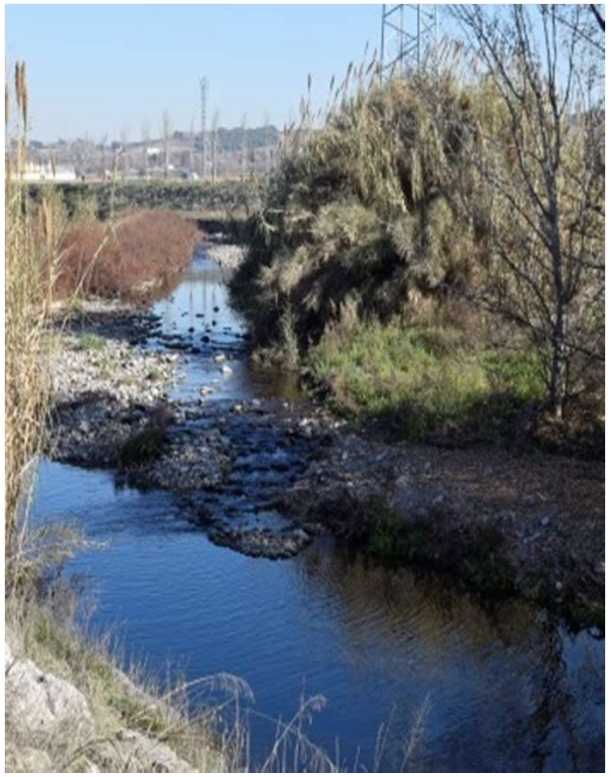
# ldding socioecological indicators to evaluate Global Change effects on Mediterranean river bas
# The case studies of la Tordera and Besòs River Basins (NE Catalonia)

**Antoni Mas-Ponce (ICTA-UAB)**,Roberto Molowny-Horas (CREAF-UAB), Eduard Pla (CREAF-UAB) & Sònia Sànchez-Mateo (ICTA-UAB)





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## L'Observatori de la Tordera i del Besòs.
## Long-term monitoring project of socioecological indicators in Mediterranean river basins

### Main goals

- ✓ To define **Integrated Environmental Assessment (IEA)** indicator tools and methodologies for water **sustainability** improve at river basin scale according to **Water Framework Directive** (2000/60/CE).

- ✓ To monitor the **socioecological status of the river basin** by using the developed **IEA tools and methodologies.** Three rese lines are defined for monitoring the socioecological status: biological, hydrological and physical/chemical.

- ✓ To **promote** and **improve** social learning processes in river basin management supporting **public participation and dissemina activities.**

- ✓ To **design** and to **develop** an Environmental Education and Communication Program: PROECA.



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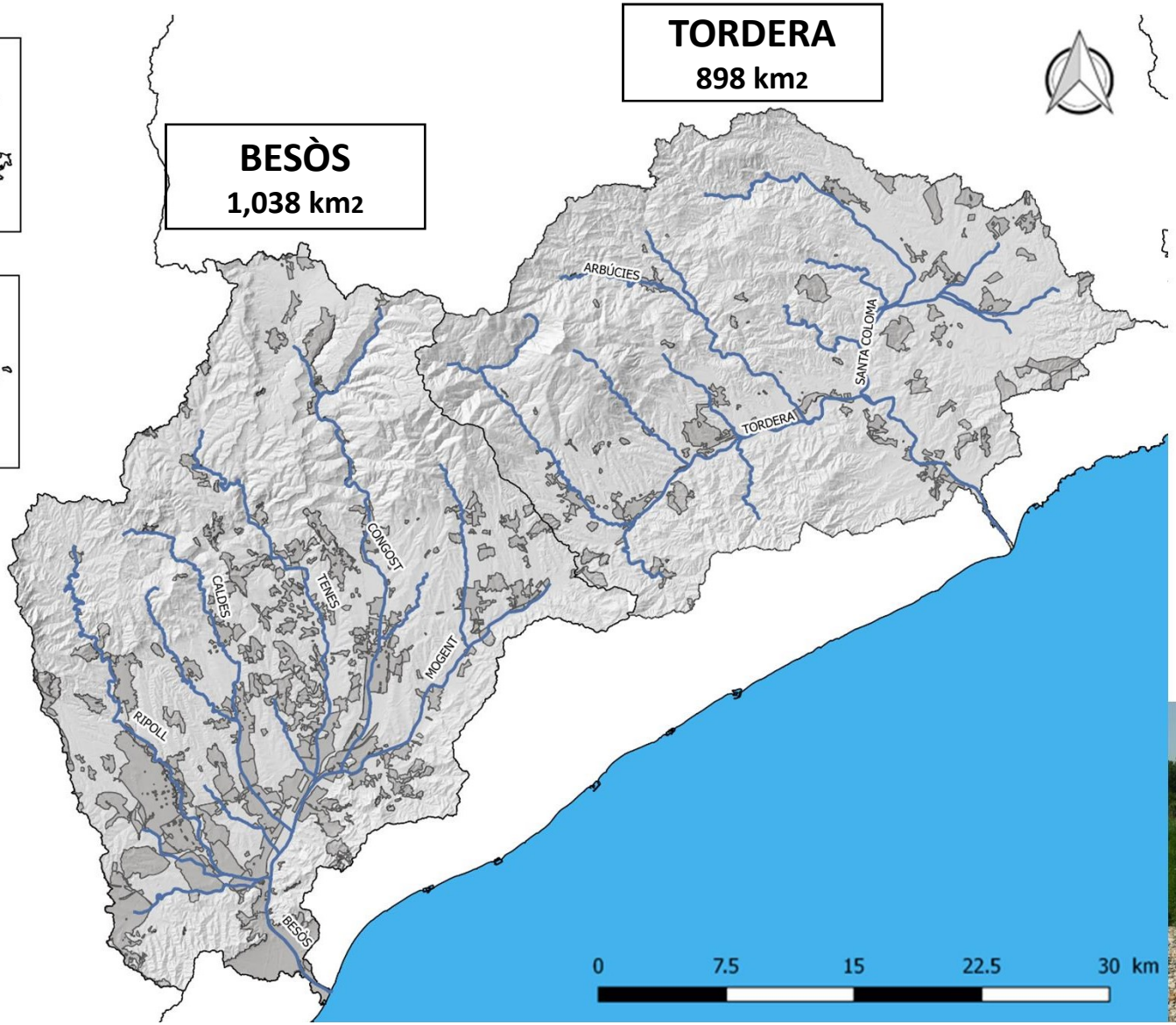
## Study site




The **Besòs and Tordera river bas** have a Mediterranean hydrolog regime and are located in the North I of Catalonia.

