

Jun 22nd, 11:10 AM - 11:25 AM

Session D1: Modelling the Efficiency of a Vertical Slot Fishway for Anadromous Fishes

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Presenter Information

Gabriela R. Cardoso, Ana F. Belo, Catarina S. Mateus, Carlos M. Alexandre, Esmeralda Pereira, Ana Telhado, João Ferreira, Felisbina Quadrado, Bernardo R. Quintella, and Pedro R. Almeida



MODELLING THE EFFICIENCY OF A VERTICAL SLOT FISHWAY FOR ANADROMOUS FISHES

Gabriela R. Cardoso, Ana F. Belo, Catarina S. Mateus, Carlos M. Alexandre, Esmeralda Pereira, Ana Telhado, João Ferreira, Felisbina Quadrado, Bernardo R. Quintella & Pedro R. Almeida

AIM OF THIS PRESENTATION....

Presenting you:

- Fishway monitoring results
- Modelling attraction efficiency results

For three
anadromous
fishes:

sea lamprey, Petromyzon marinus L.



allis shad, Alosa alosa L.

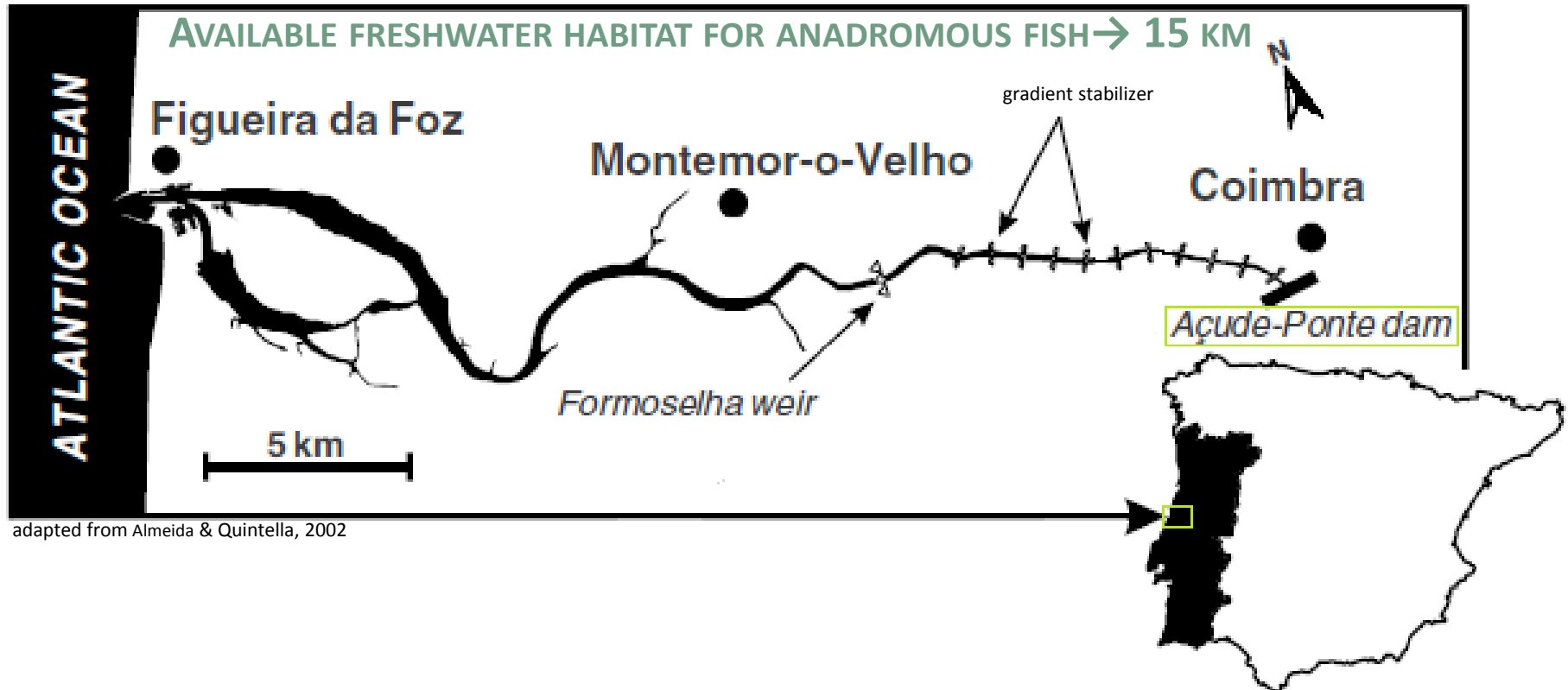


twaite shad, Alosa fallax (Lacépède, 1800)



RIVER MONDEGO AND ITS FRAGMENTATION

- Highly impounded;
- Açude-Ponte dam → first insurmountable obstacle for migratory fish species.



ANADROMOUS SPECIES THAT OCCUR IN THE RIVER MONDEGO

- River Mondego represents an important stronghold for anadromous species.
 - Gastronomic delicacies;
 - Professional fisheries development;
 - Local and regional incomes.

abertura oficial da época da
lampreia
2013.

