Jun 24th, 4:15 PM - 4:30 PM

Session B9: Influence of Biometric Parameters, Flow Condition and Water Temperature on Iberian Fish Sprinting Behavior: Volitionally Swimming Performance

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FISH PASSAGE 2015
International conference on river connectivity best practices and innovations
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Influence of biometric parameters, flow condition and water temperature on Iberian fish sprinting behavior: volitionally swimming performance.

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SEB
Society for Experimental Biology

Influence of biometric parameters, flow condition and water temperature on Iberian fish sprinting behavior: volitionally swimming performance.

0.- PRESENTATION
1.- INTRODUCTION
2.- OBJECTIVES
3.- METHODS
4.- RESULTS
5.- CONCLUSIONS

0. PRESENTATION

GEA

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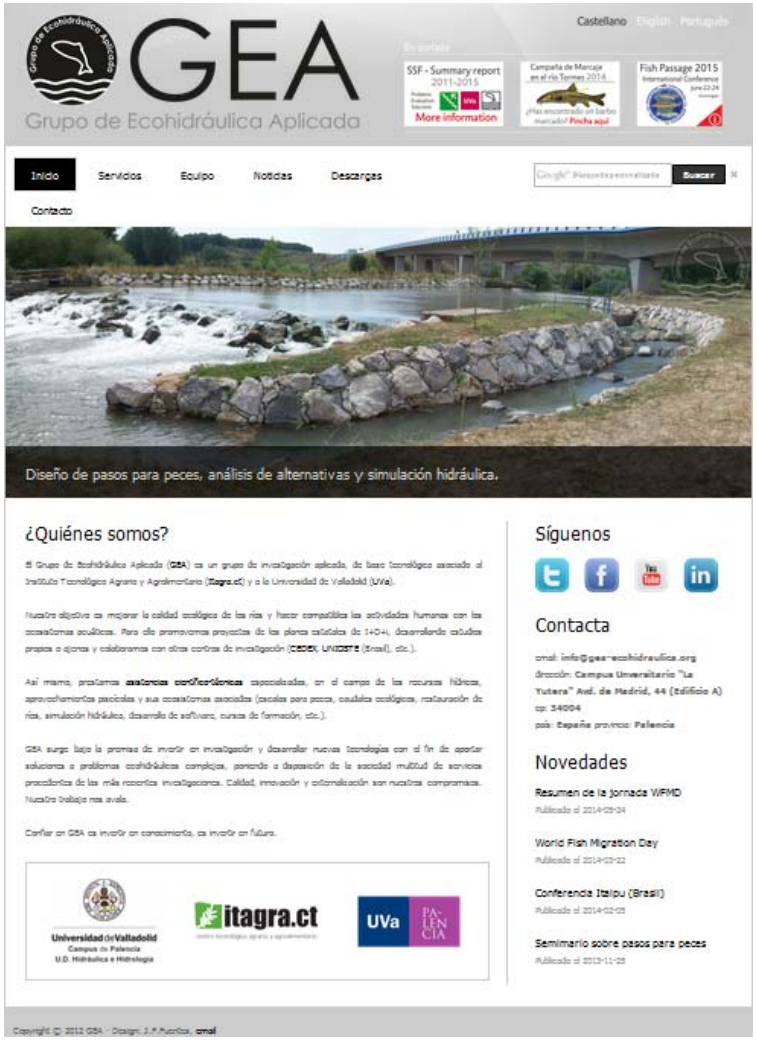
- Professors & PhD Students
- Collaborators



