

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

June 22-24, 2015 | Groningen (The Netherlands)

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

Jorge RUIZ-LEGAZPI, Francisco-Javier SANZ-RONDA, Francisco-Javier BRAVO-CÓRDOBA, Sergio MAKRAKIS and Theodore CASTRO-SANTOS





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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



GEO

Grupo de Ecohidráulica Aplicada

Who are we?

Inicio

Servicios

Equipo

Noticias

Descargas

Contacto

Colaboradores



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Doctor Ingeniero de Montes



Andrés Martínez de Azagra Paredes
Doctor Ingeniero de Montes



Sergio Makrakis
Western Paraná State
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Jorge Ruiz Legazpi
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Juan Francisco Fuentes Pérez
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Nuria Ramos González
Máster en Ingeniería de Montes



Víctor Salgado González
Ingeniero de Montes



Jorge Valbuena Castro
Ingeniero de Montes

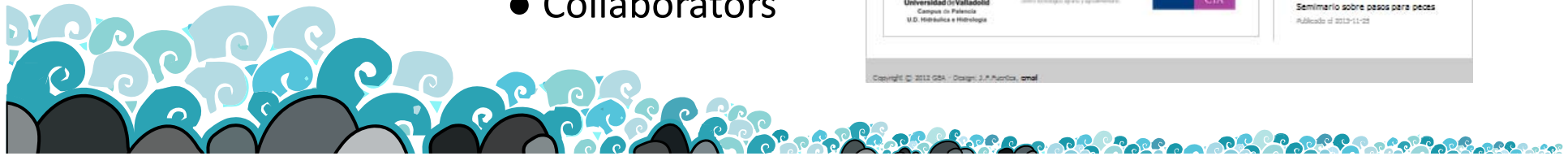
● Professors & PhD Students

● Collaborators

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The screenshot shows the GEA website homepage. At the top, there is a navigation menu with 'Inicio', 'Servicios', 'Equipo', 'Noticias', and 'Descargas'. Below the menu is a large banner image of a river with a stone structure, with the text 'Diseño de pasos para peces, análisis de alternativas y simulación hidráulica.' Below the banner is a section titled '¿Quiénes somos?' which describes the group's mission and objectives. To the right of this section are social media icons for Twitter, Facebook, YouTube, and LinkedIn. Below the social media icons is a 'Contacta' section with contact information. At the bottom of the page, there are logos for 'Universidad de Valladolid', 'itagra.ct', and 'UVA'.





