The Ebro River and major tributaries, approach of the “Free space for river” concept

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Introduction

River network is a key element in environmental dynamics and territorial planning.

Rivers are built by themselves. They construct floodplains as auto-regulation system, that is, in order to reduce by their own their excesses.

That is why the river fills exactly the territory which has created, a space whose dimensions are the adequate to the basin and valley characteristics, to the flows, the flood dischar-ges, to the slope, to the quantity and depth of the alluvions, etc.

This space in the bottom valley offers different socioeconomic advantages

Many fluvial natural hidrogeomorphologic dynamics have been fixed by defence works, which has facilitated progressive human occupation of the territories, a process that meant an increase of risks and an important loss of the natural heritage

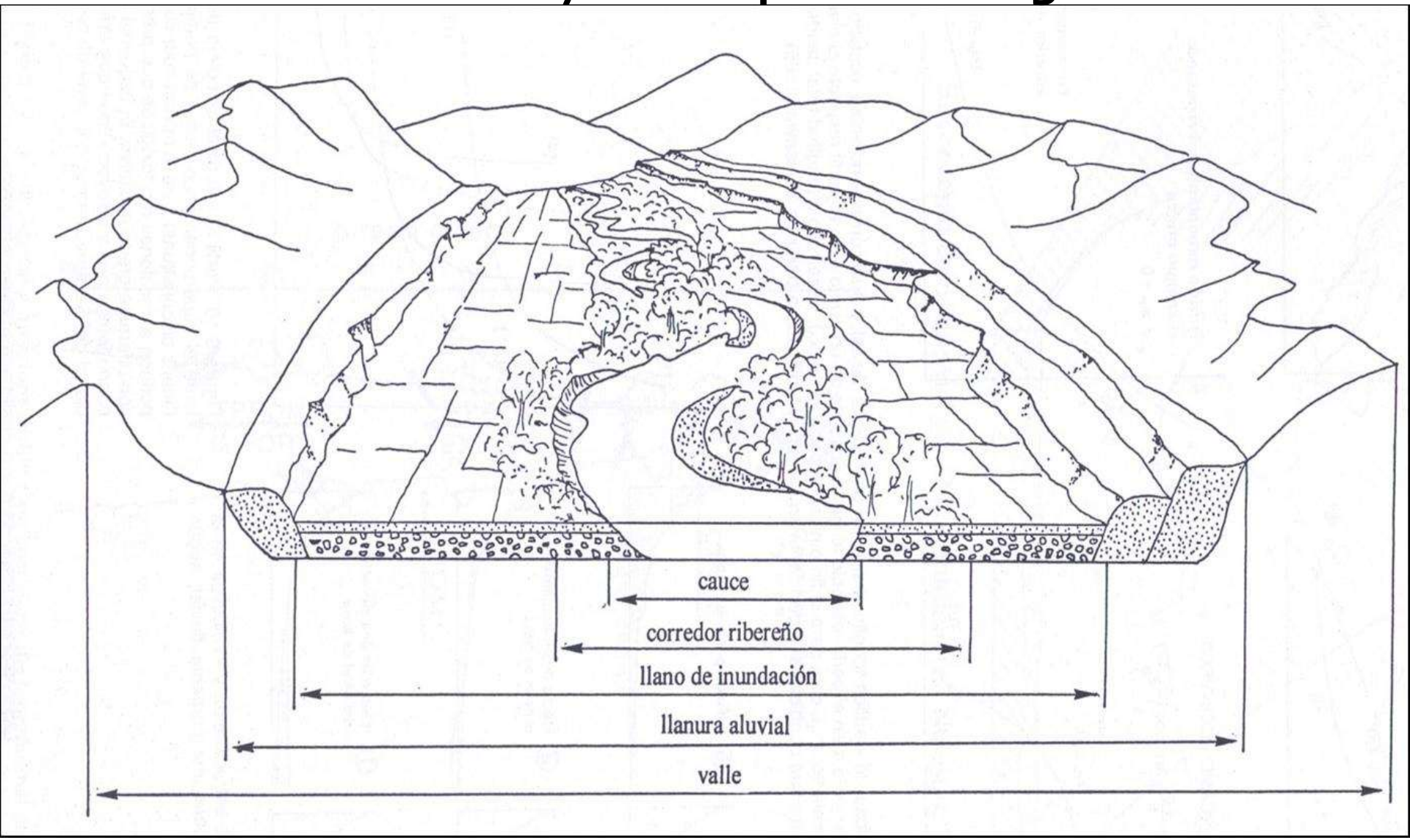
In short, in most of the fluvial systems problems arise from an environmental deterioration and increase of risks, derived from the incompatibility between fluvial dynamics and system's humanization

Fluvial Territory: Concept and background

►Fluvial Territory concept has been long discussed and found different terms in the last years: *room for rivers, espace de liberté fluvial, free space for rivers,* etc..

►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.

Fluvial Territory: Concept and background



Fluvial Territory can be defined as the land, space or landscape dominated by a fluvial system. It is a fluvial space that includes river bed, riparian corridor and the floodplain, complete or partially included.

FLUVIAL TERRITORY CONCEPT

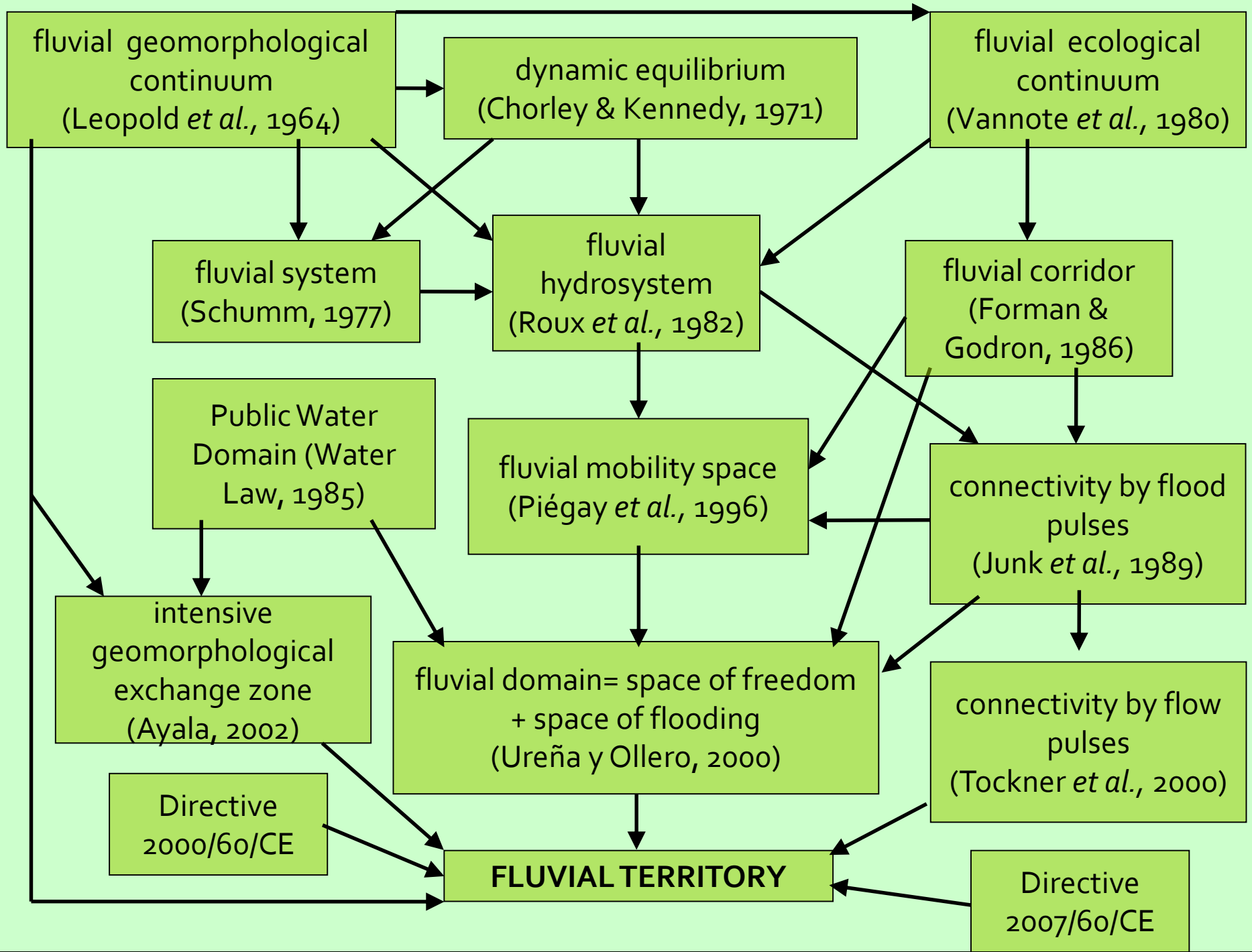
►It is first and foremost a claim: demand a **space of the river** that includes the channel, the riparian corridor and, total or partially, the floodplain.

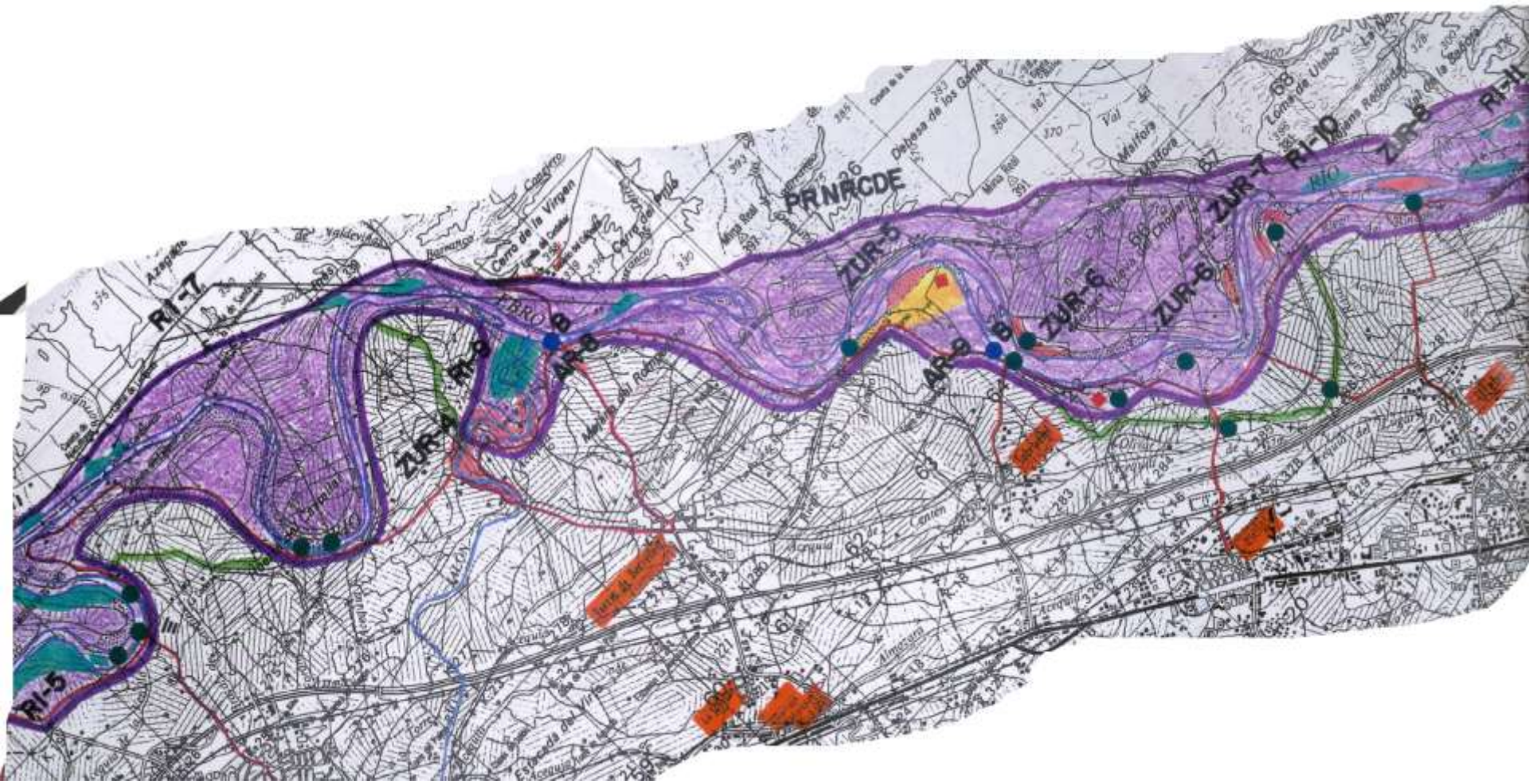
►It is a **geomorphologically and ecologically active** strip, of maximum efficiency and complexity as natural system.

►It must be **wide, continuous**, **subject to flood, erodible, not defended and not built.** Ripraps and dikes must be removed or moved away.

►Its boundaries are precise but they should not be permanent as they should be adapted to fluvial mobility.

►It should be a **Land Planning** legal concept, specifically an adaptation of the Land Planning to the Fluvial Dynamics. It has not to be necessarily public; it could maintain the private propriety with conditional uses and bannings (new buildings, arid extractions…).

