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Attraction and Passage Efficiency of a Vertical-Slot Fish Pass for Sea Lamprey

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Presenter Information
Bernardo Quintella, C. S. Mateus, C. M. Alexandre, E. Pereira, A. F. Belo, R. Oliveira, and P. R. Almeida

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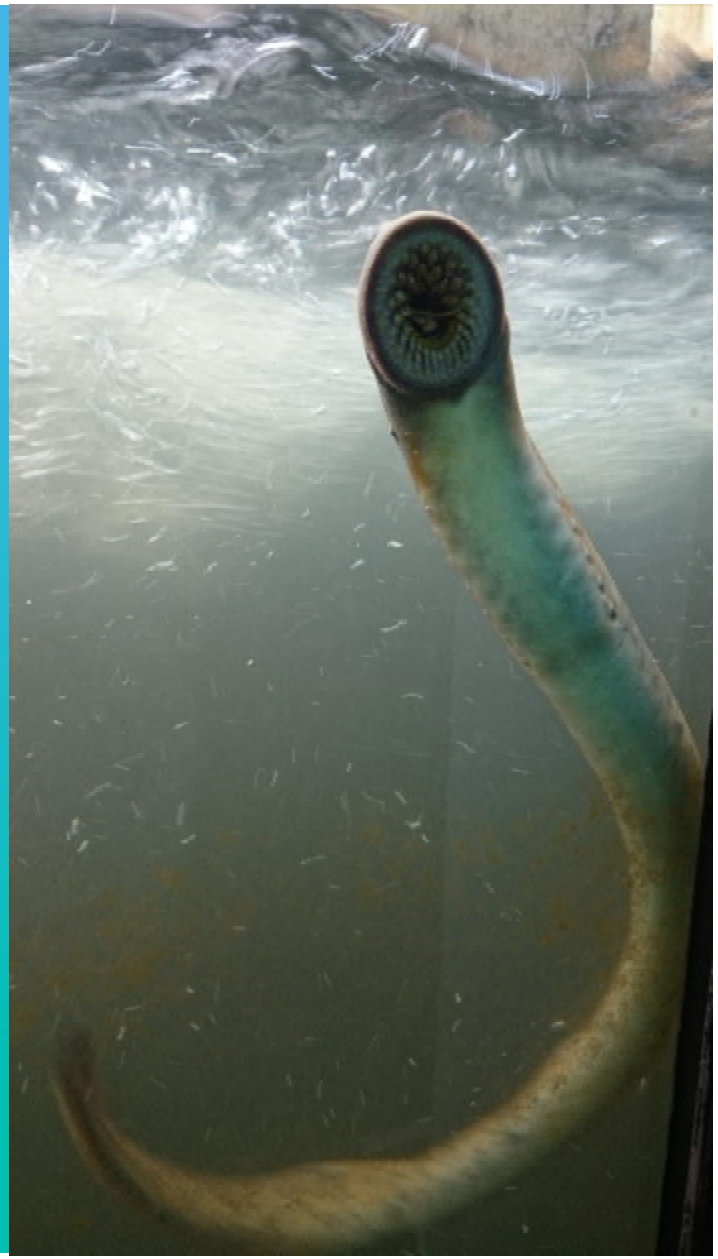
ATTRACTION AND PASSAGE EFFICIENCY OF A VERTICAL-SLOT FISH PASS FOR SEA LAMPREY



Bernardo QUINTELLA, C.S. MATEUS, C.M. ALEXANDRE, E. PEREIRA, A.F. BELO, R. OLIVEIRA, P.R. ALMEIDA

INTERNATIONAL CONFERENCE ON ENGINEERING AND ECOHYDROLOGY FOR FISH PASSAGE
JUNE 19-21, 2017 | Oregon State University Corvallis, Oregon (USA)

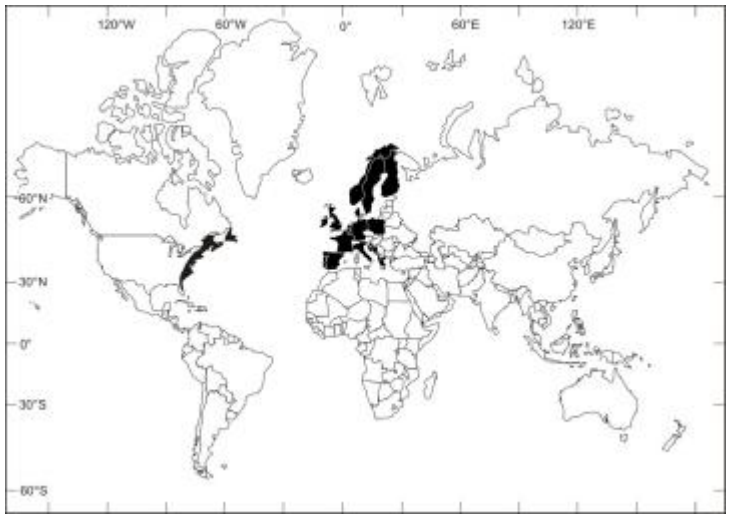
MARE
UNIVERSIDADE DE ÉVORA
Ciências ULisboa

Outline

- Sea lamprey background
- Coimbra fishway (River Mondego)
- Attraction efficiency
  - Lamprey counts / statistical model
- Passage efficiency
  - PIT tagging
- Pre & post operational monitoring
- Conclusions

Sea lamprey background

- Anadromous species (1.2 m length; 2.3 kg weight)
- Worldwide distribution - both sides North Atlantic
- “Vulnerable” (Portuguese Red List, 2005)
- “Least concern” (Global IUCN Red List, 2014)
  - Pop. trend: stable



Socio-economic relevance

Gastronomy festivals

Cultural Heritage

Lamprey Brotherhood

Threats - commercial fishing

FYKE net

Drift TRAMMEL net

PESQUEIRAS (traps)