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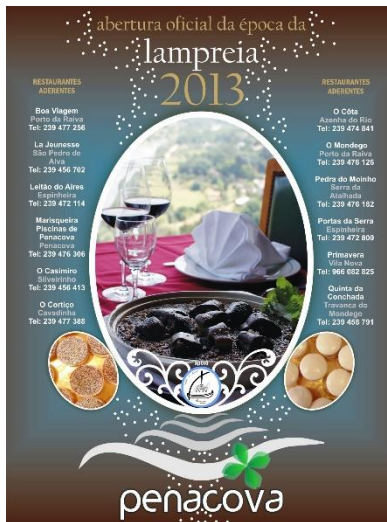
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Serra de Alcañice
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Portos de Serra
Espinho
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Primavera
Vila Nova
Tel: 966 622 625

Quilote do Conchada
Travessa do Mondego
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época oficial
lampreia
janeiro 2014 abril
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MONTEMOR-O-VELHO
FESTIVAL DO ARROZ DA LAMPREIA
SABORES DO CAMPO E DO RIO
14 a 23 MARÇO 2014
TASQUINHAS' DOÇARIA' ANIMAÇÃO' CONFERÊNCIAS



MONTEMOR-O-VELHO
Centro de Alto Rendimento
1 a 10 de abril 2014

Mostra de Gastronomia nos Restaurantes
Tasquinhas e Animação: 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 de Abril
Show Cooking: Gastronomia Costeira

XV Festival da Lampreia da Estiva / 19 Março

www.cm-montemorvelho.pt
www.facebook.com/municipio.montemorvelho

festival do arroz da lampreia
MONTEMOR-O-VELHO
Centro de Alto Rendimento
1 a 10 de abril 2014

Mostra de Gastronomia nos Restaurantes
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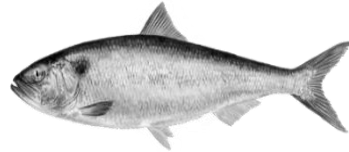
TARGET SPECIES

sea lamprey, Petromyzon marinus L.



Classified as
Vulnerable (VU)

allis shad, Alosa alosa L.



Classified as
Endangered (EN)

twaite shad, Alosa fallax (Lacépède, 1800)



Classified as
Vulnerable (VU)

...in the Portuguese Red List of Threatened Species.

Threats:

- Loss of longitudinal connectivity;
- Overfishing and poaching;
- Water pollution;
- Destruction of ammocoetes beds through inert extraction.

AÇUDE-PONTE DAM AND A VERTICAL SLOT

MONITORING BUILDING



BASINS AND VERTICAL SLOTS



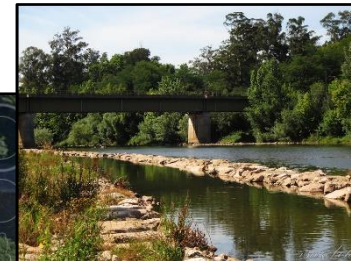
23 POOLS

DOWNSTREAM ENTRANCE

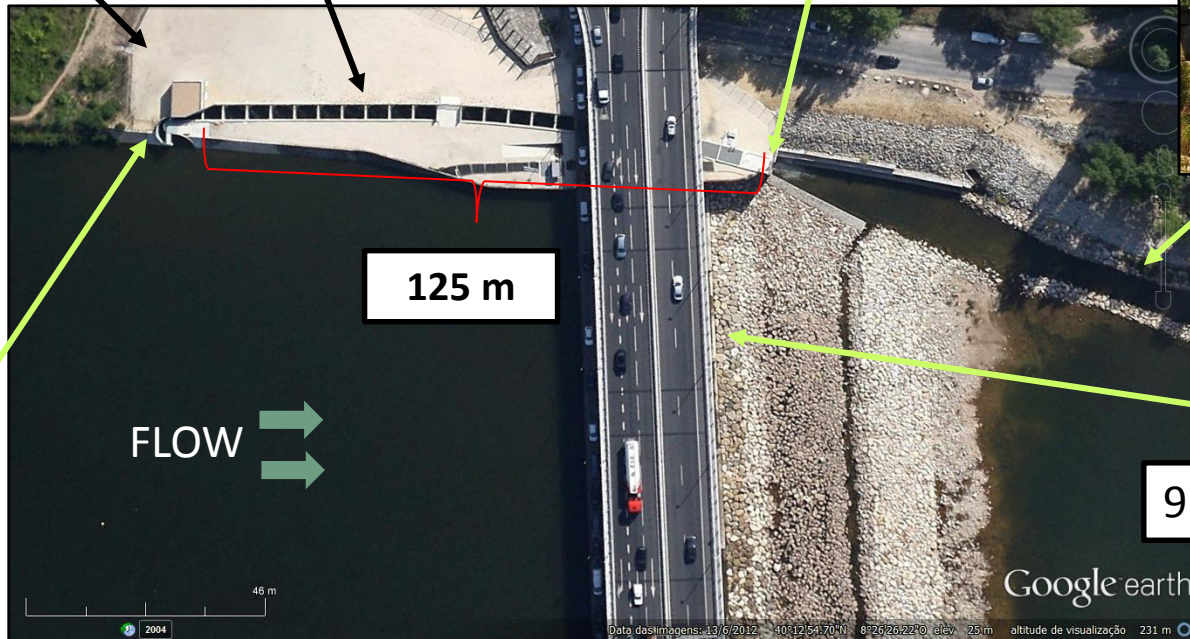


Flow discharge: $1-1.5\text{m}^3\text{s}^{-1}$
Attraction flow: $1.5-2.5\text{m}^3\text{s}^{-1}$