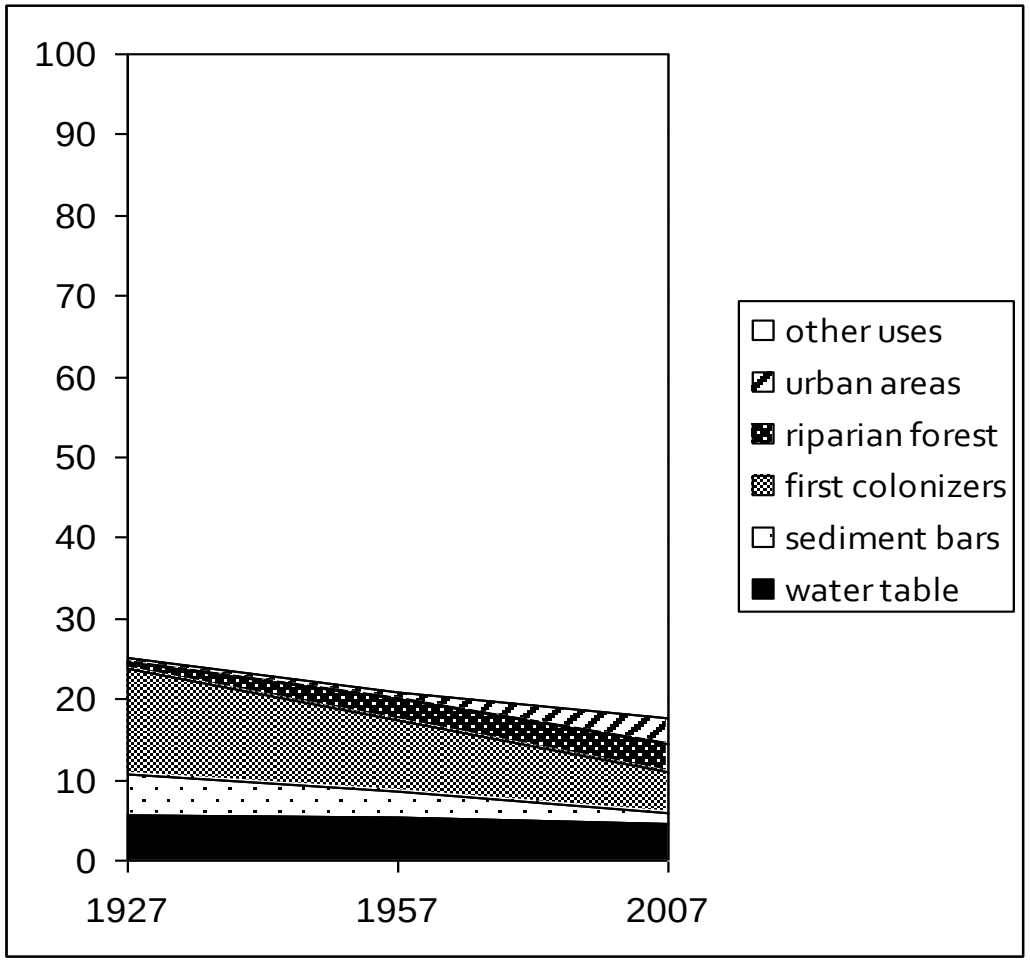

fluvial geomorphological continuum (Leopold *et al.*, 1964)
dynamic equilibrium (Chorley & Kennedy, 1971)
fluvial ecological continuum (Vannote *et al.*, 1980)
fluvial system (Schumm, 1977)
fluvial hydrosystem (Roux *et al.*, 1982)
fluvial corridor (Forman & Godron, 1986)
Public Water Domain (Water Law, 1985)
fluvial mobility space (Piégay *et al.*, 1996)
connectivity by flood pulses (Junk *et al.*, 1989)
intensive geomorphological exchange zone (Ayala, 2002)
fluvial domain= space of freedom + space of flooding (Ureña y Ollero, 2000)
connectivity by flow pulses (Tockner *et al.*, 2000)
Directive 2000/60/CE
FLUVIAL TERRITORY
Directive 2007/60/CE

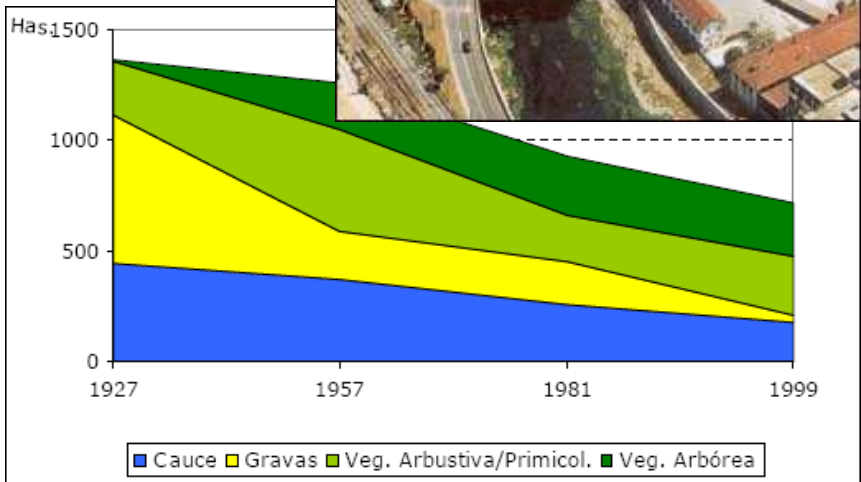


Background: proposal in Ebro river upstream Zaragoza (Ollero, 1993) “Park of naturalization of Ebro River’s riversides and dynamic course”

Fluvial Territory: Objectives and usefulness

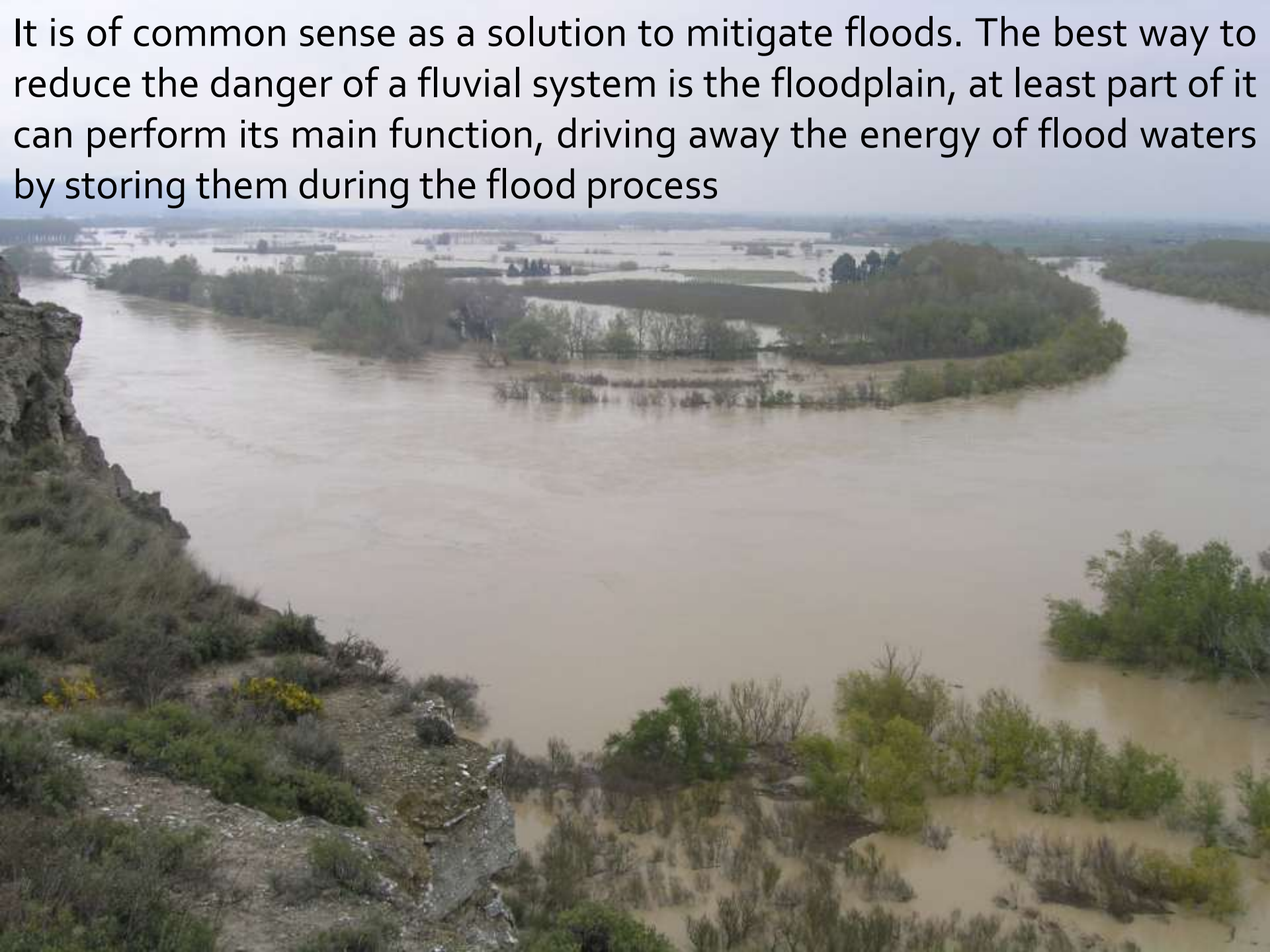
This concept starts to be considered with the consolidation of important invasions of fluvial spaces in European rivers during the XX century





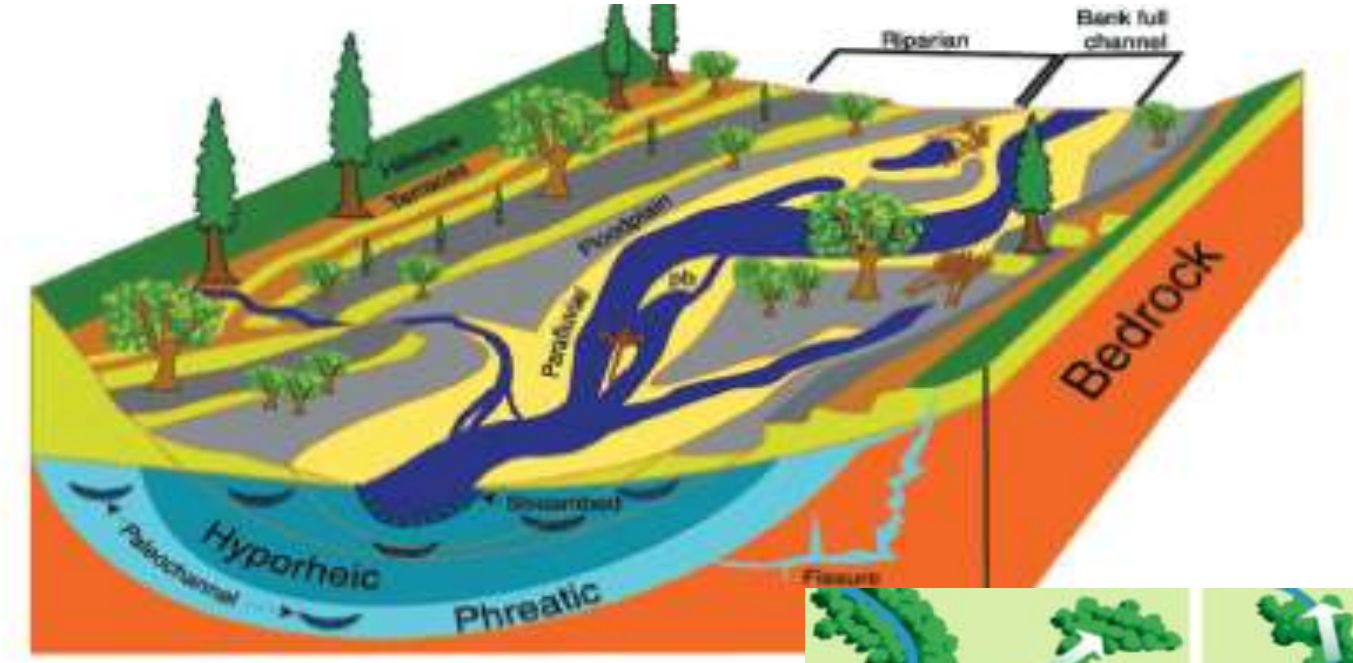
Floodplain land uses of rural zone surface evolution on the middle reach Ebro (above) and low Cinca (right)

It is of common sense as a solution to mitigate floods. The best way to reduce the danger of a fluvial system is the floodplain, at least part of it can perform its main function, driving away the energy of flood waters by storing them during the flood process



FLUVIAL TERRITORY, GEODIVERSITY and BIODIVERSITY

►The Fluvial Territory is a space that allows the river to erode, sediment and overflow, and develop all the interactions among the channel, riversides, fluvial annexes, the hyporreic zone and the phreatic.



USEFULNESS OF FLUVIAL TERRITORY
key of conservation, restoration and risk mitigation

►It contributes to naturalize the running of the river and to diversify the geomorphological environments, that is why **increases** channel and riparian **biodiversity**.

Habitats Directive

►The conservation of functions, interactions, dynamics, continuity and connectivity of fluvial ecosystems is fundamental for the **good ecological status**.

Water Directive

►It is a flooding space and, therefore, contributes to reduce peak flows by flooding, minimizing flooding levels which benefits the population centres downstream (new defense system).

Floods Directive

►It resolves land planning problems of flooding areas, contributing to reduce exposition what means in a short-term a great saving in defenses and compensations.

Sustainability

►It improves and consolidates the **fluvial landscape** which gets naturalness.

►It constitutes the essential basis, both functional and territorial, for the CONSERVATION of fluvial spaces and for RESTORATION

Delimitation

► Due to its characters, objectives and determining factors, the Fluvial Territory should be delimited by geomorphological, ecological and historical (fluvial evolution) criteria, and should not have permanent boundaries, but periodically revised, just in order to be continually adapted to its own fluvial dynamics.

► In meandering channels it should cover at least the meander belt.

