Practical work in hydrodynamic modelling (River2D)

Habitat improvement for native species

See and print protocol file provided (PT and ENG)

UC de MODELAÇÃO E PLANEAMENTO AMBIENTAL (19/20)

Trabalho prático de Modelação Hidrodinâmica

Requalificação de Habitats Fluviais para Espécies Nativas (Rio Ocreza)

Pretende-se com este trabalho modelar diversas intervenções na morfologia do leito do rio que visem a requalidicação e criação de habitat para as seguintes espécies autóctones: boga-comum (*Pseudochondostroma polylepis*), barbo-comum (*Luciobarbus bocagei*) e verdemã (*Cobitis paludica*). Para tal sugere-se a introdução de alterações morfológicas tais como ilhas, açudes, deflectores, empoçamentos laterais, entre outras.

O segmento fluvial em estudo tem cerca de 170 m de comprimento e cerca de 9 m de largura. Considerou-se que a rugosidade absoluta ao longo do troço é homogénea e igual a 0,5 m. O ficheiro topografia (Excel) corresponde ao levantamento topográfico com 600 pontos georeferenciados. As curvas de preferência de habitat encontram-se nos ficheiros barbo, boga e verdema (formato txt), e referem-se a preferências de velocidade, profundidade e substrato.

As condições de fronteira e alturas de escoamento a jusante para diferentes caudais encontram-se definidas na Tabela 1.

Tabela 1 – Altura de escoamento (m) na secção de saída

Q (m3/s)	h (m)
0,8	138,5
1,1	138,7
1,6	138,9

A secção de jusante do modelo corresponde à secção transversal definida pelas seguintes coordenadas:

Margem direita: x – 33292,579; y – 7590,536;

Margem esquerda: x – 33343,861; y – 7538,153

O substrato do troço bem como as curvas de preferência foram definidos tendo em conta as classes de substrato indicadas na Tabela 2. O ficheiro Substrato corresponde ao ficheiro do índice de canal.

Tabela 2 – Classes de substrato

Classe	Substrato
1	Detritos
2	Argila ou vaza (< 0,004 mm)
3	Siltes (0,004 - 0,062 mm)
4	Areias (0,062 - 2 mm)
5	Seixos (2 mm – 6,4 cm)
6	Pedras (6,4 – 25 cm)
7	Blocos (25 – 200 cm)
8	Leito rochoso (> 200 cm)

Os valores de WUA (*Weighted Usable Area*, i.e. Superfície Ponderada Útil) deverão ser optimizados para o caudal médio anual correspondente a 1,4 m3/s. De modo a não interferir com a curva de vazão da secção de jusante, sugere-se a colocação das alterações morfológicas não imediatamente a montante da secção de saída.

ENVIRONMENTAL MODELLING (19/20)

Practical work of hydrodynamic modelling

Habitat Improvement for Native Species (River Ocreza)

The aim of this work is to model several interventions in the riverbed morphology with the goal of improving habitat the following native species: straight-mouth nase (*Pseudochondostroma polylepis*), Iberian barbel (*Luciobarbus bocagei*) and Southern Iberian spined-loach (*Cobitis paludica*). For this, it is suggested the introduction of morphological alterations such as islands, small weirs, deflectors, lateral bays, among others.

The river segment under study is about 170 m long and about 9 m wide. The absolute roughness along the section was considered to be homogeneous and equal to 0.5 m. The topography file (Excel) corresponds to the topographic survey with 600 georeferenced points. Habitat suitability curves are found in the "barbo" (i.e. barbel), "boga" (i.e. nase) and "verdema" (i.e. spined loach) files (txt format), and refer to water velocity, depth and substrate preferences.

The boundary conditions and flow height downstream are available to different flows, as shown on Table 1.

Table 1 – Flow heights (m) on the outflow section

Q (m3/s)	h (m)
0.8	138.5
1.1	138.7
1.6	138.9

The downstream section of the model corresponds to the cross section defined by the following coordinates:

Right bank: x – 33292.579; y – 7590.536;

Left bank: x – 33343.861; y – 7538.153

The substrate of the river segment as well as the habitat suitability curves were defined taking into account the substrate classes indicated in Table 2. The Substrate file corresponds to the channel index file.