0. PRESENTATION



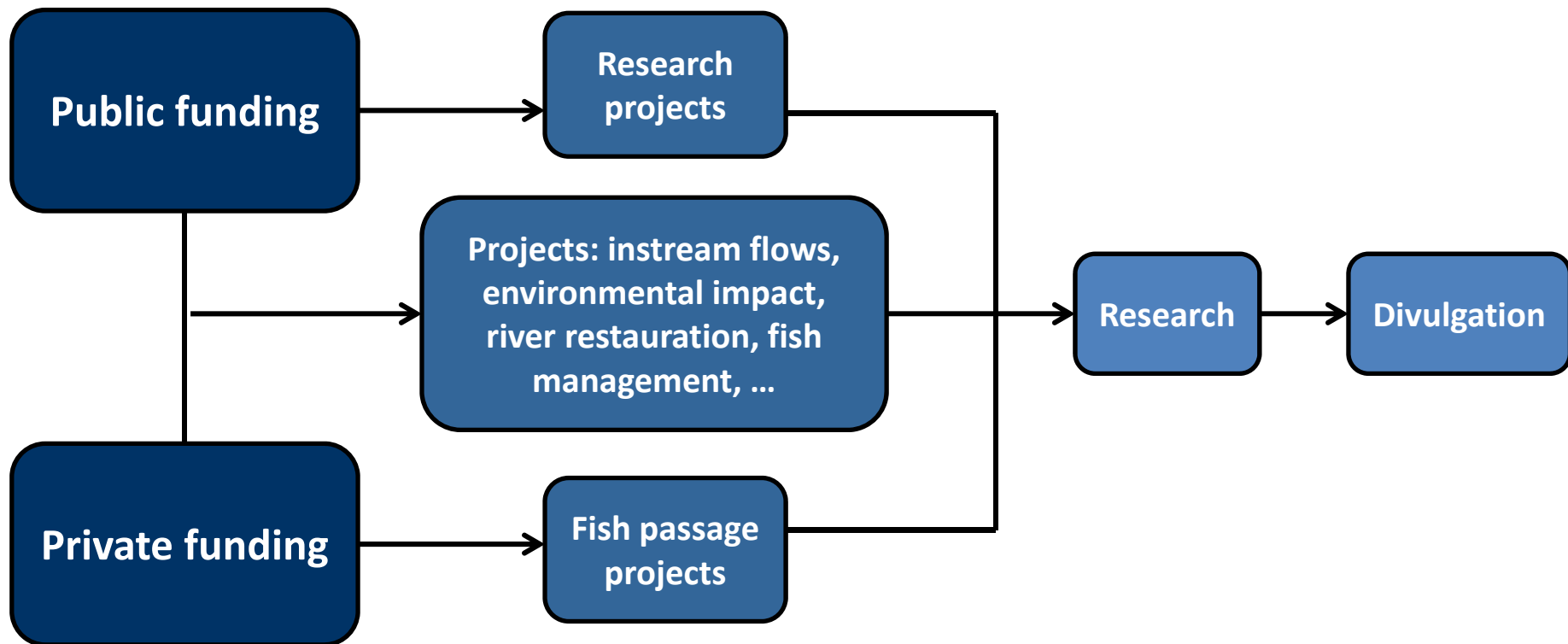
G E A

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www.gea-ecohidraulica.org

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What do we do?





1. INTRODUCTION

PROBLEMATIC

VELOCITY BARRIERS

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



FISHWAY (VT. SLOTS)



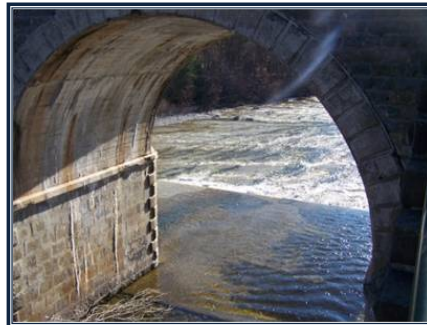
FISHWAY (SUMERGED NOTCH)



WALLS OF DAMS



GAUGING STATIONS



BRIDGES FOUNDATIONS



CULVERTS

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

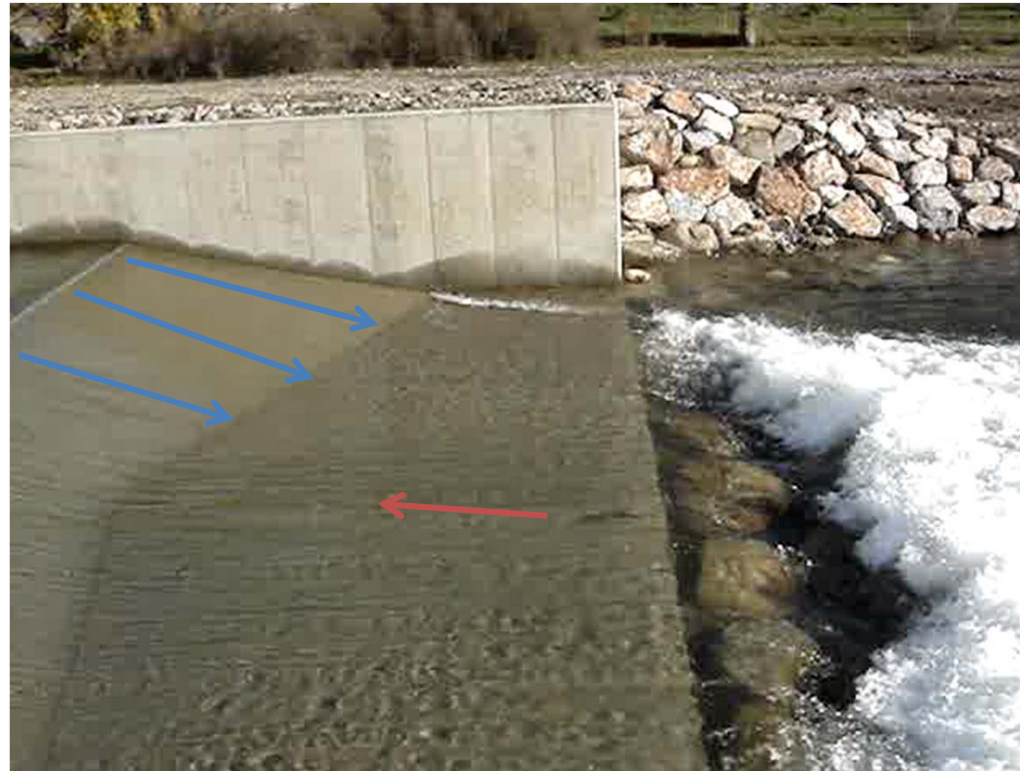




VELOCITY BARRIERS

FISH BEHAVIOR

- Flow speed
 - Slope
 - Length
 - ...