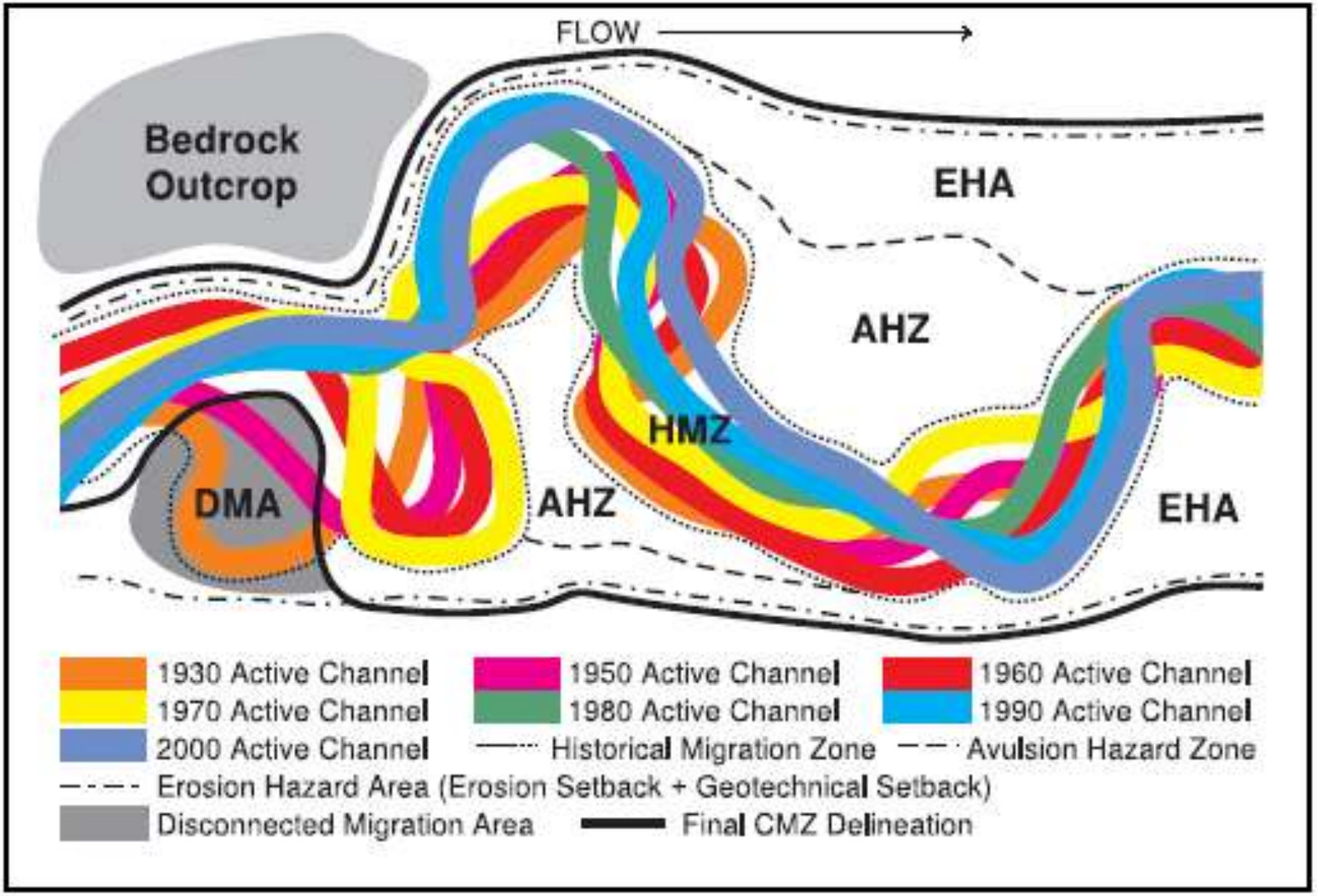


Figure 1. An example of the CMZ as the cumulative product of the Historical Migration Zone (HMZ), the Avulsion Hazard Zone (AHZ), the Erosion Hazard Area (EHA), and the Disconnected Migration Area (DMA) based on historical and field analysis and interpretation.

(Rapp & Abbe, 2003)

Delimitation

► Due to its characters, objectives and determining factors, the Fluvial Territory should be delimited by geomorphological, ecological and historical (fluvial evolution) criteria, and should not have permanent boundaries, but periodically revised, just in order to be continually adapted to its own fluvial dynamics. In meandering channels it should cover at least the meander belt. In ephemeral streams the space that are floodable.

► In meandering channels it should cover at least the meander belt.

► In ephemeral streams it should be taken into account the areas, that without constituting the floodplain, transport water and they are flooded.

►The delimitation of the F.T. is in most of the cases based on Malavoi et al. 1998 methodology, but adapted to the specific situation of Iberian Peninsula Rivers.

How FLUVIAL TERRITORY is delimited?

►Including within F.T. the different layouts of the channel since 1927 (aerial photo of Ebro Water Agency) or in their absence 1946, 1956…

►Including all the extension of riparian corridor being in 1956-57 (aerial photographies of American flight).

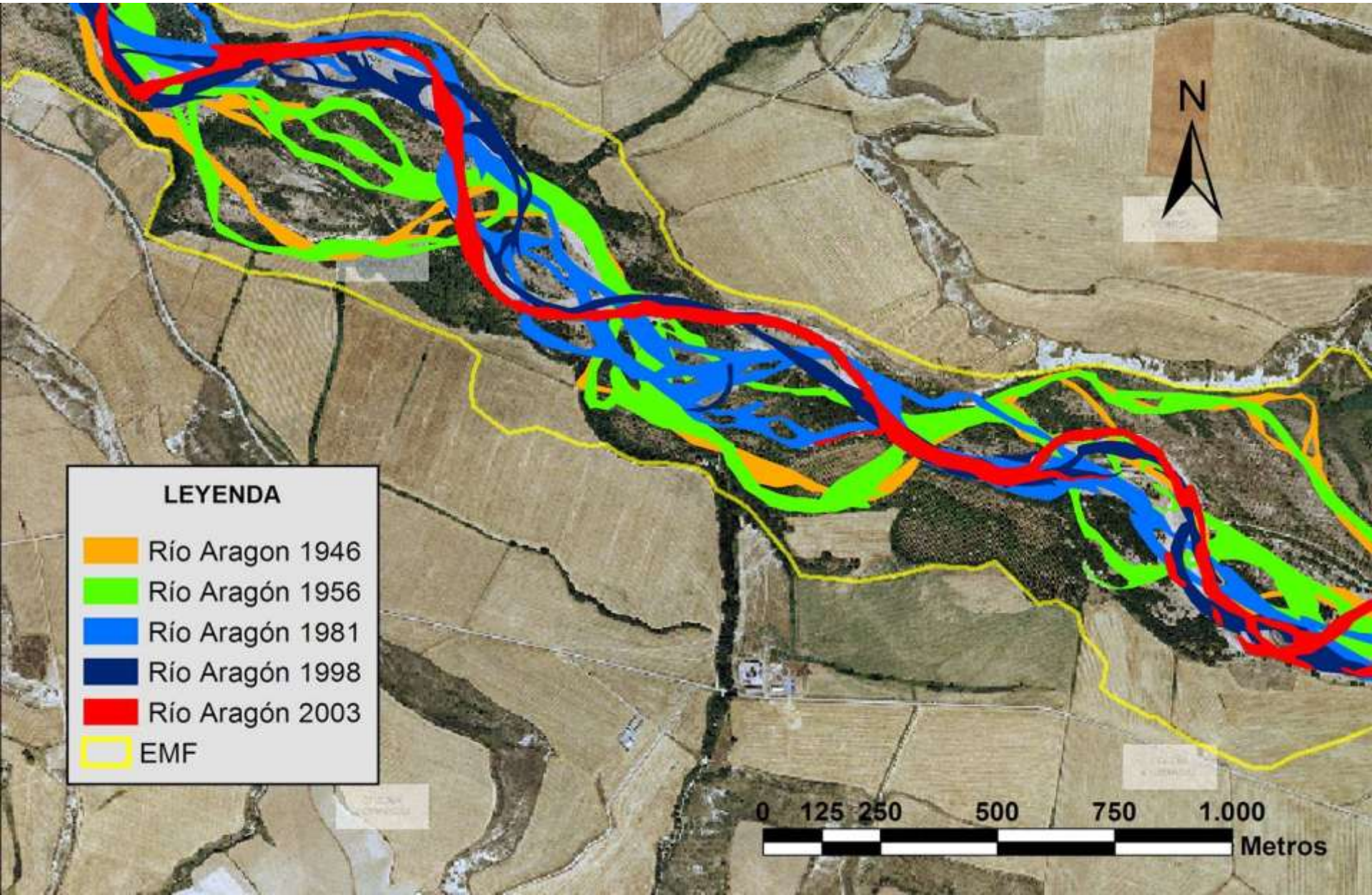
►Including the lands liable to be erode in the next decade by the own dynamics of the channel.

►Including abandoned channels, isolated riparian vegetation and other fluvial annexes disconnected from the corridor.

►Including all the flooded surface by ordinary floods (do not use return periods but hydraulic-geomorphological methods, since estimated return periods do not match many times with the flooded area.

►Excluding settled areas.

►Widening of F.T. upstream and in front of settled areas.


LEYENDA
Río Aragon 1946
Río Aragón 1956
Río Aragón 1981
Río Aragón 1998
Río Aragón 2003
EMF
N
0 125 250 500 750 1.000
Metros

Integration

►The implementation of the Fluvial Territory in large floodplains of dynamic rivers requires the removing of margin defences (such as ripraps that avoid the erosion of the banks and hold the river channel impeding its dynamics) and the re-location of the dikes that protect from the flood in the limits of this Fluvial Territory.

►The use of the Fluvial Territory should be as a natural area or other uses that would not difficult channel mobility, regulated by administrative measures.

►In rural areas it could be achieved by the concentration of lands were farming activities are being removed and in exchange the farmers could be offered eco-development measures.

►In urban areas the narrower F.T. should be integrated in green and on purpose-designed areas in order to maintain the continuity of fluvial corridor. The uses in that space must be compatible to the lateral mobility of the channel.

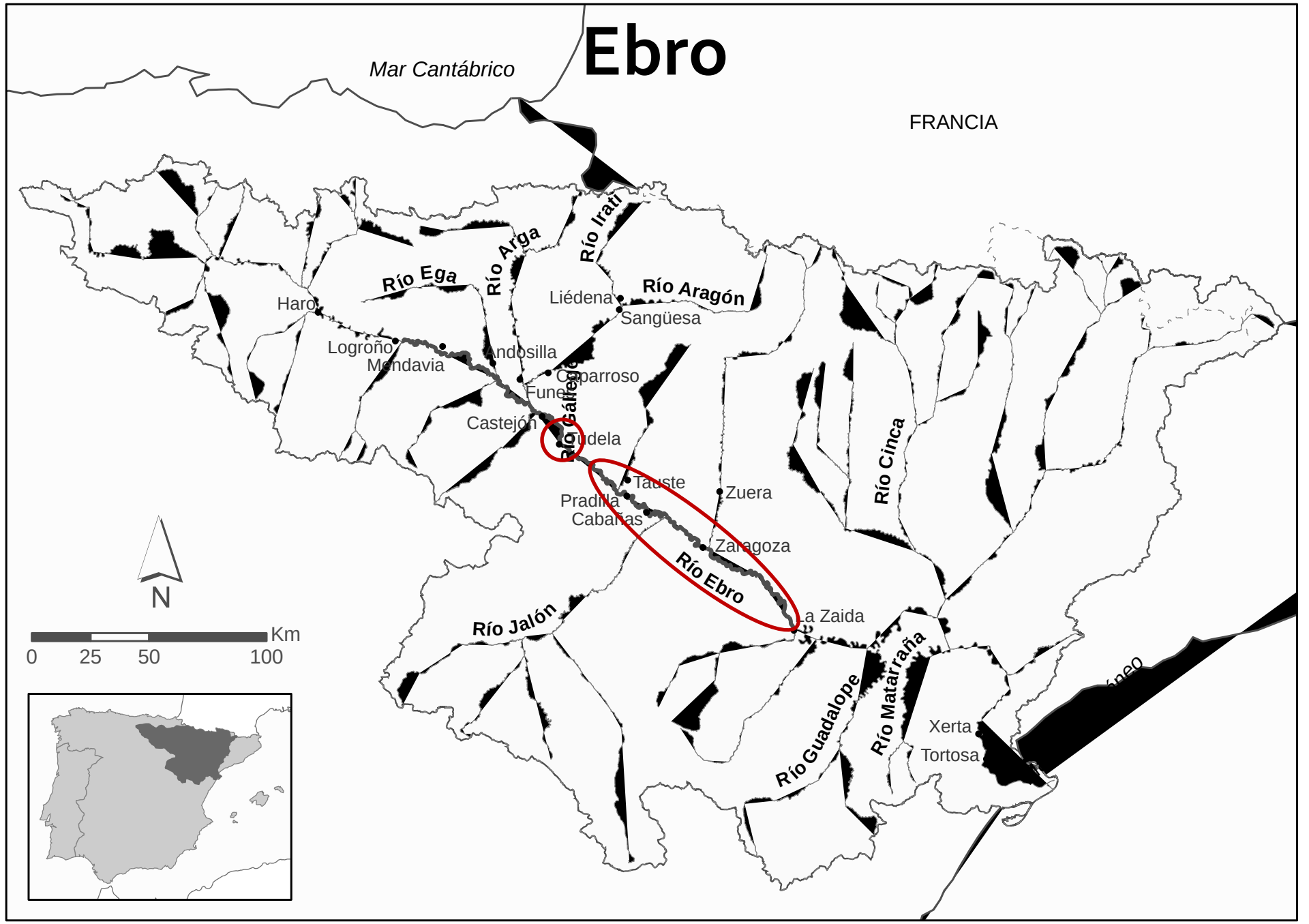
►New lineal infrastructures parallel to the channel (roads, railway, pipes, etc.) should be out of Fluvial Territory, and transversal infrastructures designed for the channel to be moved.

►All levels of Land Planning should adopt the Fluvial Territory as common criteria.

