

# Programme LIFE+

FRESHWATER PEARL MUSSEL CONSERVATION IN THE ARMORICAN MASSIF

LIFE09 NAT FR 000583

AN ACTION COORDINATED BY :



Une voix pour la nature  
(a voice for nature)

## Saving six freshwater pearl mussel *Margaritifera margaritifera* populations in the Armorican Massif (France)

2<sup>nd</sup> International seminar on the rearing of unionoid mussels

Clervaux, Luxembourg

November 26<sup>th</sup>, 2015

Marie Capoulade, Pierre-Yves Pasco, Pierrick Dury & Benoit Vincent

[www.life-moule-perliere.org/accueilmoule.php](http://www.life-moule-perliere.org/accueilmoule.php)



COLLINES NORMANDES



# Freshwater bivalves in France : 38 species

(Gargominy & al., 2011)

## Margaritiferidae : 2 species



*Margaritifera margaritifera*

*Margaritifera auricularia*

## Unionidae : 9 sp.



*Anodonta anatina*

*Anodonta cygnaea*

*Potamida littoralis*

*Sinanodonta woodiana*

*Pseudanodonta complanata*

*Unio crassus*

*Unio mancus*

*Unio pictorum*

*Unio tumidus*

## Sphaeriidae : 22 sp.

*Euglesa casertana*  
*Euglesa globularis*  
*Euglesa henslowana*  
*Euglesa hibernica*  
*Euglesa milium*  
*Euglesa nitida*  
*Euglesa obtusalis*  
*Euglesa personata*  
*Euglesa pseudosphaerium*  
*Euglesa pulchella*  
*Euglesa subtruncata*  
*Euglesa supina*  
*Odhneripisidium moitessierianum*  
*Odhneripisidium tenuilineatum*  
*Pisidium amnicum*  
*Pisidium conventus*



*Sphaerium corneum*

*Sphaerium lacustre*

*Sphaerium ovale*

*Sphaerium rivicola*

*Sphaerium solidum*

*Sphaerium transversum*

## Cyprinidae : 2 sp.



*Corbicula fluminea*

*Corbicula fluminalis*

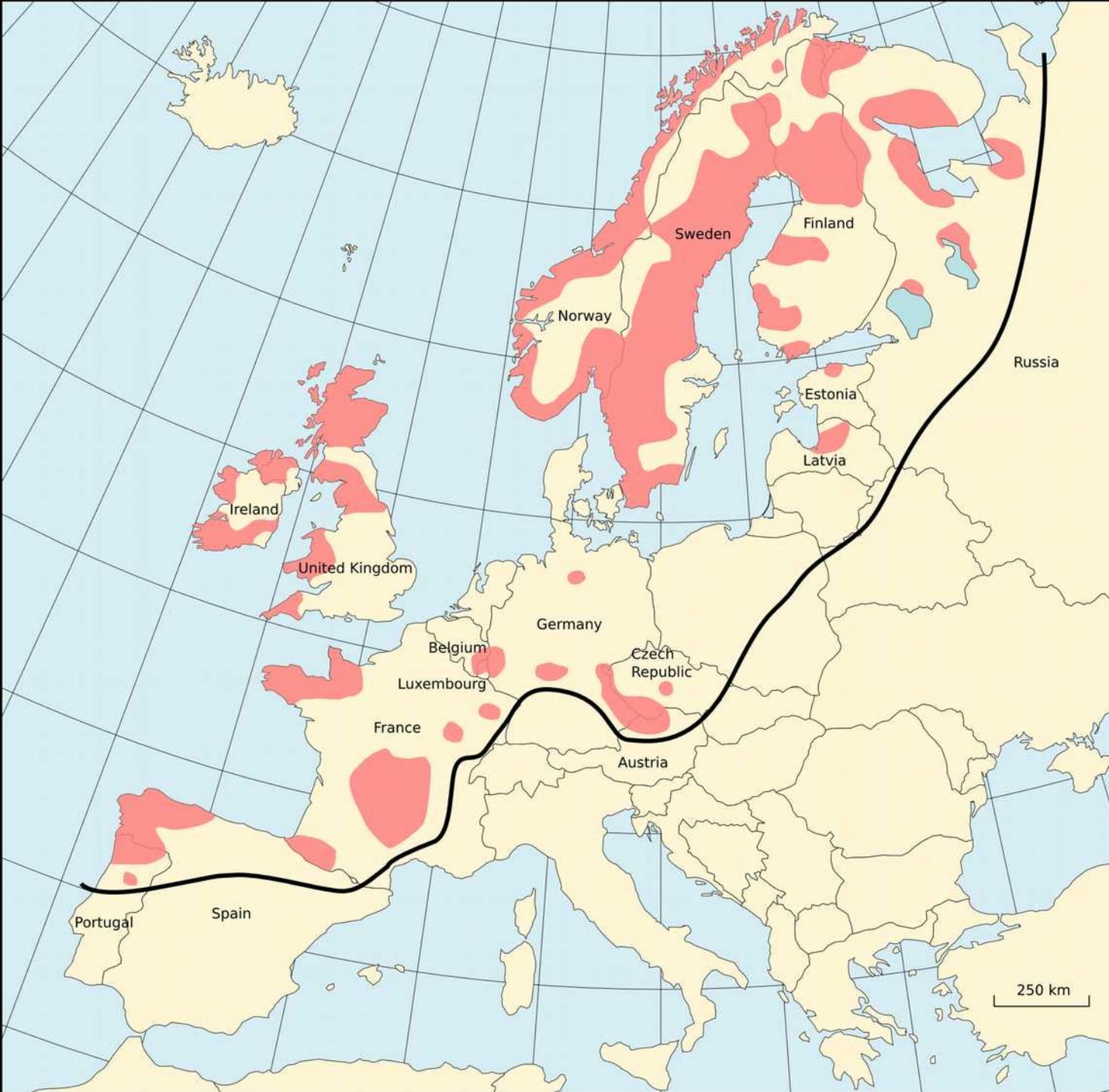
## Dreissenidae : 3 sp.