- 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.

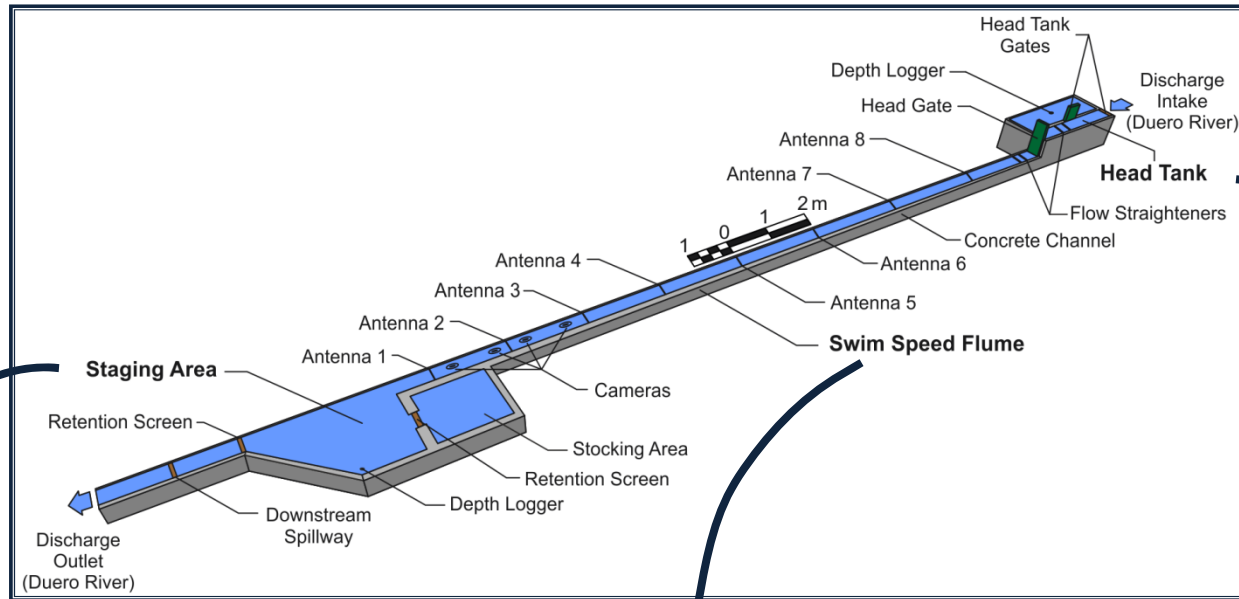




3. METHODS

MATERIAL

OPEN CHANNEL FLOW



STAGING AREA



SWIM SPEED FLUME



HEAD TANK





3. METHODS

MATERIAL

FISH SOURCE



ELECTROFISHING



NASE

*Pseudochondrostoma
duriense*

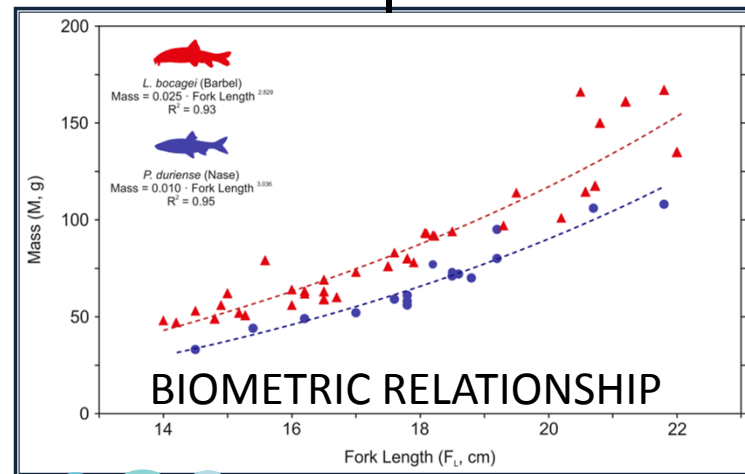


MASS & LENGTH



BARBEL

*Luciobarbus
bocagei*





3. METHODS

MATERIAL

MONITORING SYSTEM

VIDEOCAMERAS

+

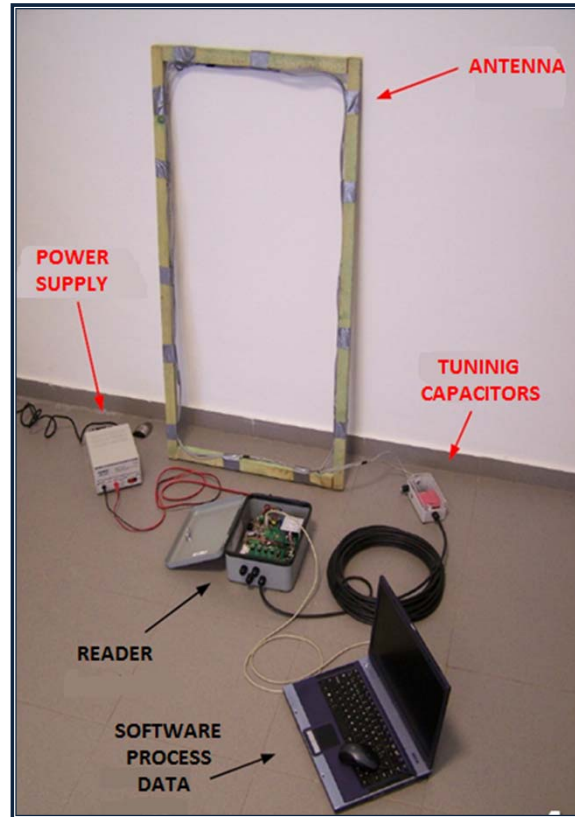
PIT

(Passive Integrated Transponder)

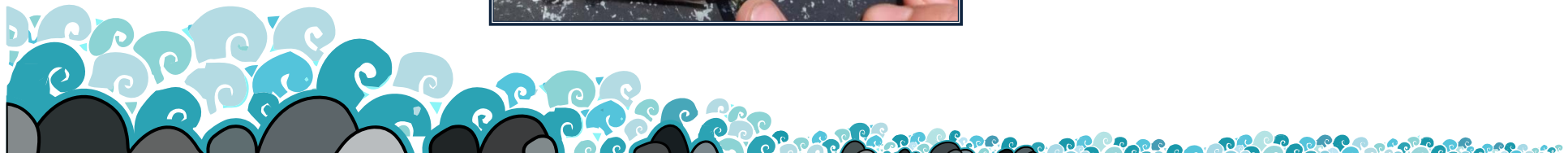
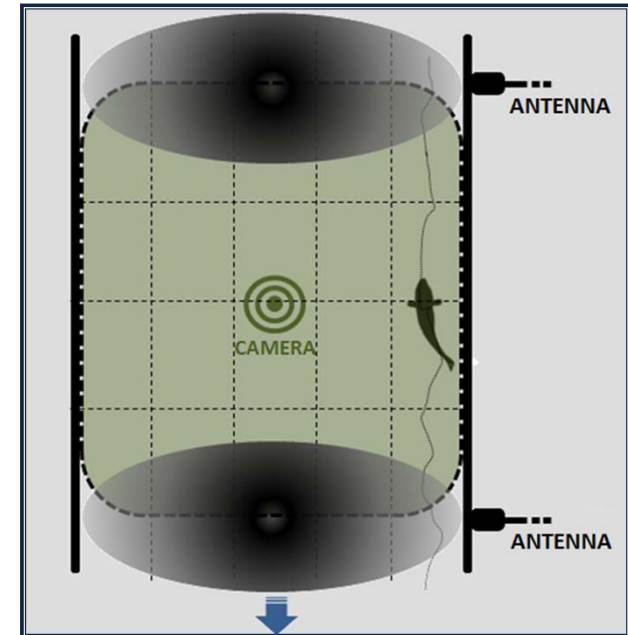
= MONITORING SYSTEM