ATTRACTION CHANNEL



UPSTREAM EXIT

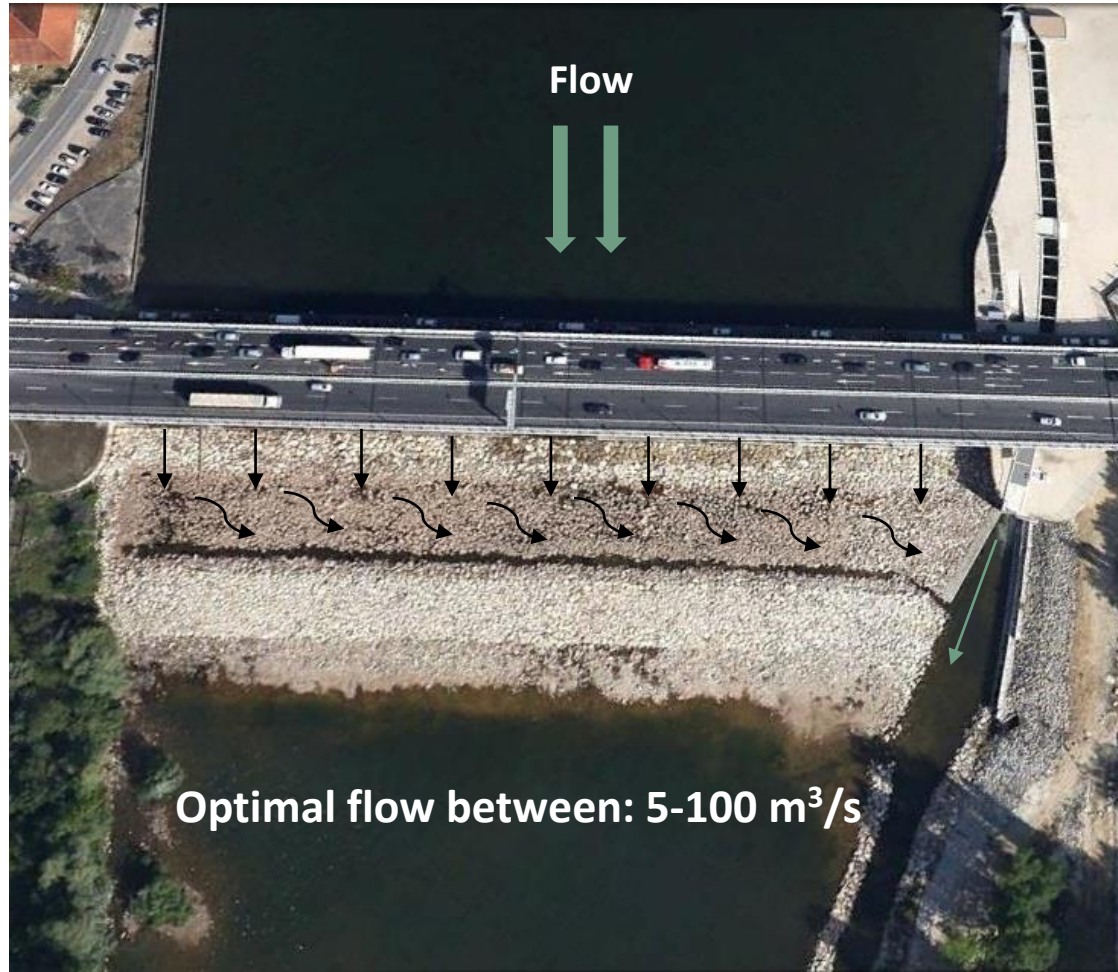


DAM GATE



9 GATES

AÇUDE-PONTE DAM AND A VERTICAL SLOT



FISHWAY MONITORING

- Efficiency for the target species is being evaluated using several methodologies, namely:
 - visual counts;
 - Tagging (radio-telemetry and PIT Tags).



METHODOLOGIES APPLIED: VISUAL COUNTS

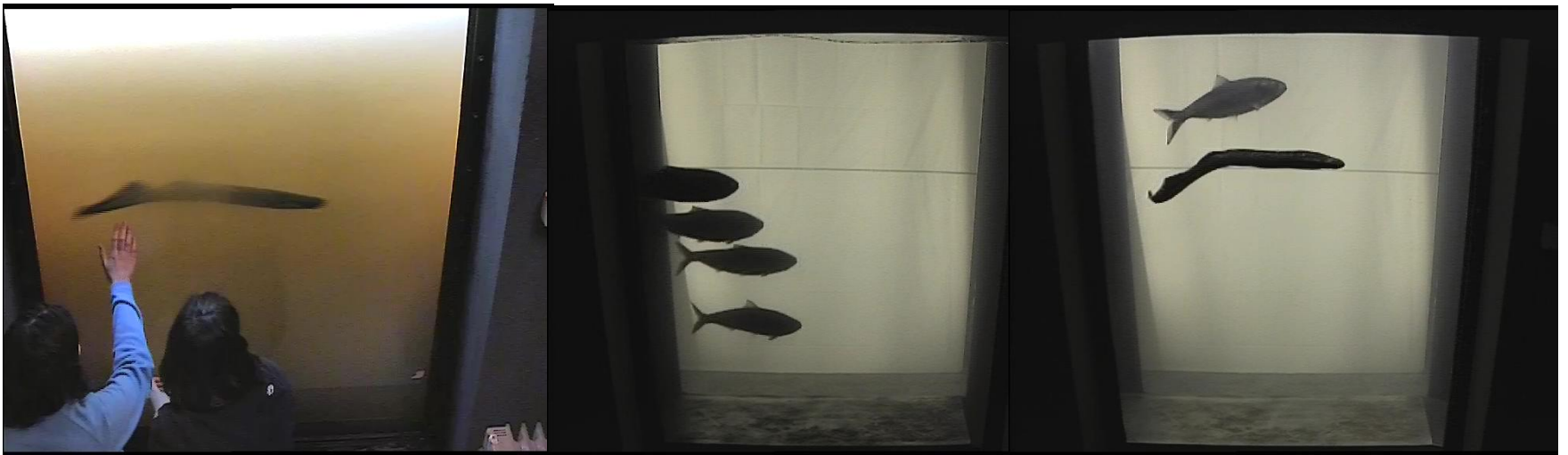
- a system to capture and record images;
- Counts made *a posteriori*;
- Continuous recording.