Threats – obstacles to migration

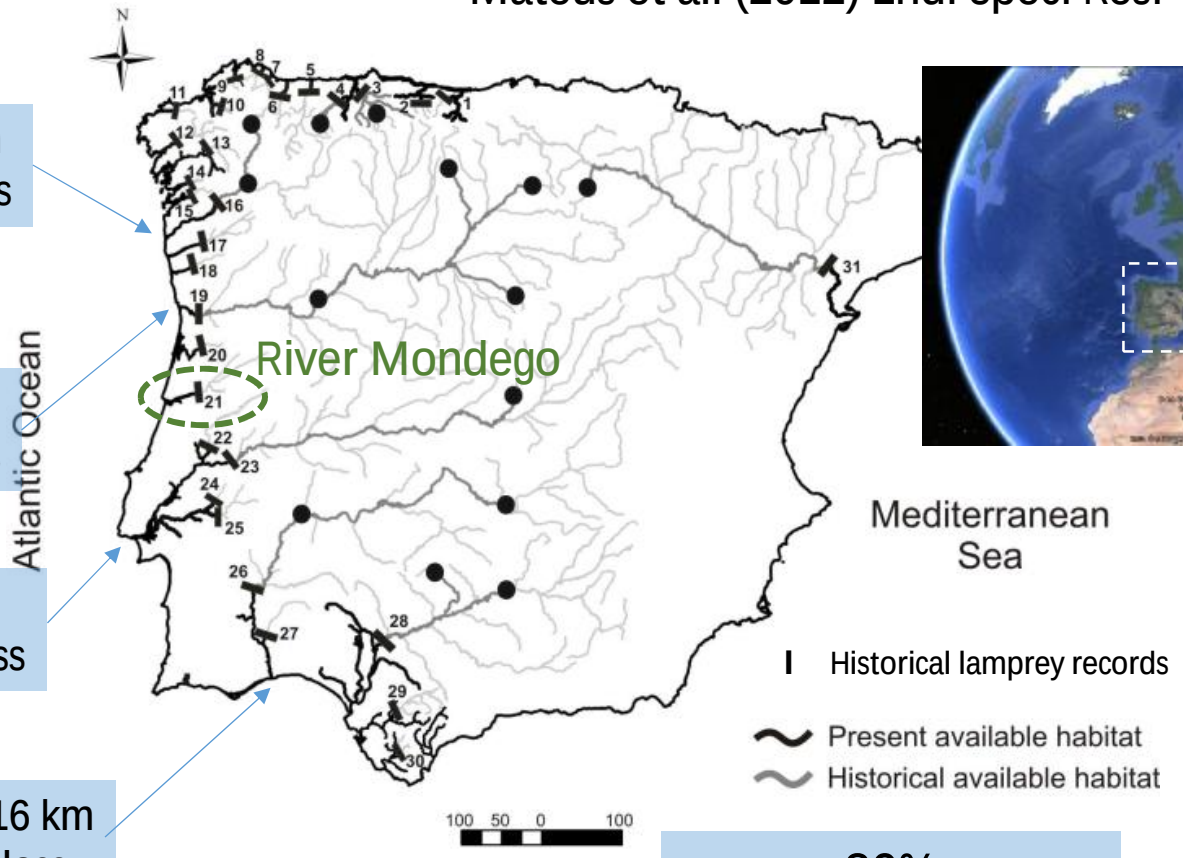
Mateus et al. (2012) End. Spec. Res.