0. PRESENTATION

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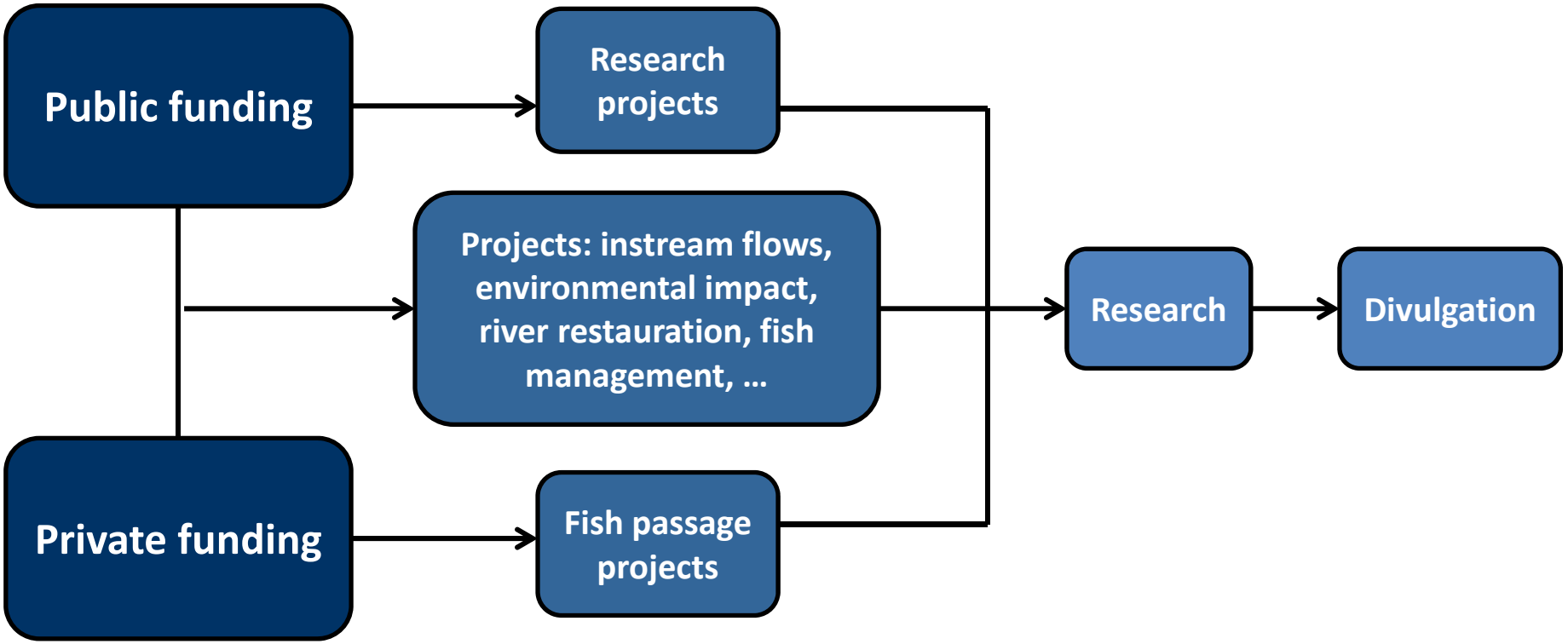
What do we do?



- Knowing the swimming ability of fish is important to detect movement limitations through hydraulic structures:

FISHWAY (VT. SLOTS)

FISHWAY (SUMERGED NOTCH)

WALLS OF DAMS

GAUGING STATIONS

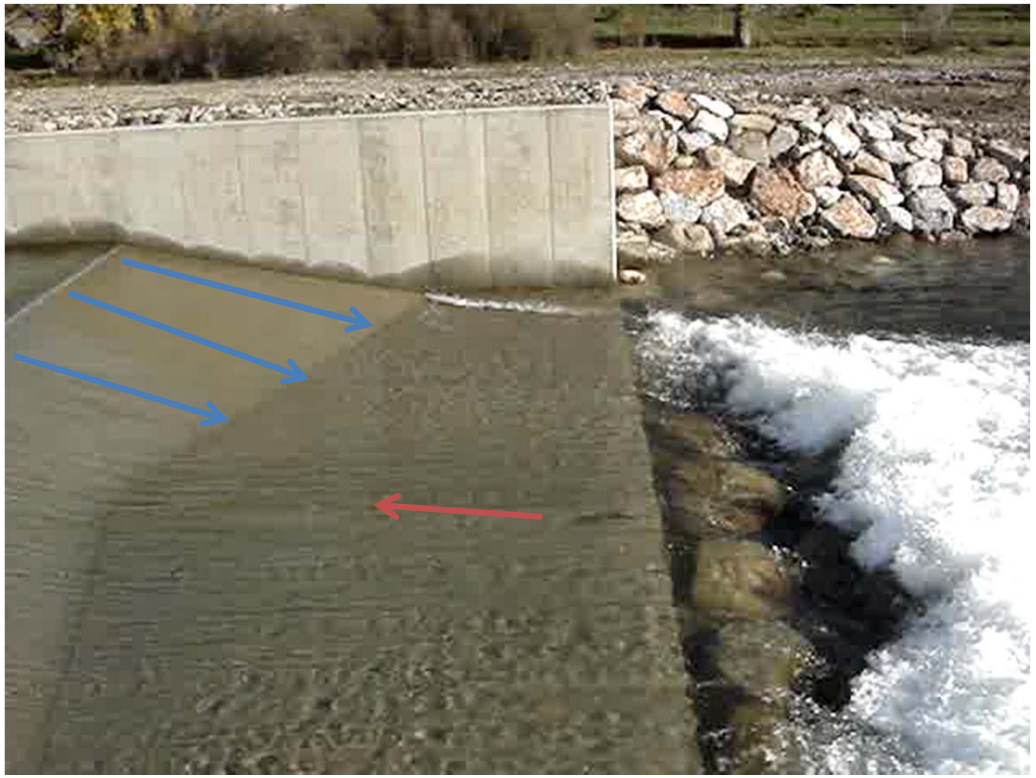
BRIDGES FOUNDATIONS

CULVERTS

- All these obstacles are collectively referred to **VELOCITY BARRIERS**

VELOCITY BARRIERS

- Flow speed
- Slope
- Length
- …



FISH BEHAVIOR

- Fish swimming performance
- Fish motivation

SUCCESS OR FAILURE

2. OBJECTIVES

1.- Knowing the **swimming performance** (maximum distance travelled, swimming speed and endurance) for two species of Iberian fish.

