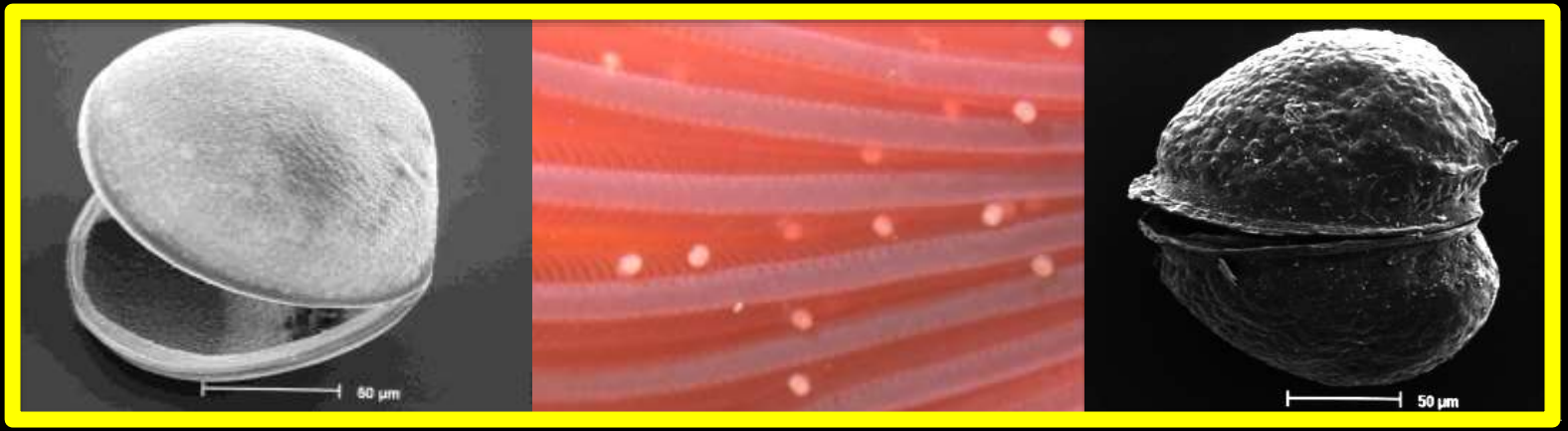
New advances toward the conservation of *Margaritifera auricularia* (Spengler 1793) in France



Joaquín Soler[1, 2]
Karl M. Wantzen[2] & Rafael Araujo[1]

[1] Museo Nacional de Ciencias Naturales – C.S.I.C.
[2] Université de Tours, CNRS UMR 7324 – CITERES

INTERNATIONAL WORKSHOP
Freshwater mussels: Search for resettlement habitats and evaluation of protection measures