+



=





3. METHODS

INSTRUMENTATION

EXPERIMENTATION

● Distance ●

● Fatigue Time ●

● Ground Speed ●

● Absolute Speed ●

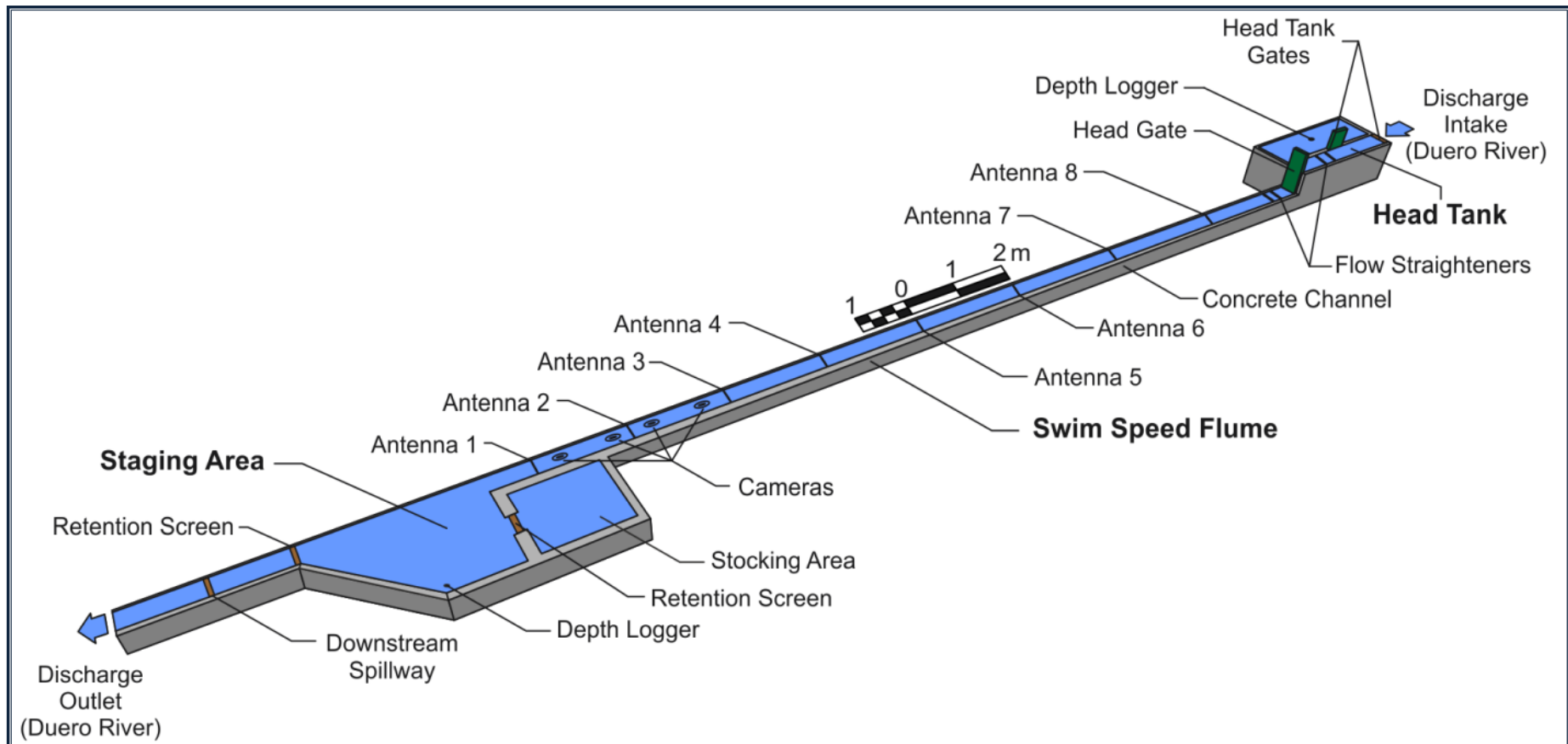


● D_{max} = "PIT antenna"

● FT = "PIT antenna"