*Dreissena polymorpha*

*Mytilopsis leucophaeata*

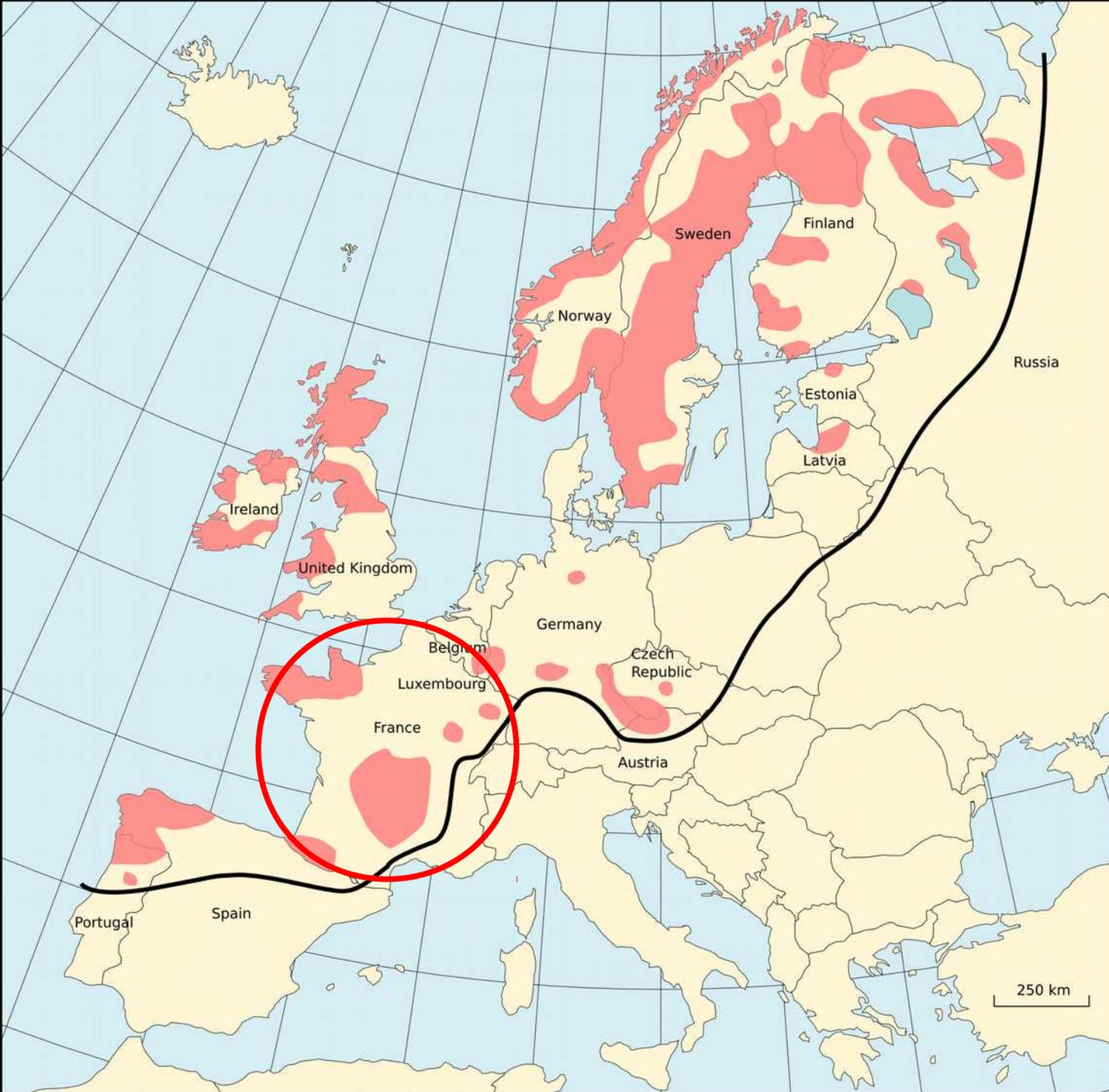
*Dreissena rostriformis bugensis*



***M. margaritifera* in Europe :**

<b>Norway</b>	<b>143,000,000</b>
<b>Russia</b>	<b>140,000,000</b>
<b>Sweden</b>	<b>39,000,000</b>
<b>Finland</b>	<b>12,000,000</b>
<b>Ireland</b>	<b>12,000,000</b>
<b>UK</b>	<b>12,000,000</b>
<b>Portugal</b>	<b>1,000,000</b>
<b>Spain (Galicia)</b>	<b>188,000</b>
<b>Germany</b>	<b>144,000</b>
<b>France</b>	<b>100,000</b>
<b>Czech rep.</b>	<b>80,000</b>
<b>Austria</b>	<b>50,000</b>
<b>Estonia</b>	<b>40,000</b>
<b>Latvia</b>	<b>25,000</b>
<b>Belgium</b>	<b>2,500</b>
<b>Luxembourg</b>	<b>200</b>

From Geist, 2010 (modified)



***M. margaritifera* in Europe :**

Norway	143,000,000
Russia	140,000,000
Sweden	39,000,000
Finland	12,000,000
Ireland	12,000,000
UK	12,000,000
Portugal	1,000,000
Spain (Galicia)	188,000
Germany	144,000
<b>France</b>	<b>100,000</b>
Czech rep.	80,000
Austria	50,000
Estonia	40,000
Latvia	25,000
Belgium	2,500
Luxembourg	200

From Geist, 2010 (modified)