The **diversity of biomes and hun activities** make them a high qua **socioecological monitoring** ar **Protection figures** (BR, Natural Pa in the upper course and **hun activities** in mid and lower course.

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### Research areas

| | |
|---|---|
| **Biological monitoring** | Diatoms<br>Macroinvertebrates<br>Fish<br>Riparian vegetation<br>Amphibians and reptiles<br>Birds<br>Aquatic mammals (otter) |
| **Hydrological and hydromorphological monitoring** | Hydrological regime<br>Fluvial continuity<br>Morphological conditions |
| **Physicochemical monitoring** | TOC<br>Conductivity (EC)<br>Eutrophization |

**PROECA**

**Environmental Education, Communication and Training Program**

Social dimension:
Knowledge transfer

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## Riparian vegetation research area

## neral goals

To stablish a qualitative valorasitation of the riparian vegetation status, including information about the flora.
To detect long-term change tendencies in the riparian vegetation using indices and indicators.
To assess the presence and the abundance of allocthones species.

| Indicator value (indicies and parameters) | Metodologia | Unitats de mostreig |
|---|---|---|
| **(Riparian Forest Quality)** | HIDRI protocol. ACA (2006)<br>Nivell de qualitat / Valor del rang<br>Molt bo: ≥ 95<br>Bo: 90 > i ≥ 75<br>Mediocre: 70 > i ≥ 55<br>Deficient: 55 > i ≥ 30<br>Dolent: < 30 | **Transects (18)**: 5 segments divided in 200m aprox. In a 1km transect |
| **inventores**<br>Allochthonous species monitoring (presence/absence); chorology analysis; % of invasive species<br>Detection of the presence/absence and the species abundance by each sampling unit<br>Frequency of apparition by each taxon<br>Abundance and cover of the species of the territory | Each inventory brings to each specie an abundance value. The abundance explain the number of species and its cover, following the phytosociological system of Braun-Blanquet (1979).<br>Percentatge de recobriment / Escala Braun-Blanquet / Codificació<br>< 1 / + / Recobriment molt baix<br>1 – 10 / 1 / Recobriment baix<br>10 – 25 / 2 / Recobriment moderat<br>25 – 50 / 3 / Recobriment elevat<br>50 – 100 / 4 i 5 / Recobriment molt elevat | **Monitoring station (18):** inventories of each monitoring station |
| **CAMPAIGNS** | 1 annual campaign (spring) | |

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## Context

a **global change context**, surface water quality depends on the **interaction of natural and anthropogenic facto** ames, *et al.*, 2006). **Human-induced Land Use and Land Cover** (LULC) changes are one of the **main impacts** **ater quality and quantity** (Khatri and Tyagi, 2015; Voza, *et al.,* 2015). In that sense, considering the Mediterrane ver basin there is **a strong influence of WWTPs in the ecological quality status** (under revision: Mas-Ponce, *et a* 20). In the case of Besòs river basin:

| | 2017 | 2018 | 2019 |
|---|---|---|---|
| **WWTP discharges/pluvial water** | 80%/20% | 48%/52% | 70%/30% |
| **Precipitations (mm)** | 470 | 933 | 430 |

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## Objectives

To explore the **main global change effects** on both study areas Tordera and Besòs river basins through **LULC analys** (1993 – 2016).

To assess the **evolution of the quality status indicators** in both study areas.

- To evaluate **biological, hydromorphological, physicochemical** indicators.
- To detect **bioindicators** (different fauna taxons) which can be used as **water quality indicators.**

To build **transversal socioecological indicators** which **assess the global change effects on Mediterranean River Basins**.

- To **detect social indicators** that can be **correlated** to those indicators used for the **ecological assessment of the fluvial system**