● $U_g = D_{max}/FT$

● $U_s = U_g + U_{flow}$





3. METHODS

INSTRUMENTATION

TRIALS

FLOW VELOCITY FIELD

W
A
T
E
R
T
E
M
P
E
R
A
T
U
R
E

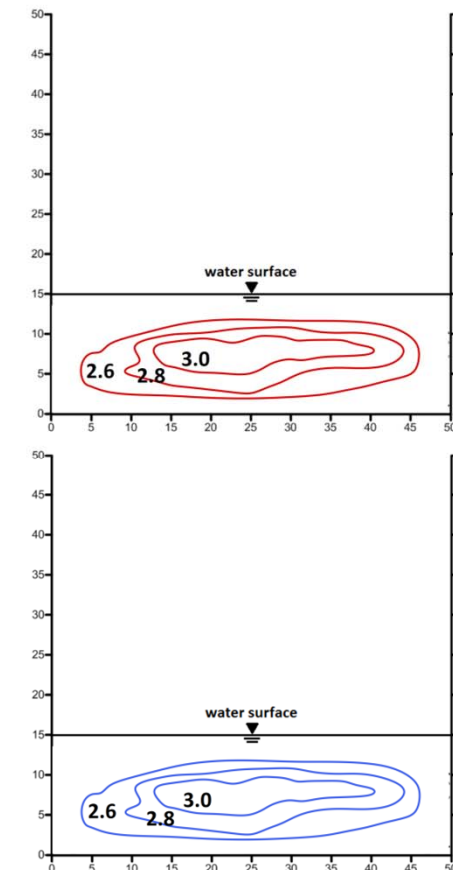
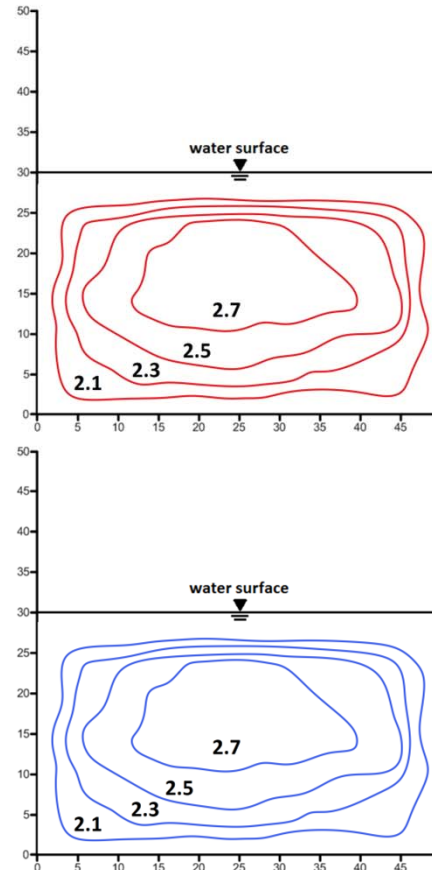
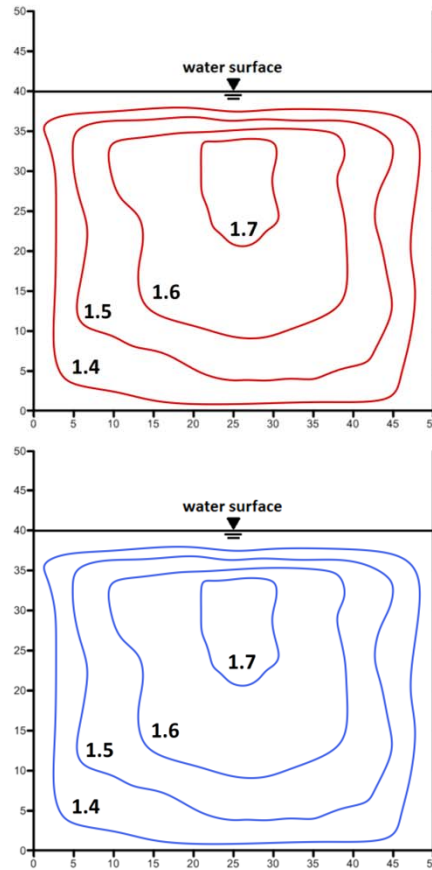
18.5 °C

13.5 °C

3.0 m/s

2.5 m/s

1.5 m/s



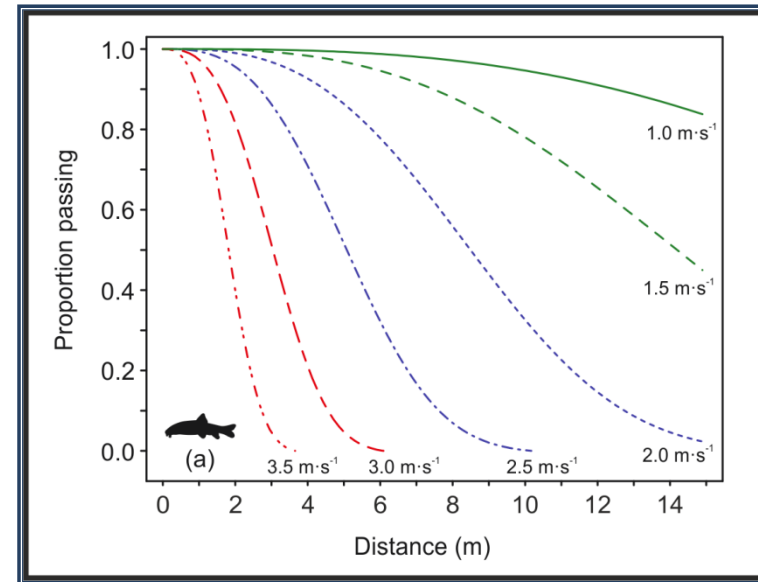


Maximum distance (D_{Max})