Table 2 – Substrate classes

Class	Substrate
1	Detritus
2	Clay (< 0,004 mm)
3	Silt (0,004 - 0,062 mm)
4	Areia (0,062 - 2 mm)
5	Cobble (2 mm – 6,4 cm)
6	Pebble (6,4 – 25 cm)
7	Boulder (25 – 200 cm)
8	Bedrock (> 200 cm)

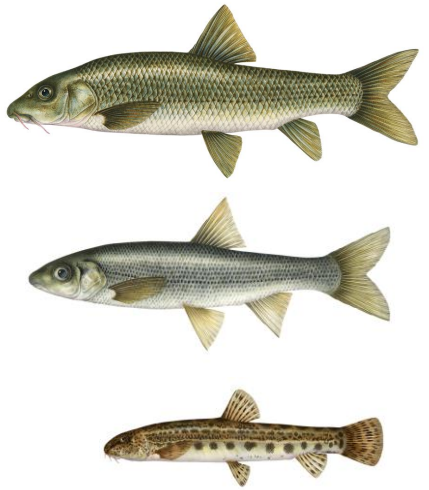
Weighted Usable Area (WUA) values should be optimized for the mean annual flow of 1.4 m3/s. In order not to interfere with the flow curve of the downstream section, it is suggested to place morphological changes not immediately upstream of the outlet section.

GOAL:

To investigate several interventions in riverbed morphology aimed at restoration and habitat creation for the following native species: nase (*P. polylepis*), barbel (*L. bocagei*) and loach (*C. paludica*).

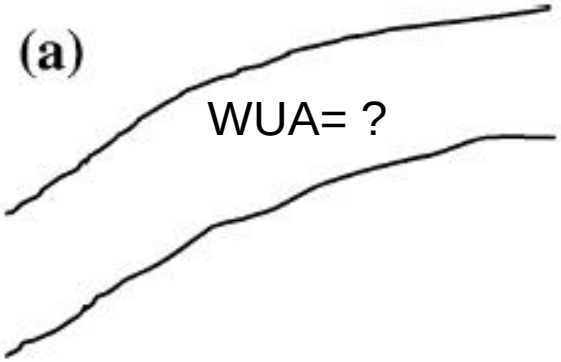
For this purpose, the hydromorphological modeling of the river section will be initially studied (modeling of 4 river flows – 0.8, 1.1, 1.4 and 1.6 m3/s) and later the introduction of morphological alterations such as submerged islands and/or deflectors.

The results of the changes will be evaluated considering habitat optimization for the species considered.



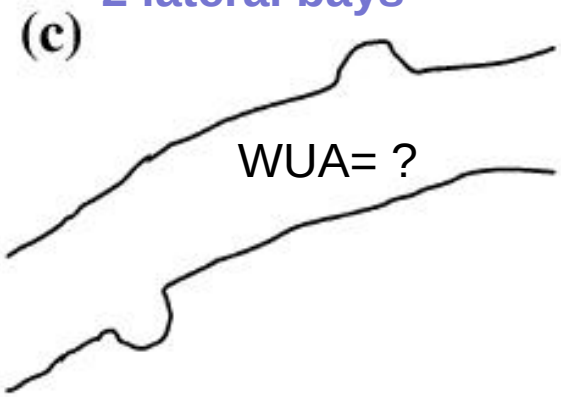
POSSIBLE MORPHOLOGICAL ALTERATIONS TO MODEL FOR COMPARISON WITH THE PRESENT SITUATION (REFERENCE)

Reference (present scenario)