**M.m. rivers in France** (from Cochet, 2004 ; Pasco & Hesnard, 2015 ; several pers.comm.)

**Armorican Massif**

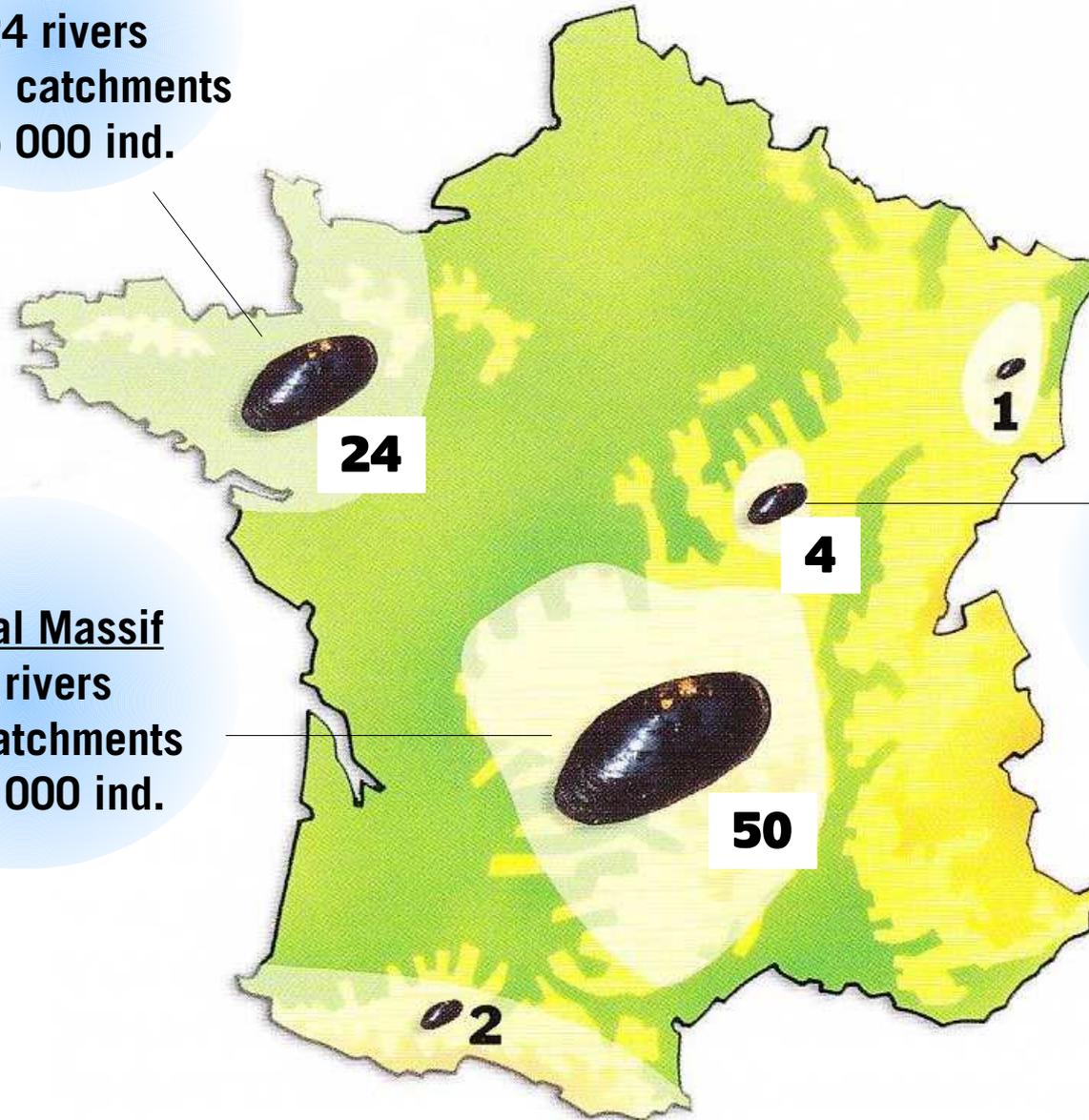
24 rivers  
on 11 catchments  
~5 000 ind.

**Central Massif**

50 rivers  
on 4 catchments  
~101 000 ind.

**Morvan**

4 rivers  
on 1 catchment  
~3 000 ind.



**Total ~ 109 000 ind.**

# Programme LIFE+

FRESHWATER PEARL MUSSEL CONSERVATION IN THE ARMORICAN MASSIF

AN  
ACTION  
COORDI-  
NATED  
BY :



Une voix pour la nature

## LIFE « Mulette » 2010-2016

Why ? Endangered populations :

- Old individuals
- No recruitment
- Small number

Objectives Save the 6 main population known at the creation of the programme

€/\$ 2.5 millions € (~2.8 millions \$)  
50% co-founded by the European Commission



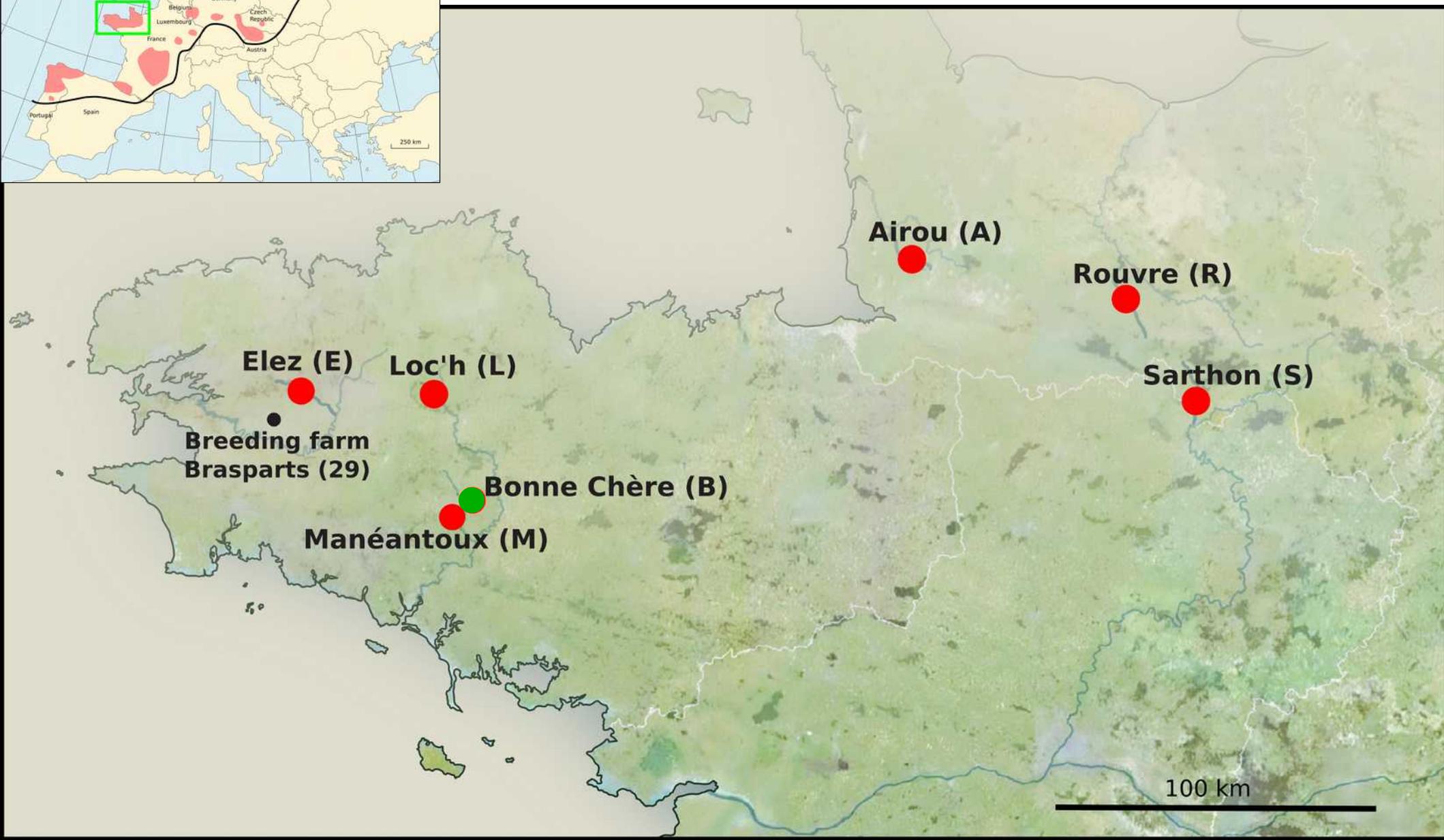
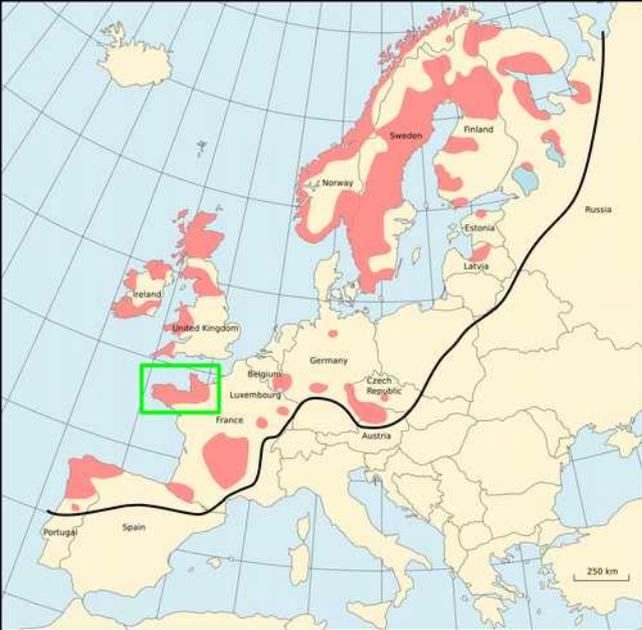
Fédération du Finistère pour la Pêche  
et la Protection du Milieu Aquatique