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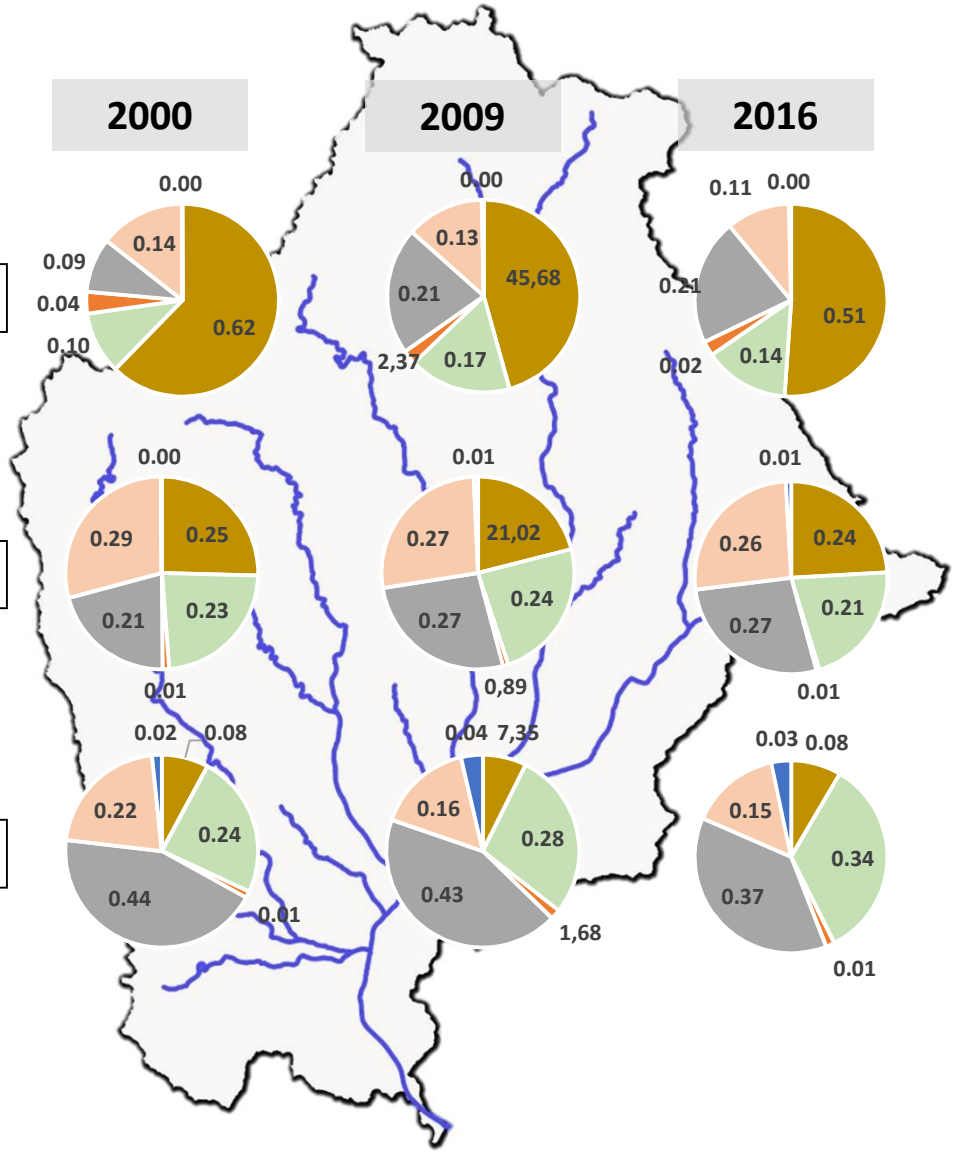
ND USE LAND COVER (2000, 2009 & 2016) | EVOLUTION OF ECOLOGICAL INDICATORS | TRANSVERSAL SOCIOECOLOGICAL INDIC




- ✓ Forested area (↓11.25%)
- ✓ Urban area (↑11.99%)

- ✓ Crops (↓3%)
- ✓ Urban area (↑6.31%)

- ✓ Crops (↓6.42%)
- ✓ Urban area(↓6.33%)
- ✓ Grasslands and Shrubs (↑10.

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asslands & Shrubs
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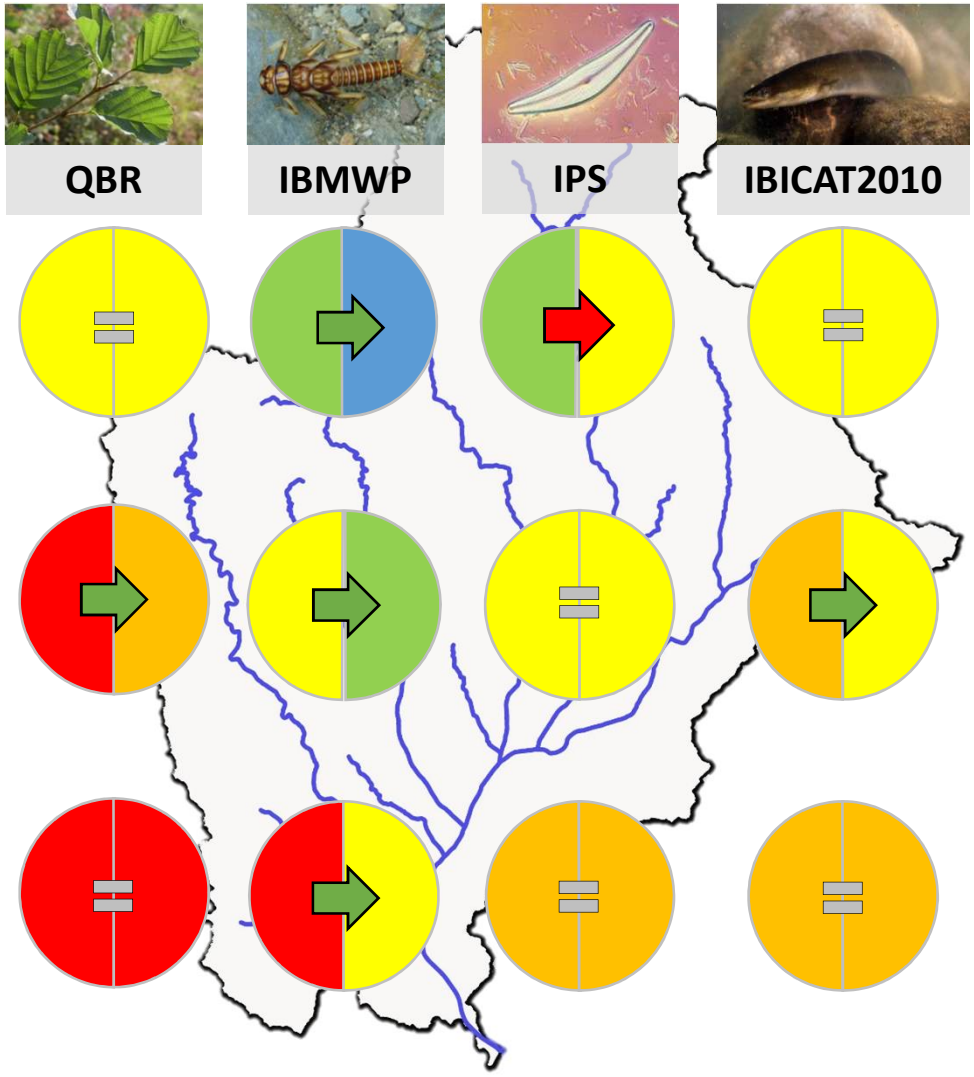