MINHO – 174 km
(69%) habitat loss

DOURO – 496 km
(96%) habitat loss

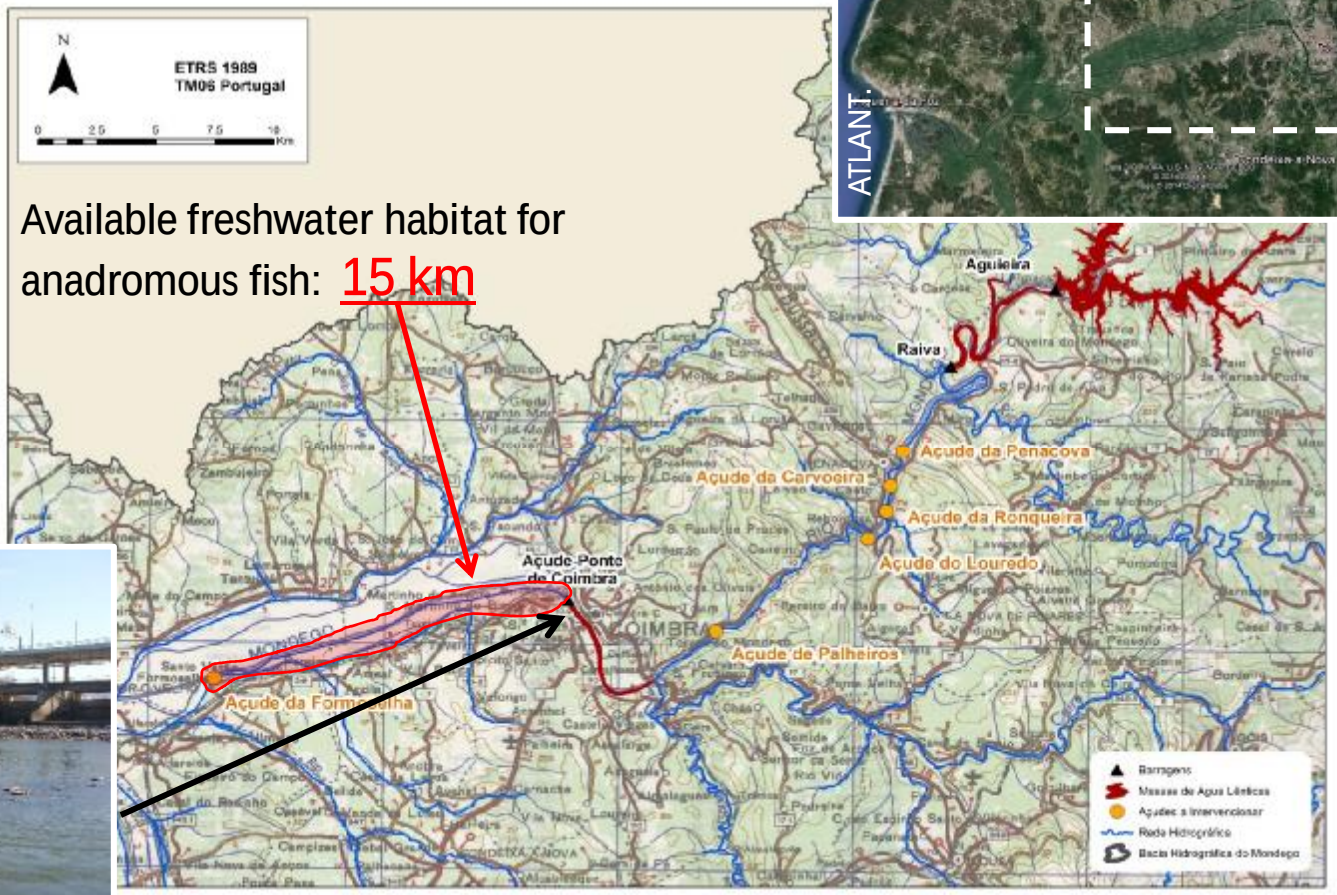
TEJO – 483 km
(76%) habitat loss

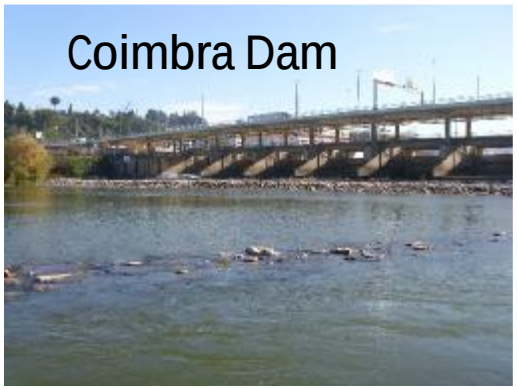
GUADIANA – 516 km
(80%) habitat loss



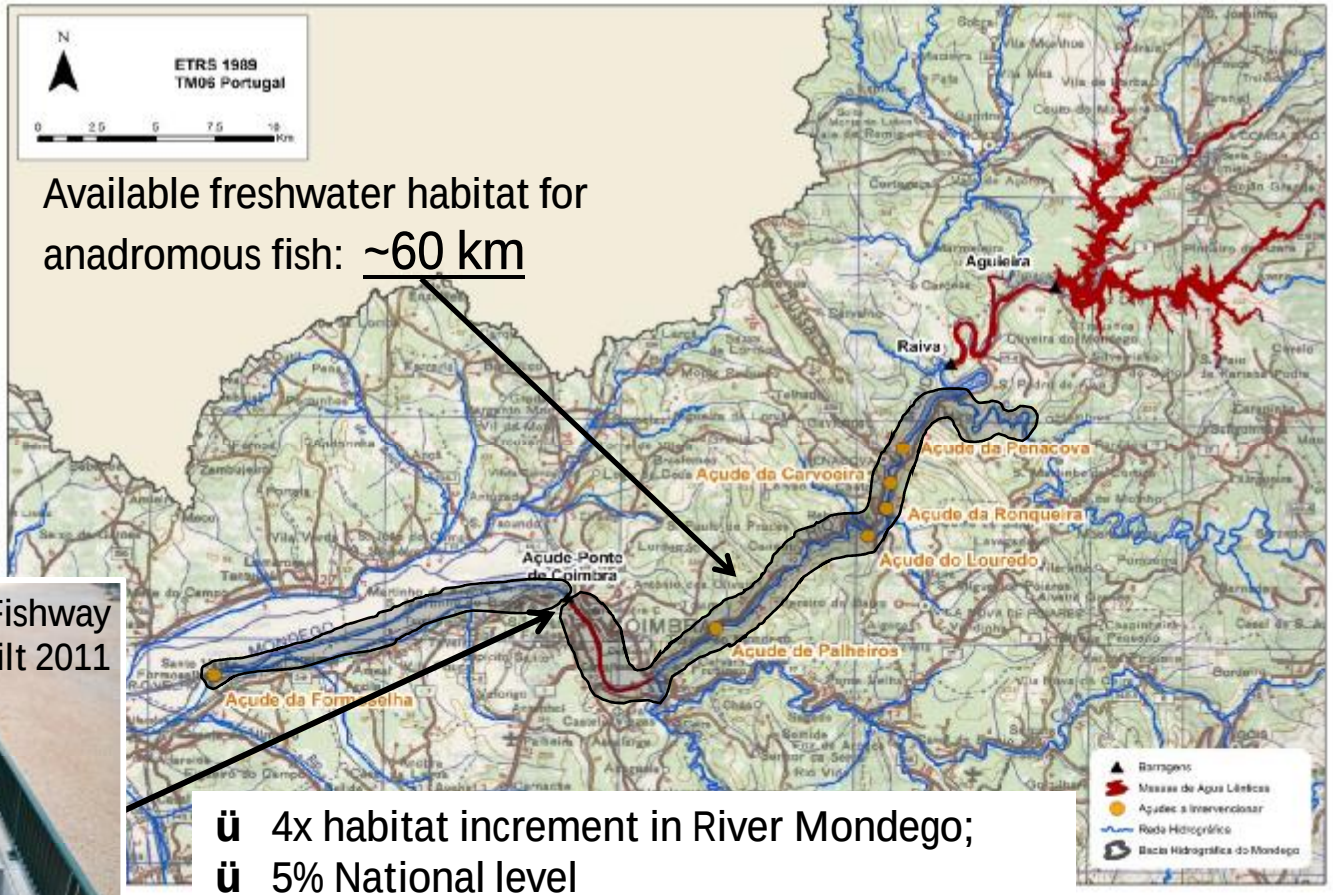
80%
of the habitat lost in
the Iberian Peninsula

River Mondego





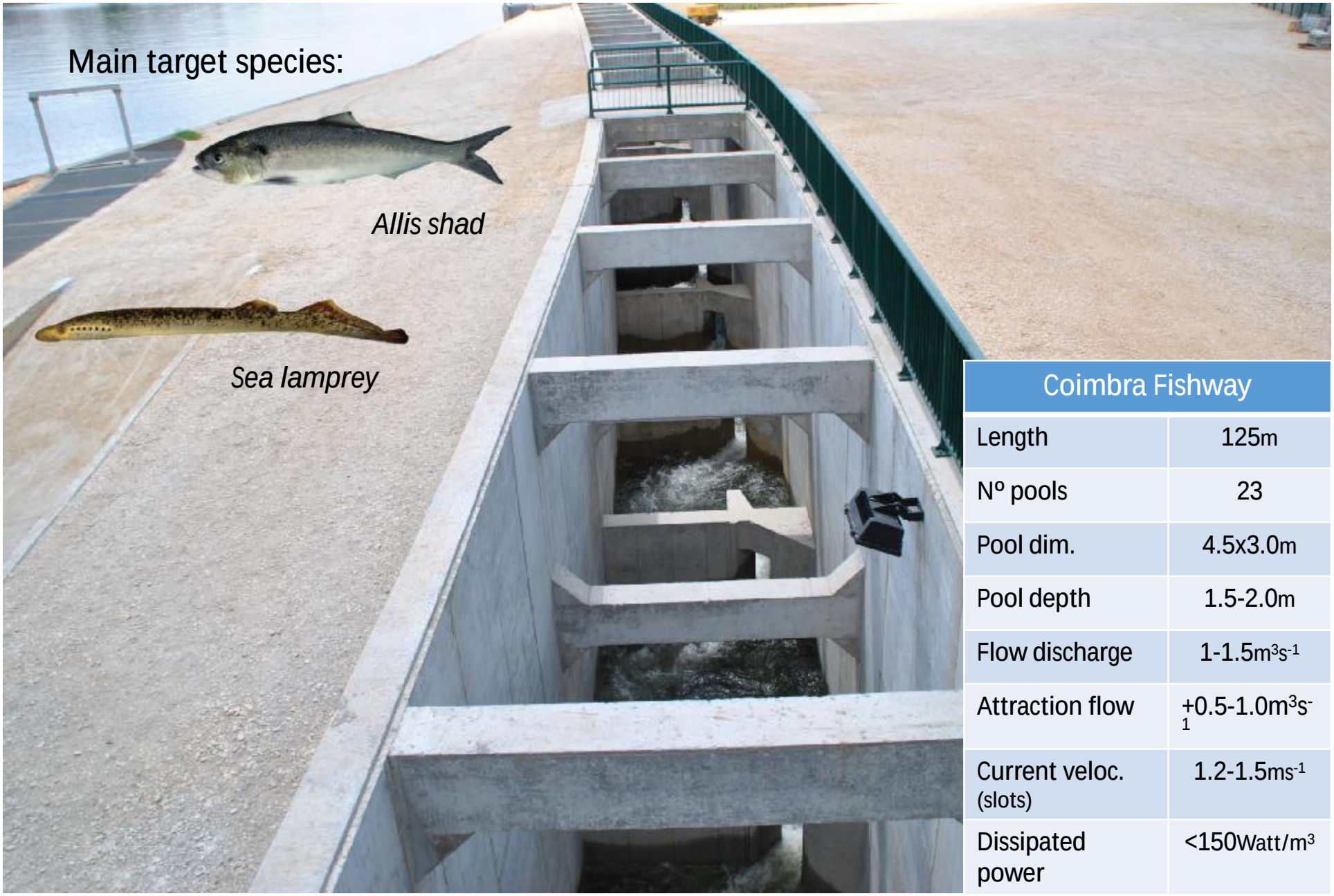
River Mondego



- 4x habitat increment in River Mondego;
- 5% National level

Coimbra Dam/fishway

Top view



Coimbra Fishway	
Length	125m
Nº pools	23
Pool dim.	4.5x3.0m
Pool depth	1.5-2.0m
Flow discharge	1-1.5m^3s^{-1}
Attraction flow	+0.5-1.0m^3s^{-1}
Current veloc. (slots)	1.2-1.5ms^{-1}
Dissipated power	<150Watt/m^3