COLLINES NORMANDES



## *M.m.* rivers of the LIFE «Mulette» programme in the Armorican Massif





Bonne Chère



Elez



Loc'h



Airou



Rouvre



Sarthon

# Environmental restoration

**Support current programmes**

**& creation of new projects with local partners :**

Natura 2000 sites extensions

Wetlands diagnostics

Agricultural-environmental help funds

Land purchase

Bank protection from cattle : fences, drinking places

Ecological continuity

Spruce cutting

Waste water station improvement

Improvement of hydraulic management linked to water production and hydropower, etc.



# Water quality

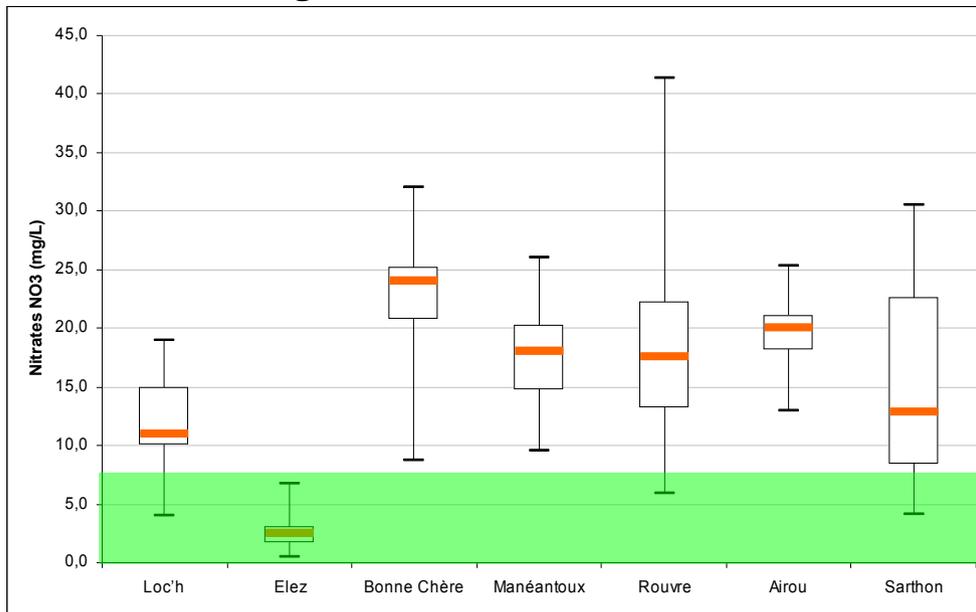
Each month :

- multiparameter : T°C, dissolved oxygene, conductivity & pH
- laboratory : nitrates N03, ortho-phosphates P04

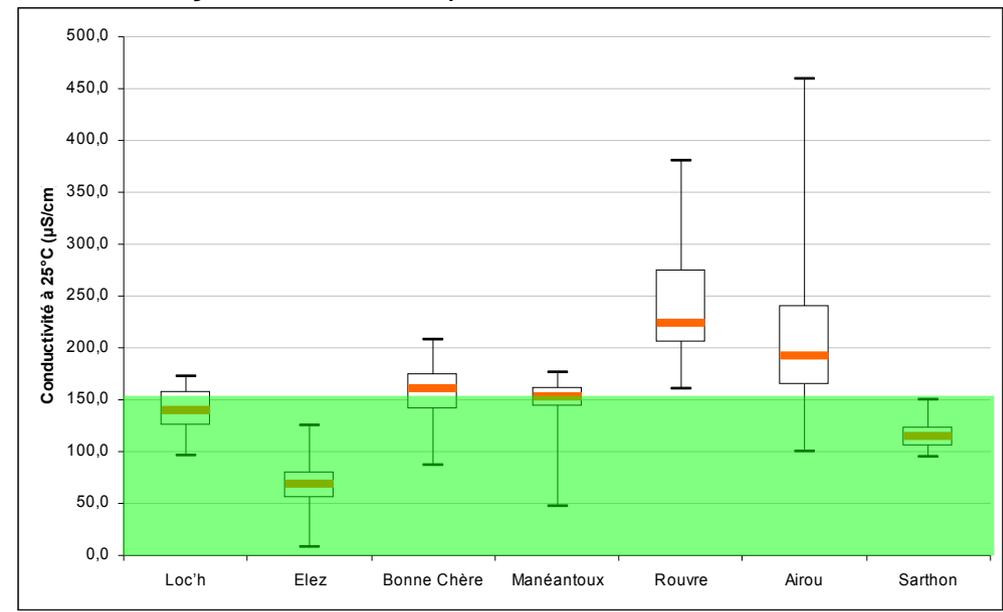
Each hour :