METHODOLOGIES APPLIED: VISUAL COUNTS

The objective of this technique is to:

- Verify the effectiveness of the fishway;
- Identify specific behavior;
- Estimate the total biomass of fishes that transposed.



METHODOLOGIES APPLIED: BRT MODEL

EXPLICATIVE-PREDITIVE MODELS → BOOSTED REGRESSION TREES (BRT)

DECISION TREES

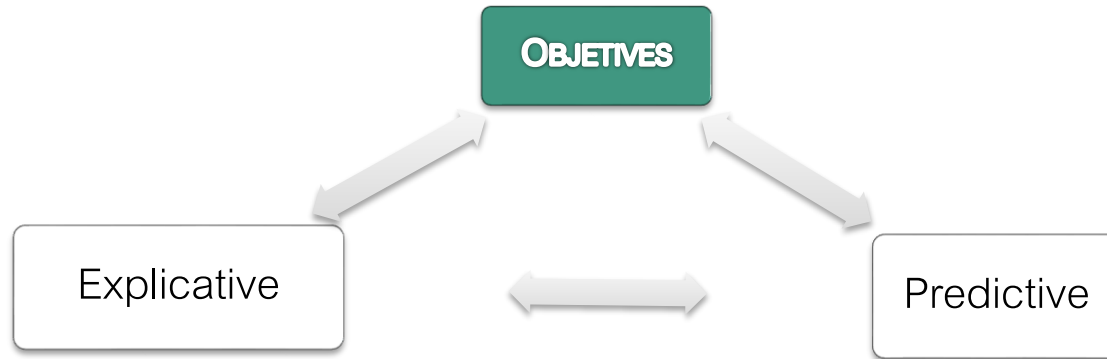
- Relate the number of counts of the studied species with environmental predictors;
- Works with binary splits.

BOOSTING

- Compose of simple model combinations;
- Has a stochastic component.

METHODOLOGIES APPLIED: BRT MODEL

EXPLICATIVE-PREDICTIVE MODELS → BOOSTED REGRESSION TREES (BRT)



Relate the number of individuals that pass the fishway with the environmental predictors.

Validate the model and predict a period during the migratory season → when a big part of the individuals will use the fishway.

METHODOLOGIES APLIED: BRT MODEL

Predictors pre-selected to explain the movements of anadromous species:

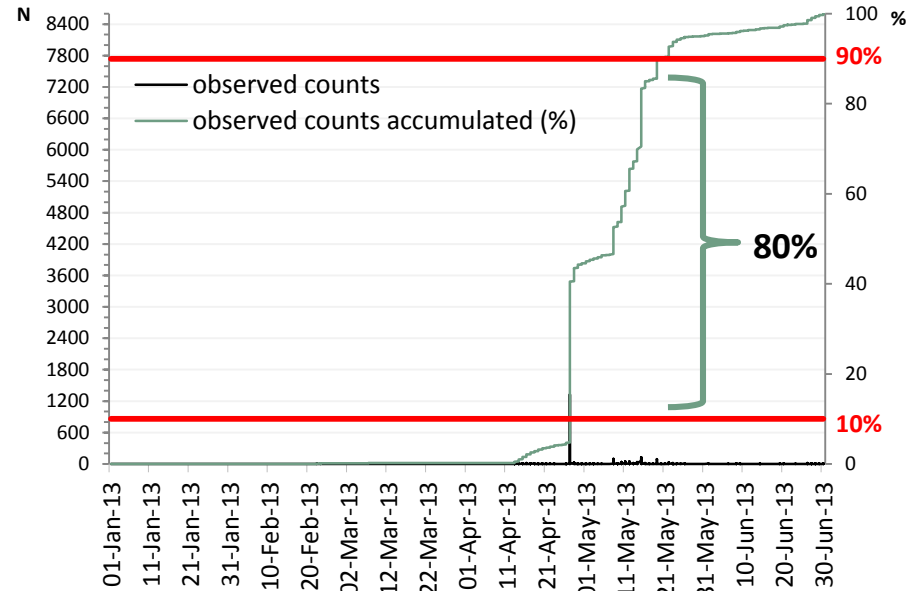
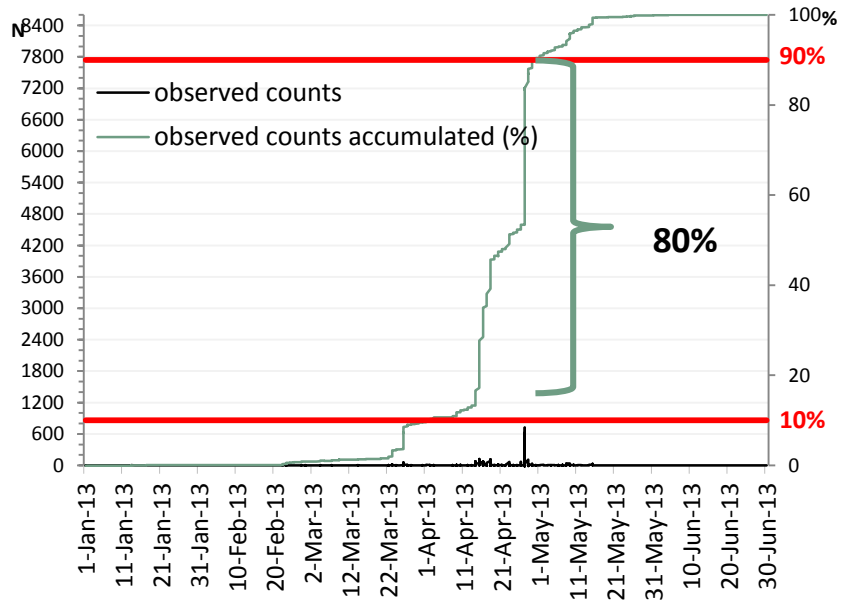
- Temperature (°C)
- Specific Conduivity($\mu\text{S}/\text{cm}$)
- Turbidity (FNU)
- *Salinity (psu)
- Flow (m^3/s)
- *Photoperiod
- Lunar Cycle
- Day Period