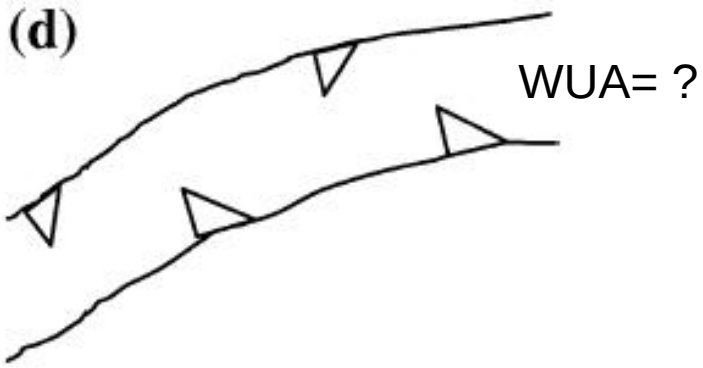


3 islands in the middle of the channel

2 lateral bays

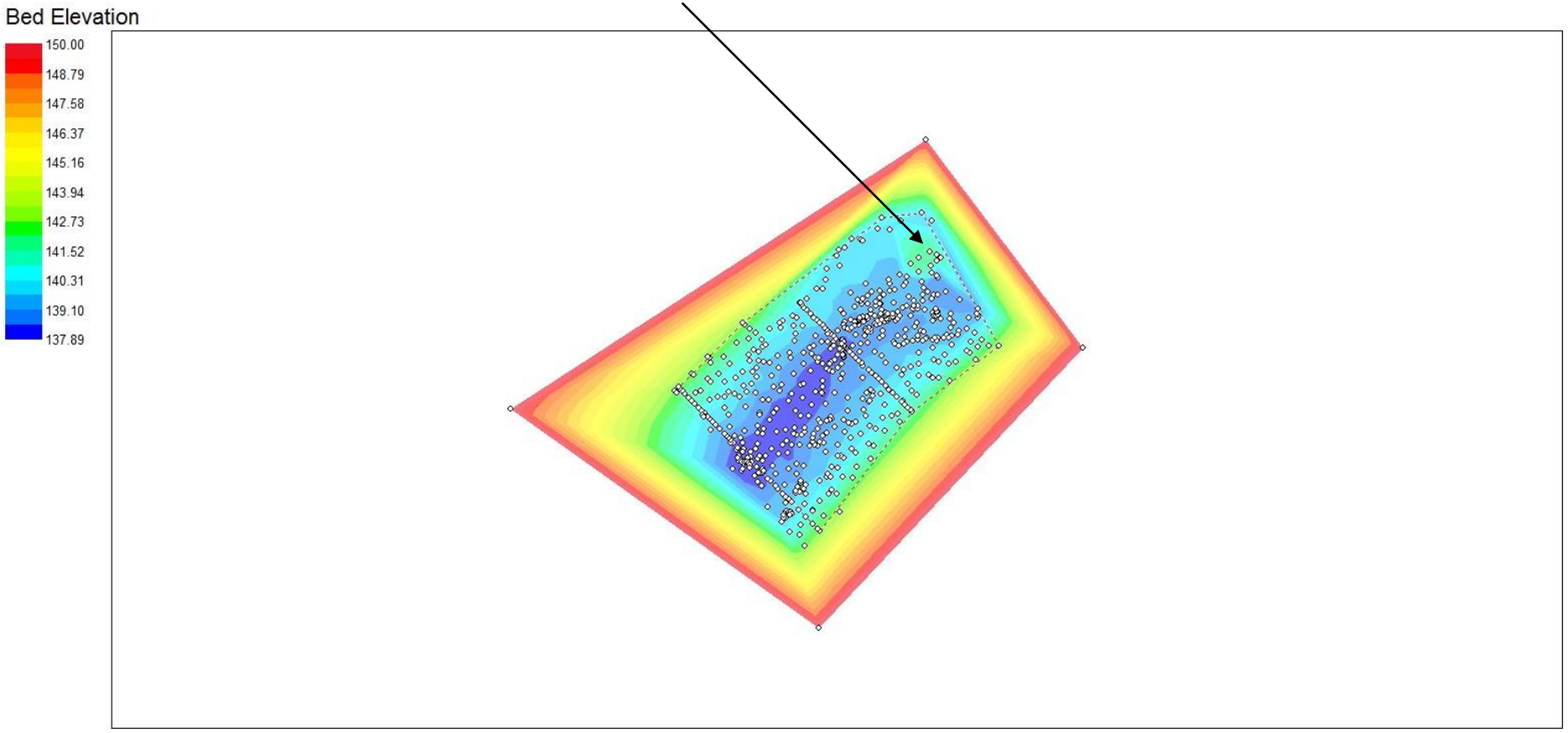


4 alternated deflectors



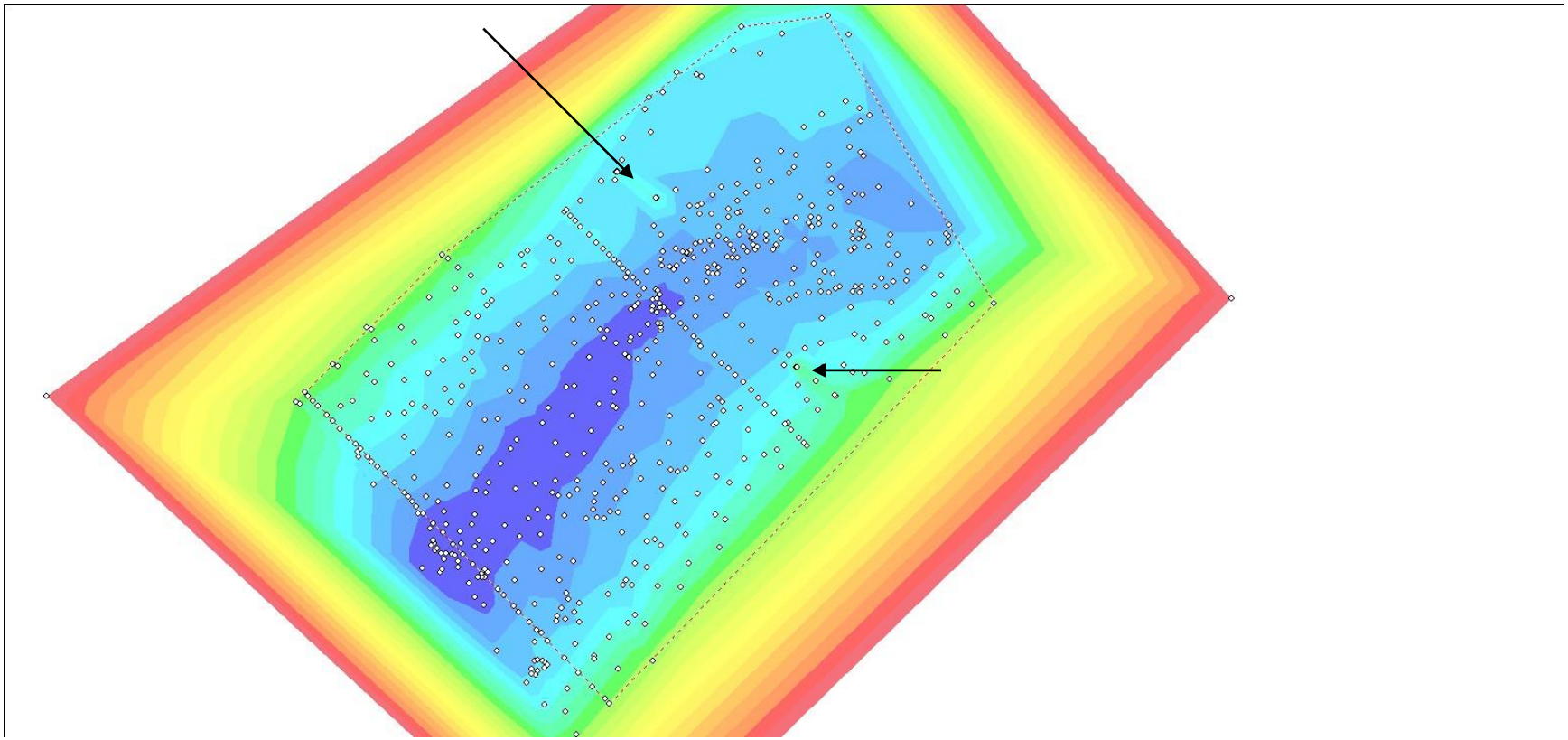