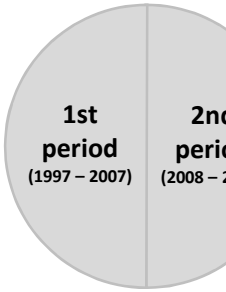


Quality stat
Excellent
Good
Normal
Deficient
Bad

Sànchez-Mateo, *et a*

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ND USE LAND COVER (2000, 2009 & 2016) | **EVOLUTION OF ECOLOGICAL INDICATORS** | TRANSVERSAL SOCIOECOLOGICAL INDIC

**QBR**

**HEADWATERS**

**MID-COURSE**

**LOWER COURSE**

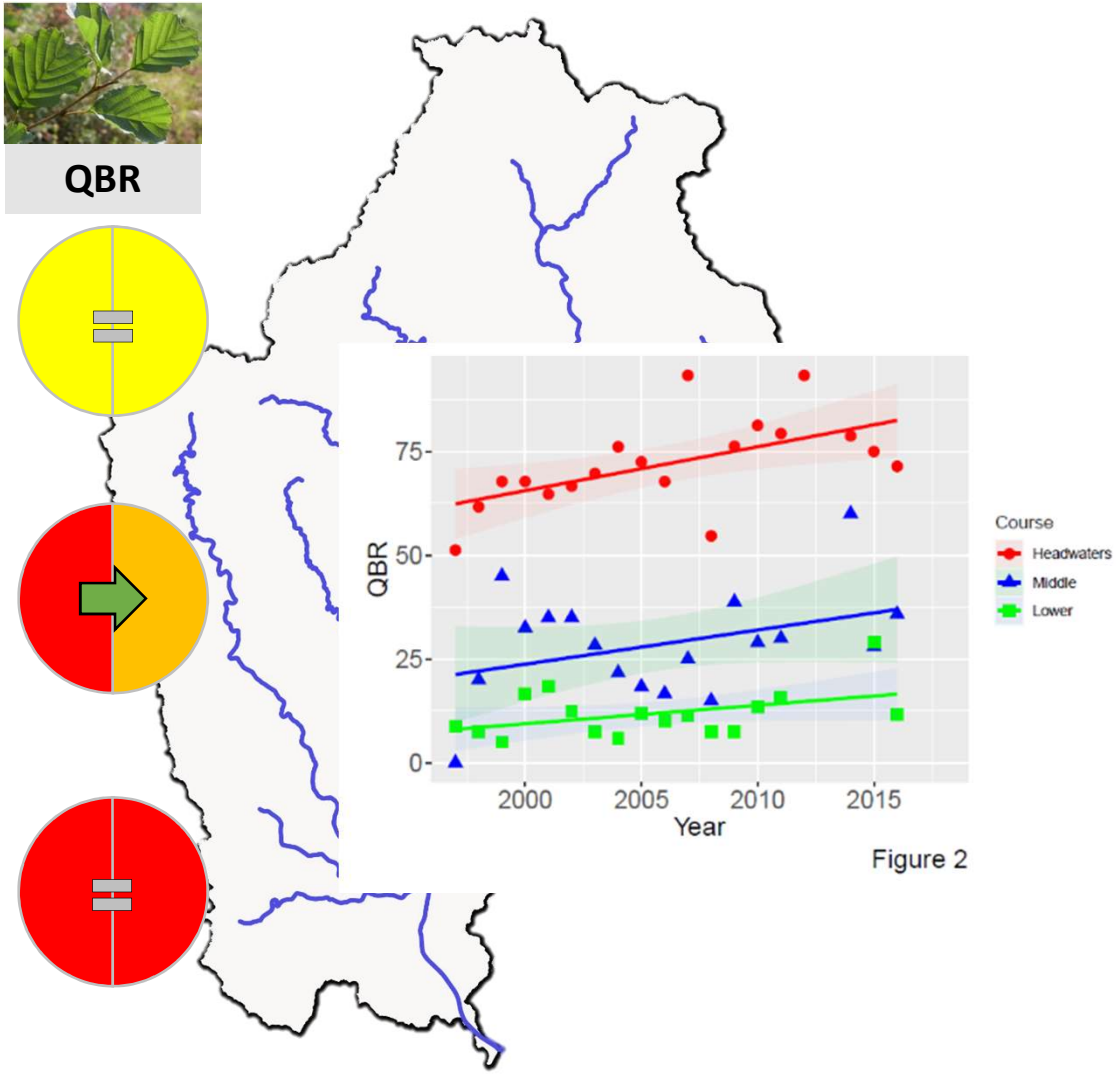
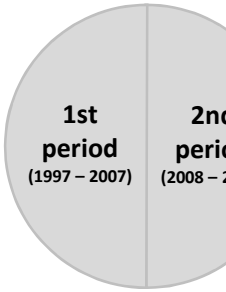



Figure 2

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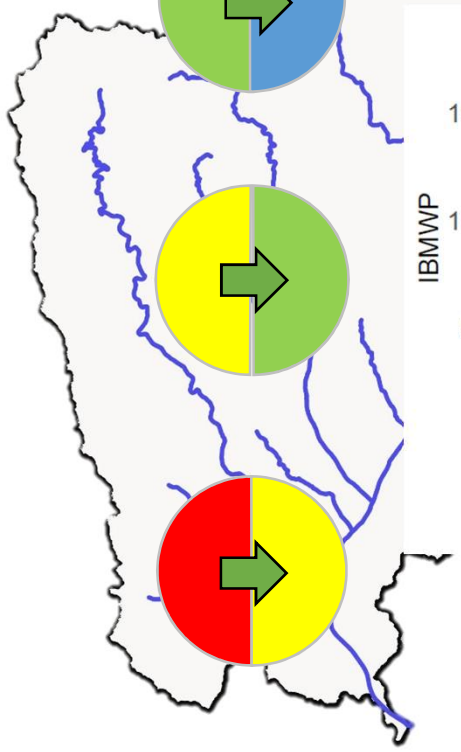
**IBMWP**