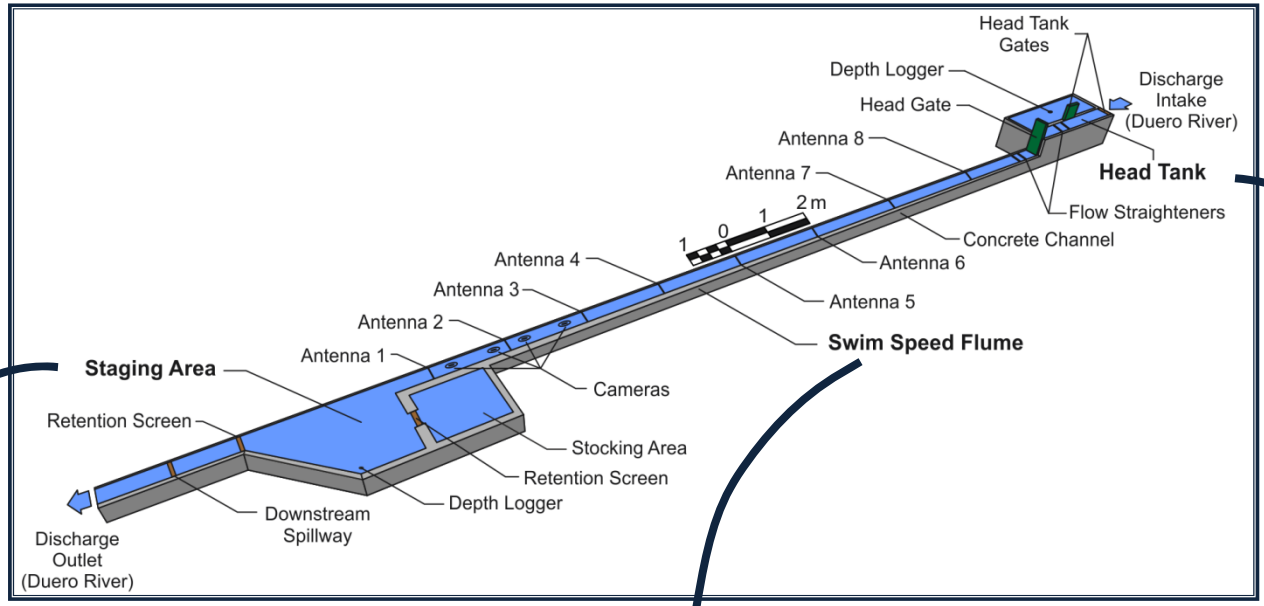
2.- Determining the **influence** of biometric (length and mass), hydraulic (flow speed) and environmental (water temperature) **parameters** in this **swimming performance**.

3.- **Applying this information** to detect velocity barriers in order to make optimum and effective **design of fish passes**, etc.