Does WUA (i.e. habitat) improve for the new modelled scenarios?

1 island created



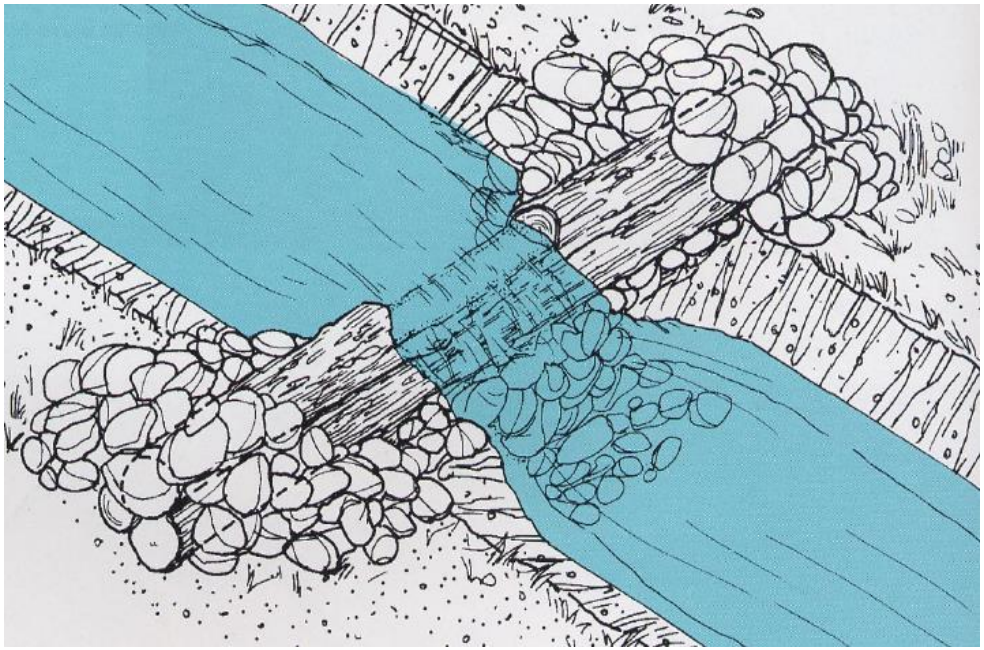
We should only create scenarios where reference WUA is very low (i.e. no or few habitat)