**HEADWATERS**

**MID-COURSE**

**LOWER COURSE**



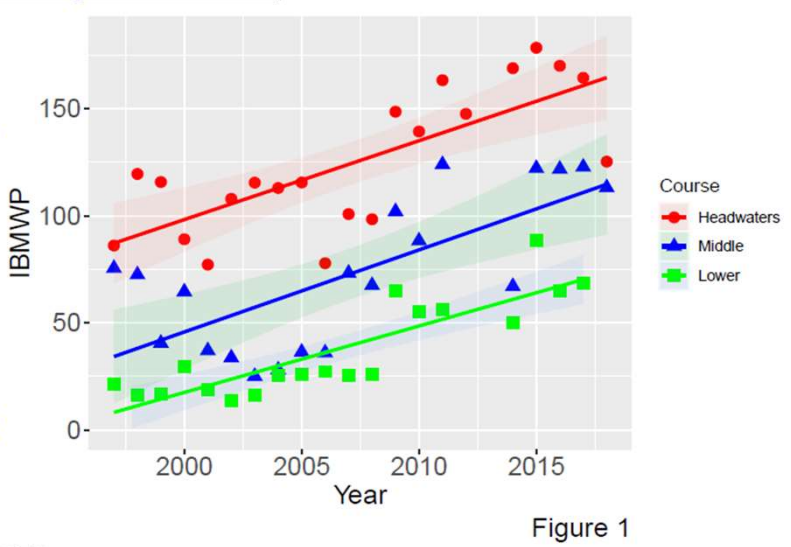
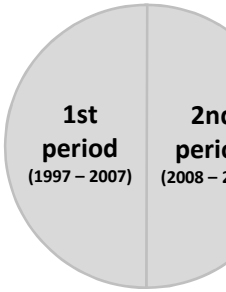



Figure 1

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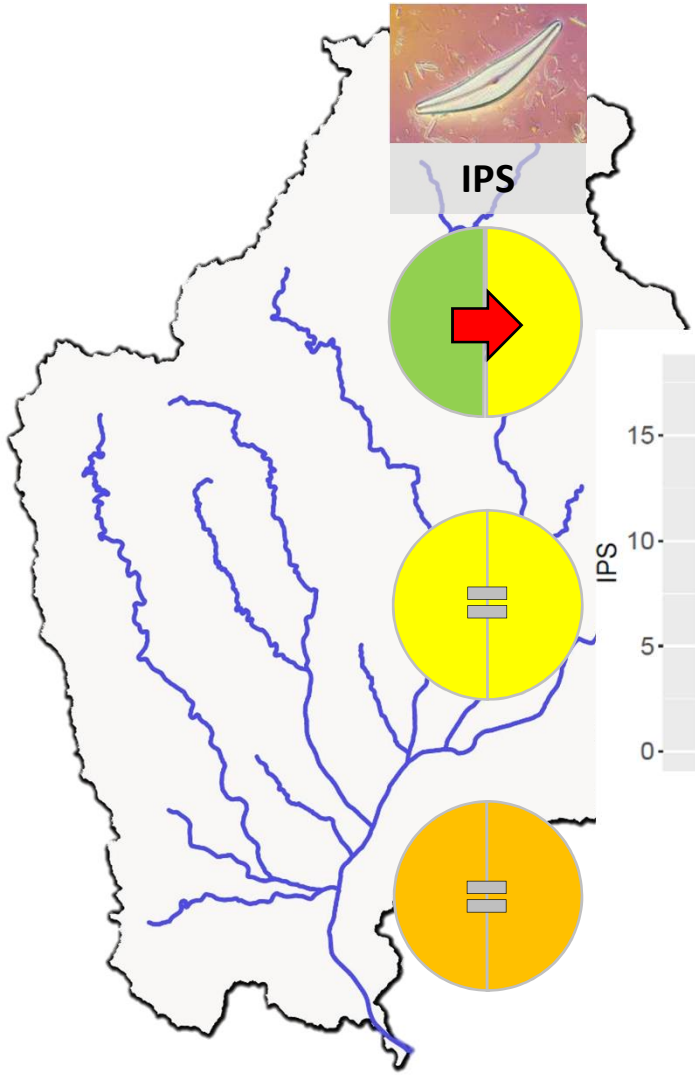
**HEADWATERS**

**MID-COURSE**

**LOWER COURSE**



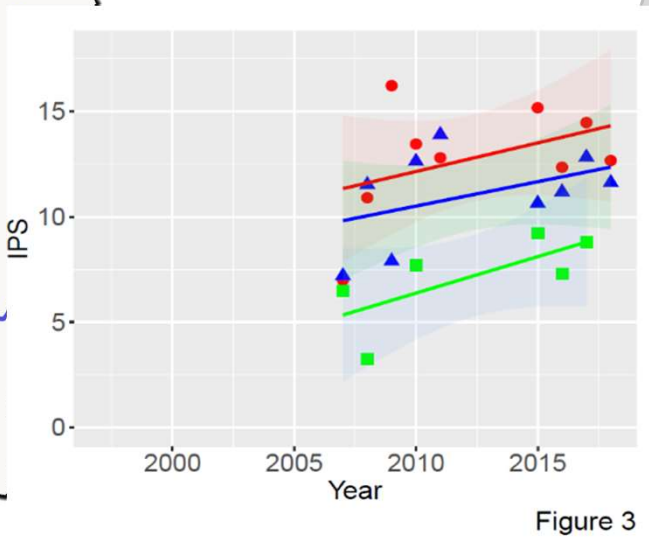




Figure 3

Bad

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## Statistical method

All the statistical analyses were carried out using **R v. 3.1.2.** (R Development Core Team, 2014).