3. METHODS

MATERIAL

OPEN CHANNEL FLOW



STAGING AREA

SWIM SPEED FLUME

HEAD TANK

3. METHODS

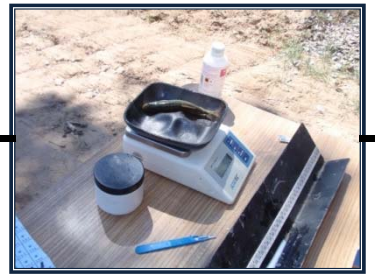
MATERIAL

FISH SOURCE

ELECTROFISHING

NASE

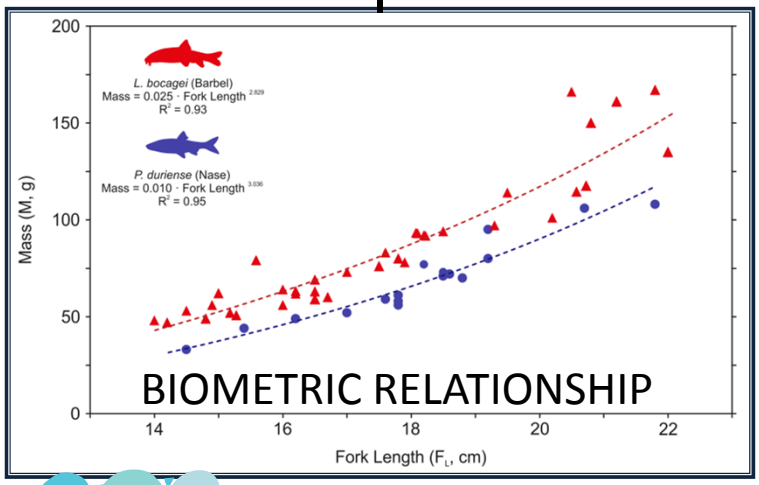
Pseudochondrostoma duriense



MASS & LENGTH

BARBEL

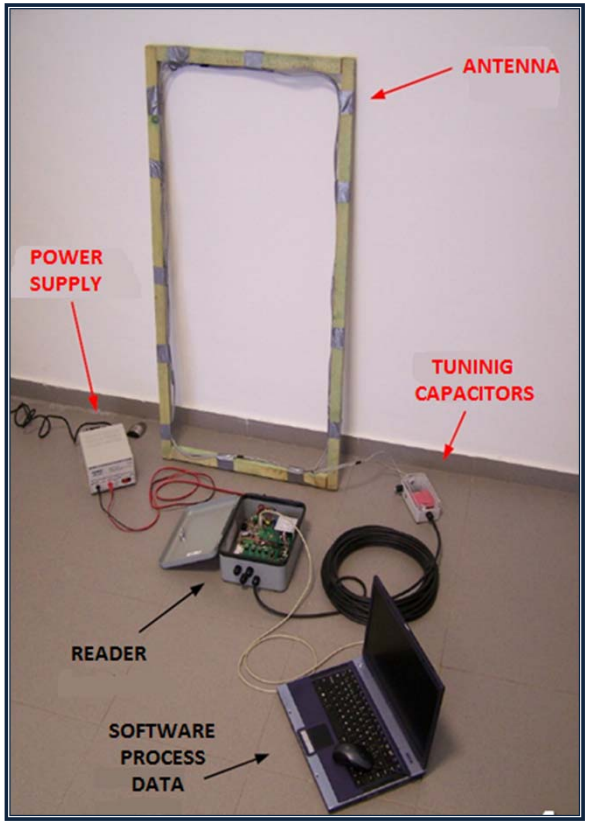