Monday 25th March – Wednesday 27th March 2019
Dresden, Germany



Photo from Prié & Cochet, 2011

Margaritifera auricularia

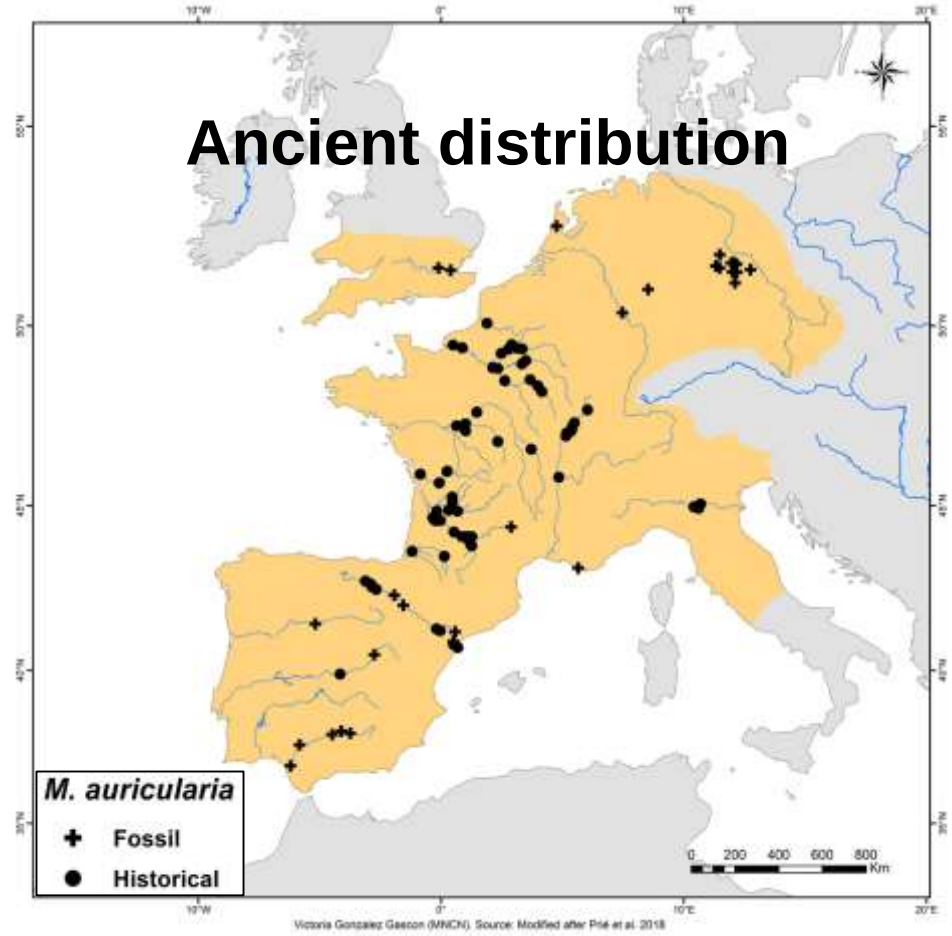
Critically Endangered (IUCN)

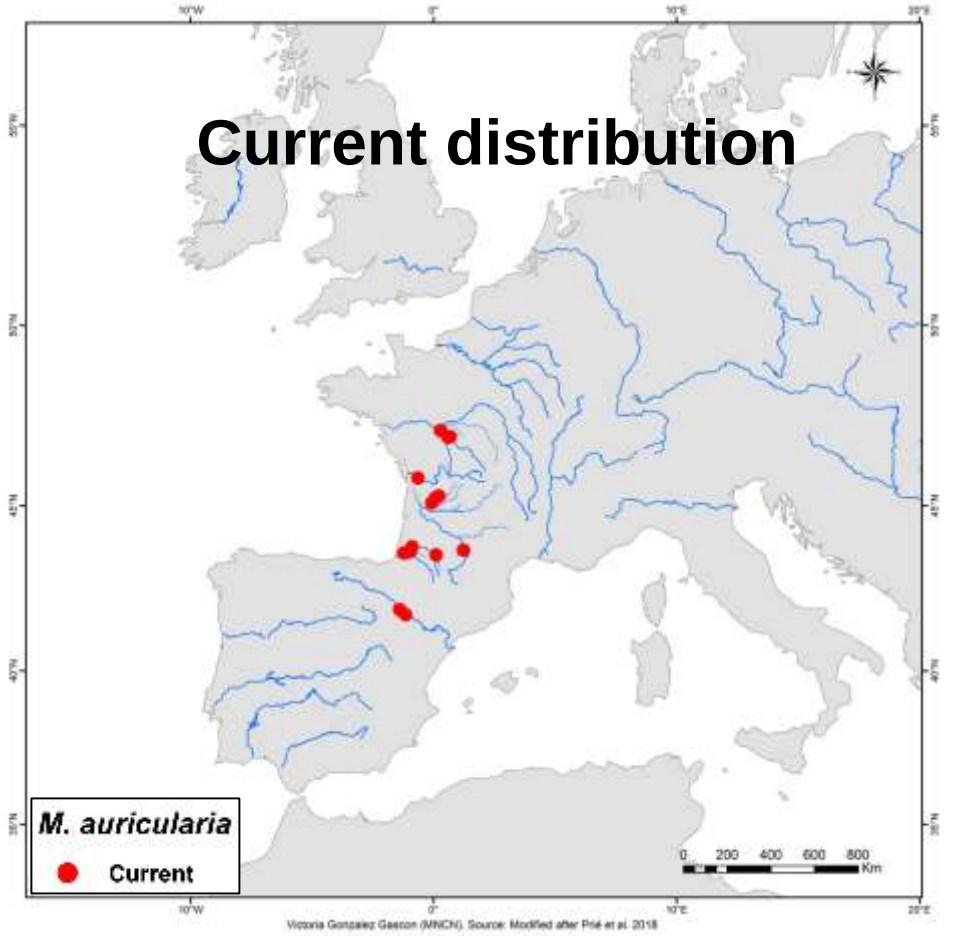


Giant pearl mussel
up to 20 cm



Middle and lower reaches
Gravel substrates





90% population decline in the last 2 centuries

Proven host fish:

out of 22 species tested



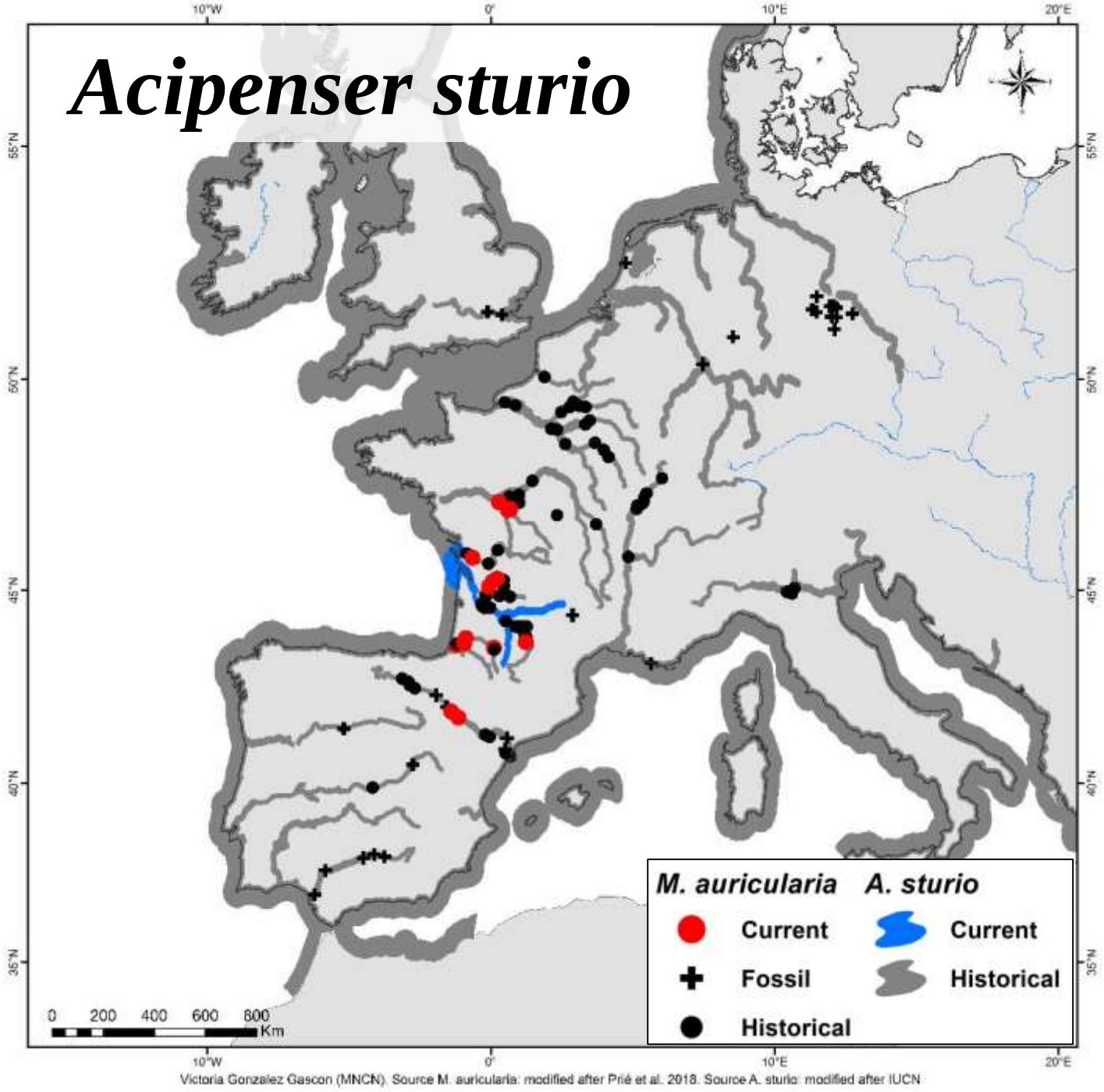
Acipenser sturio
(Europe)