A logit model is run for developing the socioecological indicators:

| Response variables | Predictor variables |
|---|---|
| Water quality indicators<br>Bioindicators | LULC<br>Topography<br>Climatic<br>Anthropogenic pressures |

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## Response variables

### Water quality indicators

| Biological indicators | Hidromorphological indicators | Physicochemical indicators |
|---|---|---|
| MWP (Macroinvertebrates)<br>IPS (Diatoms) | QBR (Riparian forest quality) | Conductivity<br>Ammonium<br>Nitrates<br>Nitrites<br>Fosfates<br>Water temperature |

### Bioindicator species selected

ish (9)
mphibians (9)
eptiles (4)
irds (20)
lammals (2)

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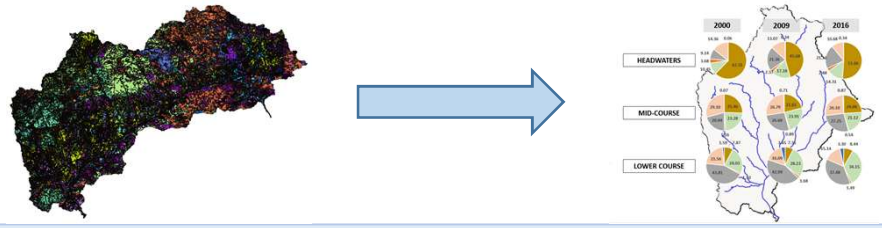
## Predictor variables

### Land Use and Land Cover changes analysis




### Topographic variables

**Maximum slope(%)** **Mean altitude (m)**

### Climatic variables

**WAI Index (annual mean)**

$$WAI=((P-ETP)/PET)x100$$

Jiménez-Cisneros

### Qualitative indicators of the anthropogenic pressures to the water bodies

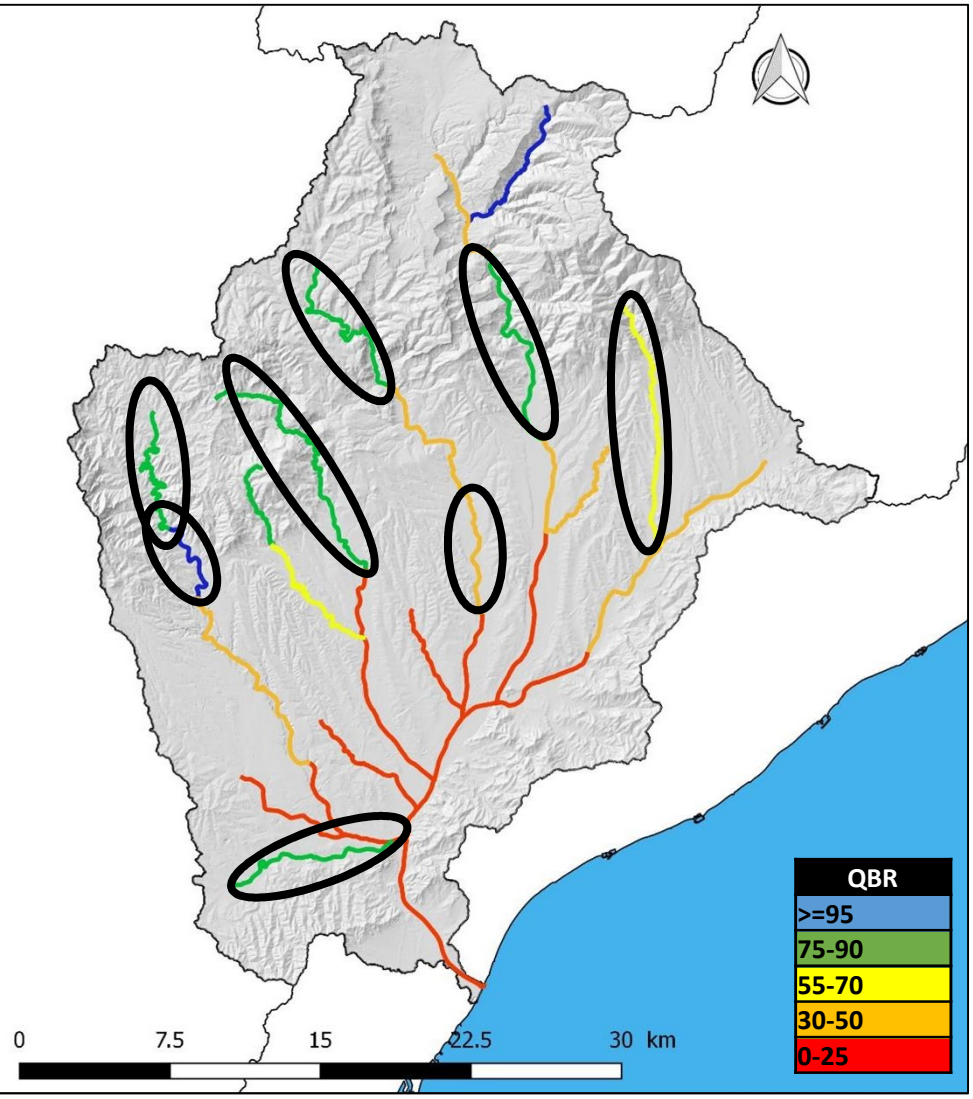
**Morphological alterations** **Punctual pollutants discharges**