Luciobarbus bocagei

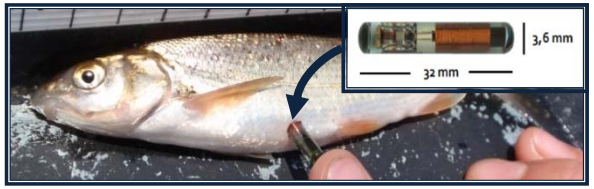


BIOMETRIC RELATIONSHIP

VIDEOCAMERAS + **PIT (Passive Integrated Transponder)** = **MONITORING SYSTEM**

+





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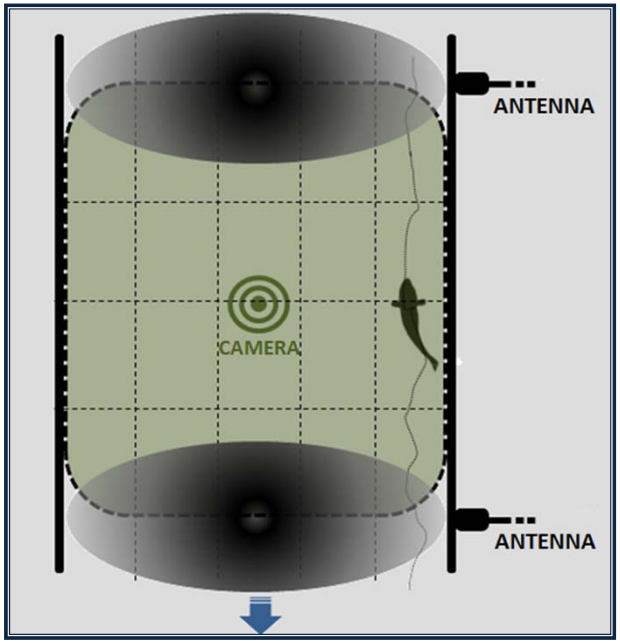
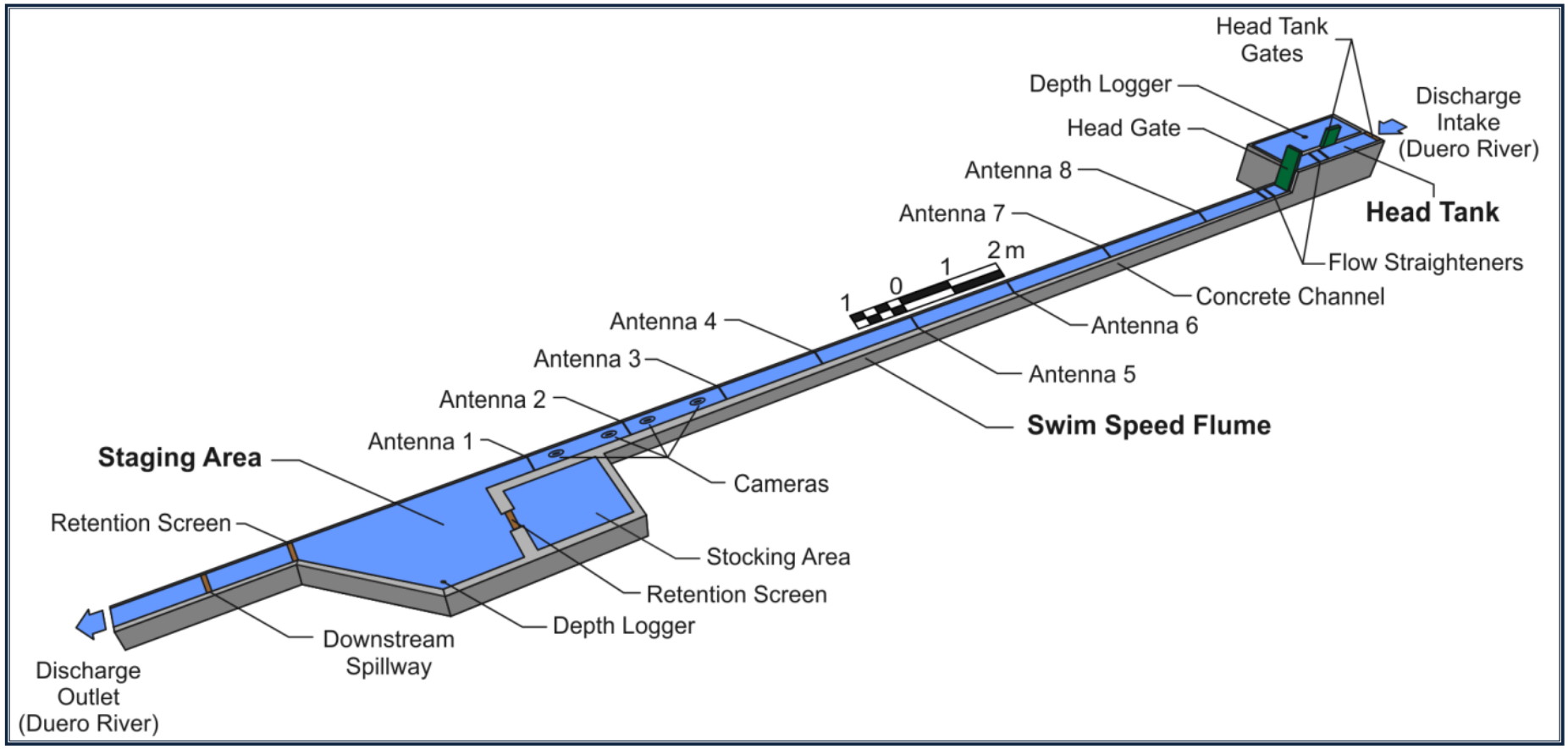