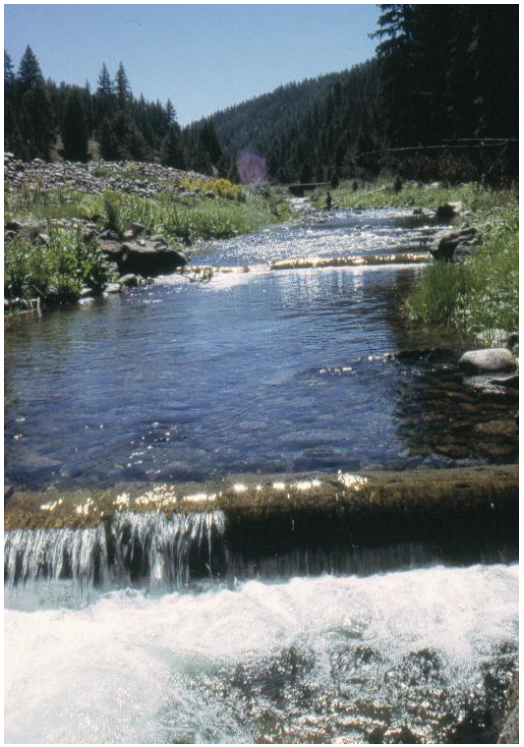
2 deflectors on opposite banks

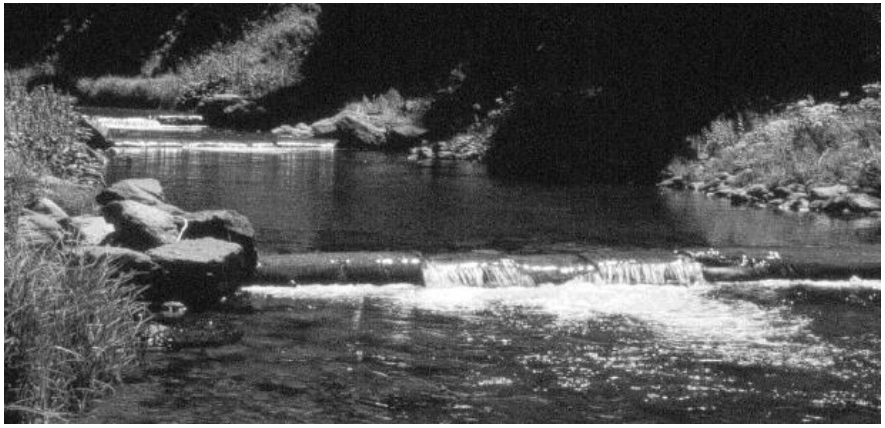


We should only create scenarios where reference WUA is very low (i.e. no or few habitat)