Attraction efficiency - methods

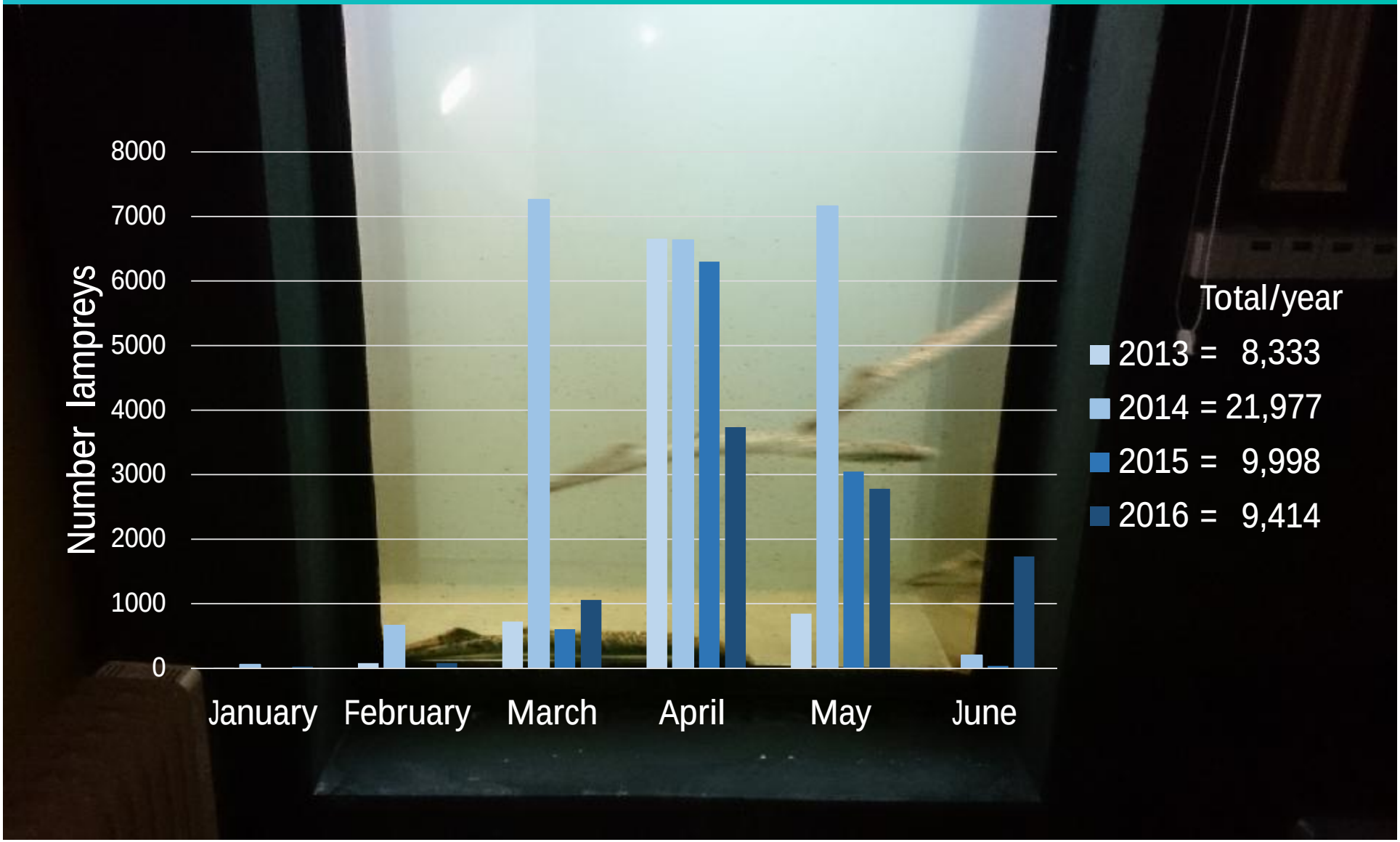
- 4 spawning seasons 2013-2016
- Continuous video recording system
- Sea lamprey counts made a posteriori
- Statistical models - relate environmental predictors with counts

Monitoring window

Video camera

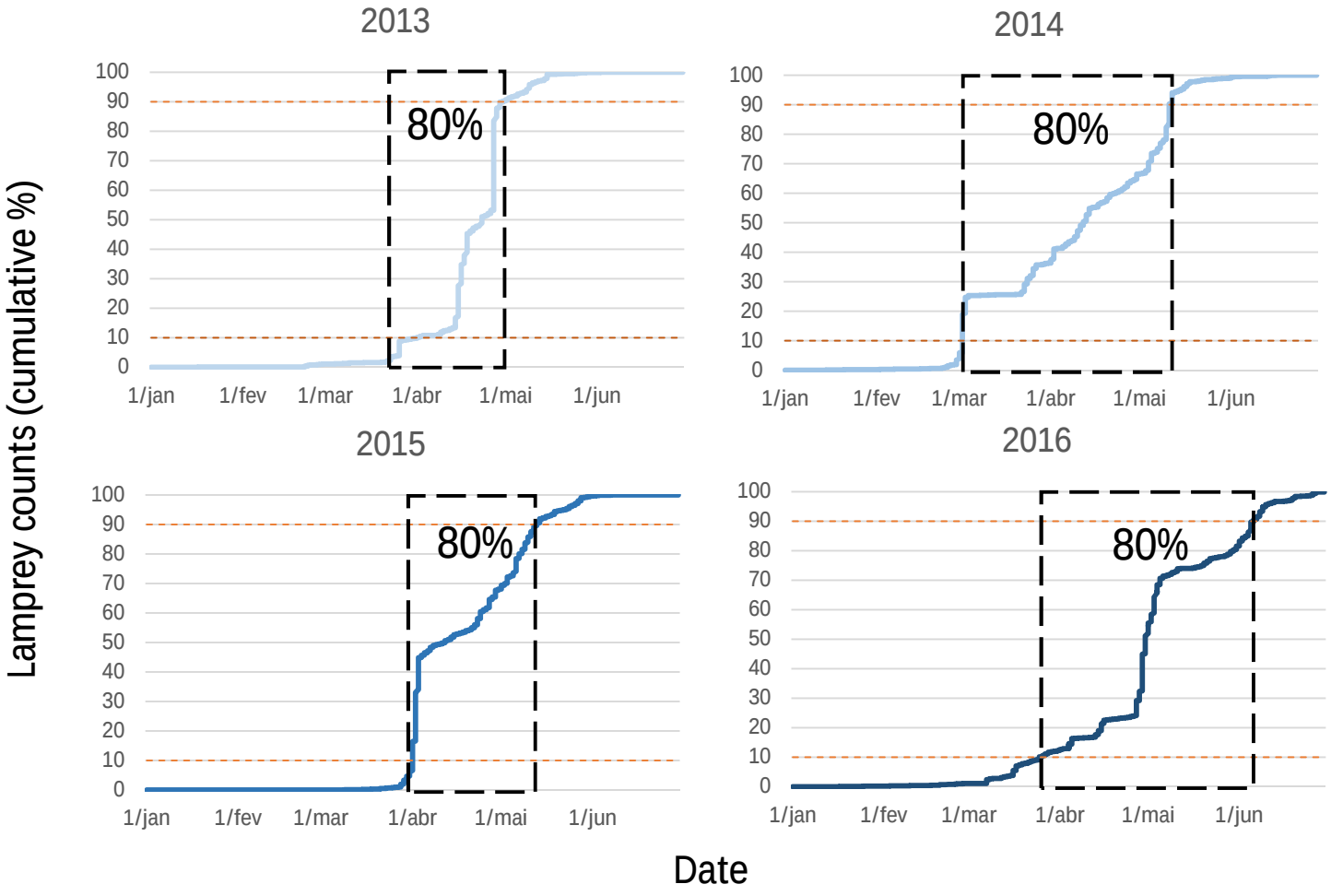
Image recording system

Attraction efficiency - counts



Attraction efficiency - counts

Set of data used (subsample - peak of spawning migration)