*Variables highly correlated ($r > |0.8|$) were excluded from the analysis.



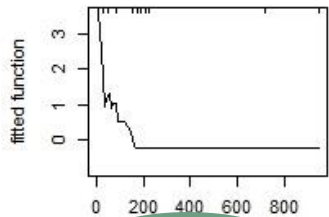
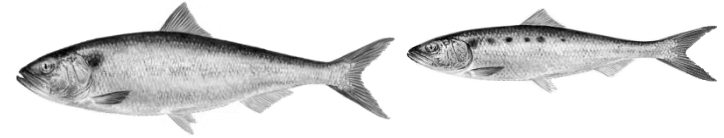
METHODOLOGIES APPLIED: BRT MODEL

set of data used

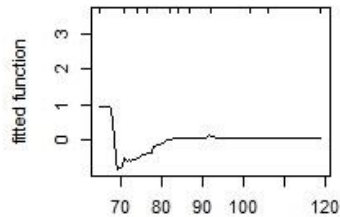


RESULTS: BRT MODEL

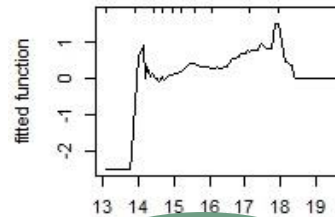
Explicative part



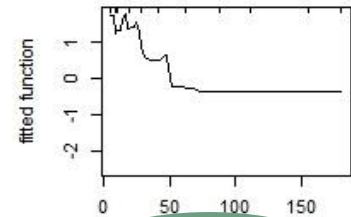
Flow (81%)



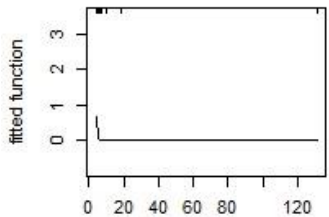
SpeCond (10.8%)



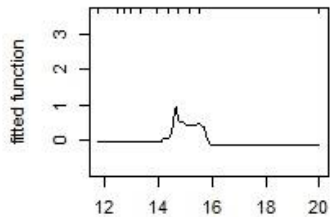
Temp (45.5%)



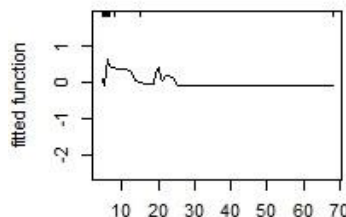
Flow (42.6%)



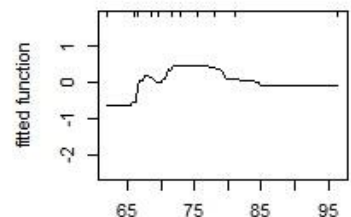
Turb (3.2%)



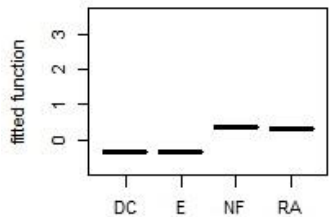
Temp (3%)



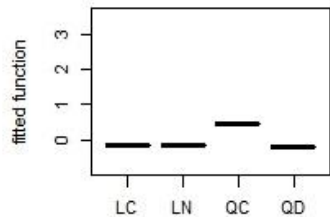
Turb (6.1%)



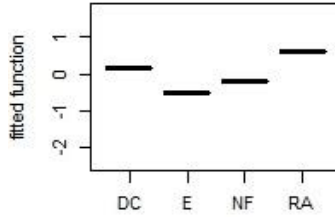
SpeCond (5.4%)



DayPer (1.7%)