Acipenser naccarii (Adriatic)
Acipenser baerii (Siberia)
Acipenser ruthenus (Asia-Europe)



Salaria fluviatilis
(Mediterranean)

Acipenser sturio



Victoria Gonzalez Gascon (MNCN). Source M. auricularia: modified after Prié et al. 2018. Source A. sturio: modified after IUCN

Hypothesis for *M. auricularia* hosts

Relationship with marine environment

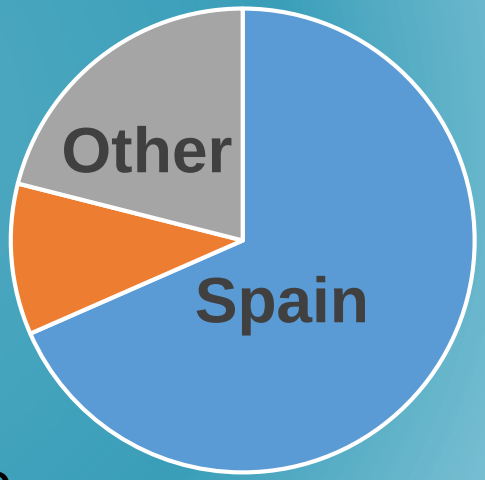
- *Acipenser* ssp are anadromous fishes
- *S. fluviatilis*, restricted to freshwater but can tolerate high salinity levels and belongs to a marine family