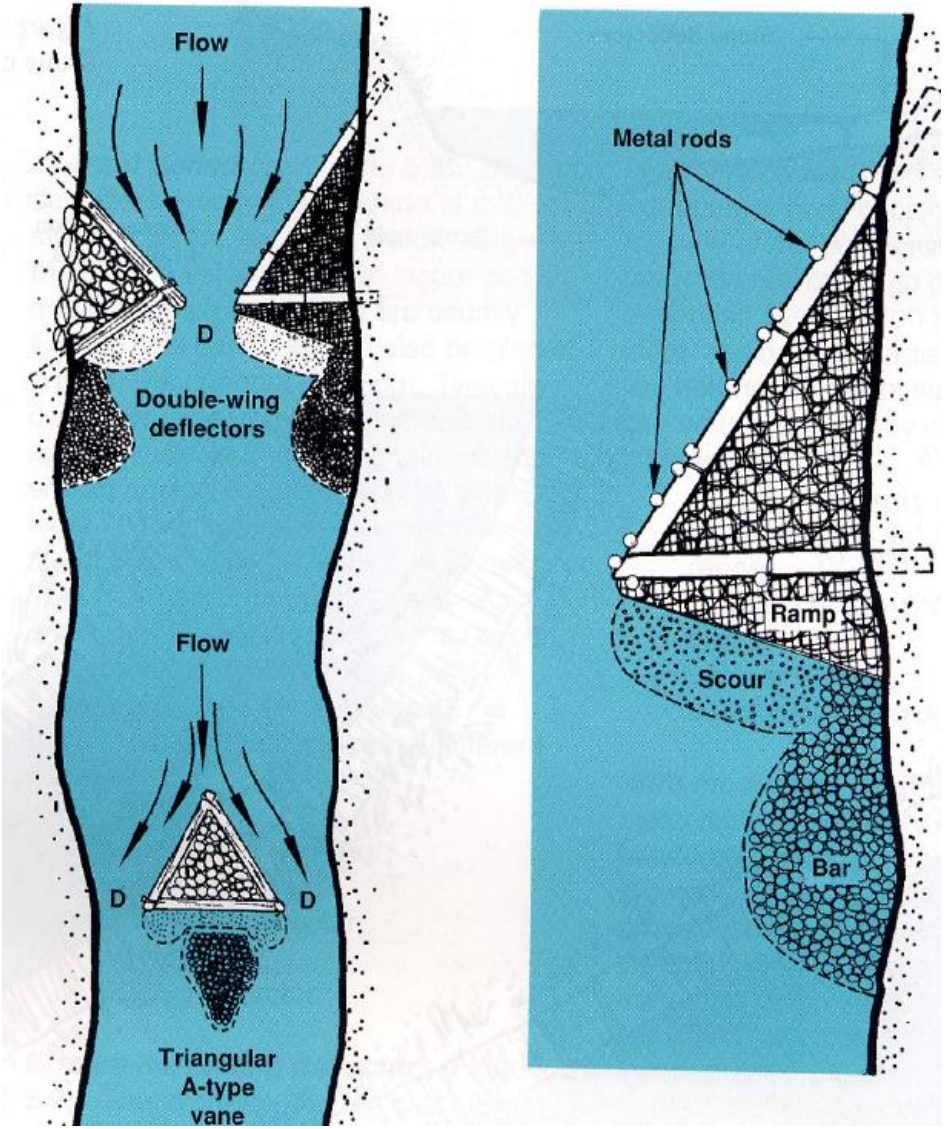
Small low-head weirs



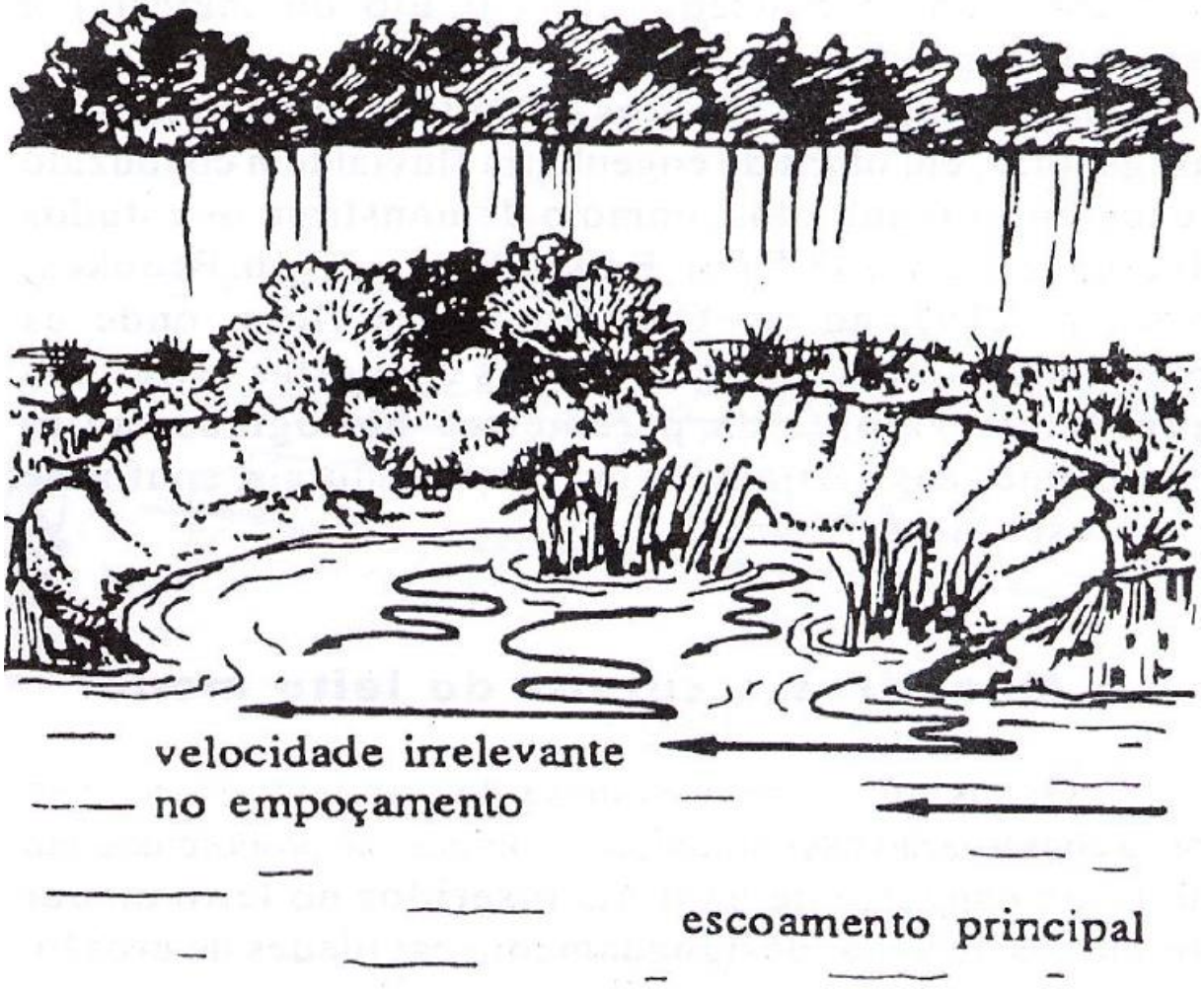




Triangular deflectors

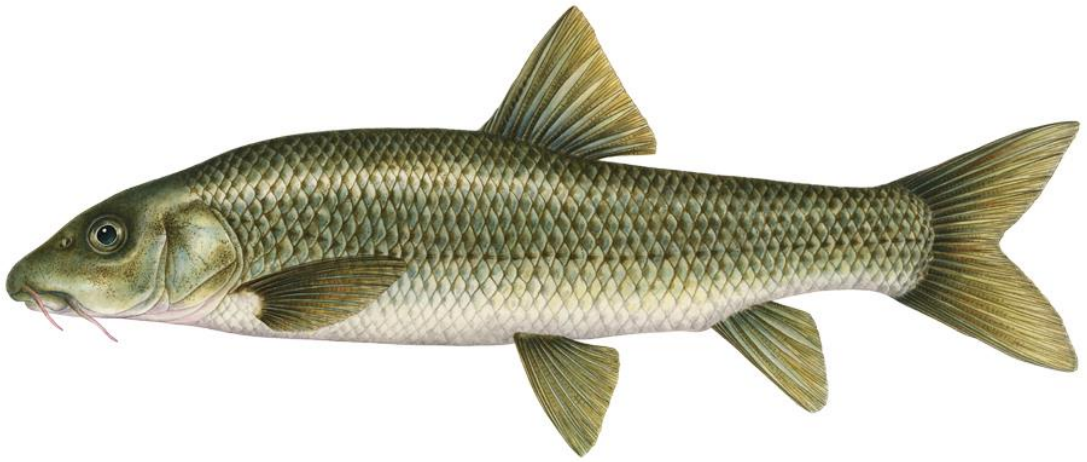


Lateral bays



Target species

Iberian barbel
(*Luciobarbus bocagei*)



Ecology

Large cyprinid fish (can grow up to 50 cm TL).