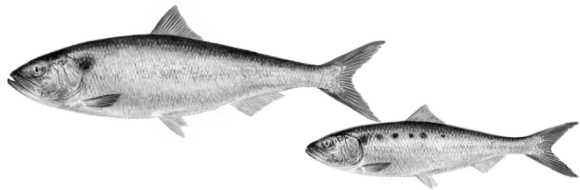
LunFas (0.4%)





DayPer (0.4%)

RESULTS: BRT MODEL

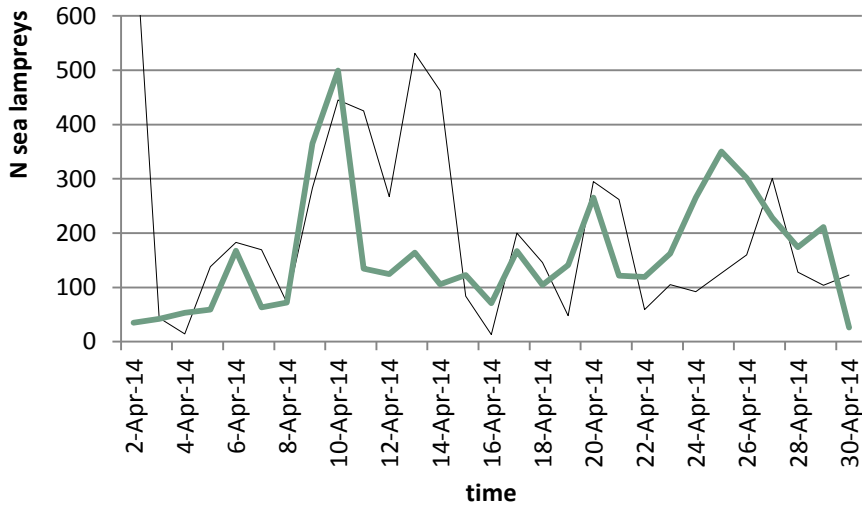
Performance of the models



Cv correlation	R ²
0,55 ; se = 0,093	 0,80
0,523 ; se = 0,075	 0,90

RESULTS: BRT MODEL

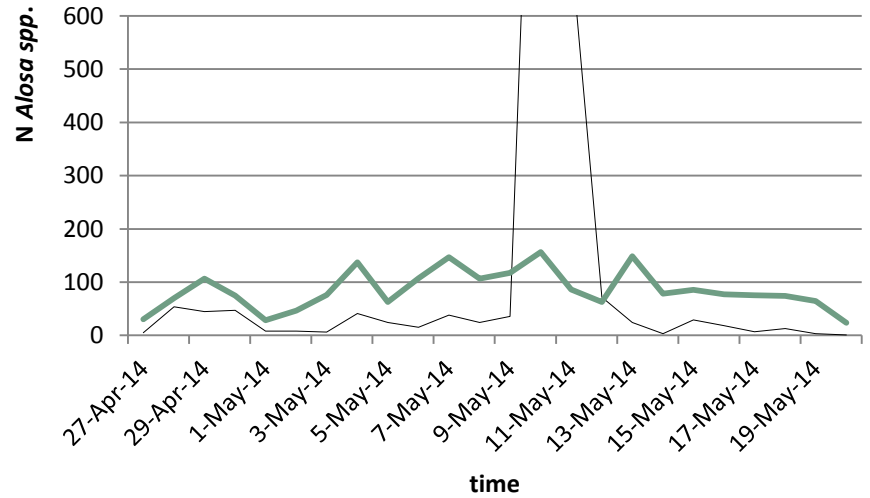
Predictive part



— observed counts — expected counts

6077

4717



— observed counts — expected counts

2835

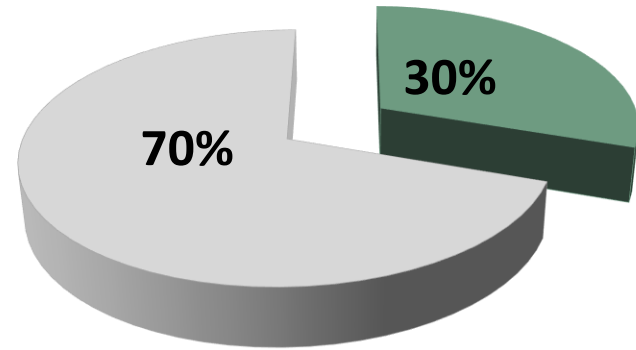
2044

METHODOLOGIES APPLIED: PIT-TAGS

- In 2014;
- 225 sea lampreys were captured by a fyke net;
- Tagging with a Pit-tag;
- Antenna installed in the last basin;
- Allows to estimate the efficiency of the fishway for sea lamprey.