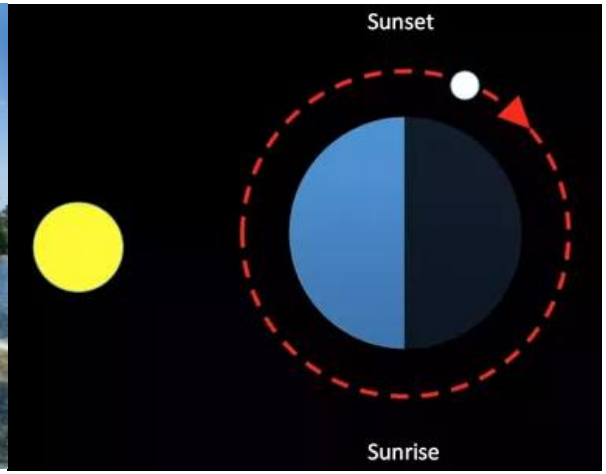


Attraction efficiency - predictors

Pre-selected predictors to relate with the sea lamprey counts:

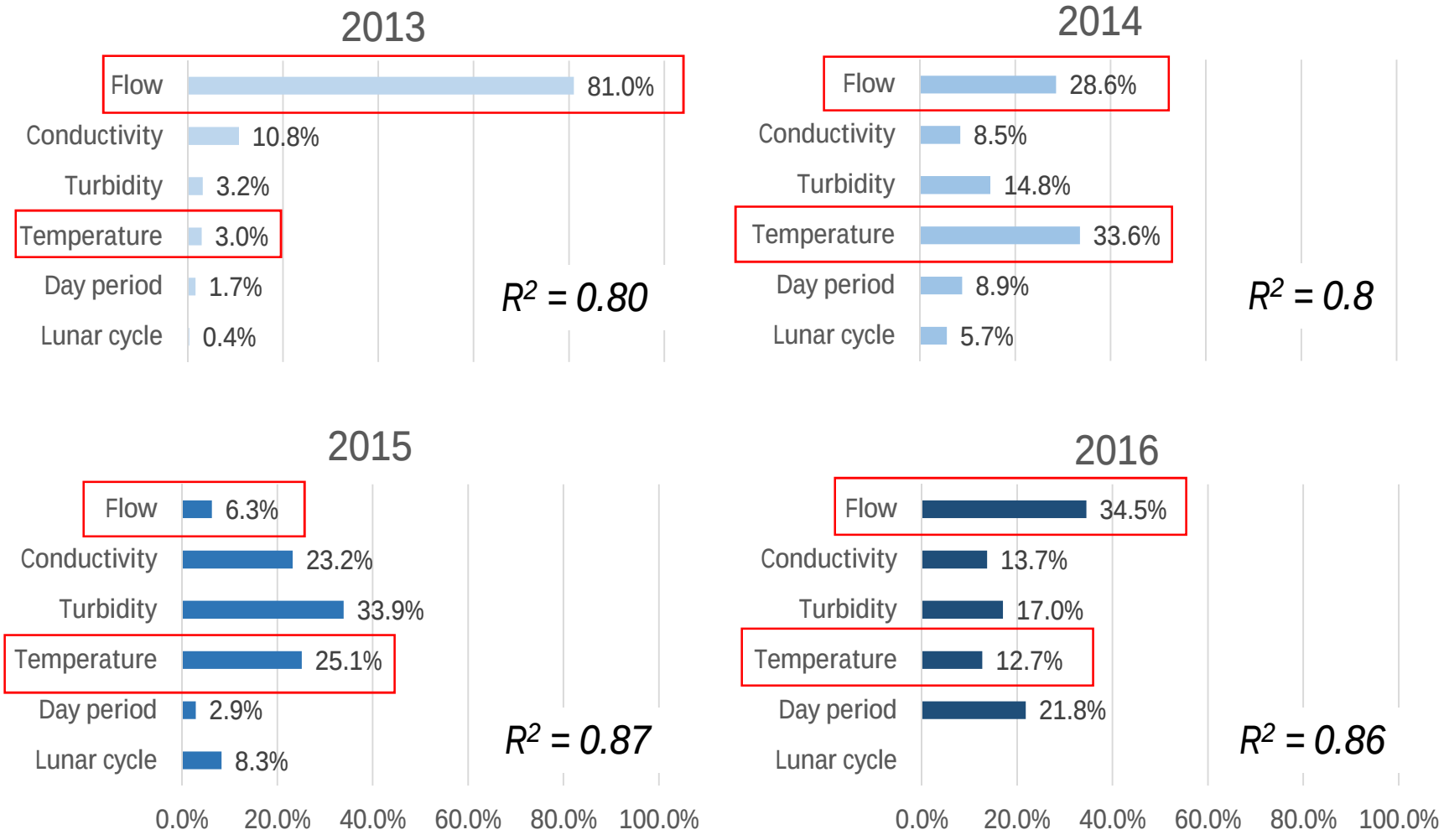
- Water temperature (Temp - °C)
- Specific Condutivity (SpeCon - µS/cm)
- Turbidity (Turb - FNU)
- Discharge Flow (Flow - m^3/s)
- Lunar Cycle (LunCyc – Full Moon; Last Quarter; New Moon; Firs Quarter)
- Day Period (DayPer - Night, Sunrise; Day; Sunset)
- Photoperiod (Phot - Day length in hours)