University of Tours
2014-2018

Conservation and reinforcement of populations

Scientific knowledge

France



90% of the living populations in France
No biological information

Conservation and reinforcement of French populations

Conservation ecology of *Margaritifera auricularia* (Spengler, 1793) in France

- Population status
- Reproductive biology
- Captive breeding

Conservation ecology of *Margaritifera auricularia* (Spengler, 1793) in France

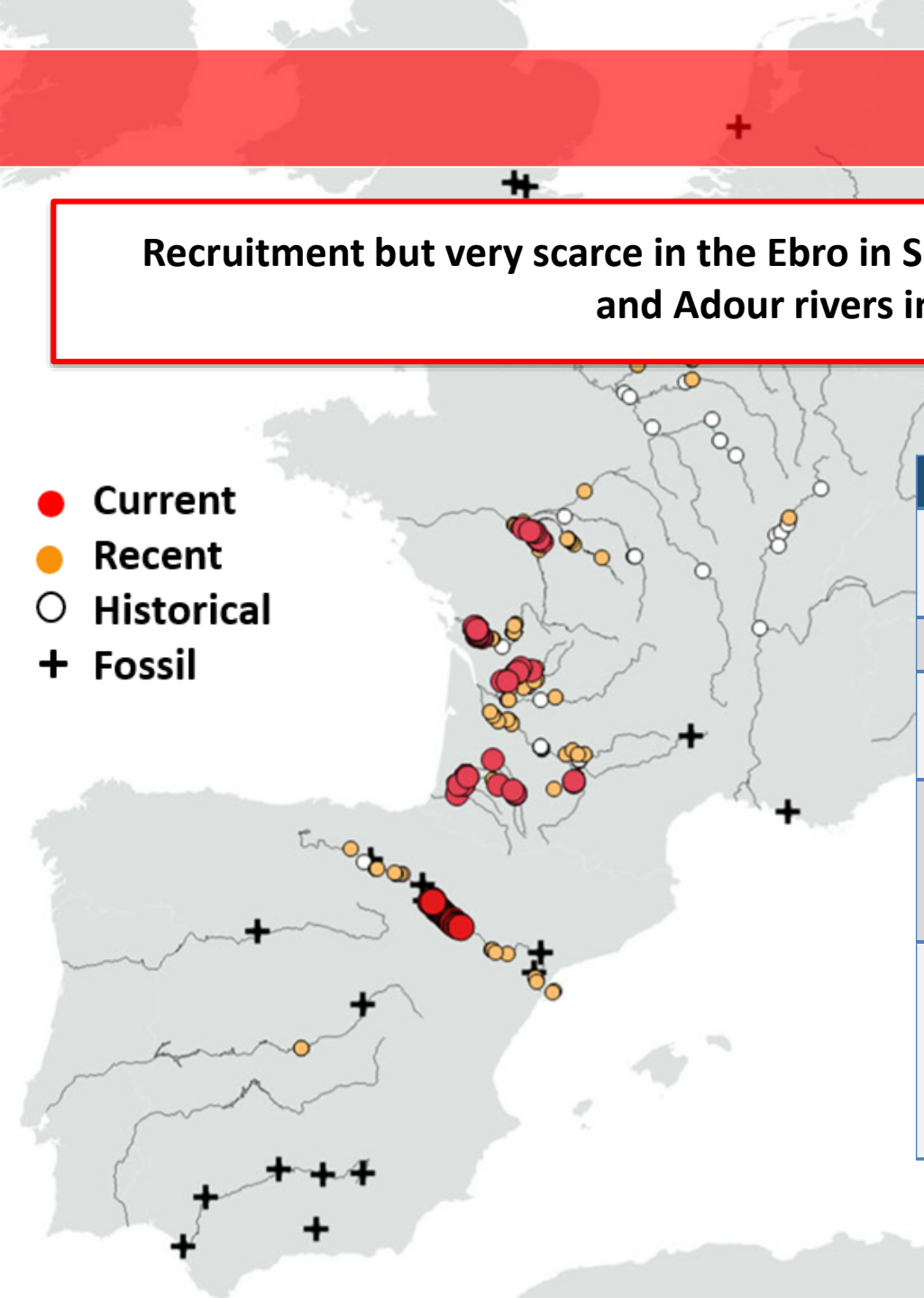
Population status

Reproductive biology

Captive breeding

Results

Recruitment but very scarce in the Ebro in Spain and in the Charente, Dronne and Adour rivers in France



Basin	River	Population size
Loire	Vienne	>100
	Creuse	>150
Charente	Charente	100,000
Garonne	Dronne	>100
	Save	<30
Adour	Adour	>300
	Arros	200
	Luy	150
Ebro	Upper Ebro	>1
	Canal Imperial	4,000
	Canal de Tauste	200
	Quinto Ditch	25

Prié et al., 2018.

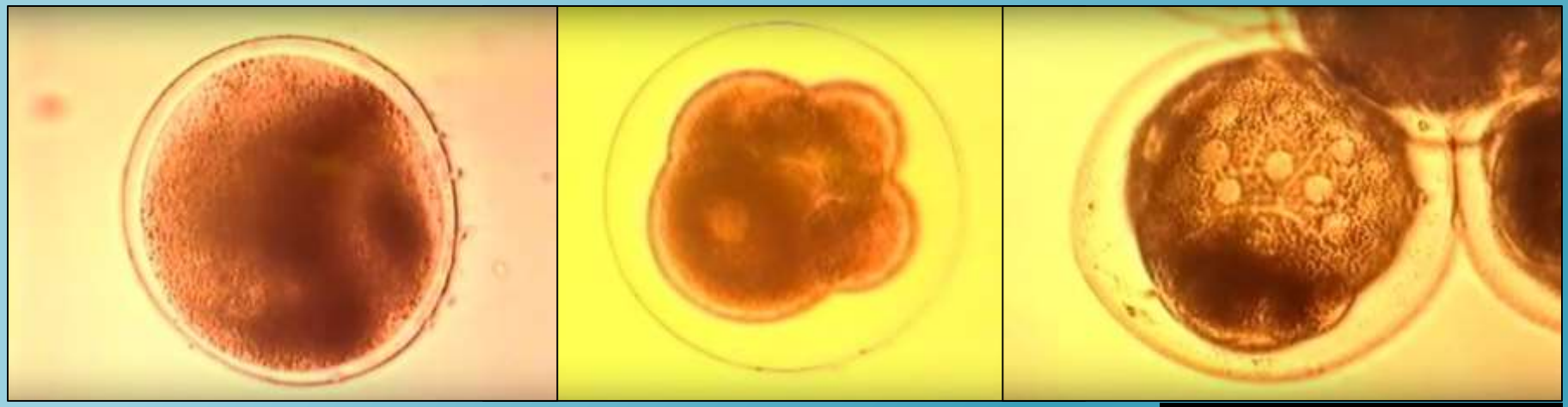
Conservation ecology of *Margaritifera auricularia* (Spengler, 1793) in France