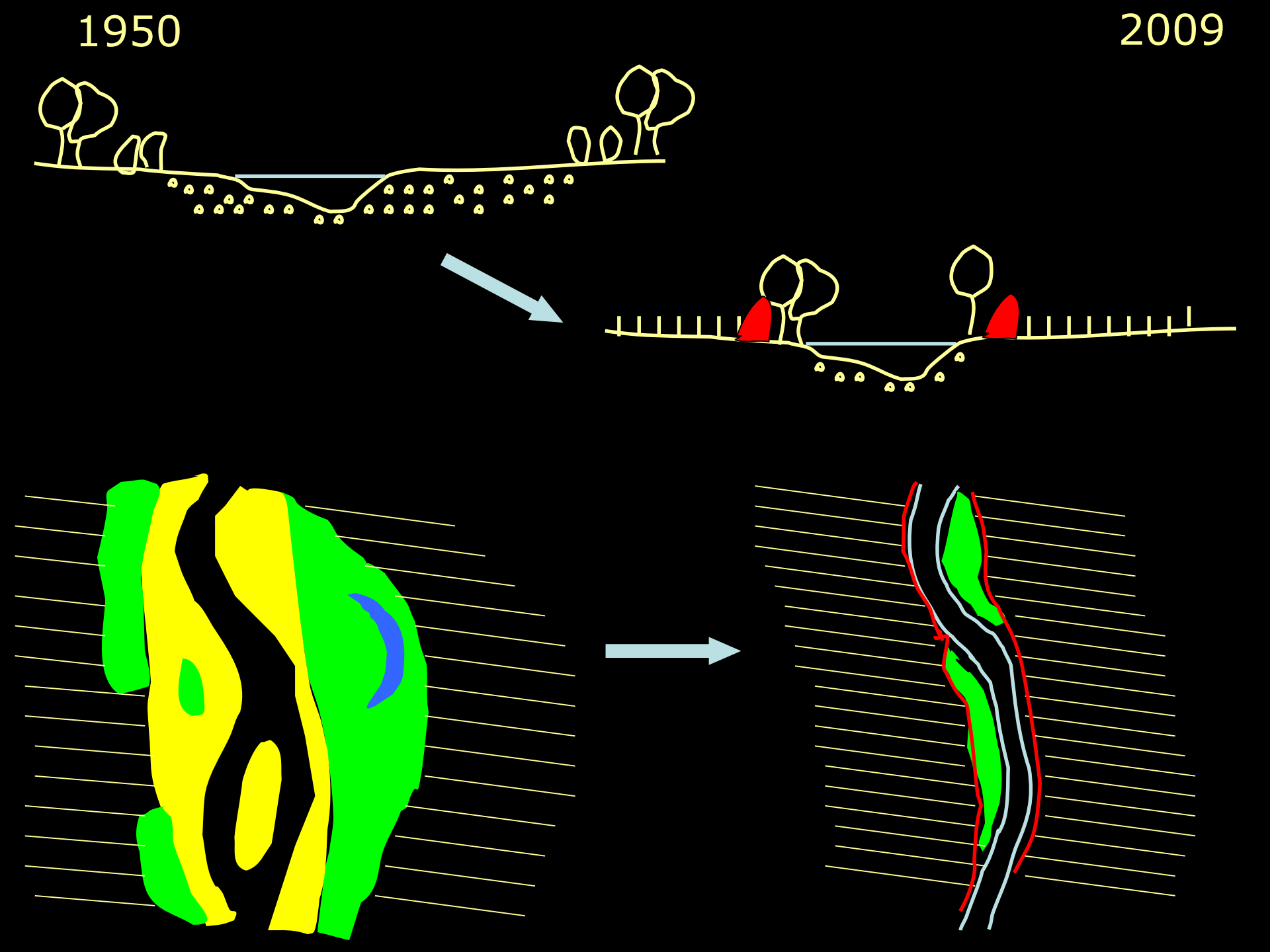
► Banning arid abstractions should be basic as it was established in France by law.

Proposals

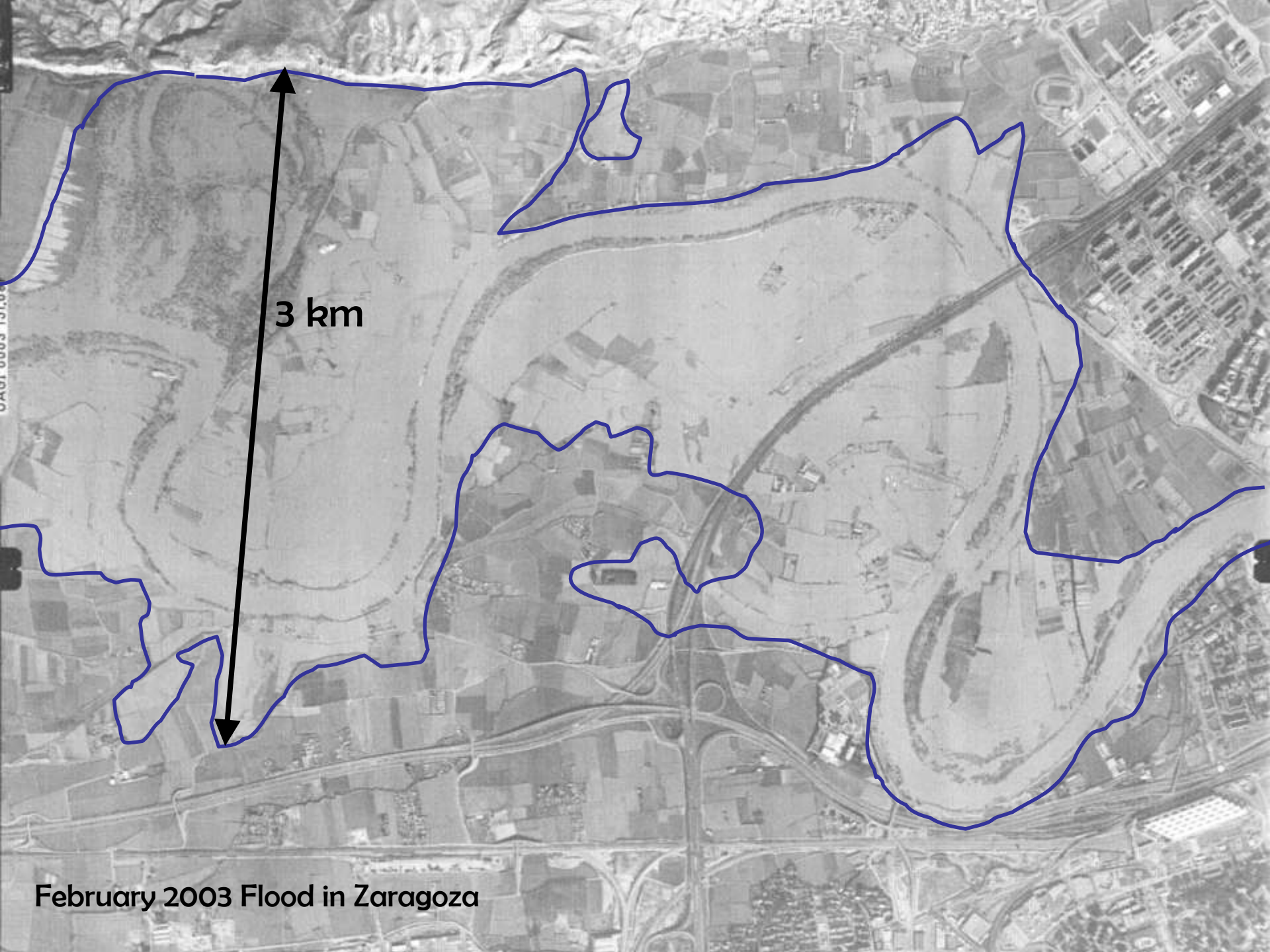

SAN SEBASTIÁN/DONOSTIA
Reinosa
VITORIA-GASTEIZ
PAMPLONA/IRUÑA
LOGROÑO
Calahorra
HUESCA
Barbastro
SORIA
LLEIDA
ZARAGOZA
Calatayud
TARRAGONA
Alcañiz
TERUEL



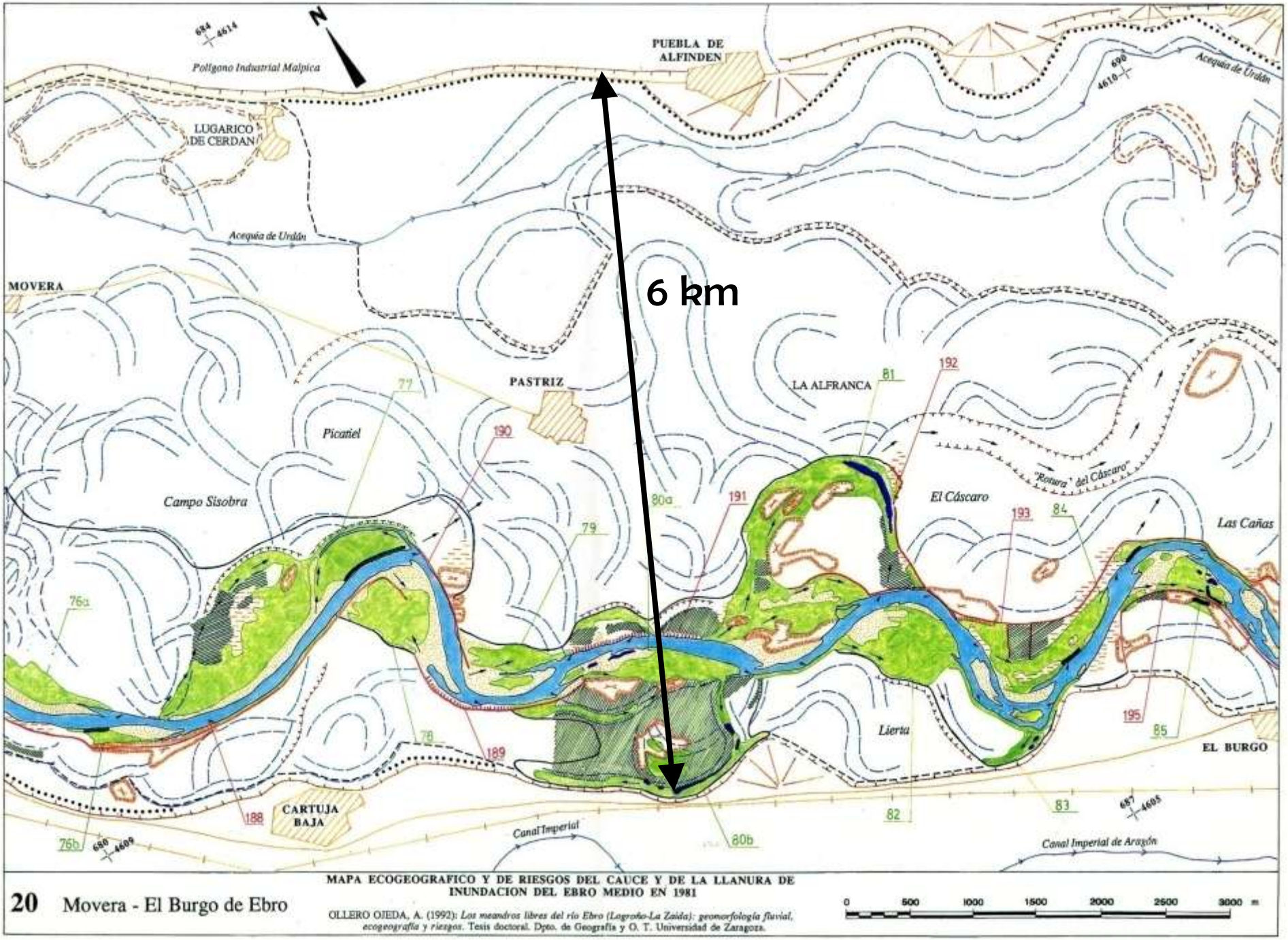
Ebro basin and the free meandering Middle Ebro River


1950
2009

February 2003 Flood
in Ebro River



February 2003 Flood in Zaragoza

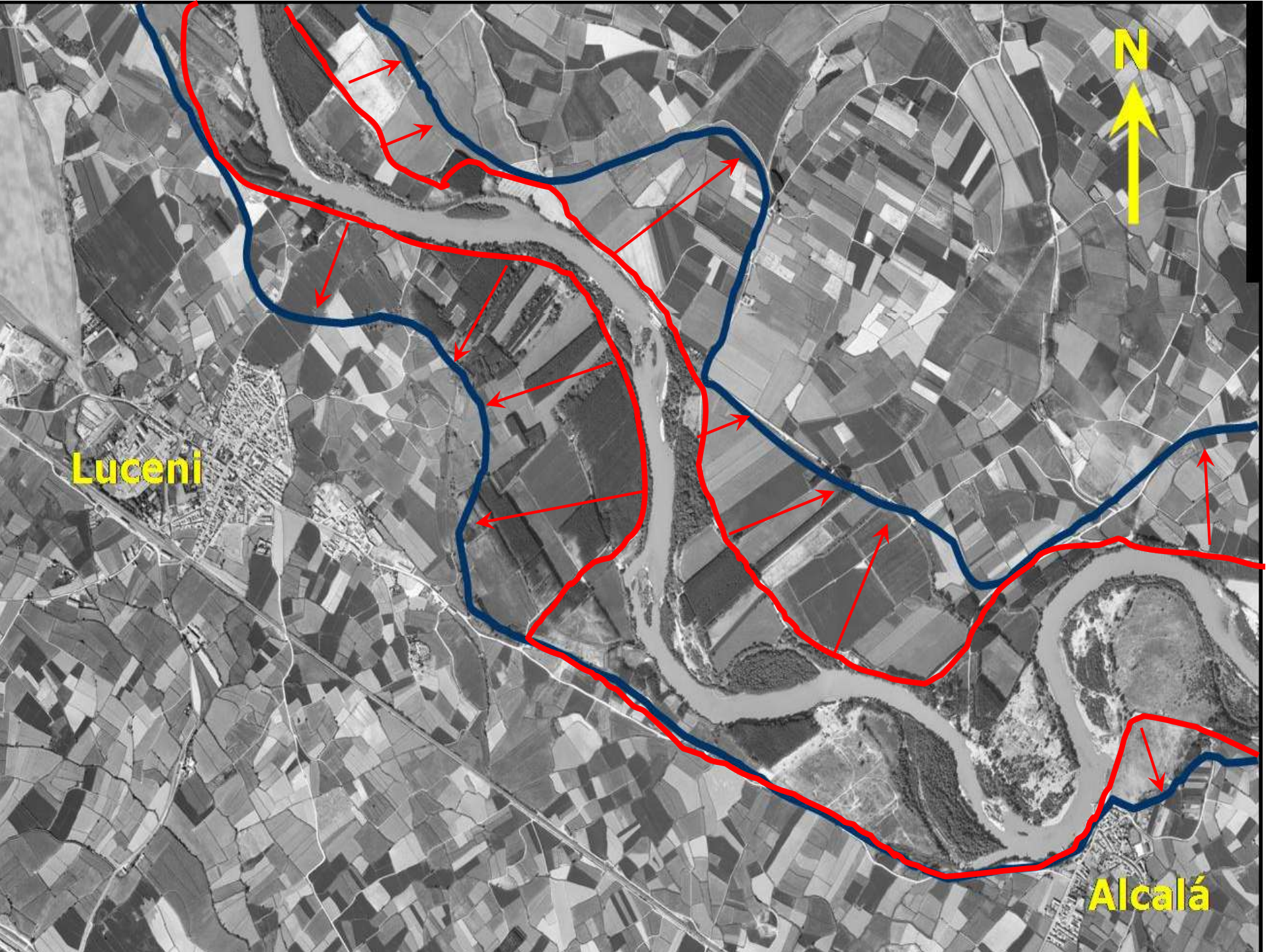


20 Movera - El Burgo de Ebro

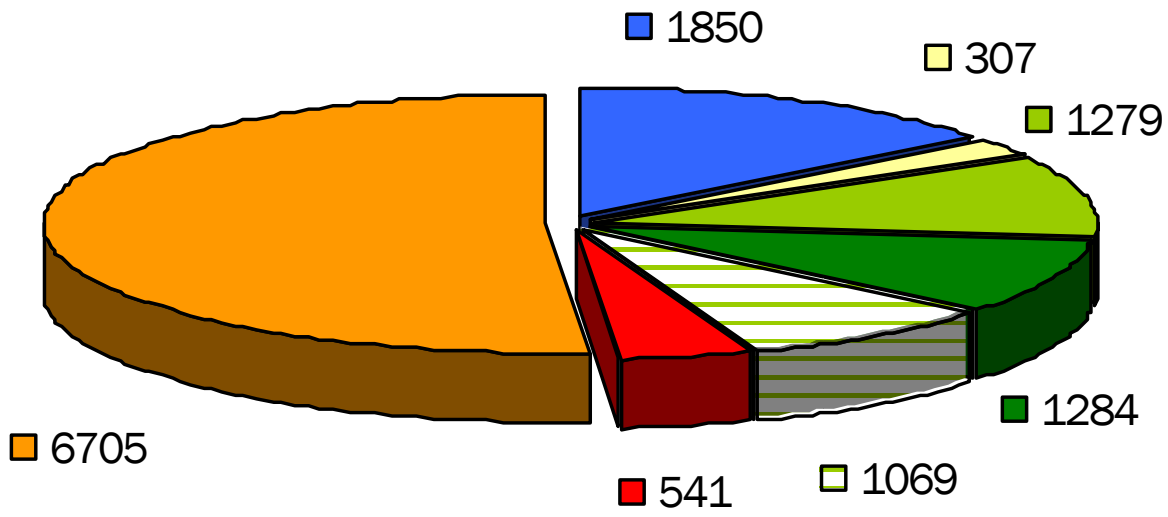
MAPA ECOGEOGRAFICO Y DE RIESGOS DEL CAUCE Y DE LA LLANURA DE INUNDACION DEL EBRO MEDIO EN 1981

