

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

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**2nd International Seminar
Rearing of unionoid mussels**

**Clervaux, Luxembourg
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The LIFE programme « Conservation of the freshwater pearl mussel from the Armorican Massif » (2010-2016) aims to save the six remaining populations of *Margaritifera margaritifera* in the West part of France (Figures 1a and 1b).

The main issue on each river (Table 1) is the non-recruitment in juvenile since several years. While restoration actions of river habitat were conducted, a reinforcement of juvenile from a breeding farm started in 2012.

We use cylindrical tubes (like hair curler, or « bigoudis » in french) to test the efficacy of these reinforcements, through 2 experiences presented in this poster.

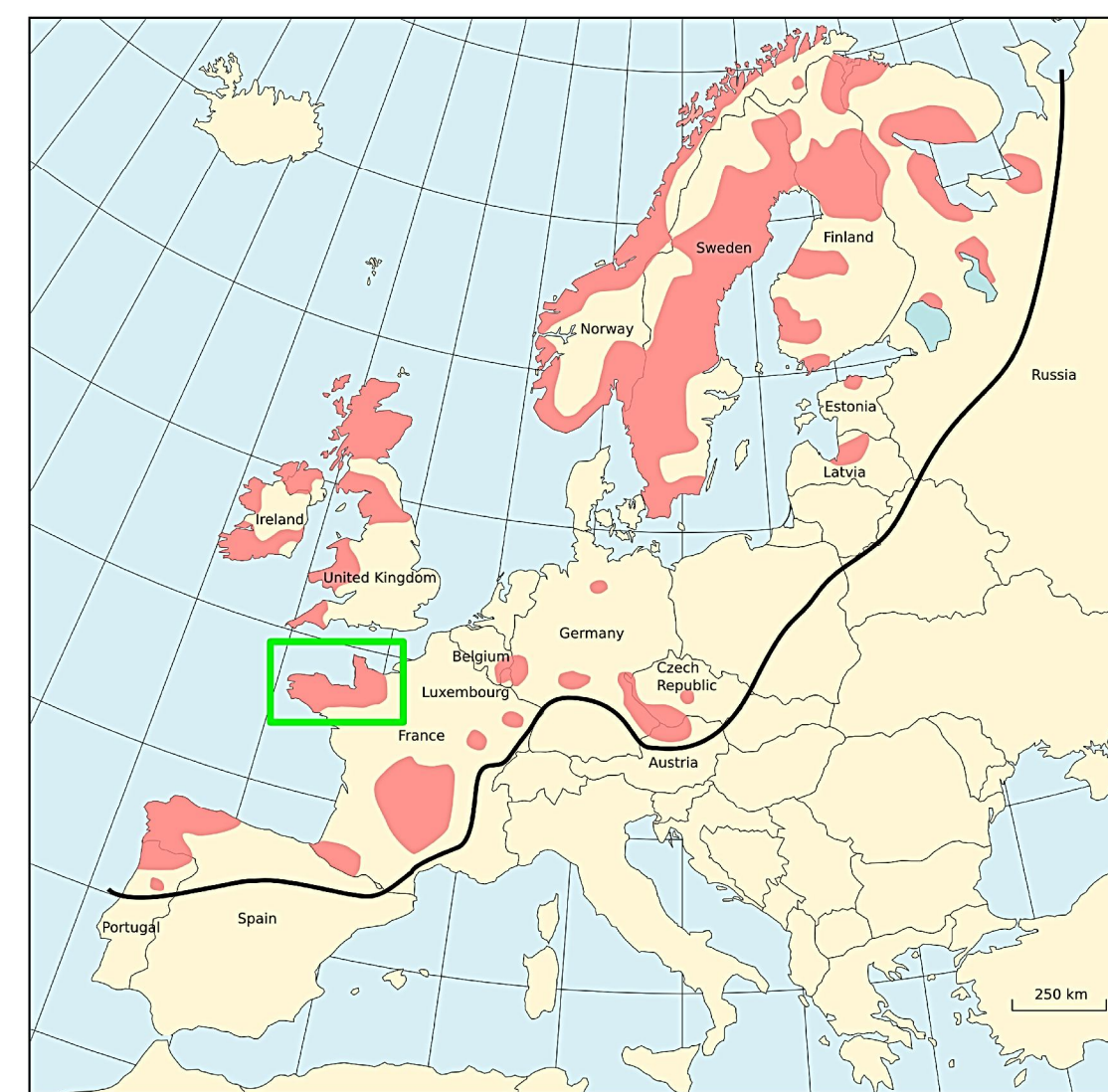


Figure 1a. Distribution of Freshwater pearl mussel in Europe (from Larsen, 2005, modified). The green rectangle shows the LIFE programme area