- temperature recorder HOB00167

Nitrates N03 (<8mg/L for *M.m.*)



Conductivity at 25°C (<150µS/cm for *M.m.*)



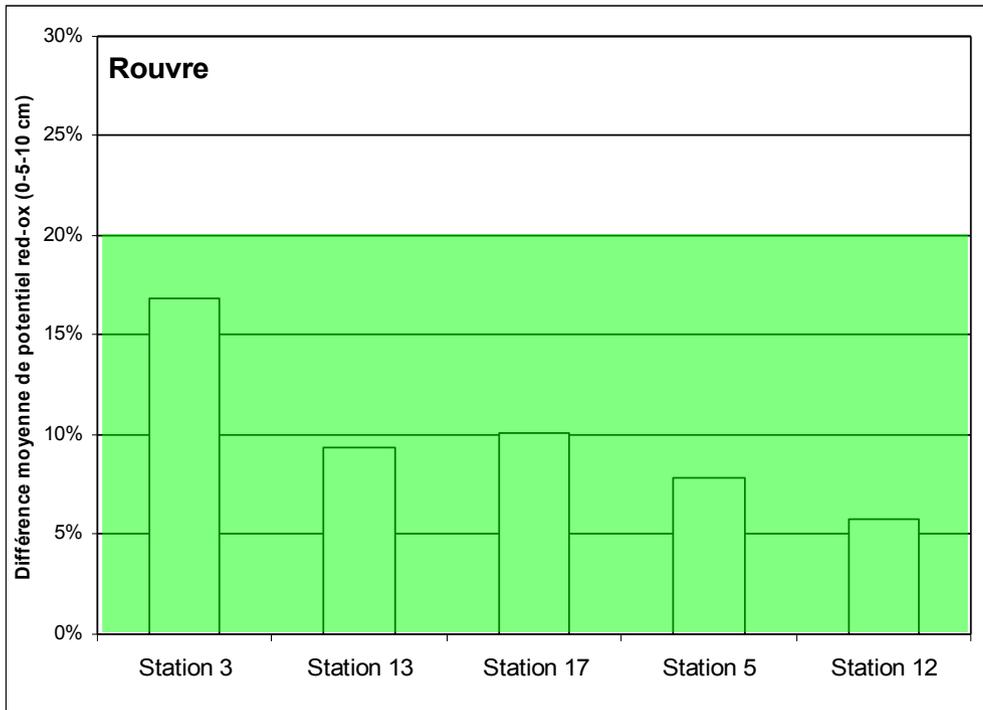
# Sediment quality

During low water in summer :

- penetrability
- conductivity and pH gradient at 0 and 5cm depth
- red-ox potential gradient
- hypoxie sticks

To monitor mussel habitat  
To look for favourable reinforcement places

Mean red-ox potential gradient (0-5cm depth) : <20% for *M.m.*



From Geist & Auerswald, 2007



# Host fish populations

## Brown trout mean density since 2011 (per 100 m<sup>2</sup>)

Bonne Chère	0+ ~ 6.3 1+ ~ 4.9
Manéantous	0+ ~ 7.4 1+ ~ 3.4
Loc'h	0+ ~ 2.2 1+ ~ 11.9
Airou	0+ ~ 3.3 1+ ~ 8.2
Rouvre	0+ ~ 9.5 1+ ~ 5.8
Sarthon	0+ ~ 2.2 1+ ~ 5.0
Elez	0+ ~ 5.2 1+ ~ 2.2

## Host-fish preference studies *Salmo salar* vs *Salmo trutta fario*

- Bonne Chère in 2012
- Airou in 2014

And the winner is

...

*Salmo trutta fario*



# Mussel populations

## *M.m.* mean number per river

Elez	1,200-1,500
Bonne Chère	2,000-2,500
Loc'h	180-200
Airou	250-300
Rouvre	100
Sarthon	200-250