OLLERO OJEDA, A. (1992): *Los meandros libres del río Ebro (Logroño-La Zaida): geomorfología fluvial, ecogeografía y riesgos.* Tesis doctoral. Dpto. de Geografía y O. T. Universidad de Zaragoza.

0 500 1000 1500 2000 2500 3000 m


N
Luceni
Alcalá

F.T. of Ebro between Novillas and La Zaida: 13.035 ha (30% of floodplain), average width of 1.184 m, it implementation would suppose moving away the defences an average of 350 m each margin.



- Láminas de agua (Ebro y galachos)
- Barras de sedimentos
- Primicolonizadoras
- Vegetación ribereña madura
- Plantaciones de chopos
- Zonas degradadas y vías de comunicación
- Cultivos

Surface distribution (ha) of different land uses types incorporated in the proposal of Fluvial Territory for Ebro River between Novillas and La Zaida (Ollero *et al.*, 2005).

Restoration of Soto Tetones floodplain in Tudela (Navarre)

- Removal 110 m of a dike
- 100 has of public propriety of Tudela council
- Previous land use, rice field
- Natural space due to a exchange when a hydro electrical power station was established near in the 80'
- Objective: Recover the natural flood reduction process and improve the reception capacity of different species with the diversification of habitats
- Cost: 145.184 €

Soto Tetones: Ebro River


2006
Defences removal
Drainage plugging
Pool construction


2003

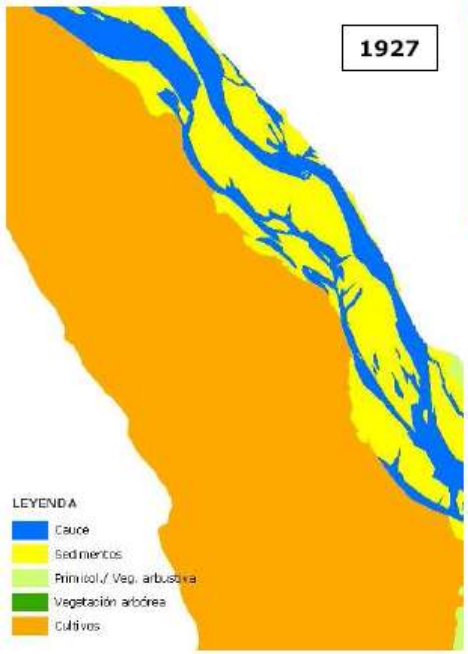

2006


2006

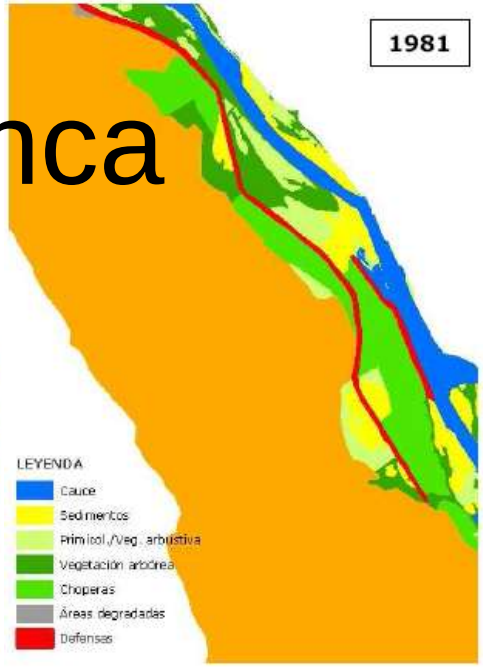

2006


2008

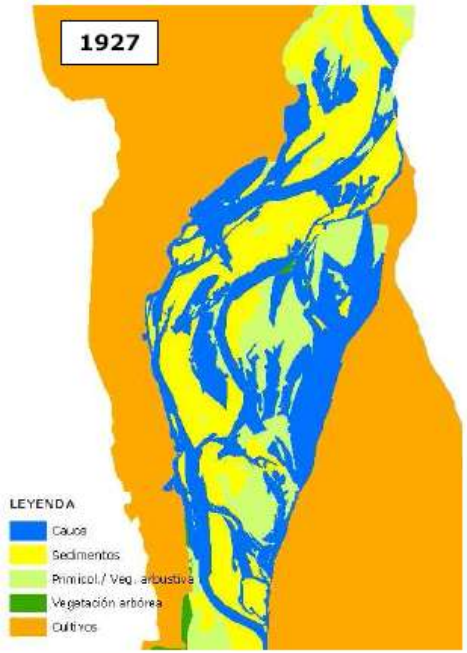
Cinca

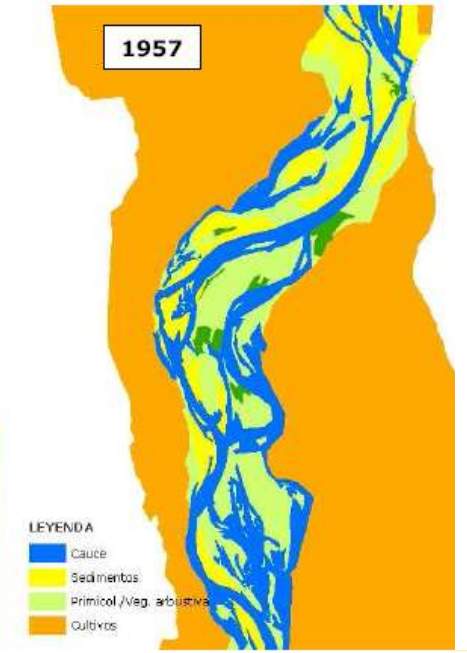

1927
LEYENDA
Cauce
Sedimentos
Primicol./ Veg. arbustiva
Vegetación arbórea
Cultivos

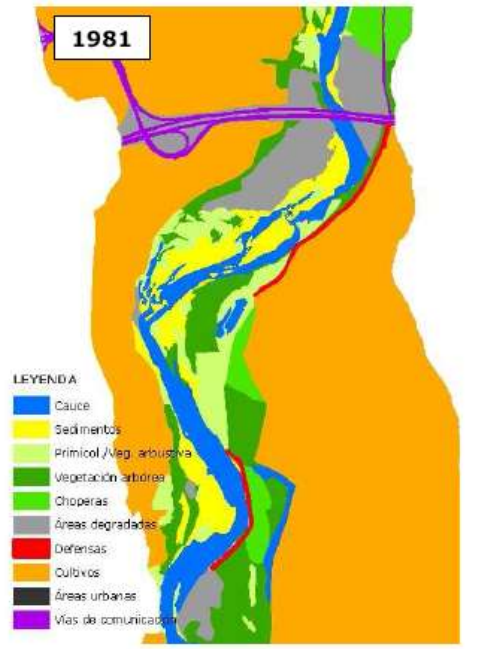

1957
LEYENDA
Cauce
Sedimentos
Primicol./Veg. arbustiva
Vegetación arbórea
Cultivos

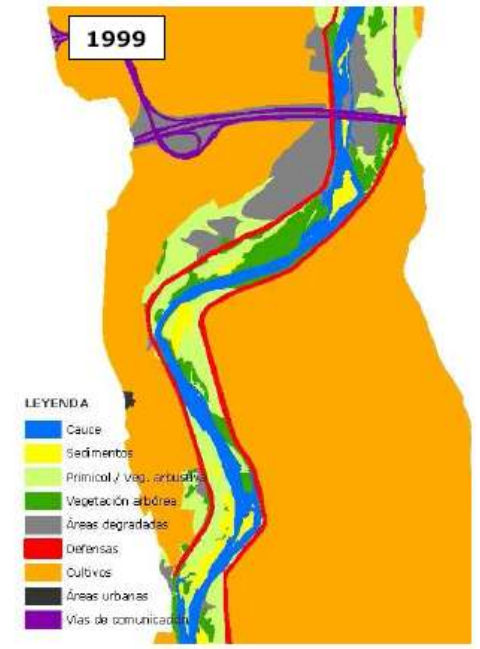

1981
LEYENDA
Cauce
Sedimentos
Primicol./Veg. arbustiva
Vegetación arbórea
Choperas
Áreas degradadas
Defensas


1999
LEYENDA
Cauce
Sedimentos
Primicol. /Veg. arbustiva
Vegetación arbórea
Repoblaciones
Áreas degradadas
Defensas
Áreas urbanas


1927
LEYENDA
Cauce
Sedimentos
Primicol./ Veg. arbustiva
Vegetación arbórea
Cultivos


1957
LEYENDA
Cauce
Sedimentos
Primicol./Veg. arbustiva
Cultivos


1981
LEYENDA
Cauce
Sedimentos
Primicol./Veg. arbustiva
Vegetación arbórea
Choperas
Áreas degradadas
Defensas
Cultivos
Áreas urbanas
Vías de comunicación

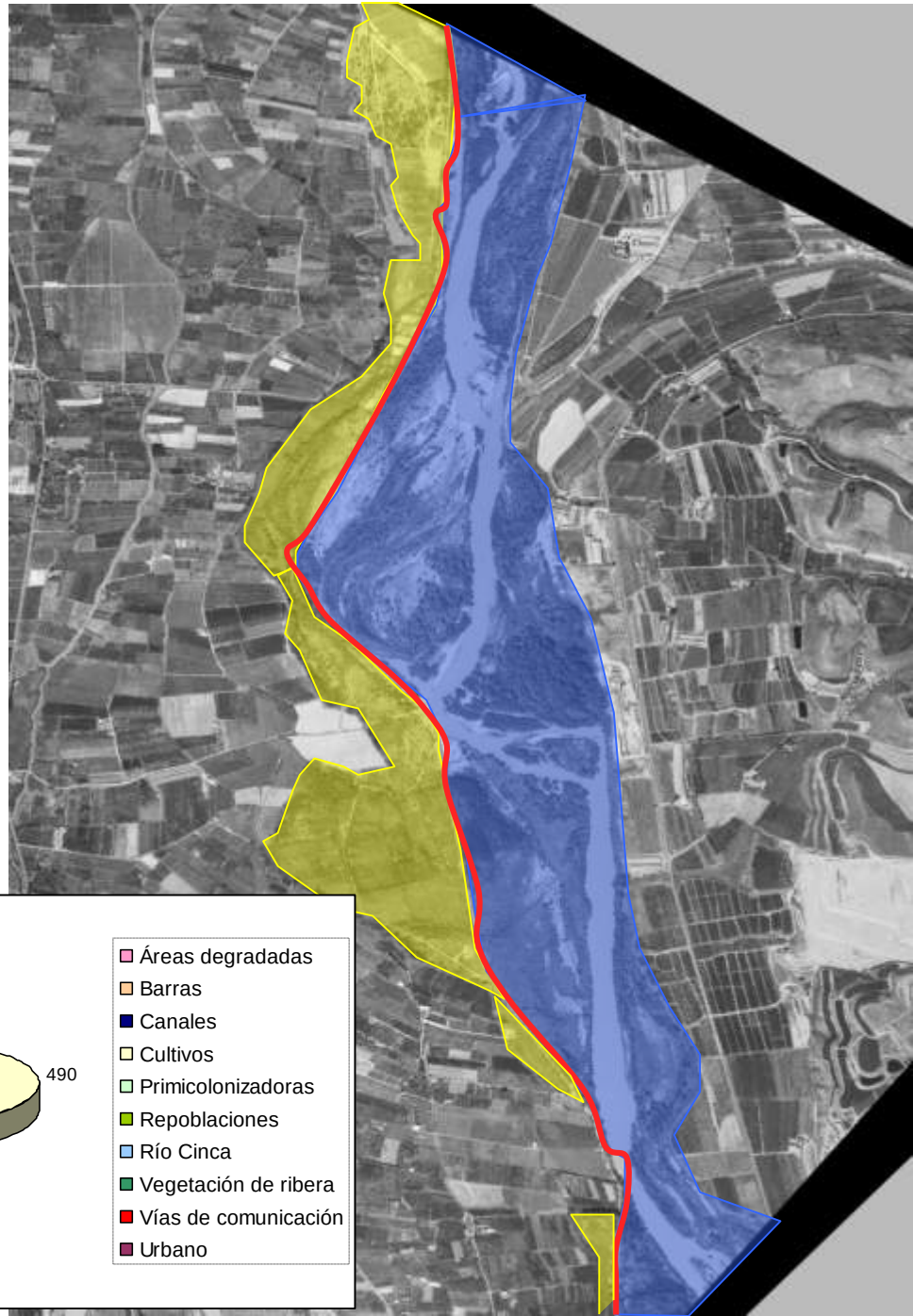

1999
LEYENDA
Cauce
Sedimentos
Primicol./ Veg. arbustiva
Vegetación arbórea
Áreas degradadas
Defensas
Cultivos
Áreas urbanas
Vías de comunicación