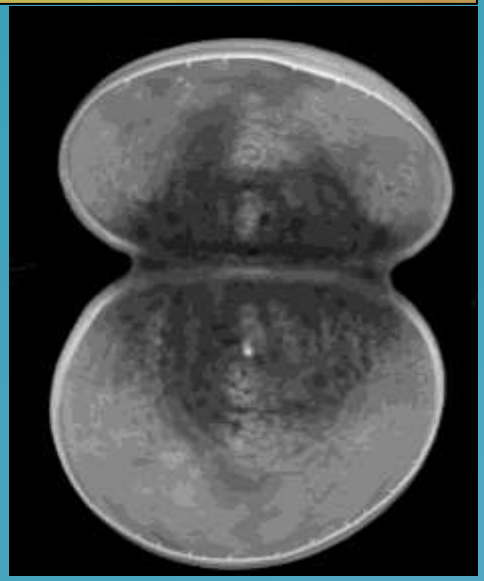
Population status

Reproductive biology

Captive breeding

Results





- Ova and developing embryos in March

- Glochidial release in early to mid-April
  (25-37 days)

- Some weeks later than Spanish populations

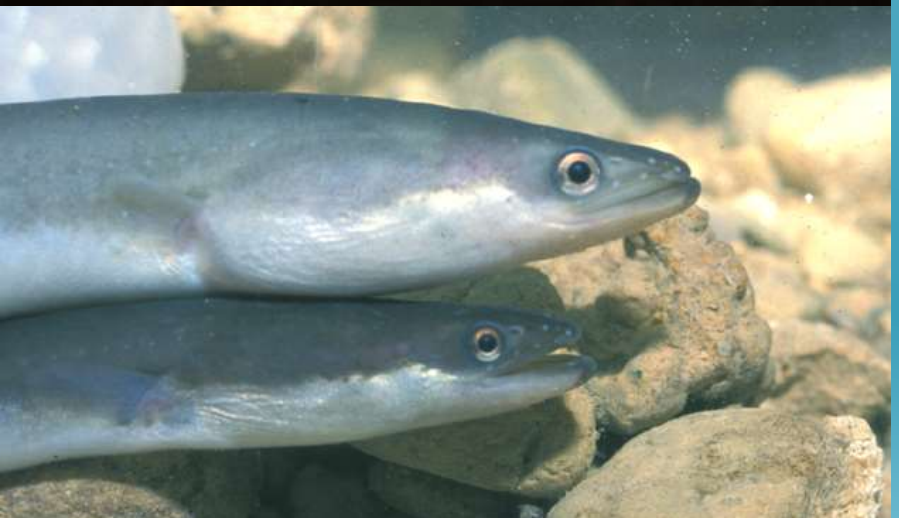
- Estimated number of larvae per gravid mussel ≈2,000,000

Natural infestation

966 individuals
29 species



Gasterosteus aculeatus



Anguilla anguilla

Experimental infestation 2017



Gasterosteus aculeatus

Suitable host for *M. auricularia*, but…

High glochidia loss

Not present in Creuse & Vienne

OTHER HOST SPECIES IN FRANCE ?