**detectability not the same from a river to an other : depend on morphological characteristics**

# Looking for glochidias

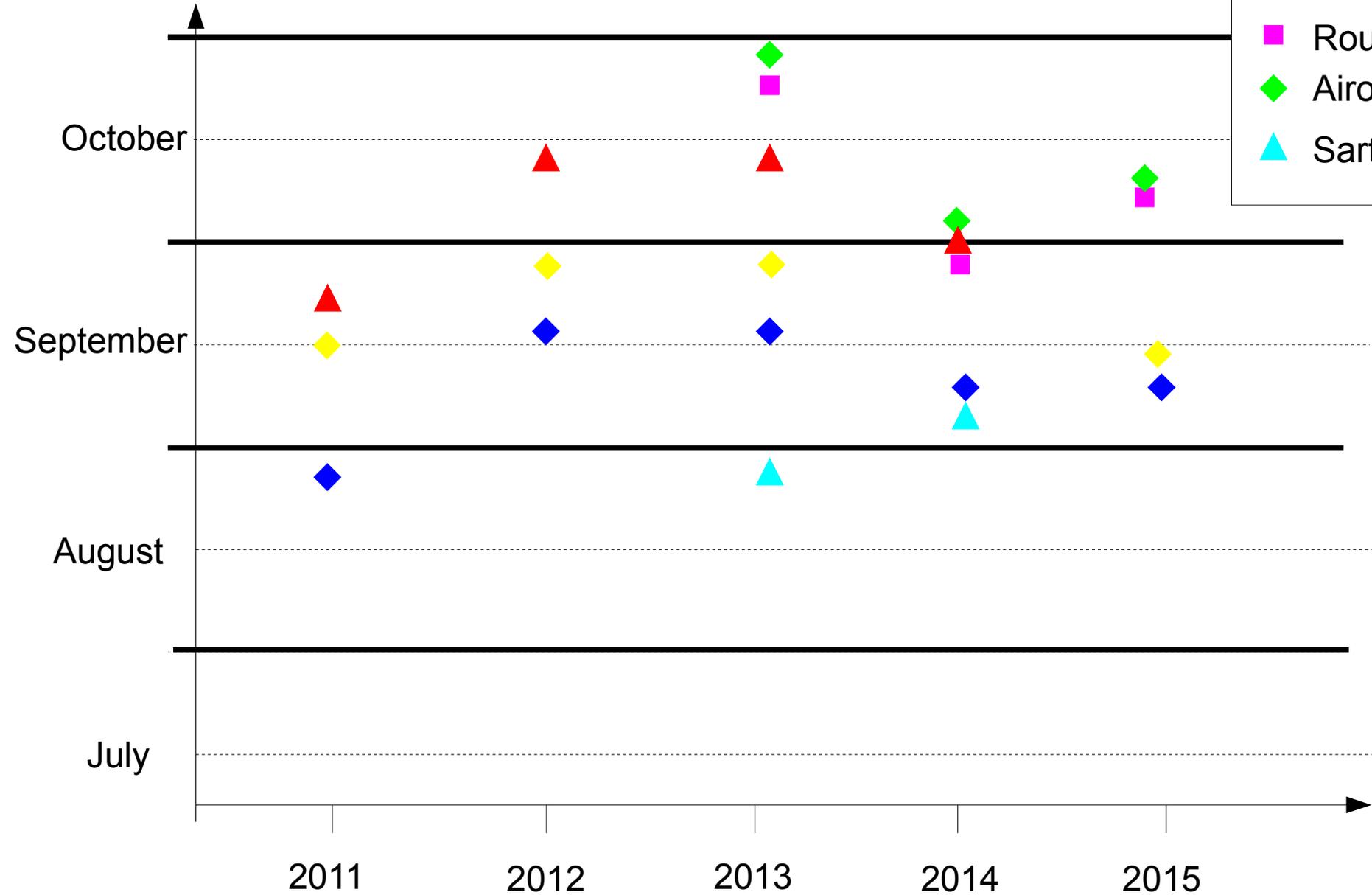


25 μm

# Glochidia collection since 2011

Rivers

- ▲ Elez
- ◆ Bonne Chère
- ◆ Loc'h
- Rouvre
- ◆ Airou
- ▲ Sarthon



# Breeding farm

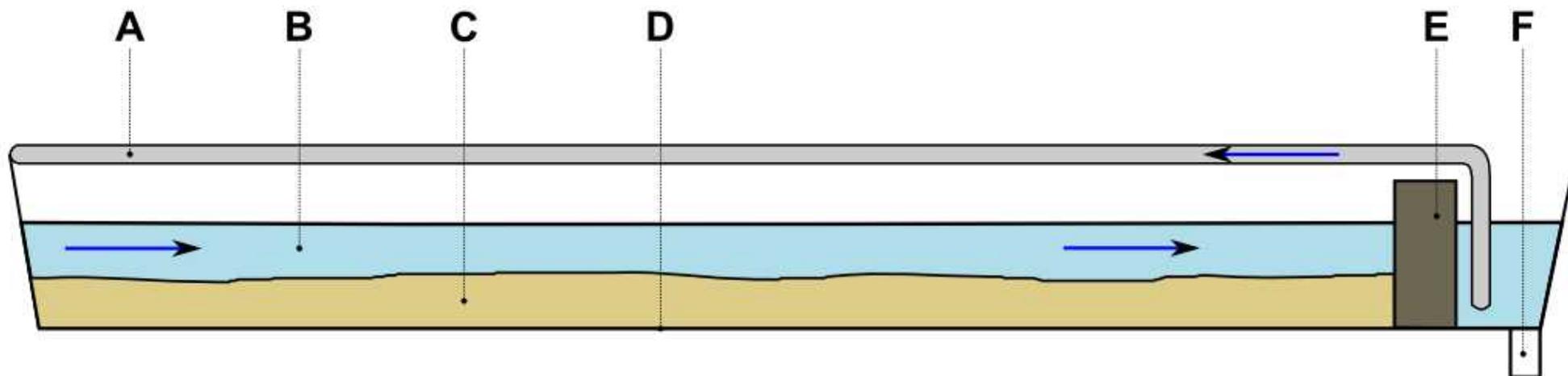


# Breeding farm

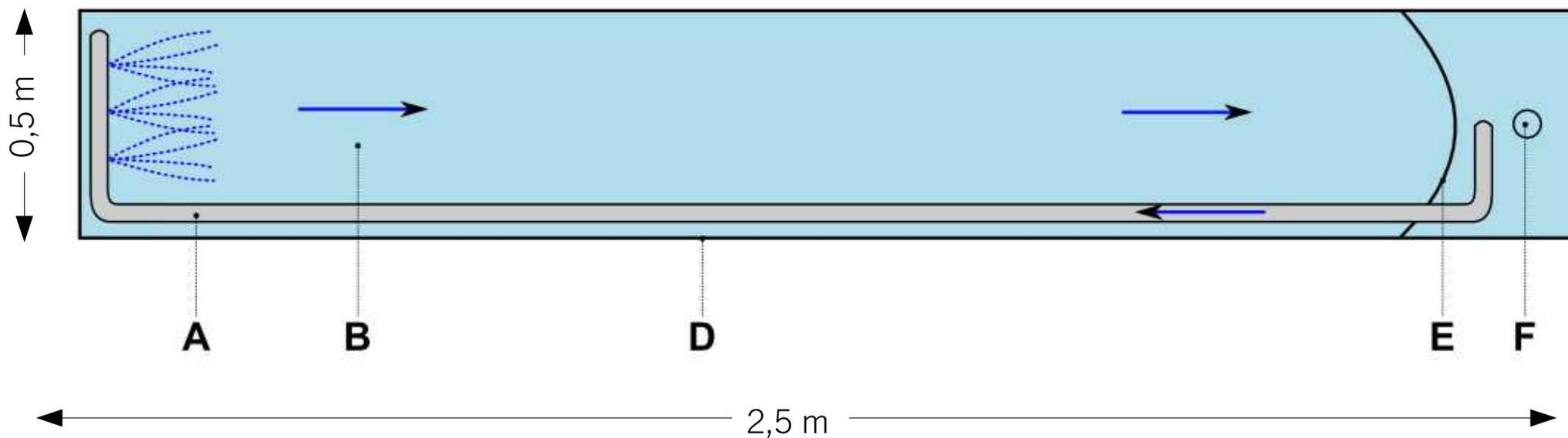




Side view :



Top view :



Rearing troughs, side view and top view

A: return pipe of the water supplied by a pump;  
C: aquarium substrate;  
E: grid containing sand on one side;

B: water filtered at 36 µm;  
D: plastic trough;  
F: trough purging system.