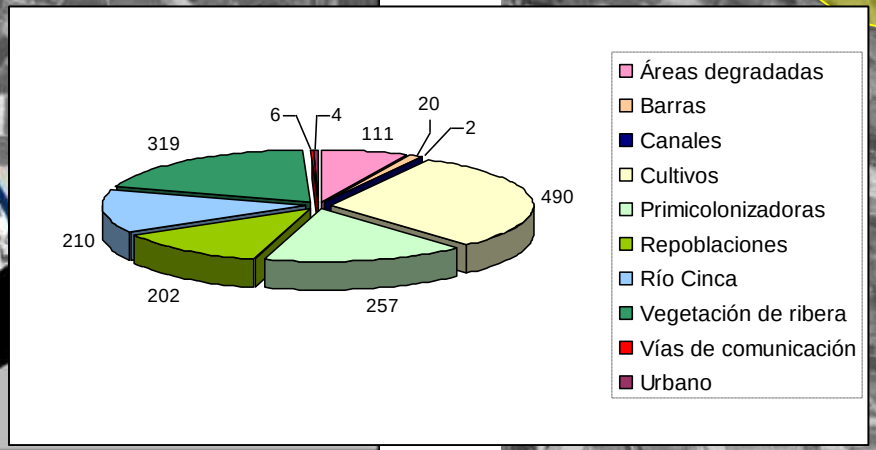
Fraga

Ministerio de Medio Ambiente		ESTUDIO DE ZONAS INUNDABLES DEL RÍO CINCA ENTRE LA PRESA DE EL GRADO Y EL EMBALSE DE RIBARROJA	10/05-ANS	INCLAM	1/4.000	ZONAS INUNDABLES AVENIDAS DE 50, 100 y 500 AÑOS DETALLE FRAGA	3

Fraga


Ballobar
Zaidín




6
4
20
111
2
319
490
210
202
257
Áreas degradadas
Barras
Canales
Cultivos
Primicolonizadoras
Repoblaciones
Río Cinca
Vegetación de ribera
Vías de comunicación
Urbano

National Strategy of River Restoration. Pilot action in Cinca River upstream Fraga

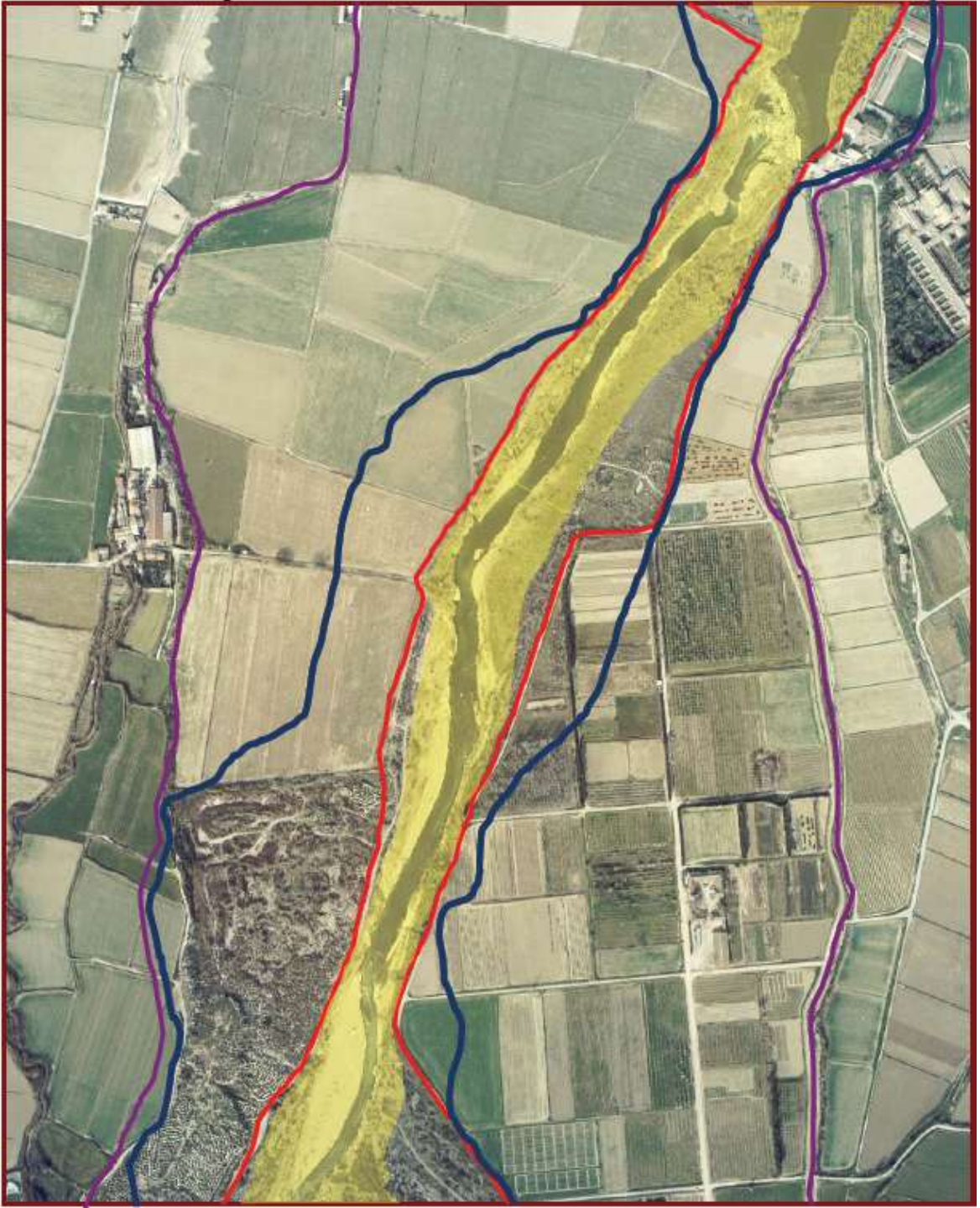
Gállego

año 1998

año 2004

0 500 m

Recent dynamics in the low reach of Gállego river (1998-2004)



Low reach of Gállego river

- Current Fluvial Territory or Minimum: the current riparian corridor. Leisure activities permitted
- Protected Fluvial Territory: where nothing can be done inside
- Basic Fluvial Territory: completely floodable, restriction of human land uses
- Ideal Fluvial Territory or Maximum: total floodplain

límites **Área de Influencia Fluvial**

límites **TERRITORIO FLUVIAL**

límites **Territorio Fluvial Actual**

Territorio Fluvial Protegido

AGENDA 21 ZARAGOZA

UPC

AYUNTAMIENTO DE ZARAGOZA

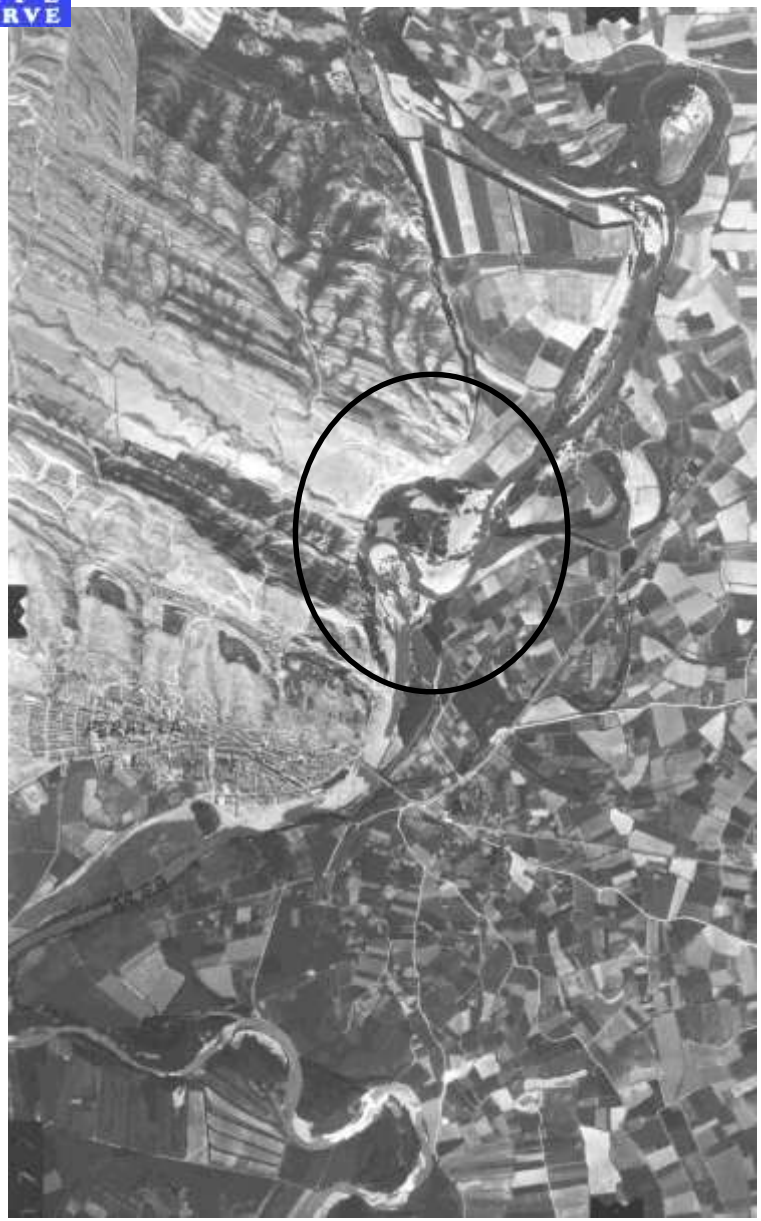
Arga and Aragón

In the technical bases of the Management Plan for the Site of Community Importance “Lower Reaches of Aragon and Arga Rivers” fluvial continuum space, predecessor of the Fluvial Territory, was proposed as one of the key elements of biodiversity conservation planning in this Natura 2000 space.

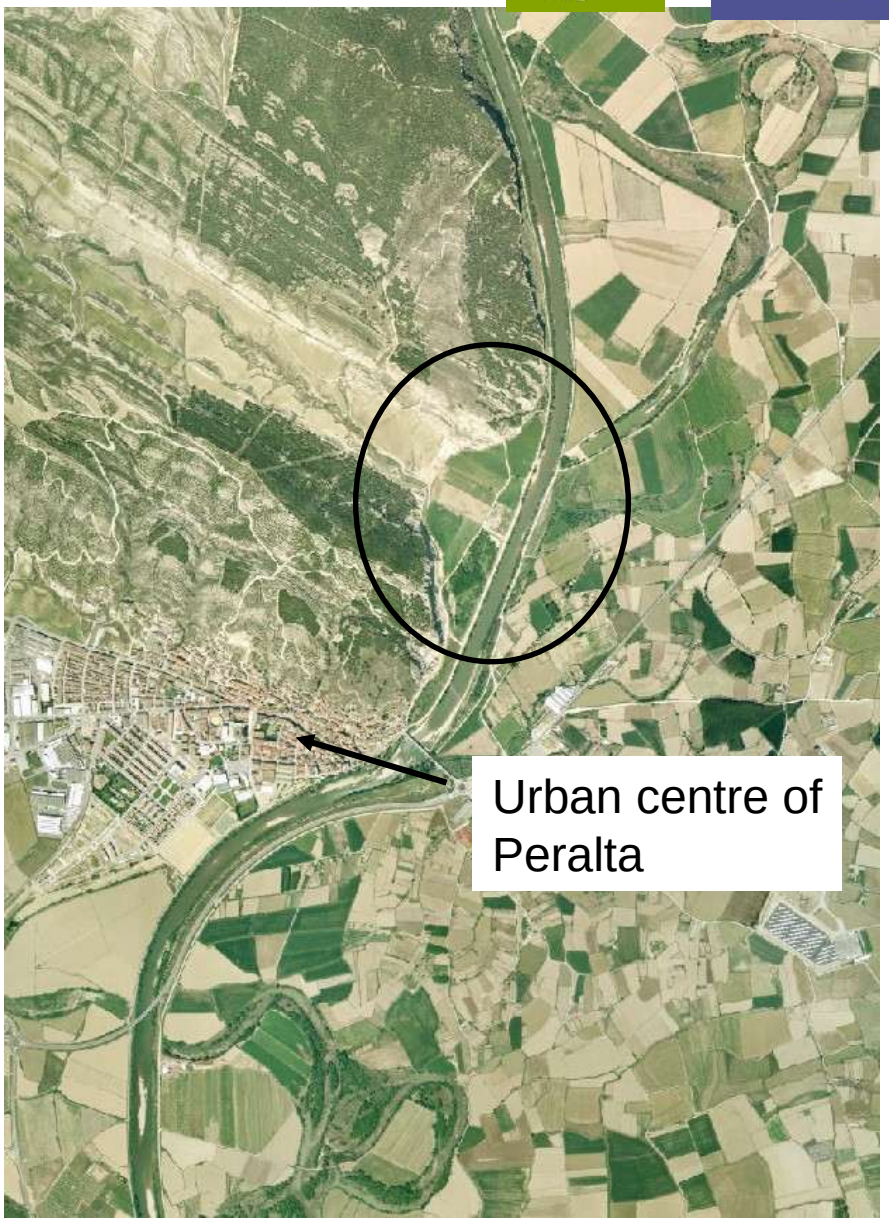
Later, under different EU co-funded projects, some of the actions proposed in the plan are being carried out establishing the Fluvial Territory as a solution through which biodiversity conservation, flood risk management and human land uses are combined.