Experimental infestation 2018

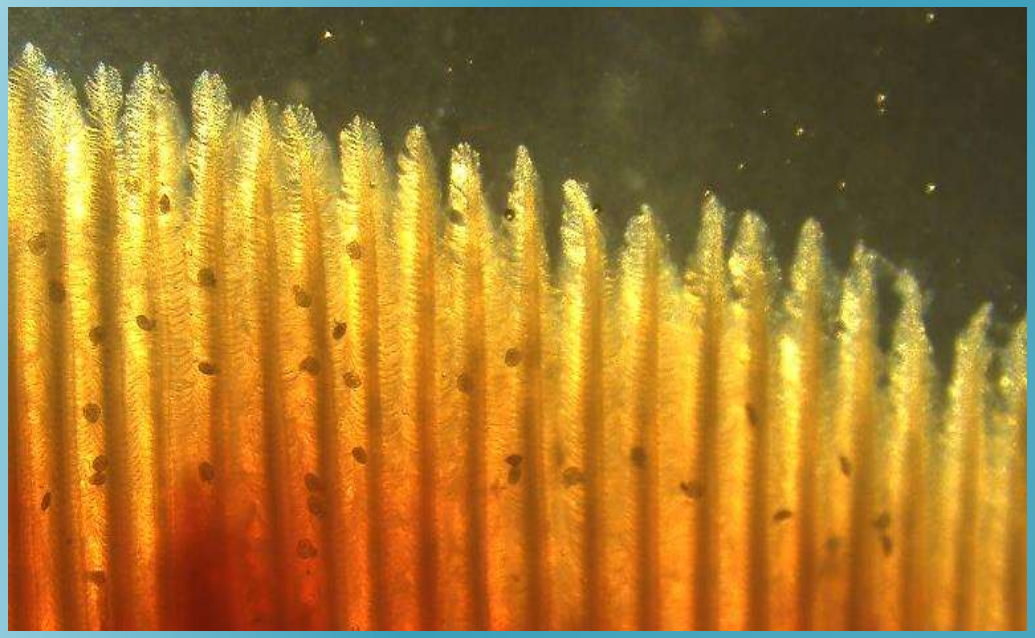
Petromyzon marinus

13,827 living juveniles from a single lamprey





Experimental infestation 2018



Silurus glanis

Confirmed host

Electrofishing
27 specimens **NOT INFESTED**

Not good ecological host

Acipenser sturio

***Acipenser naccarii* (Adriatic)**

***Acipenser baerii* (Siberia)**

***Acipenser ruthenus* (Asia-Europe)**

Salaria fluviatilis

Gasterosteus aculeatus

Petromyzon marinus

Silurus glanis

Paradox: host generalist

Preference for marine-related host

Conservation ecology of *Margaritifera auricularia* (Spengler, 1793) in France

Population status

Reproductive biology

Captive breeding

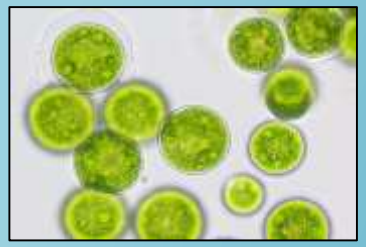
Results

Different rearing systems for juveniles 2015, 2016, 2017

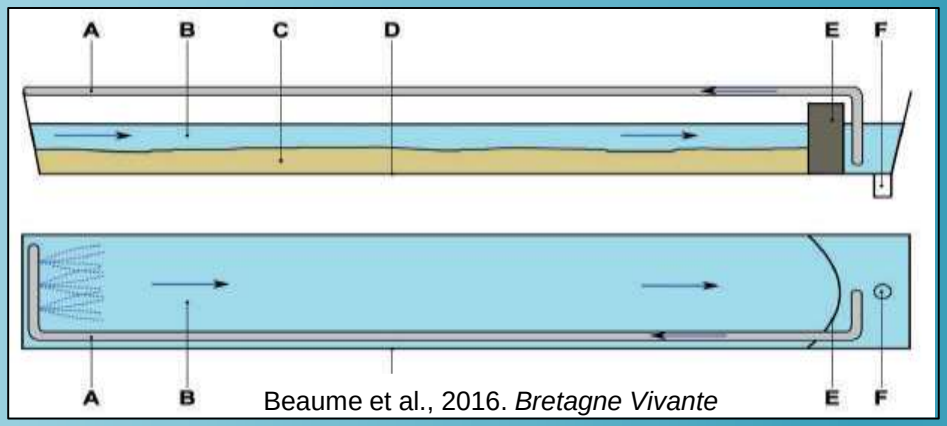
2015/16

Artificial channels:

- Sediment + algae
- River water







Beaume et al., 2016. *Bretagne Vivante*

2017

Small boxes:

- Algae
- Detritus
- Bacteria
- Egg yolk







SUMMARY

- The current lack of recruitment does not seem to be related to the infertility of the specimens.
- Estimated number of larvae around 2,000,000.
- The beginning of glochidial release in early to mid-April.
- Some weeks later than in Spain, likely due to differences in water temperature.

- Coincidence with anadromous fish migrations (*Acipenser sturio*, *Petromyzon marinus*).

- Ancient relationship with diadromous fish probably because of dispersion advantage.

- Decline of migratory fish species due to anthropogenic causes has lead to the decline of *M. auricularia.*

- Critical situation of *M. auricularia* populations, aggravated by new threats such as invasive species and massive mortalities.

- Reinforcement of populations needed.
- Survival results in captive breeding are still very low, so further research is required.
- *Petromyzon marinus* as a conservation tool: release of infestated lampreys.


Thank you!

ACKNOWLEDGMENTS