## **Infection**

1 brown trout (~17 g) for 1 000 – 2 000 glochidias  
with water bubbling and oxygen supply  
from 30 min to an hour

### **Infection**

1 brown trout (~17 g) for 1 000 – 2 000 glochidias  
with water bubbling and oxygen supply  
from 30 min to an hour

### **Ex-situ rearing systems**

miniature artificial watercourse of 100 to 200 L  
bed of sand of 2–3 cm thick  
aquarium pump to allow a continuous flow of water

## Infection

1 brown trout (~17 g) for 1 000 – 2 000 glochidias  
with water bubbling and oxygen supply  
from 30 min to an hour

## Ex-situ rearing systems

miniature artificial watercourse of 100 to 200 L  
bed of sand of 2–3 cm thick  
aquarium pump to allow a continuous flow of water

## Water

filtered to 36  $\mu\text{m}$  then decanted and brought to the right temperature  
each week, 80 % of the water is renewed **after mixing** and siphoning the troughs  
physicochemical parameters regularly monitored (temperature, dissolved oxygen and nitrite)



### **Infection**

1 brown trout (~17 g) for 1 000 – 2 000 glochidias  
with water bubbling and oxygen supply  
from 30 min to an hour

### **Ex-situ rearing systems**

miniature artificial watercourse of 100 to 200 L  
bed of sand of 2–3 cm thick  
aquarium pump to allow a continuous flow of water

### **Water**

filtered to 36  $\mu\text{m}$  then decanted and brought to the right temperature  
each week, 80 % of the water is renewed after mixing and siphoning the troughs  
physicochemical parameters regularly monitored (temperature, dissolved oxygen and nitrite)

### **Nutrition**

daily intake of food is supplied (1 mL of "Shellfish diet 1800" and 1 mL of "Nano 3600")

### **Infection**

1 brown trout (~17 g) for 1 000 – 2 000 glochidias  
with water bubbling and oxygen supply  
from 30 min to an hour

### **Ex-situ rearing systems**

miniature artificial watercourse of 100 to 200 L  
bed of sand of 2–3 cm thick  
aquarium pump to allow a continuous flow of water

### **Water**

filtered to 36  $\mu\text{m}$  then decanted and brought to the right temperature  
each week, 80 % of the water is renewed after mixing and siphoning the troughs  
physicochemical parameters regularly monitored (temperature, dissolved oxygen and nitrite)

### **Nutrition**

daily intake of food is supplied (1 mL of "Shellfish diet 1800" and 1 mL of "Nano 3600")

### **Concentration of mussels**

5 000 to 10 000 mussels 0+ seems to be optimal for the first year of rearing

# At the breeding farm in June 2015

	Elez	Bonne Chère	Loc'h	Airou	Rouvre	Sarthon
Cohort 0+ 2015	10,000	10,000	0	2,000	15,000	5,000
Cohort 1+ 2014	5,000	10,000	2,000	3,000	0	7,000
Cohort 2+ 2013	2,500	2,500	2,400	0	0	0
Cohort 3+ 2012	1,210	5	30	0	0	0
Total	18,710	22,505	4,430	5,000	15,000	12,000

**Total of ~ 77 000 mussels**

# Sixty days of quarantine

Brittany waterways considered free of contagious diseases, including viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN)

Rivers in Lower Normandy are not considered free of these diseases.

## Quarantine

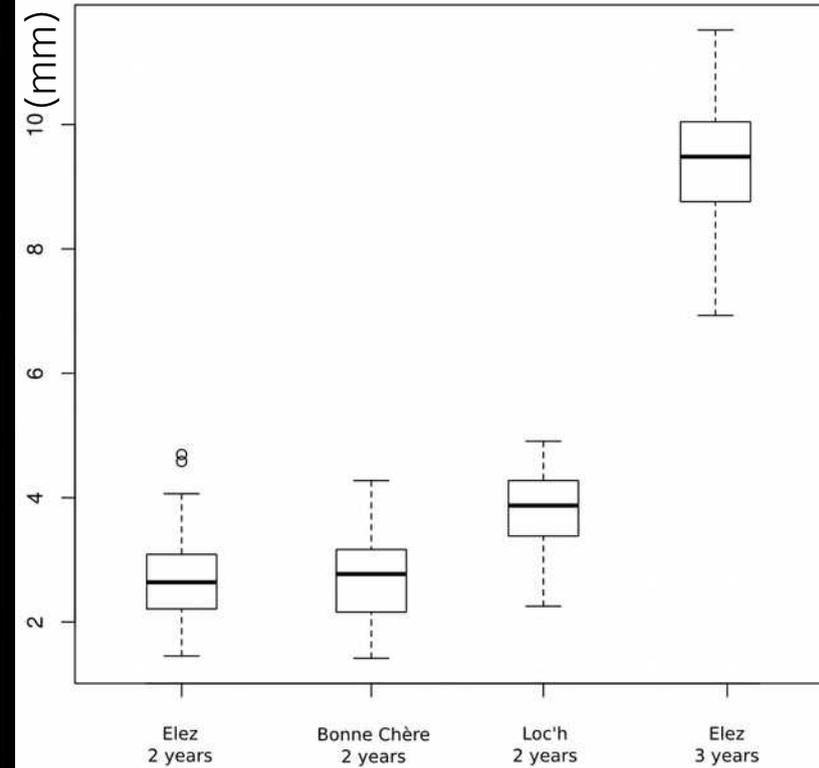
all effluents must be treated with ozone

to lift the quarantine, virological and serological analyses are conducted on sentinel trout (rainbow trout present in the basins) 15 days before the end of the quarantine to certify the absence of these diseases