Example of an action: Dike partial removal in Vallacuera gully

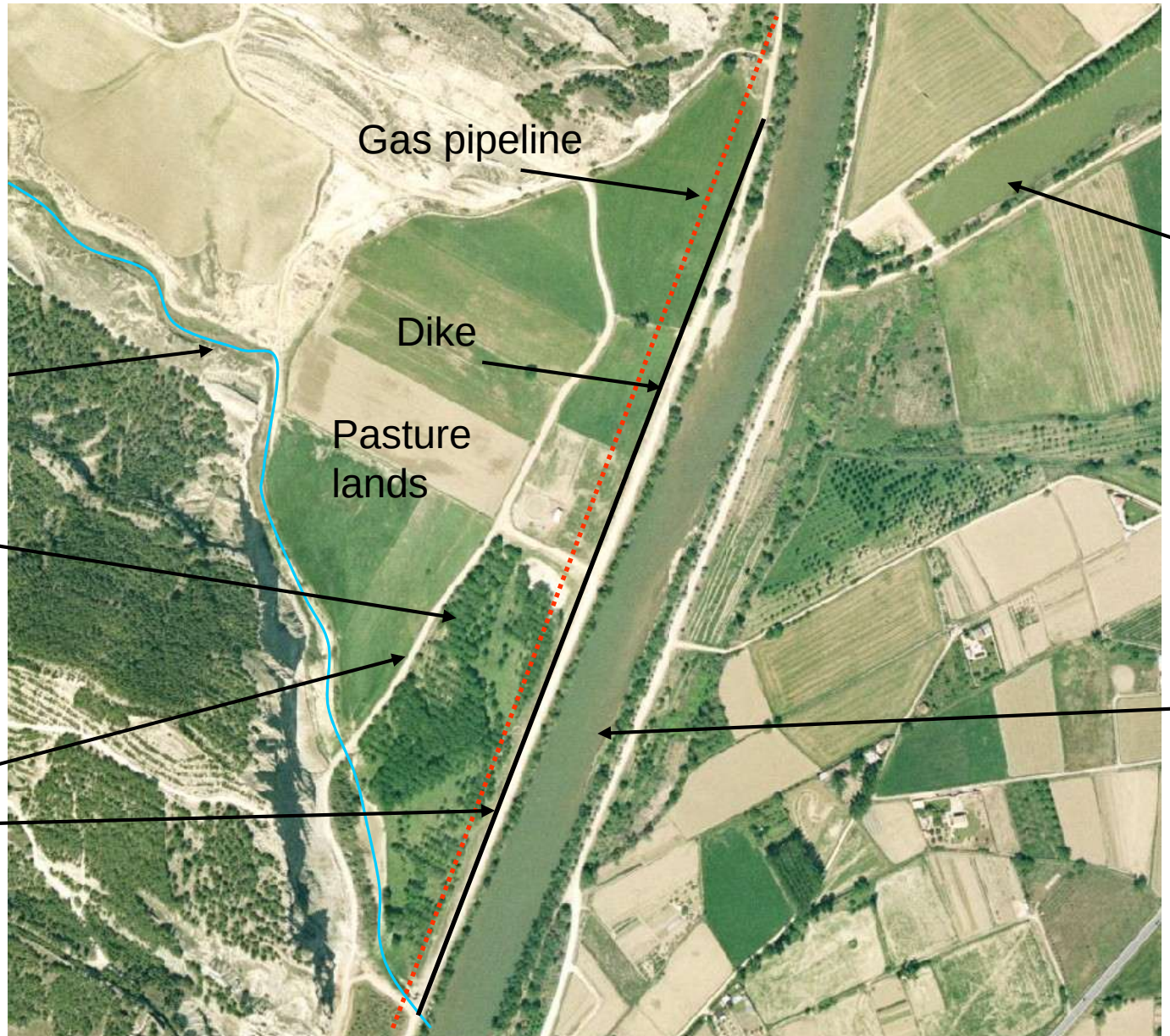
- It was canalised in the 80'
- Objective: To naturalize the river Arga in that reach to increase the surface to reduce peak flows during floods.
- Other objectives: to favour the conditions to the develop of natural vegetation, in a way that the fauna reception capacity enhances.
- Land use: pastures and few productive poplar plantation
- Determining factors: rural track and gas pipe
- Total cost: 138.000 €

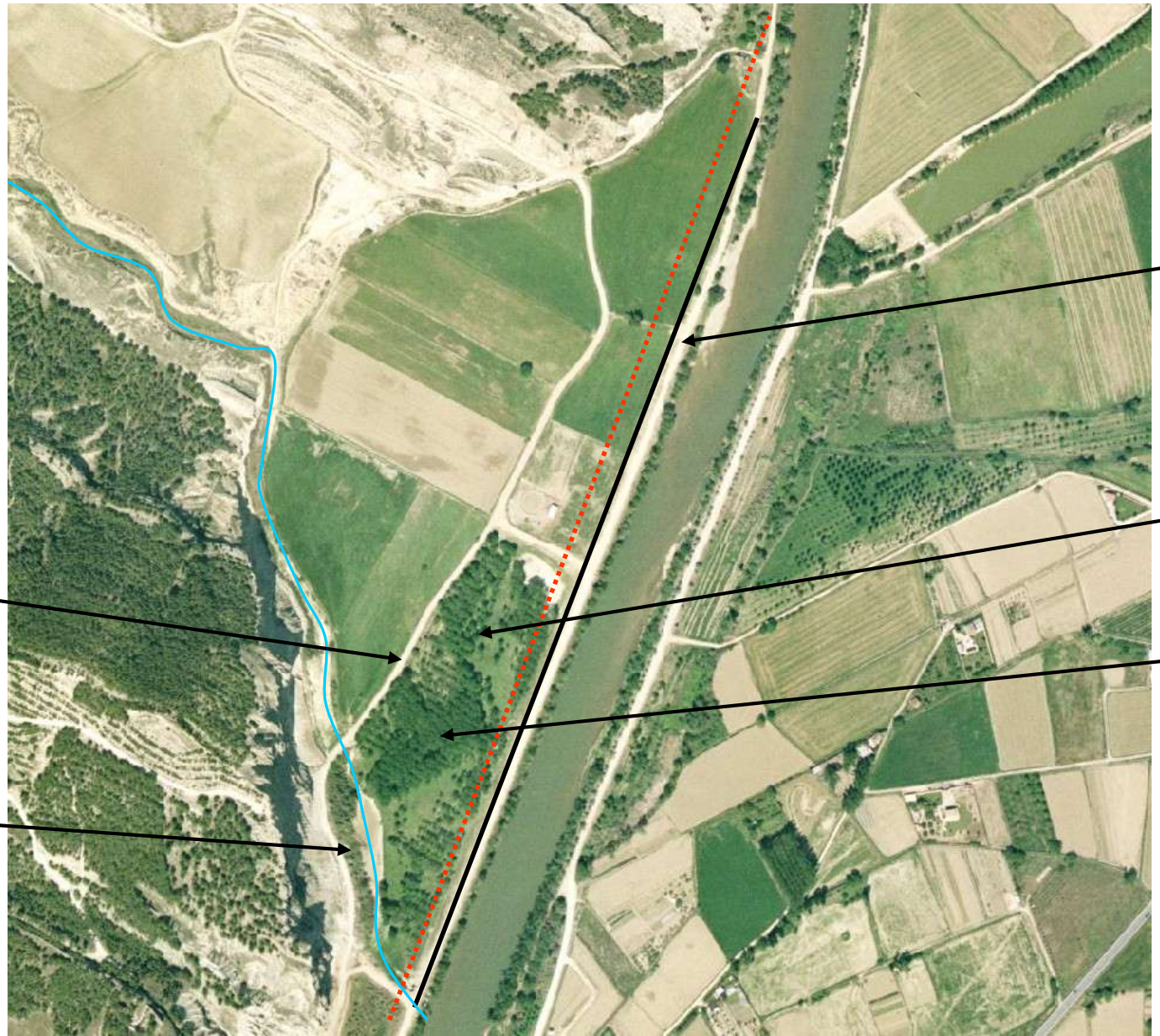


1963



Nowadays


Gas pipeline
Former channel of Arga River
Dike
Gully
Pasture lands
Poplar plantation
Current channel
Rural tracks


Dike removing
Excavation of a pool for the mink
Poplar plantation cut down
Improved rural track
Riprap

- Dike elevation has been reduced to fields elevation
- Preserving the previous existing riparian vegetation

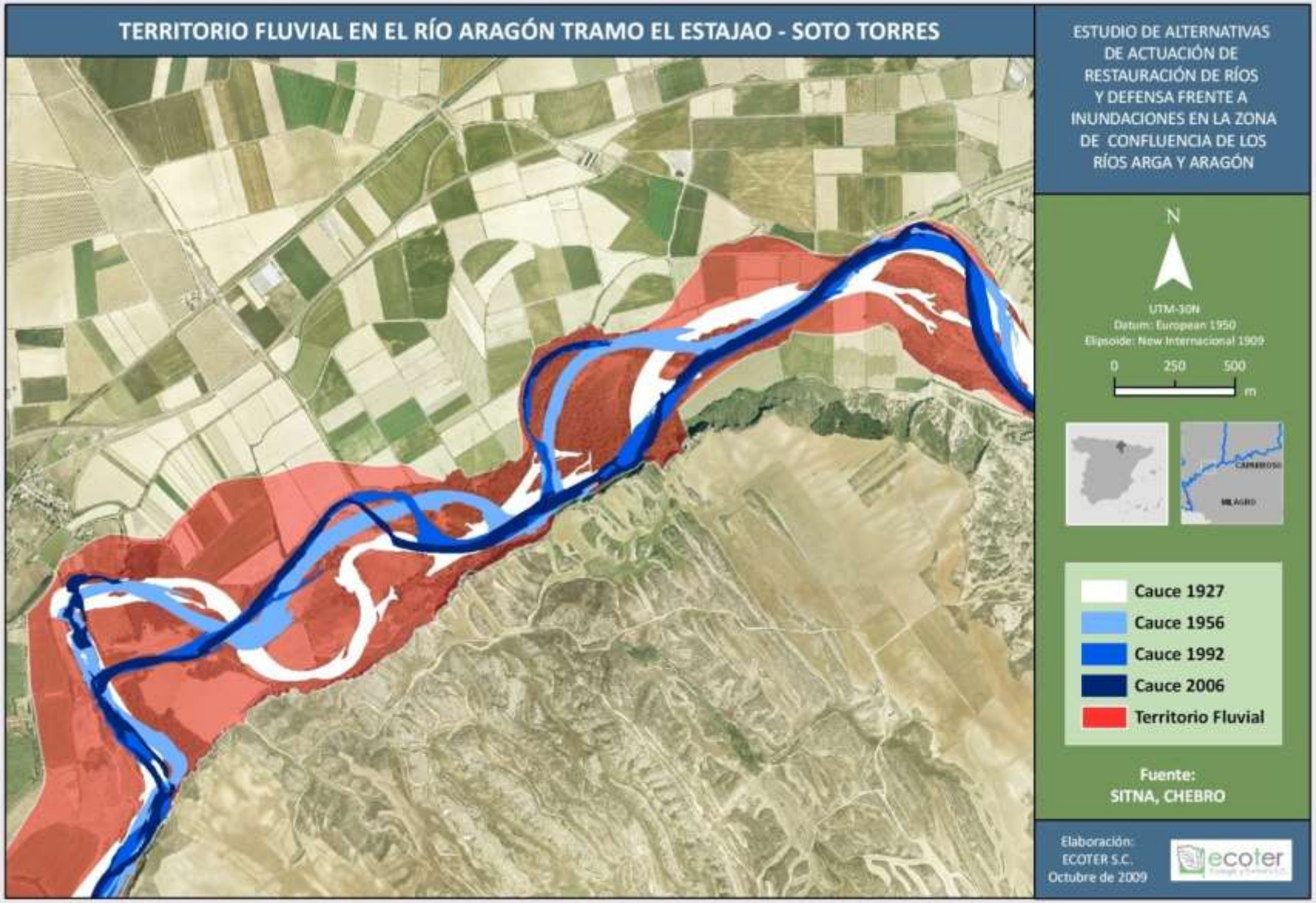
- Part of dike material was used to improve a rural track and the rest for other restoration work.
- Caution with gas pipeline

- Removal of part of the existing poplar plantation
- Creation of a wetland: excavated to phreatic and with smooth slopes

Ecosystemic Management of Rivers with European Mink-GERVE


LIFE
GERVE
Ecosystemic Management of Rivers with European Mink-GERVE
BEST LIFE-NATURE PROJECT
Life
Life


Ecosystemic Management of Rivers with European Mink-GERVE
LIFE GERVE
BEST LIFE-NATURE PROJECT
Life
Life



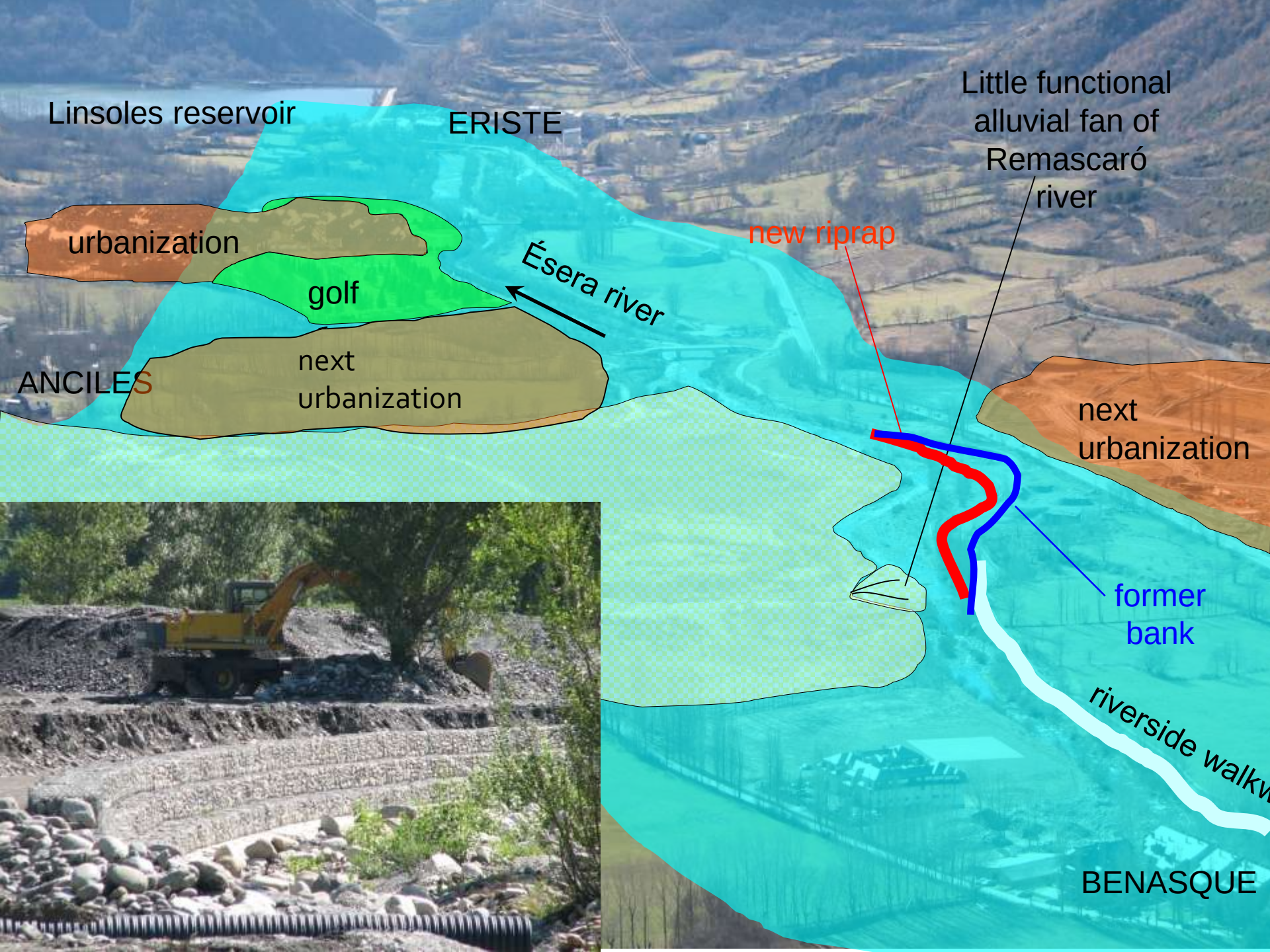
After the success of the project at the moment a new project is been carried out. Through geomorphologic, hydraulic and ecologic studies of the area, the Fluvial Territory is being defined in the lower reaches of these rivers. This definition will be the key element on which flood management and biodiversity conservation will be based.