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

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

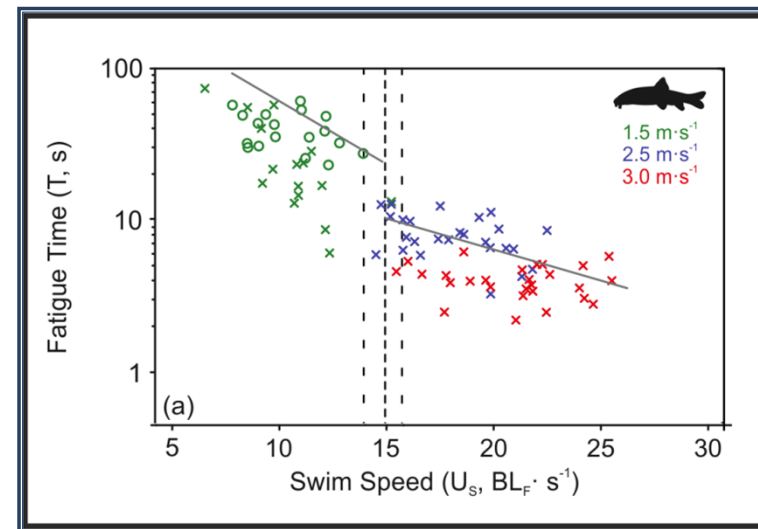
where D_{Max} is the maximum distance in meters, β s are coefficients, X_i s are the k -covariates, and ε is the error term.



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:

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





4. RESULTS

INFLUENCE PARAMETERS

PERFORMANCE

HYDRAULICS

Flow velocity



BIOMETRICS

Fork length



FL

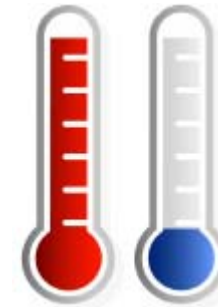
Mass



M

ENVIRONMENTAL

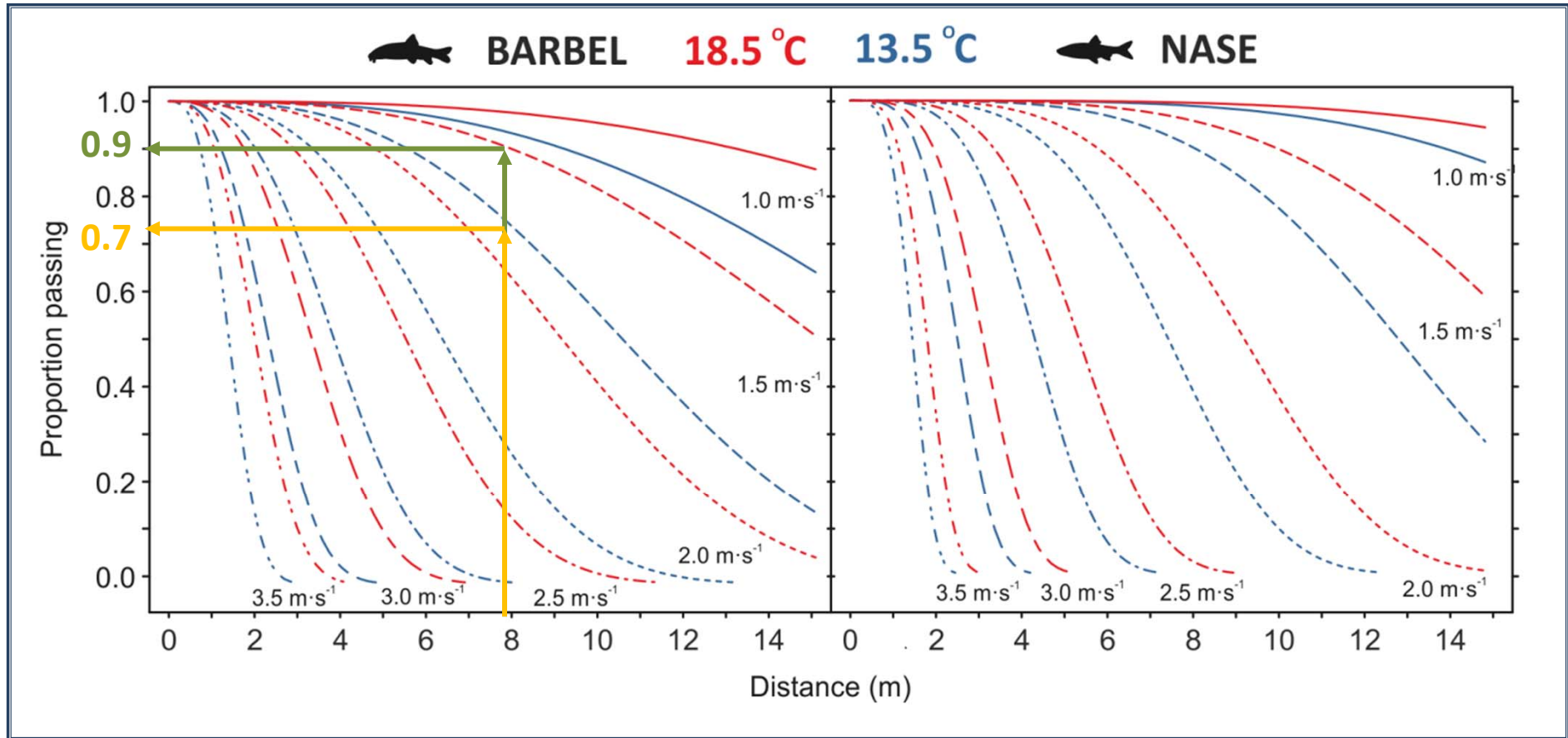
Water temperature





4. RESULTS

MAXIMUM DISTANCE