RESULTS: PIT-TAGS

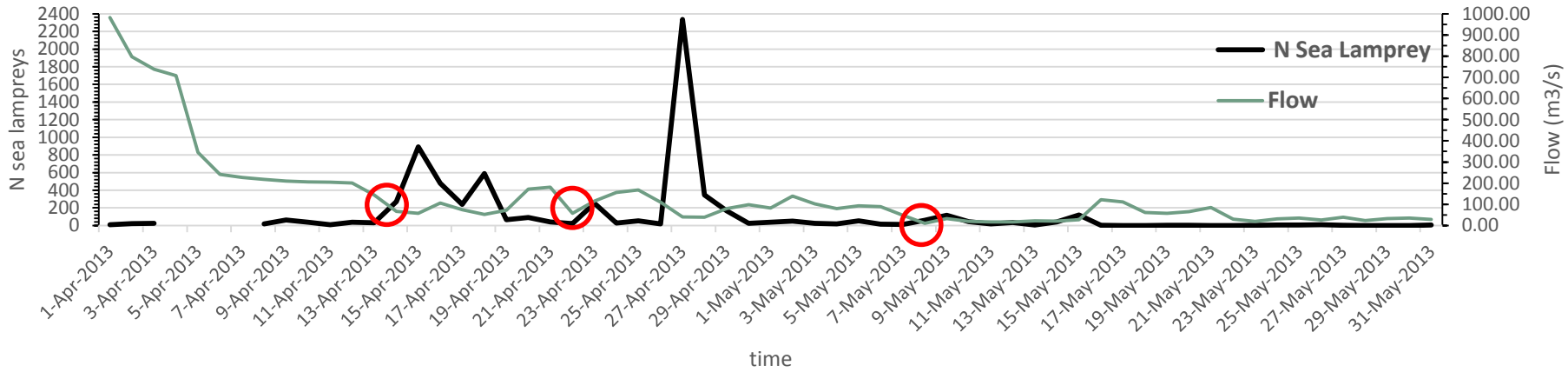


■ Successful passages

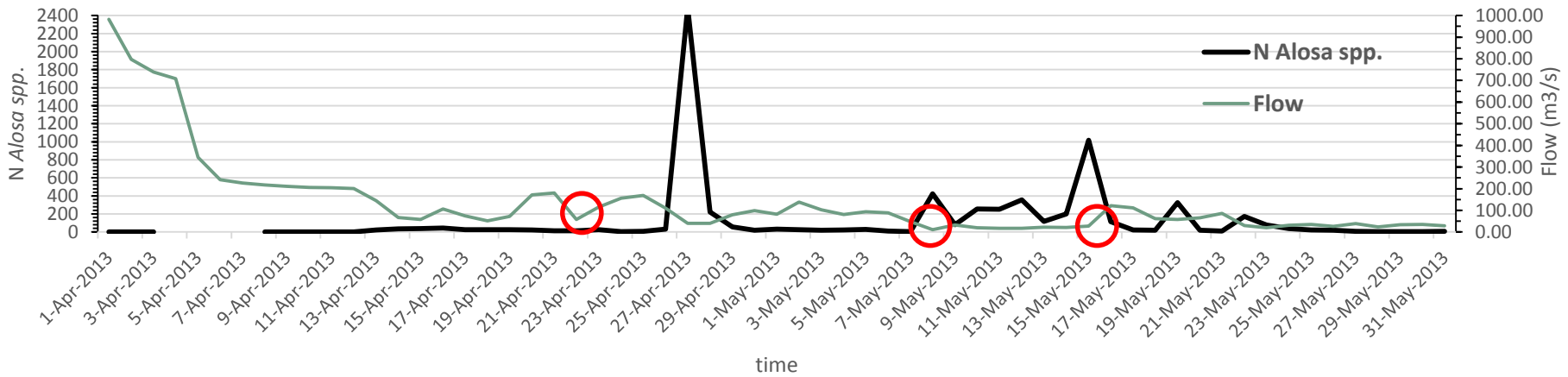
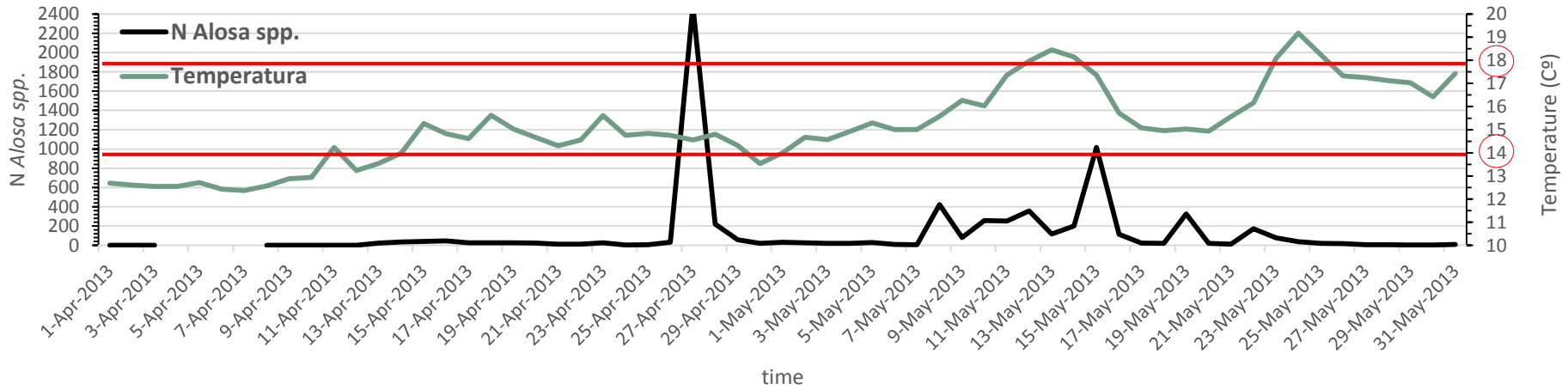
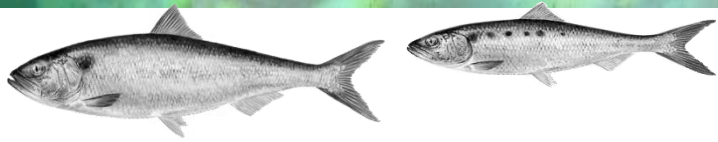
■ Unsuccessful passages

88% of the passages occurred at a lower flow (<50 m³/s).