3. METHODS

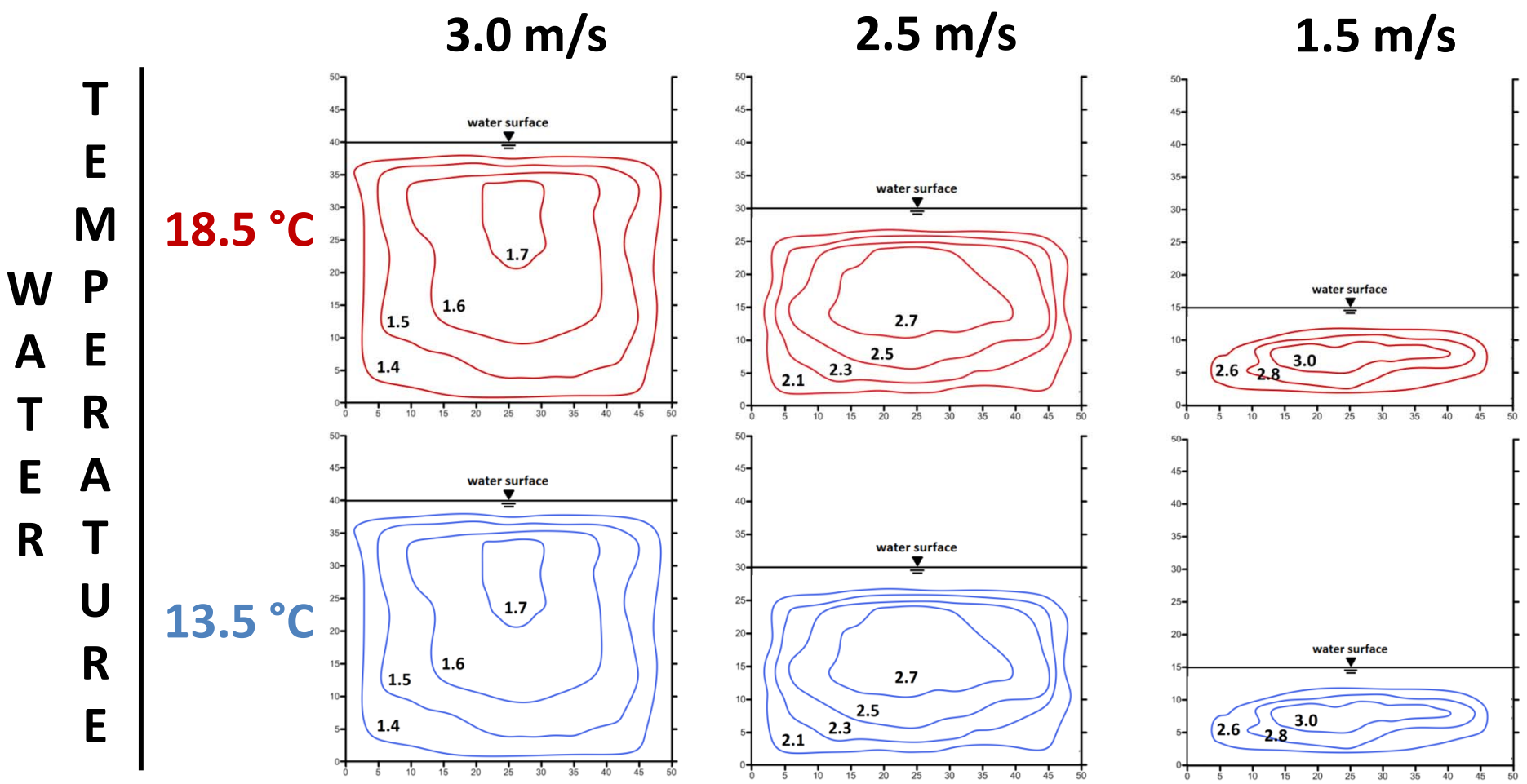
INSTRUMENTATION

EXPERIMENTATION

- **Distance** → D_{max} = "PIT antenna"
- **Fatigue Time** → FT = "PIT antenna"
- **Ground Speed** → $U_g = D_{max}/FT$
- **Absolute Speed** → $U_s = U_g + U_{flow}$



FLOW VELOCITY FIELD

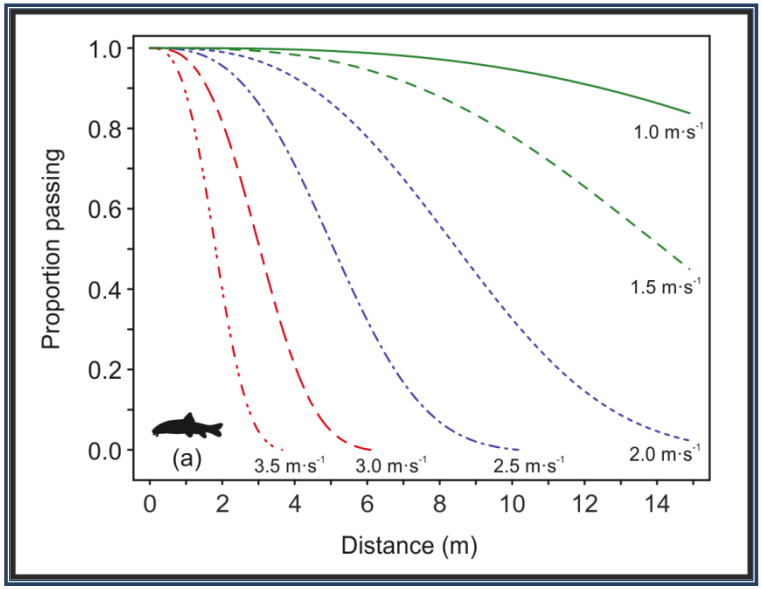


Maximum distance (D_{Max})

D_{Max}, we used parametric Accelerated Failure Time models (AFT) that follow the form:

$$ln\,(D_{max}) = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k + \varepsilon$$

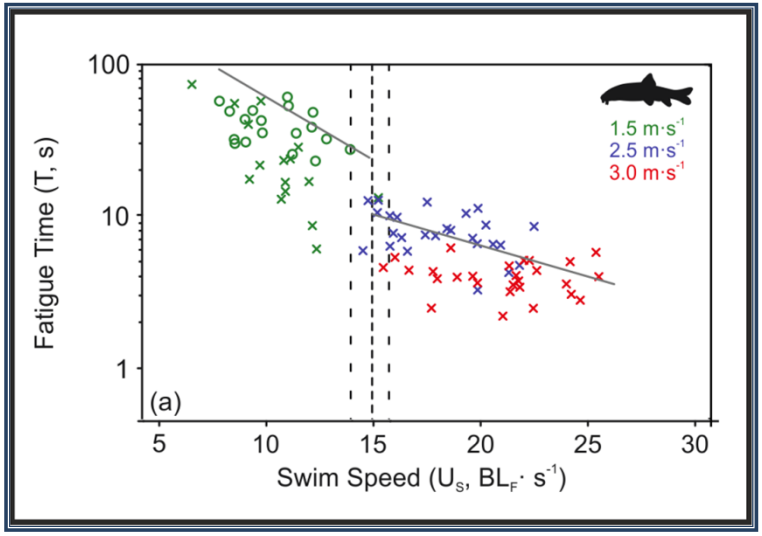
where D_{Max} is the maximum distance in meters, βs are coefficients, X_is are the k-covariates, and ε is the error term.



