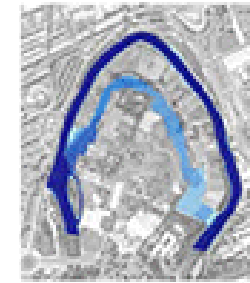
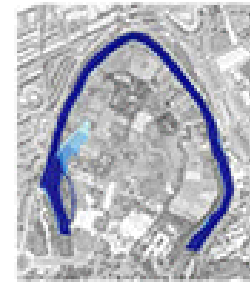
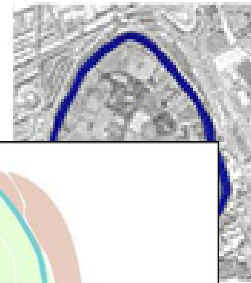
Q 5 AÑOS (268 m³/s)



Q 10 AÑOS (320 m³/s)



EFECTO



Un corredor verde a orillas del río y junto a las murallas.

Los meandros del Arga se acercan y se alejan de Pamplona configurando un pasco para viandantes y ciclistas de alto valor paisajístico que integra naturaleza, presas, molinos y puentes históricos. Fresnos, sauces, alisos, tilos, endrinos... la flora autóctona recuperada y el entorno campestre de huertas y granjas, contrasta con el ambiente urbano que se levanta intramuros.



Source: Pamplona City Hall

Flood abatement and ESS in cityscapes: Arga River in Pamplona



Source: Pamplona City Hall

Flood abatement and ESS in cityscapes: Arga River in Pamplona



Flood abatement and ESS in cityscapes: Arga River in Pamplona



Lessons learned

- Application of NBS in river systems is a feasible way to comply with the EU multi-faceted legal framework (good status, risk reduction, biodiversity)
- NBS design and application must provide multiple outcomes, in a relevant and measurable manner
- NBS must be very closely linked to hydrological, geomorphological, ecological and social features and gradients in the river
- Breaking long-lasting inertias on river management through NBS can be extremely hard-to-do, but it commonly becomes a no-return path
- NBS are no panacea, and are exposed to failure if not adequately designed, maintained and updated...but no other technique provides such multi-functionality and resilience to river systems

fernando.magdaleno@cedex.es



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

MINISTERIO
DE AGRICULTURA Y PESCA,
ALIMENTACIÓN Y MEDIO AMBIENTE

CEDEX
CENTRO DE ESTUDIOS
Y EXPERIMENTACIÓN
DE OBRAS PÚBLICAS