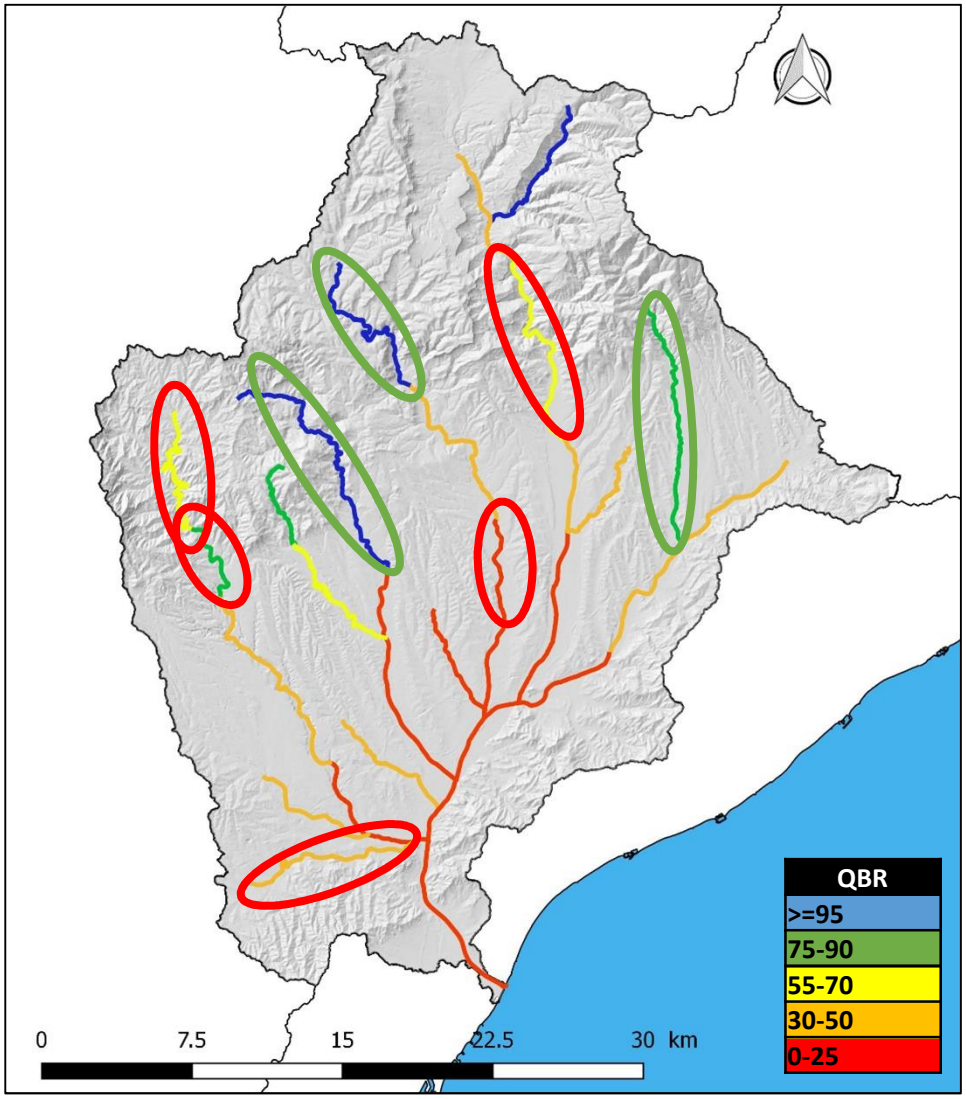
IMPRESS 2005 & 201

# QBR (riparian vegetation)

## Fieldwork results vs Predicted results

## Besòs 2009

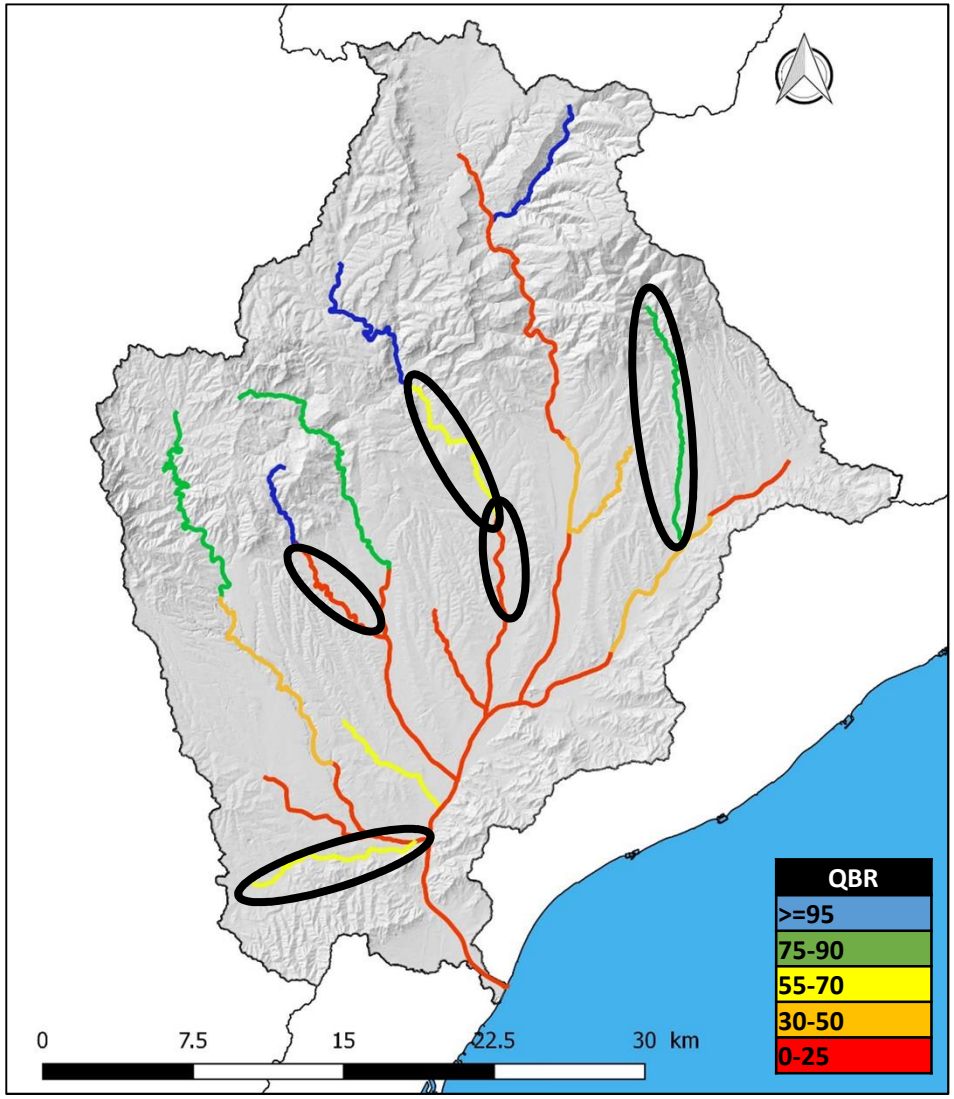


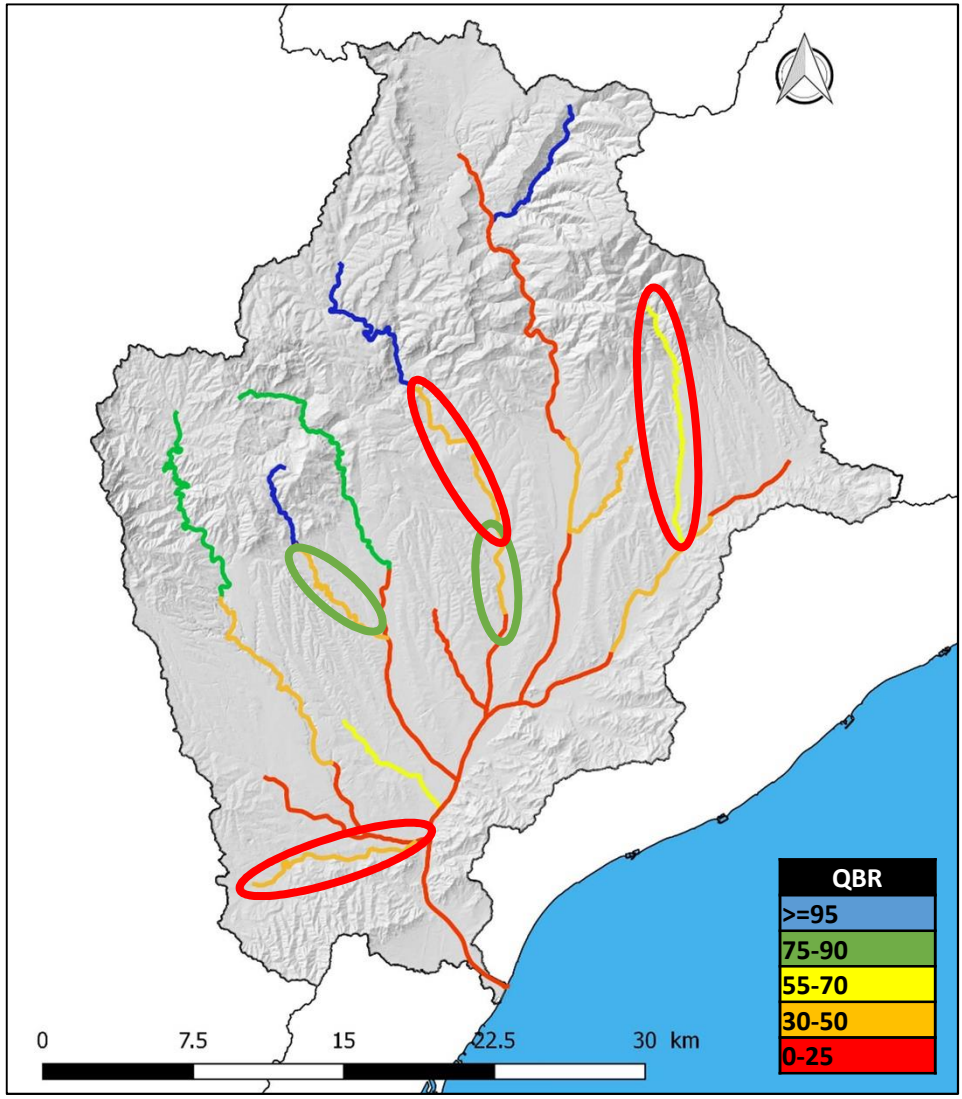



# QBR (riparian vegetation)

## Fieldwork results vs Predicted results

## Besòs 2016



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## Discussion

- The creation of these socioecological indicators allows to **take into account the human interaction on the water quality assessment**. These results can be used as an **integrative tool** for **river basin management.**

- It is needed **to impulse long-term monitoring programs** for having **continuous and robust water quality status data**.