Length of young mussels (in mm)  
(March 2015)



**Mean survival rates :**

**0 to 1 year ~ 60 %**

**1 to 2 years ~ 80 %**

**2 to 3 years ~ 90 %**

**Global mean survival  
rate of 70%**

# Reinforcements

**Directs**



**In situ**



...see poster

# Direct reinforcements

## Young mussels

Cohort 0+	> 5 millions
Cohort 1+	180,000
Cohort 2+	4,000
Cohort 3+	0

## Local infected host fish

Elez	32
Bonne Chère	321
Loc'h	30
Airou	80
Rouvre	102
Sarthon	63

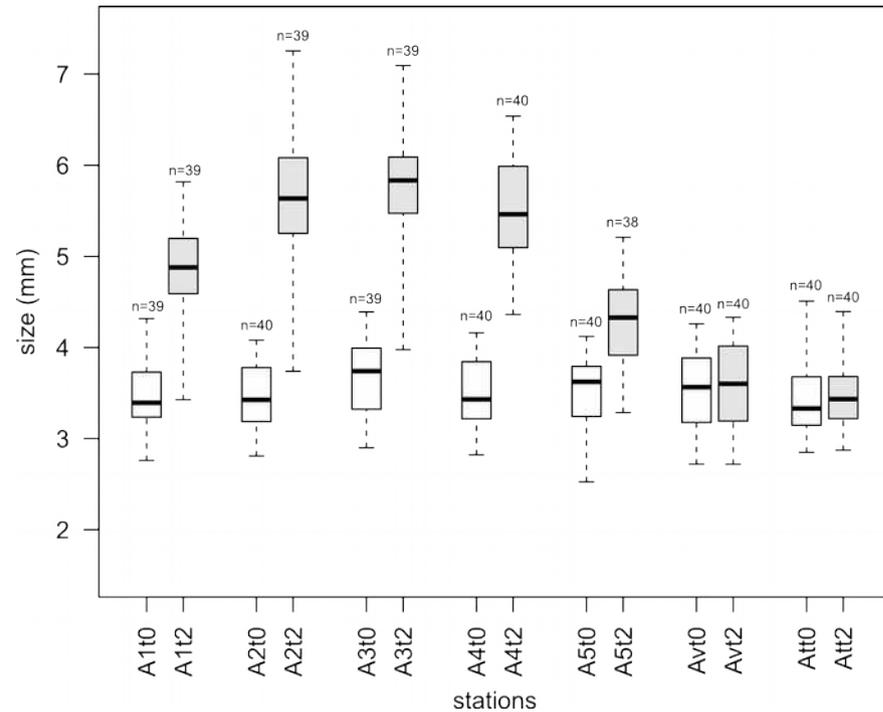
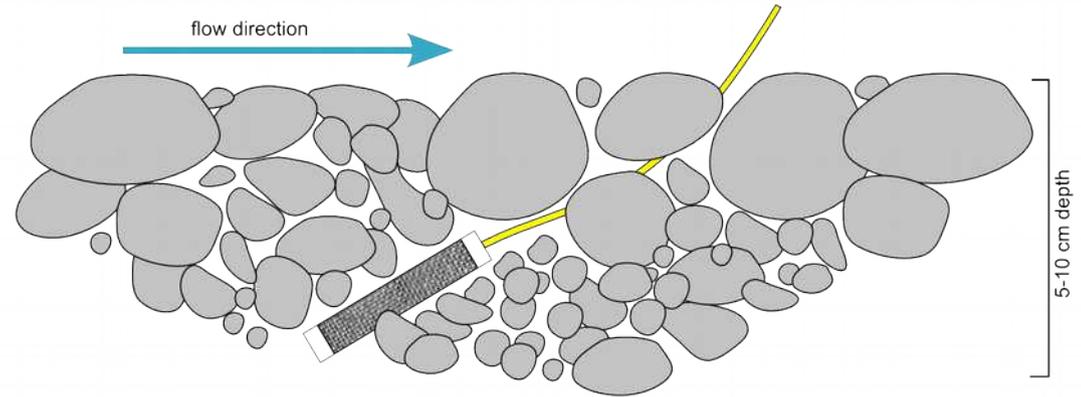
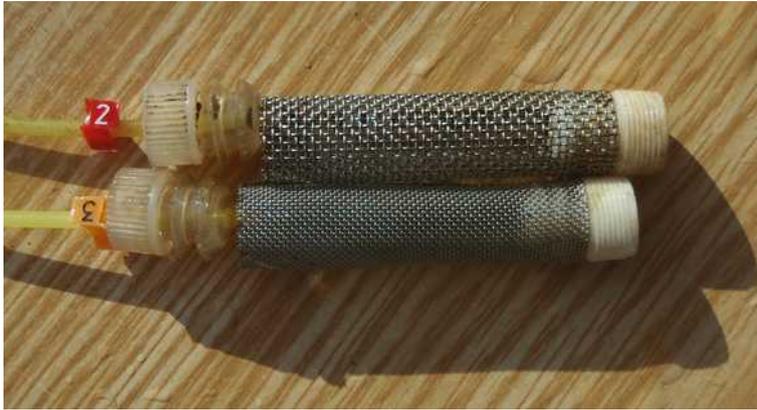
## Fish-hatchery infected host-fish (local brown trout)

Elez	5,500
------	-------



# Reinforcement experiments and in-situ breeding systems with *Margaritifera margaritifera* in the Armorican Massif (France)

Programme LIFE+ NAT FR 000583 / 1st September 2010 - 31st August 2016



## July-September 2015

Mean survival

95 %

Mean growth

0,6 mm (+/- 0,15)

...see poster

**200 1+ mussels per river (2-4mm)  
5 stations per river  
4 tubes per station  
10 mussels per tube**

	Survival %	Growth (mm)	sd
E	98,7%	0,73	0,18
L	84,7%	0,62	0,14
M	99,4%	0,19	0,07
A	98,5%	1,66	0,2
R	96,0%	0,84	0,3
S	98,0%	0,61	0,14
Farm	95,8%	0,14	0,09



...see poster

# Conservation et restauration des populations et de l'habitat de la moulette perlière en Europe



Actes du colloque international



# And after...



August 31st 2016 : the end ?

populations still endangered...

Regional Action Plan in construction

Thank you !



Devulder