Swim speed–fatigue time relationship

Moving-point regression approach (Castro-Santos 2005; Castro-Santos et al. 2013). This approach fits successive models that follow the form:

$$ln\,(T) = \beta_0 + \beta_1 C_{ps} + \beta_2 U_s + \beta_3 C_{ps} U_s + \varepsilon$$

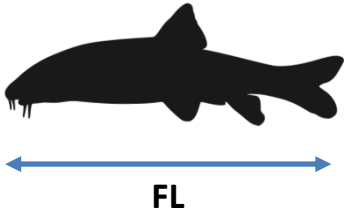


HYDRAULICS

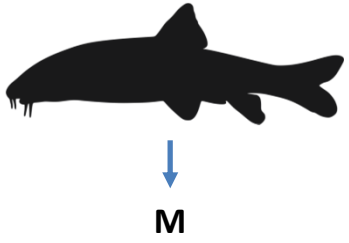
Flow velocity ✓

BIOMETRICS

Fork length ✓

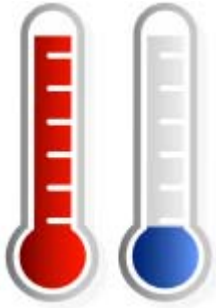


Mass ✗



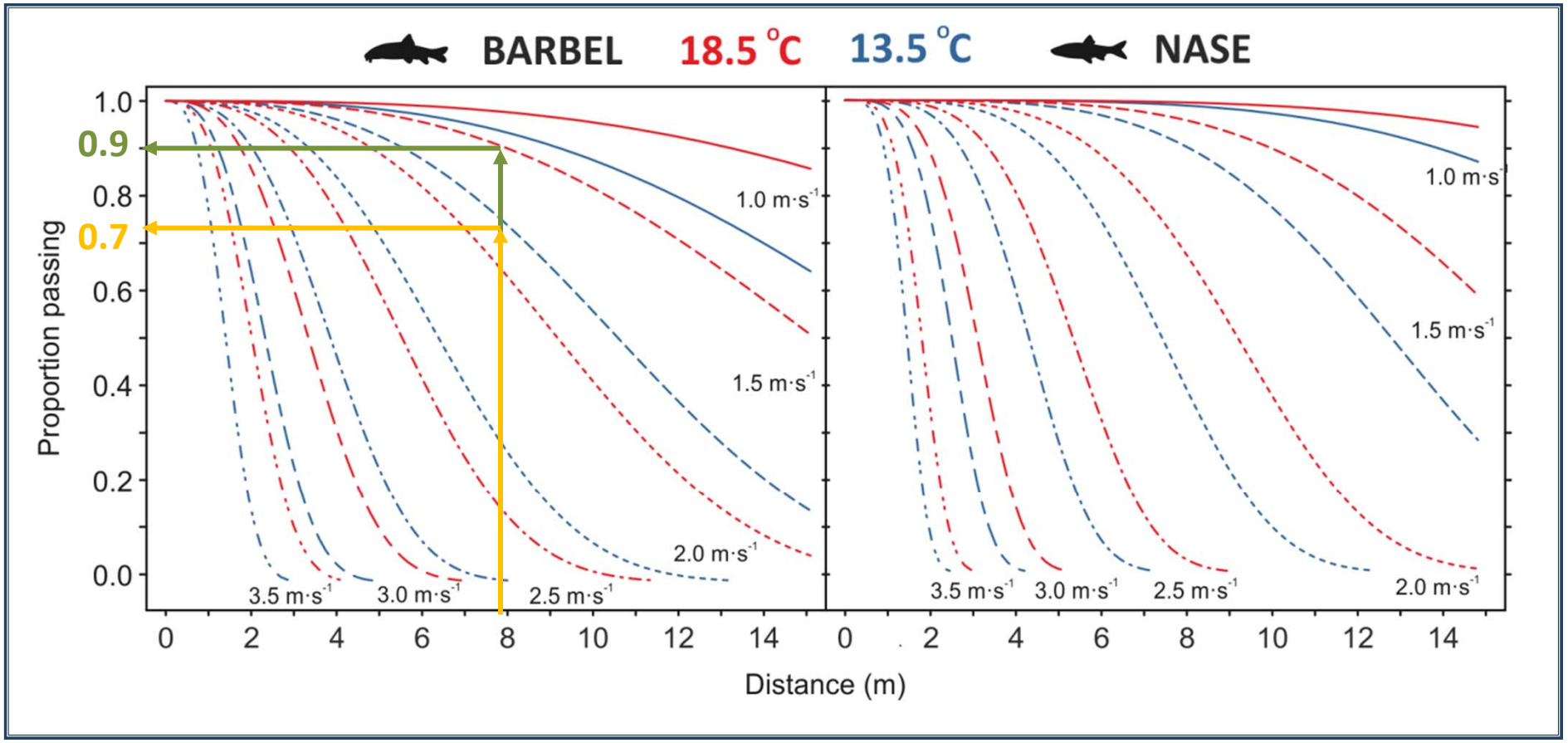
ENVIRONMENTAL

Water temperature ✓



4. RESULTS

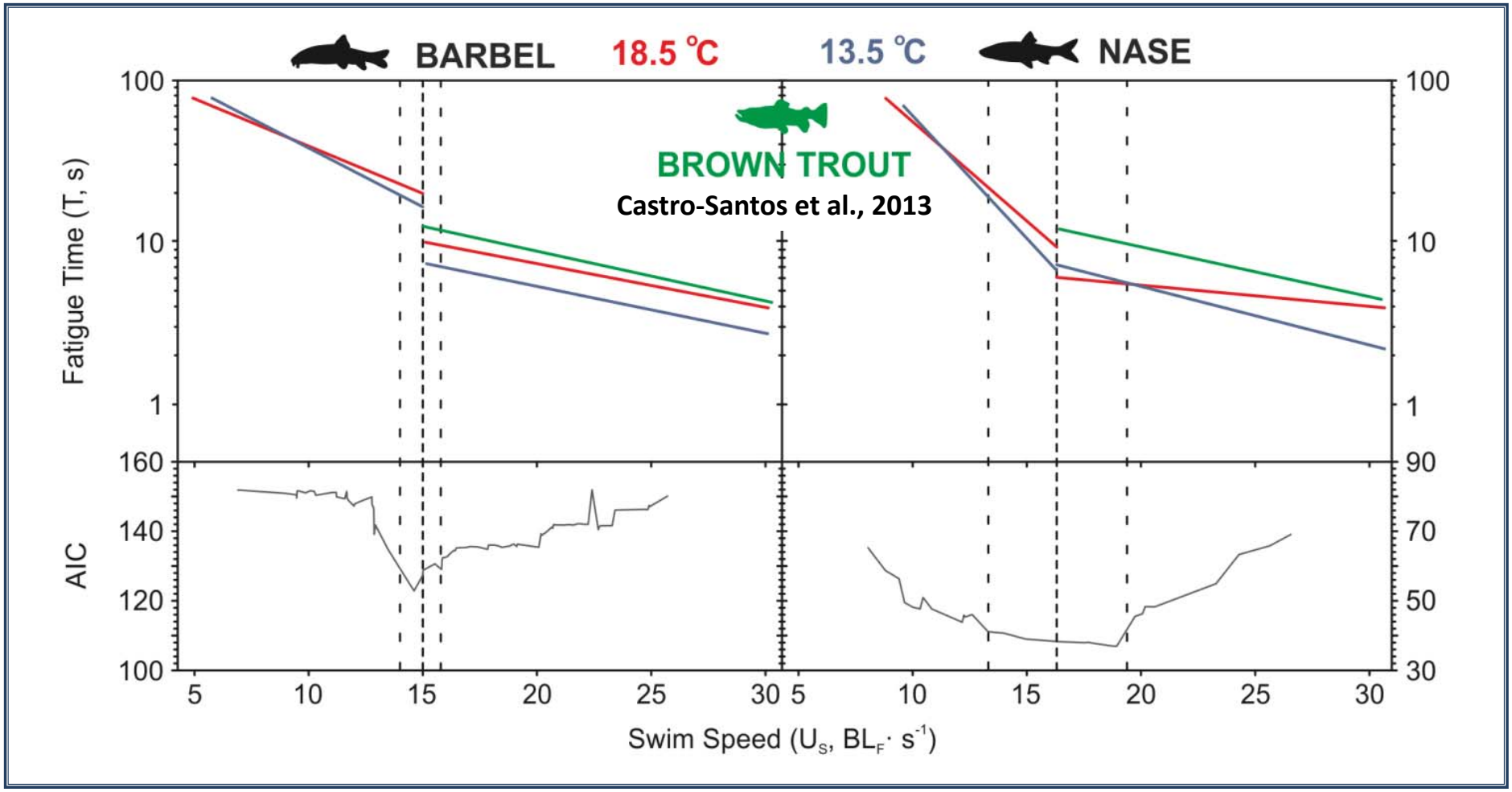
MAXIMUM DISTANCE



Flow velocity + **Water temperature** = **DISTANCE**

4. RESULTS

FATIGUE TIME-SWIM SPEED RELATIONSHIP



5. CONCLUSIONS

1.- **Flow velocity** and **water temperature** are the **primary variables influencing the distance** both species were able to travel.

2.- **Performance of both species is similar** at high flow velocities, with fish attaining absolute speeds superior to 20 $BL_F \cdot s^{-1}$. Nevertheless, **barbel is a more resistant** swimmer than nase at low flow velocities.

3.- Swimming endurance and speed greatly **exceeds previously published observations** for barbel and nase and are similar to what has been observed for salmonids.

4.- These data have **important implications** for restoring river connectivity, including design specifications for culverts and fishways.

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