RESULTS: COUNTS X RELEVANT PREDICTORS



RESULTS: COUNTS X RELEVANT PREDICTORS

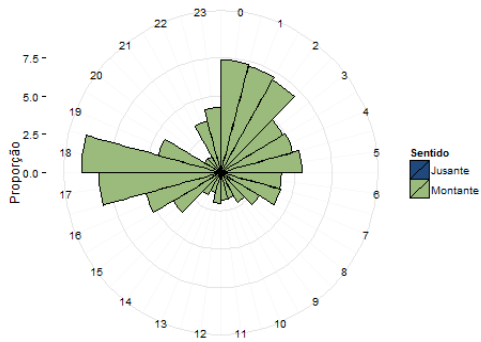


RESULTS: TRANSPOSITION PATTERNS

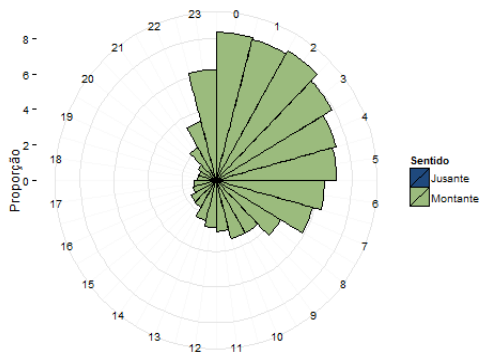


- Measurements made from the video recordings;
- Length-weight relationship : $W = aL^b$

2013



2014



2013

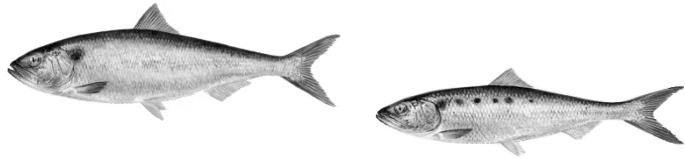
• 9611,53 kg

2014

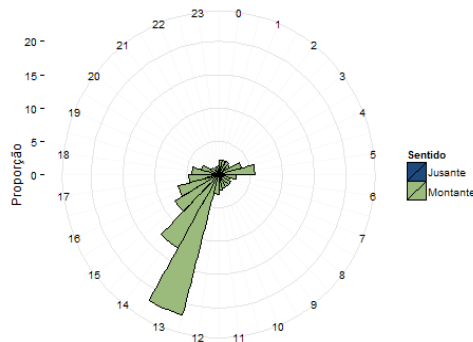
• 25375,46 kg

biomass input

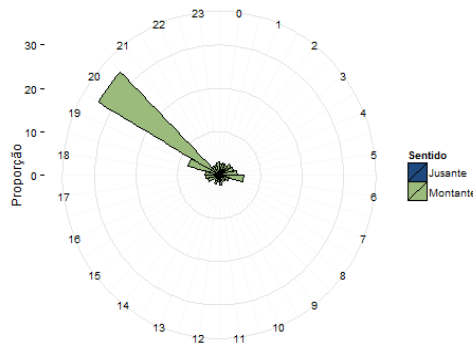
RESULTS: TRANSPOSITION PATTERNS



2013



2014



2013

• 14310,81 kg

2014

• 6499,02 kg

biomass input

SOME CONCLUSIONS...

- BRT models show that:
 - Dam discharges significantly influence the migratory behavior of sea lamprey and *Alosa spp.*;
 - The efficiency was limited during high discharge periods;
 - To *Alosa spp.* the temperature was so importante as flow to the response variation;
 - The pit-tag technique and the relation between data counts and predictors emphasizes the results of the BRT models.

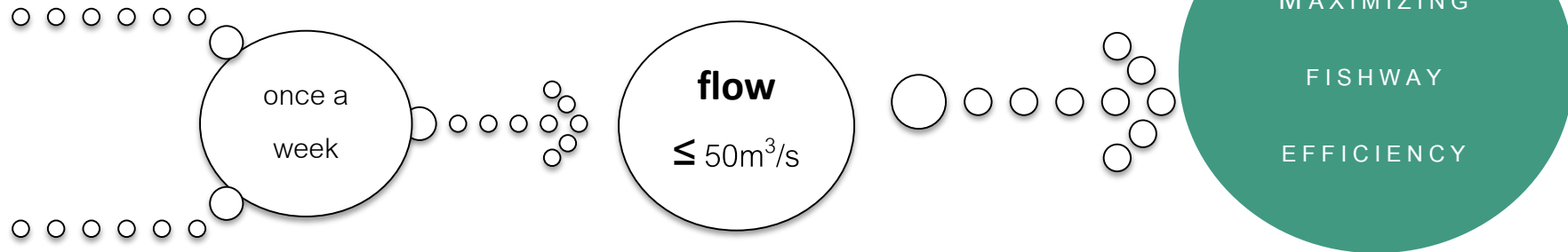


SOME CONCLUSIONS...

Proposal for a measure management



In April



Between April and May



ACKNOWLEDGEMENTS

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- Coimbra fishway monitoring program
(<http://apambiente.wix.com/pppeixescoimbra>)



- A big thanks to the other counters:
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- For the help with the measurements:
Cátia Ferreira, Joana Casimiro e Sara Basílio.