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



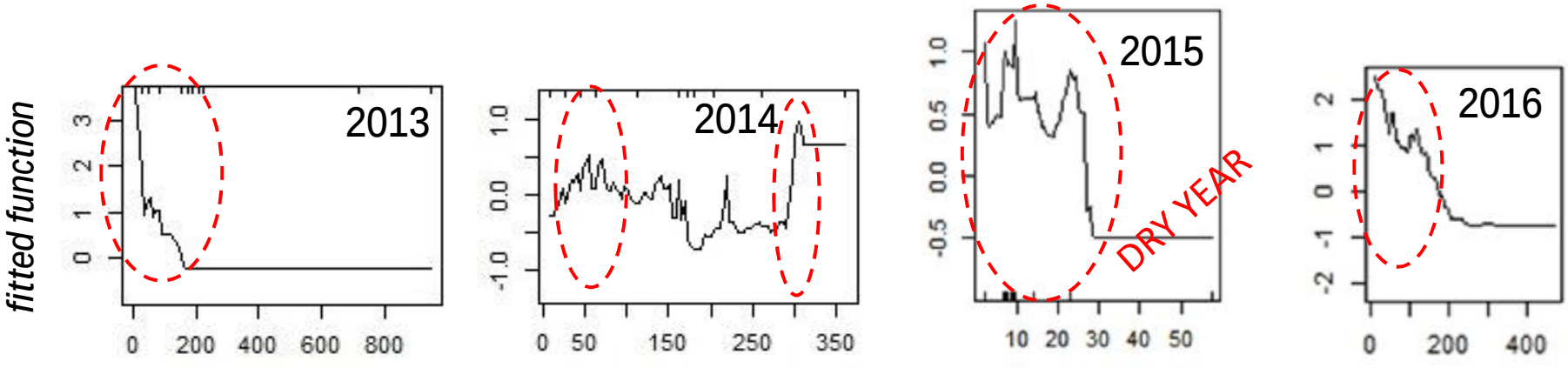
Attraction efficiency – BRT model

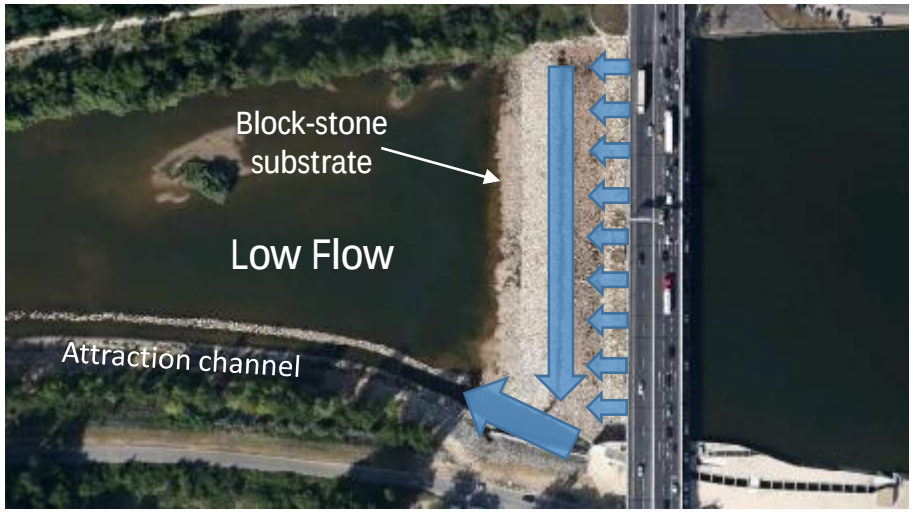
Predictors explanatory percentages:

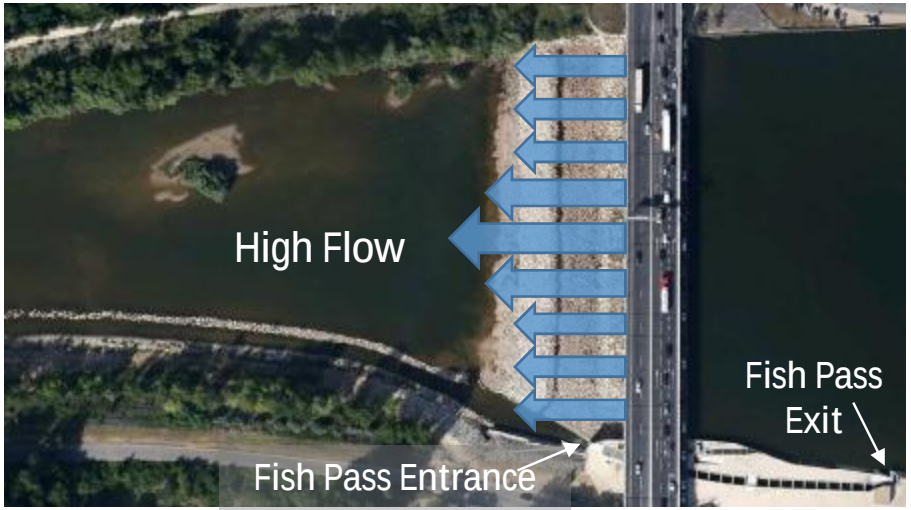


Attraction efficiency – BRT model

Flow: low flows increase the attraction efficiency for sea lamprey







Attraction efficiency – BRT model

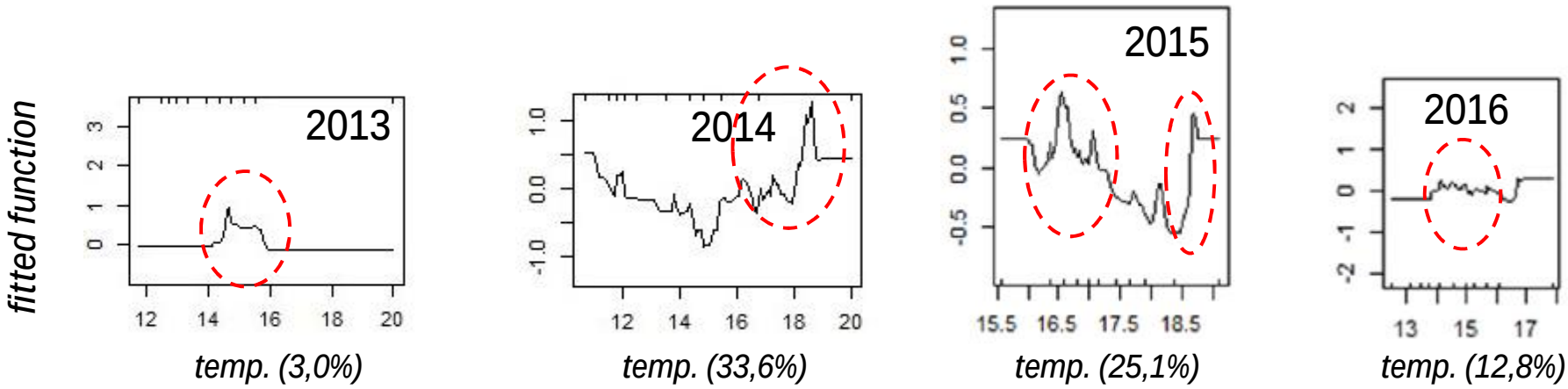
Flow: low flows increase the attraction efficiency for sea lamprey

400 m^3/s
(High flow)

20 m^3/s
(Low flow)