Ubiquitous species, though it seems to avoid strong current speeds and very cold waters.

Moderately tolerant, it can be found in rivers with poor water quality.

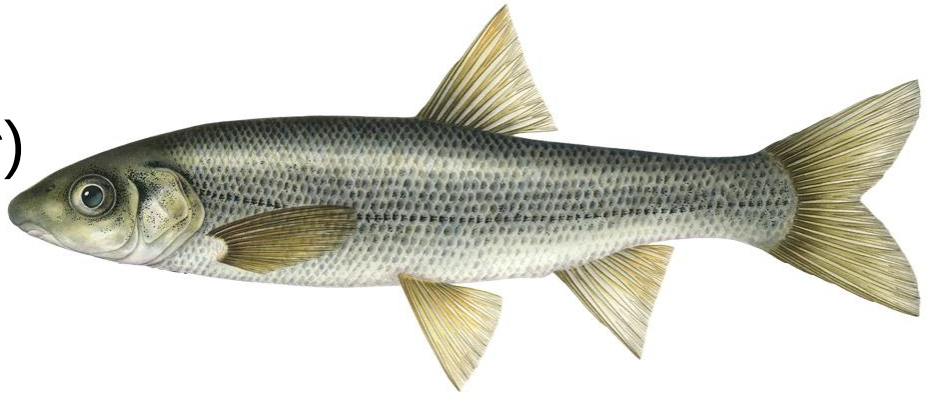
In spring-summer it tends to initiate long-range reproductive migrations. Reproduction occurs in shallow beds with coarse substrate (gravel, pebbles).