APPLICATION DIFFICULTIES

- Urban and economic pressures

Zaragoza, little flood of June of 2008


río Gállego
Su unifamiliar está muy cerca
Villas de Jarandín
PROMOCIÓN EN VENTA
PROVENZA


Linsoles reservoir
ERISTE
Little functional alluvial fan of Remascaró river
urbanization
golf
Ésera river
new riprap
next urbanization
ANCILES
next urbanization
former bank
riverside walkw
BENASQUE

DIFFICULTIES OF THE IMPLEMENTATION OF FLUVIAL TERRITORY

- ►Urban and economic pressures
- ►Legal and administrative deficits: minimal legal application of Public Hydraulic Domain and consolidated protective legality on private property
- ►Private propriety (compatible with flooding but not with erosion) coming from legalized land occupations in many cases
- ►Need of making aware to the riverside populations that ask for "cleanings" and defenses
- ►Management plans necessity and of "river agreements" (land purchase, exchanges, compensations, insurances) to make compatible human activities, floods and environmental objectives
- ►Problems with transportation networks and preexisting infrastructure (sewers, gas pipelines…)
- ►Periodical check or update of boundaries is needed
- ►Integration of this measure with flow management and other environmental measures is essential

STRONG POINTS FOR THE IMPLEMENTATION OF FLUVIAL TERRITORY

- Creation of the National Strategy of River Restoration

GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
Programa AGUA

Estrategia Nacional Restauración de Ríos

Working groups

GEOMORPHOLOGICAL CHANGES IN CHANNELS. RESTORATION ON AFFECTED FLUVIAL SYSTEMS BY CHANNELIZATIONS AND DREDGINGS.

FIRST PROPOSAL:

FLUVIAL MOBILITY TERRITORY

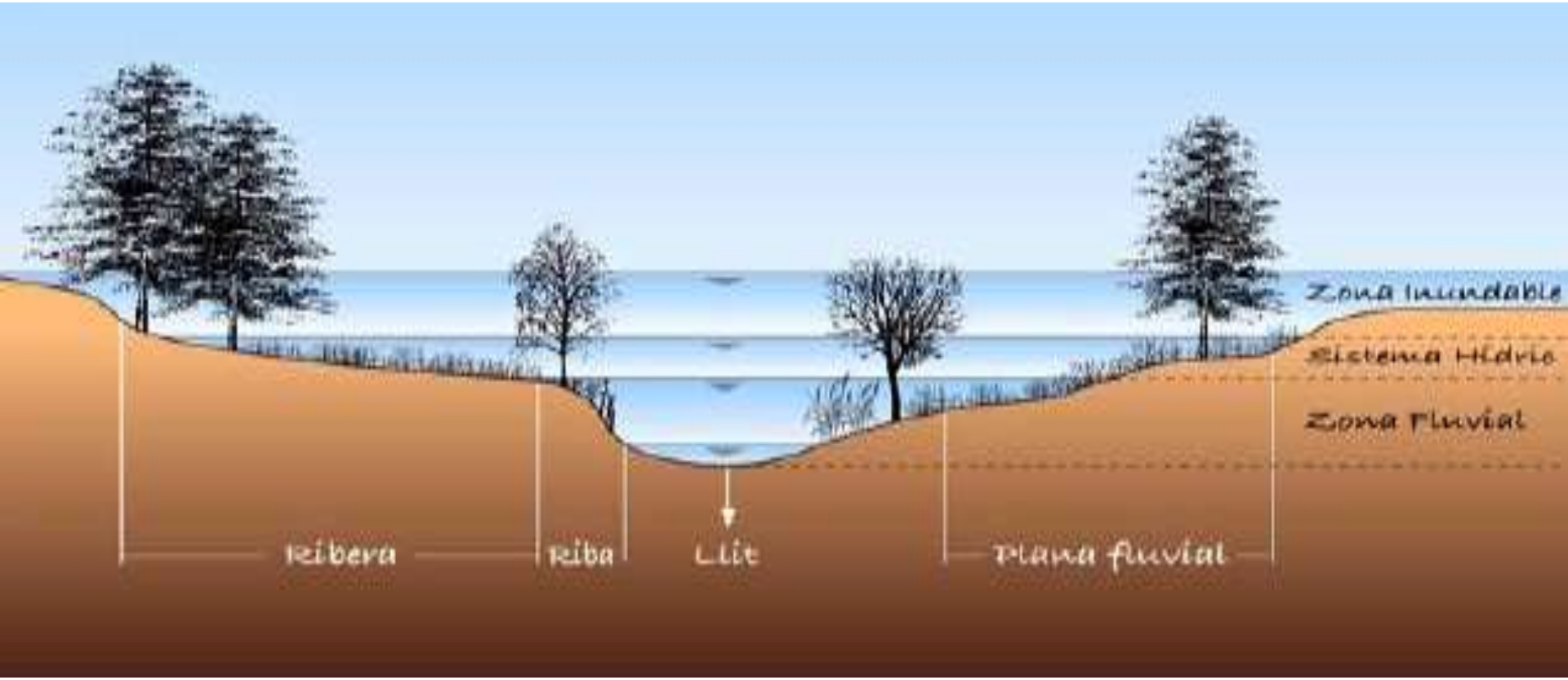
STRONG POINTS FOR THE IMPLEMENTATION OF FLUVIAL TERRITORY

- Creation of the National Strategy of River Restoration
- Catalunya new regulations for the hydrological and fluvial management

Initiatives in Catalunya

► Concepts related to the Mobility Space in the hydrologic and fluvial management

► Suggest the delimitation of three areas in the Fluvial Space: Fluvial Zone, Hydrological System and Floodable Area



STRONG POINTS FOR THE IMPLEMENTATION OF FLUVIAL TERRITORY

► Creation of the National Strategy of River Restoration

► Catalunya new regulations for the hydrological and fluvial management

► Scientific and technical work of environmental and fluvial systems' experts

► Iberian Centre of Fluvial Restoration was founded in 2009, integrated in the *European Centre for River Restoration*

► The interest of lots of local entities

CIREF
centro ibérico de restauración fluvial

Perspectives

►The FLUVIAL TERRITORY is scientifically consolidated and is technically feasible.

►It is necessary to introduce it in political and administrative fields, with enormous difficulties. Time would be necessary.

►It could be more "marketable" its implementation in the field of flooding risk management that for environmental and fluvial restoration objectives.

►In the same way, there are recent initiatives of accepting of controlled flooding of agrarian fluvial spaces, but it is not accepted the fluvial erosion (propriety loss)

►Pilot actions are needed, proof examples

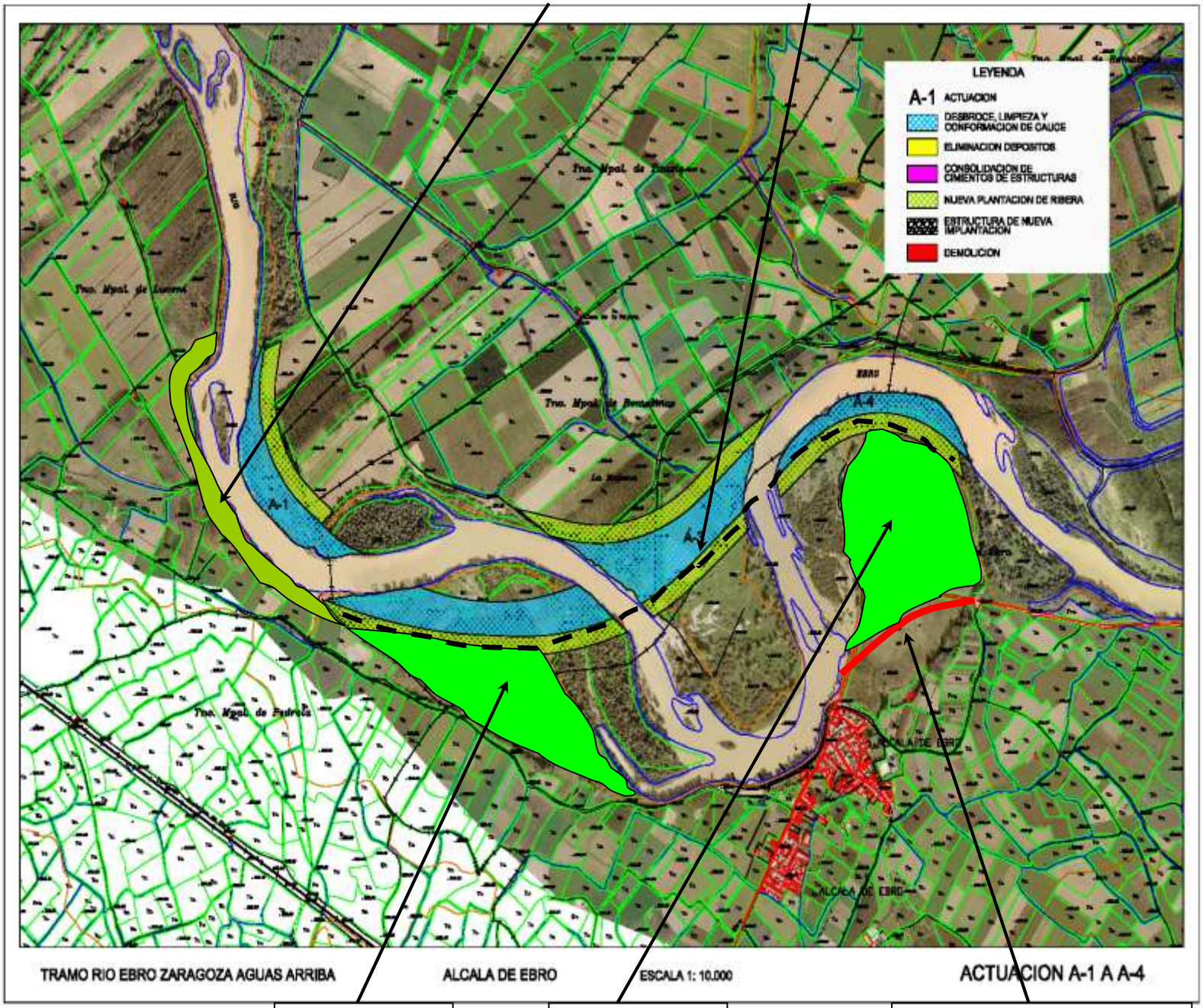
a) as initiatives that can "encourage" other cases and

b) to carry out a monitoring to test processes and trends.

Technical commission in Ebro Water Agency (2008)

1) Make permeable the dikes with floodgates, getting controlled flooding areas with a capacity of 53 hm^3 upstream Zaragoza for a 10 years flood.

2) Relief channels to increase the capacity of drainage in front of the 6 settled areas with more risk: Novillas, Pradilla, Boquiñeni, Alcalá, Cabañas y Pina.


Add riparian plantation
Unnecessary riparian plantation
LEYENDA
A-1 ACTUACION
DESBROCE, LIMPIEZA Y CONFORMACION DE CAUCE
ELIMINACION DEPOSITOS
CONSOLIDACION DE CIMIENTOS DE ESTRUCTURAS
NUEVA PLANTACION DE RIBERA
ESTRUCTURA DE NUEVA IMPLANTACION
DEMOLICION
A-1
A-4
TRAMO RIO EBRO ZARAGOZA AGUAS ARRIBA
ALCALA DE EBRO
ESCALA 1: 10.000
ACTUACION A-1 A A-4
Return to grove
Return to grove
Moving away a concrete dike

Technical commission in Ebro Water Agency(2008)

1) Make permeable the dikes with floodgates, getting controlled flooding areas with a capacity of 53 hm^3 upstream Zaragoza for a 10 years flood.

2) Relief channels to increase the capacity of drainage in front of the 6 settled areas with more risk: Novillas, Pradilla, Boquiñeni, Alcalá, Cabañas y Pina.

3) Retirement of the dikes that protect from 10 years flooding and setting up of a new line of continuous dikes on the boundaries of 25 years.

Meanwhile, during the little flood of 2008 June dikes were broken in several points to "save" the Expo exhibition site from the flood. That is, somehow the Fluvial Territory is being put into practice.

To respect (or give back) the fluvial territory is an intelligent measure. Faced to the habitual emergency measures against the river or of resistance, it is an **adaptation** strategy of **resilience**. The best we respect and conserve the fluvial territory, the best will work the fluvial system and more benefits will give.


MERCI DE VOTRE ATTENTION