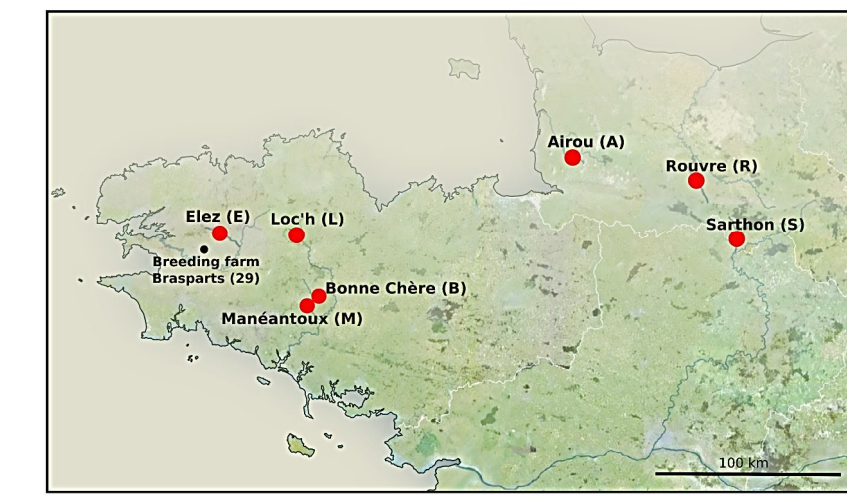


Figure 1b. Localization of rivers and breeding farm

Table 1. Main hydromorphological and physico-chemical characteristics of the distinct rivers (standard deviation into brackets) (E : Elez, L : Loc'h, B : Bonne Chère, M : Manéantoux, A : Airou, R : Rouvre, S : Sarthon)

River	Upstream catchment (km ²)	Total length of the river with tributaries (km)	Nitrate N-NH ₄ (mg/L)	pH	Conductivity at 20°C (µS/cm)	Muscle production in 2011-2014
E	28	30	0.57 (0.26)	6.1 (0.5)	62 (16)	1,200 - 1,300
L	19	29	2.07 (0.83)	7.0 (0.5)	128 (20)	150-200
B	17	27	4.99 (1.01)	6.6 (0.3)	142 (23)	2,300 - 2,400
M	5	10	3.99 (1.03)	6.9 (0.3)	135 (0.8)	0
A	115	60	4.45 (0.54)	7.3 (0.6)	194 (76)	200-250
R	324	361	4.04 (1.52)	7.7 (0.4)	219 (50)	90-100
S	120	128	3.60 (1.98)	7.2 (0.5)	105 (13)	150-200



For the experiences, young mussels from the breeding farm are placed into cylindrical tubes made of stainless steel (« bigoudis »). These tubes are of 5cm long and 1.1cm diameter, with a mesh of 0.42 or 0.80mm (made by the French company called Gantois www.gantois.com). For the two experiences, young mussels were 1 year old except for the river L where they were 2 years old. They were selected manually one by one to have individuals between 2 and 3mm long. Aquarist gravels are placed into the tubes and put in the streams before the experiences which permit the biofilm development. Nylon strings are connected to the top of the tubes to find it at the end of the experiences. This technique was elaborated by the research team of the Agronomic National Research Institute (INRA, France) to test the embryonic survival of salmonid eggs (Dumas & Marty, 2006). Other methods of in-situ reinforcements are currently tested : silos and boxes.

On each river, some hydro-morphological and physico-chemical criterias helped us to find favourable stations : riffle top, dissolved oxygen > 10mg/L, redox potential at 0 and 5cm > 300mV. On each station, 4 tubes were installed : 2 with a mesh size of 0.42 mm and 2 others with a mesh size of 0.80mm. At the beginning of the experiences and at each checking, the shell length is measured from photographs, with the software ImageJ (<http://rsbweb.nih.gov/ij/>). The alive mussels are counted during this checking. Between each checking, tubes are not cleaned up or controlled.