- It is proved the **usefulness of the statistical model** to build socioecological indicators on different Mediterranean river basins as, for its **transversality**, this can be suitable to **other river basins**.

- In addition, considering a **socioecological context**, it must be assumed to include to this model the **Traditional Ecological Knowledge (TEK) of the river basin inhabitants** through **participatory processes** (ex. PGIS, P-Mapping, etc.).

- Considering the QBR index as an hydromorphological indicator, this assessment aims to explore to include other riparian vegetation aspects from a **biological assessment** such as the **richness and % of autochthonous and allochthones species**.

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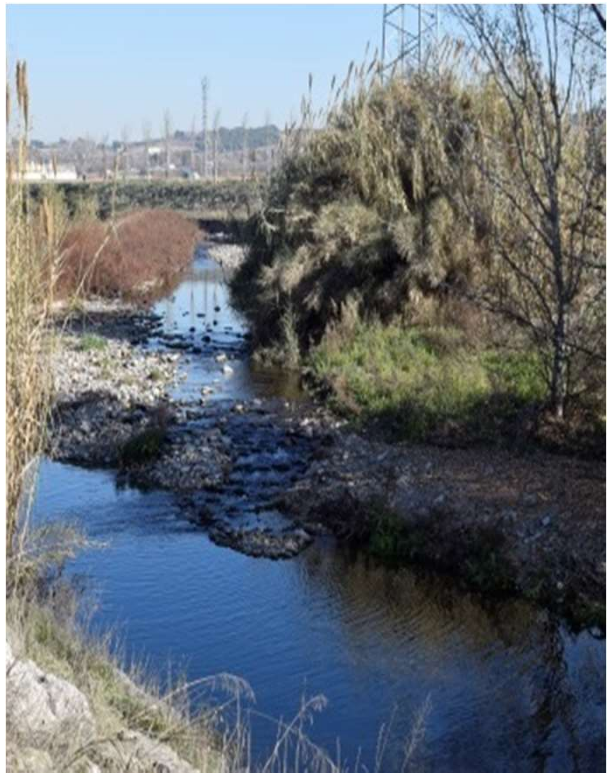



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