↓ Flow velocity + ↑ Water temperature = ↑ DISTANCE

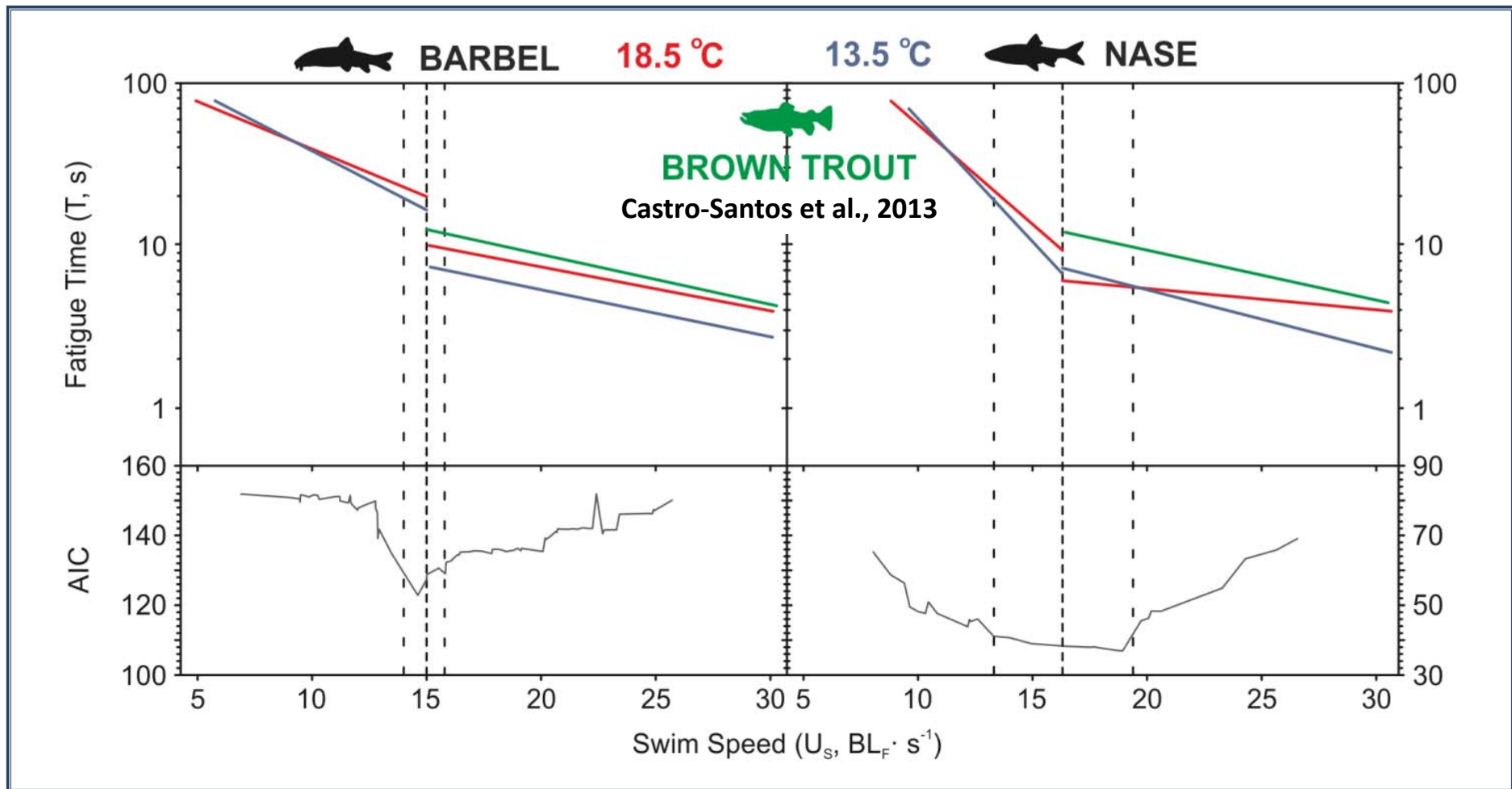




4. RESULTS

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 $20 \text{ BL}_F \cdot \text{s}^{-1}$. 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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THANKS !!!