Omnivorous species, it feeds mainly on the bottom of rivers.

Further details @
http://www.cartapiscicola.es/#/species/bboc

Target species

Iberian straight-mouth nase
(*Pseudochondrostoma polylepis*)



Ecology

Medium to large size cyprinid fish (up to 50 cm TL).

Inhabits preferentially moderate to strong current with good environmental quality (moderately sensitive species).

In spring-summer it tends to initiate long-range reproductive migrations. Reproduction occurs in beds with coarse substrate (gravel, gravel).

It feeds preferentially at the bottom of rivers, or scraping the aquatic surfaces, mainly consuming debris and plant material.

Further details @
http://www.cartapiscicola.es/#/species/cpol

Target species

Southern Iberian spined-loach
(*Cobitis paludica*)

Ecology

Native species of the south-central basins of Portugal, up to 15 cm TL.

Species with benthic habits, tends to prefer areas with vegetation and fine substrates of gravel, sand and slit.

It preferably occupies watercourses with weak to moderate currents.

Tolerant species, it can persist in strongly degraded systems, including poor water quality.

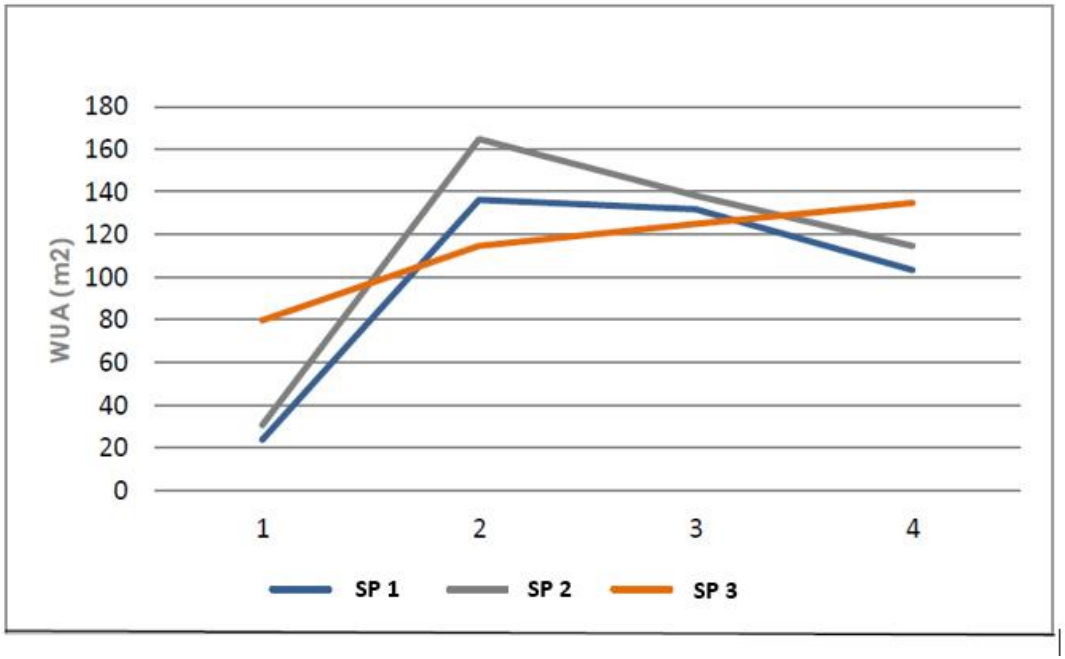
It feeds mainly on debris and invertebrates.

Further details @
http://www.cartapiscicola.es/#/species/cpal

Examples of typical outputs from this work

Reference according to different flows – which best optimize species habitat?

	SPECIES 1	SPECIES 2	SPECIES 3
FLOW 1	23,64	30,84	79,79
FLOW 2	136,25	164,75	114,55
FLOW 3	131,68	138,05	124,83
FLOW 4	103,11	114,57	134,86



Examples of typical outputs from this work

Comparing reference with alternative scenarios – which best optimize species habitat?

WUA (m2) | Q=1,4 m3/s	No changes	2 islands	1 lateral pool	1 large island	deflector+2islands
Species 1	131,68	88,25	135,48	160,82	102,14
Species 2	138,05	94,76	141,95	162,65	114,47
Species 3	124,83	140,01	125,35	150,40	142,76