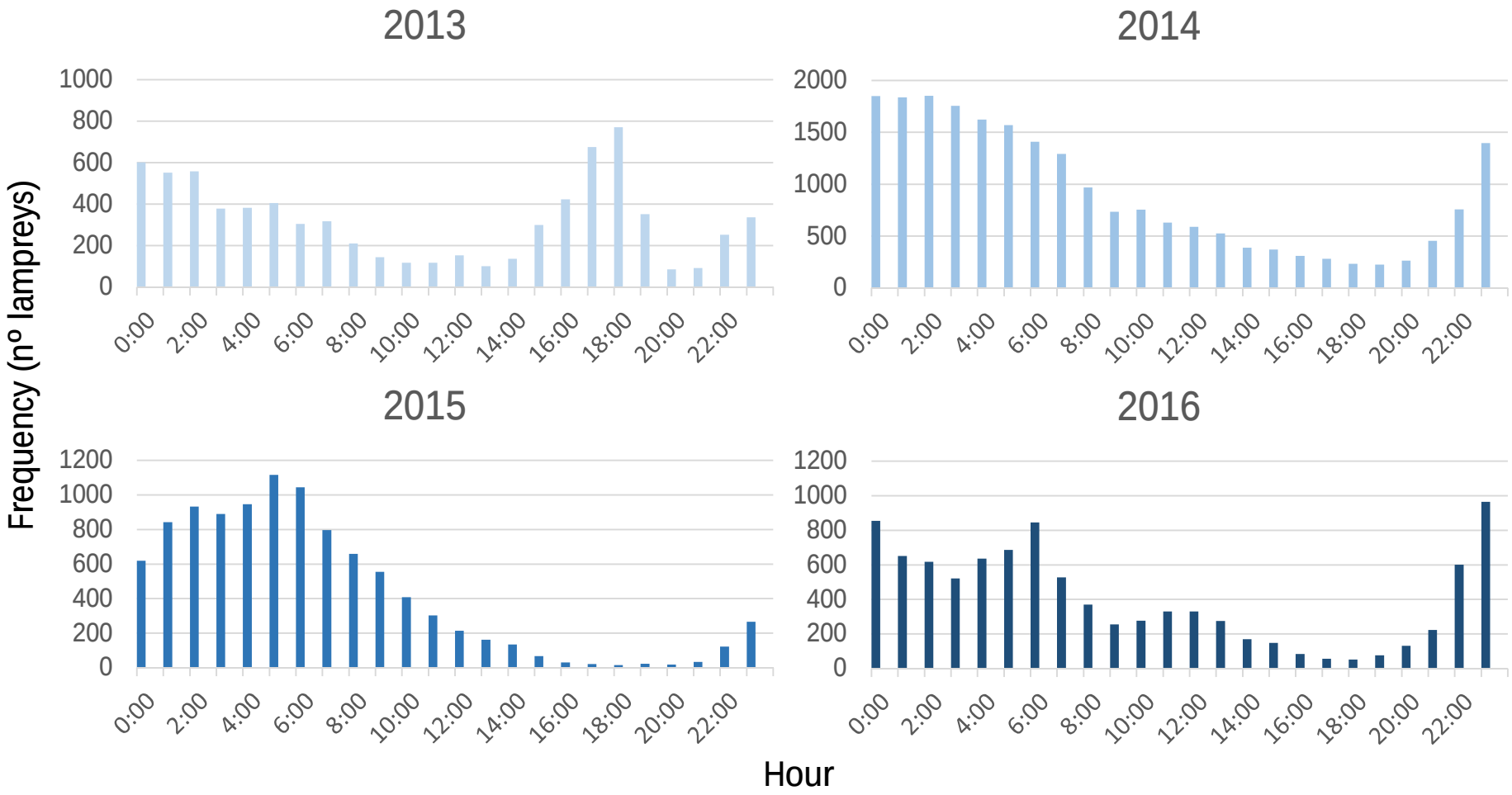
Attraction efficiency – BRT model

Temperature: peak of activity from 15-19 °C



Attraction efficiency – BRT model

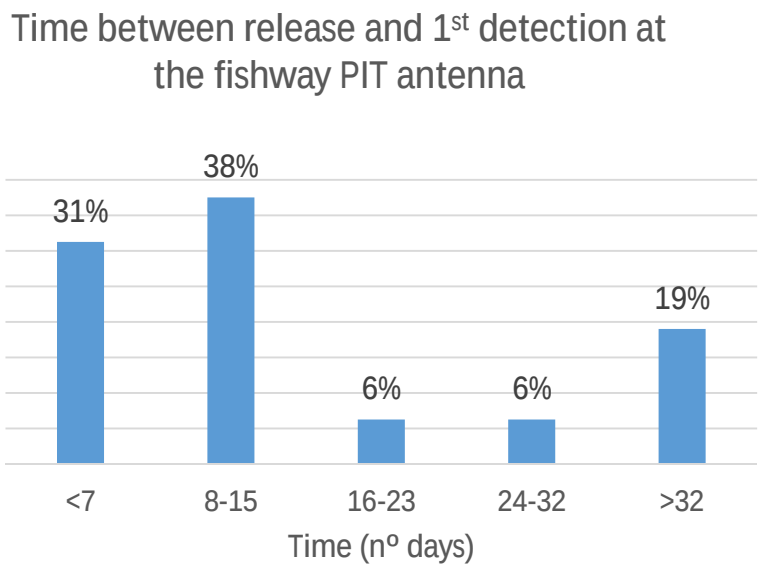
Day period: nocturnal activity pattern during fishway negotiation

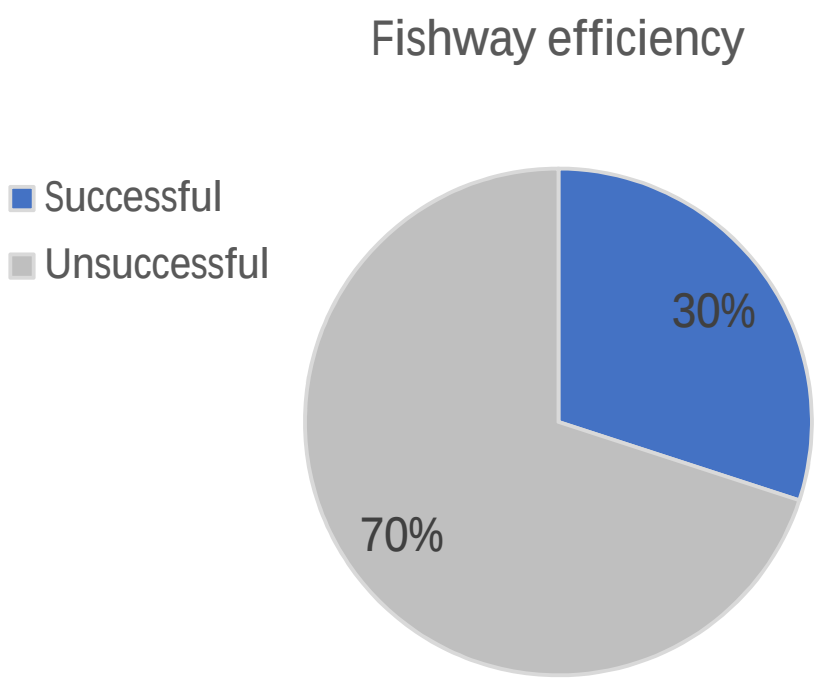


Passage efficiency – PIT tagging

Passage efficiency – PIT tagging

PIT tagging 2014 spawning season

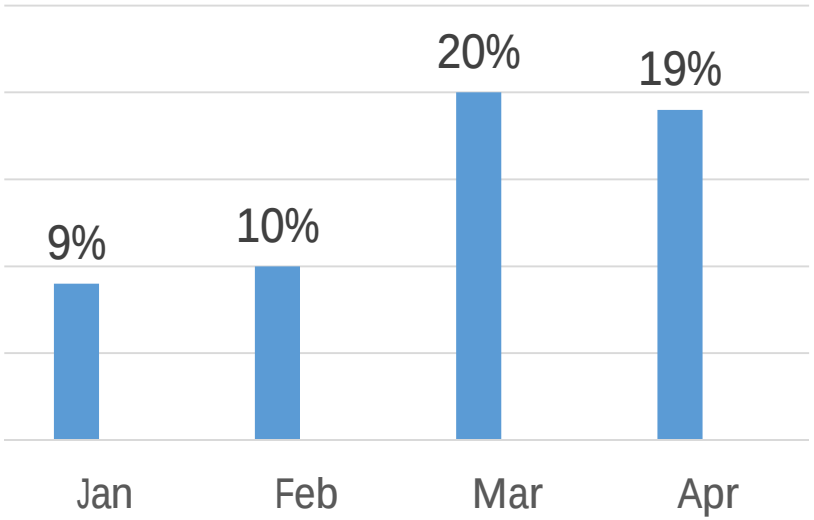


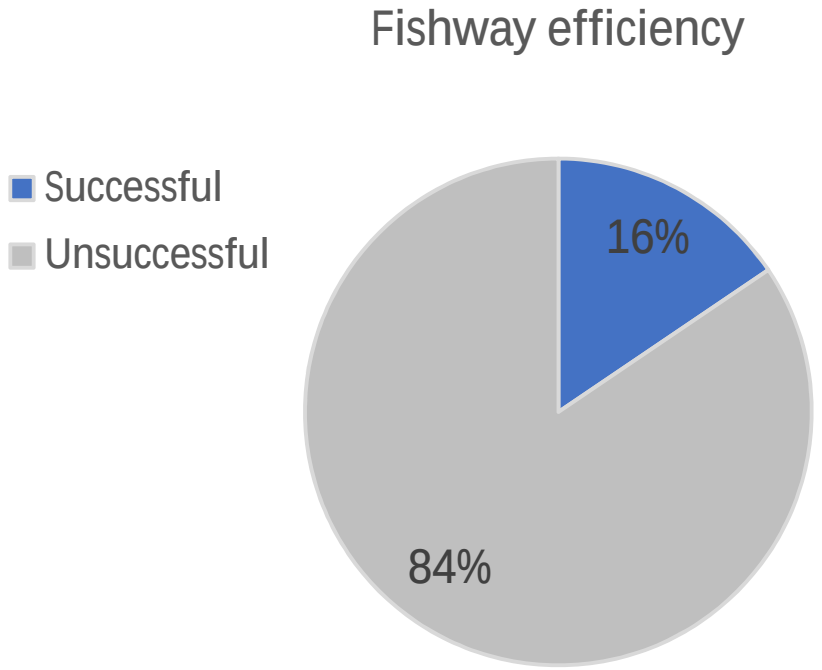


#225 sea lampreys PIT tagged in April 2014

Fishway efficiency for lampreys

PIT tagging 2015 spawning season



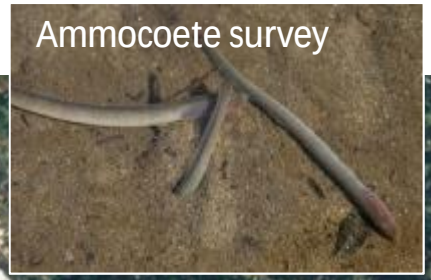


#103 sea lampreys PIT tagged Jan-Apr 2015

Pre a post operational monitoring

Pre a post operational monitoring – lamprey abundance

Electric fishing monitoring
#34 sampling stations

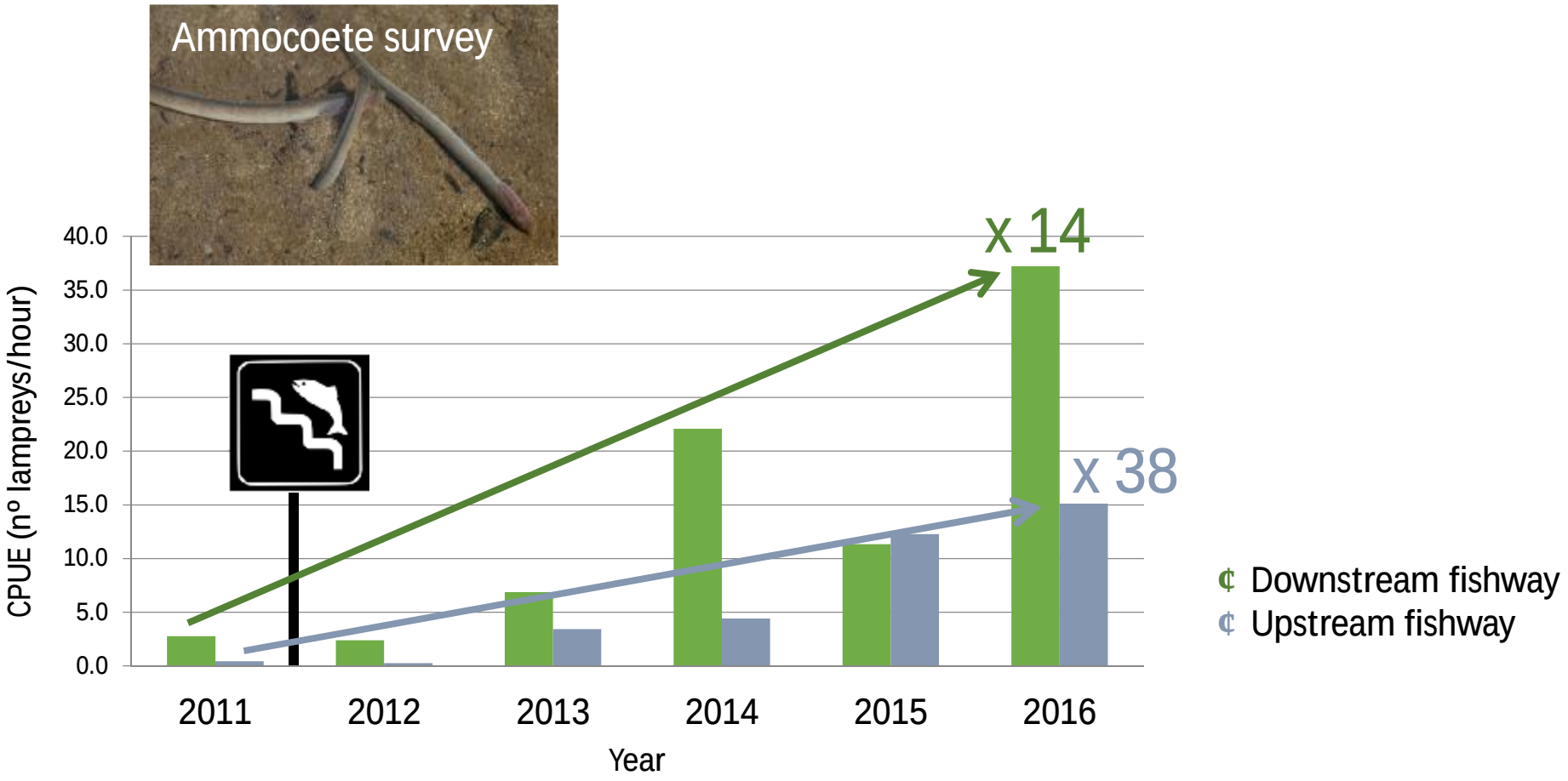


Ammocoete survey

Coimbra
Fishway

Pre a post operational monitoring

Pre a post operational monitoring – lamprey abundance



Conclusions

- Attraction efficiency of Coimbra fishway for sea lamprey is mainly conditioned by flow and temperature;
- It is possible to improve the attractiveness of the fishway through flow regulation (3 large dams upstream) during a certain period of the spawning migration (water reach 14-18°C temperature) and night period;
- Passage efficiency can be improved but 30% was enough to promote a 38x increment in ammocoete abundance in the upstream stretch.

Acknowledgements

Funding:

- Ø Coimbra fishway monitoring program (http://apambiente.wix.com/pppeixescoimbra)
- Ø PROMAR project - Habitat restoration for diadromous fish in River Mondego (http://www.rhpdm.uevora.pt/)