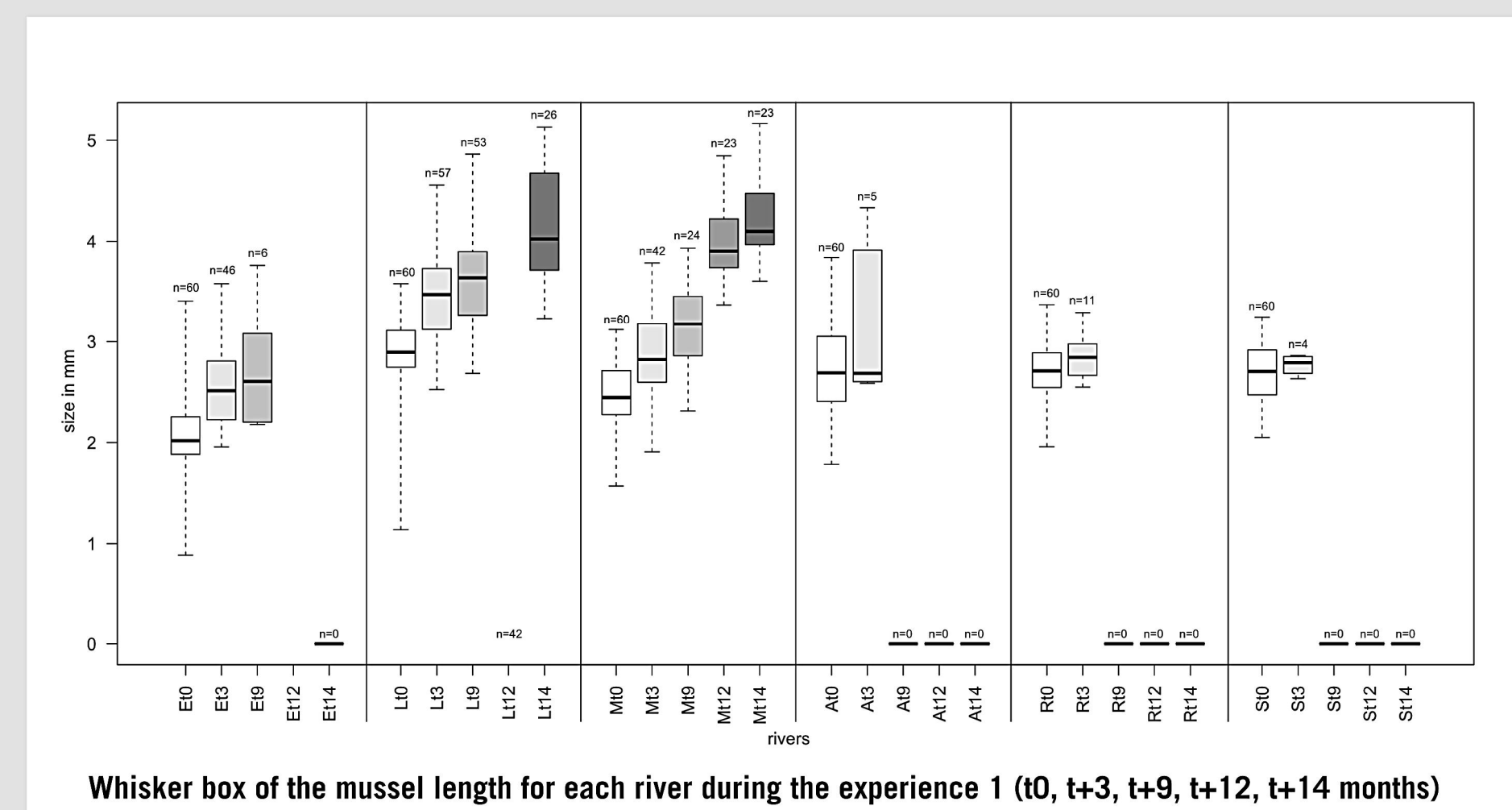
Experience 1

Tubes (72 tubes)

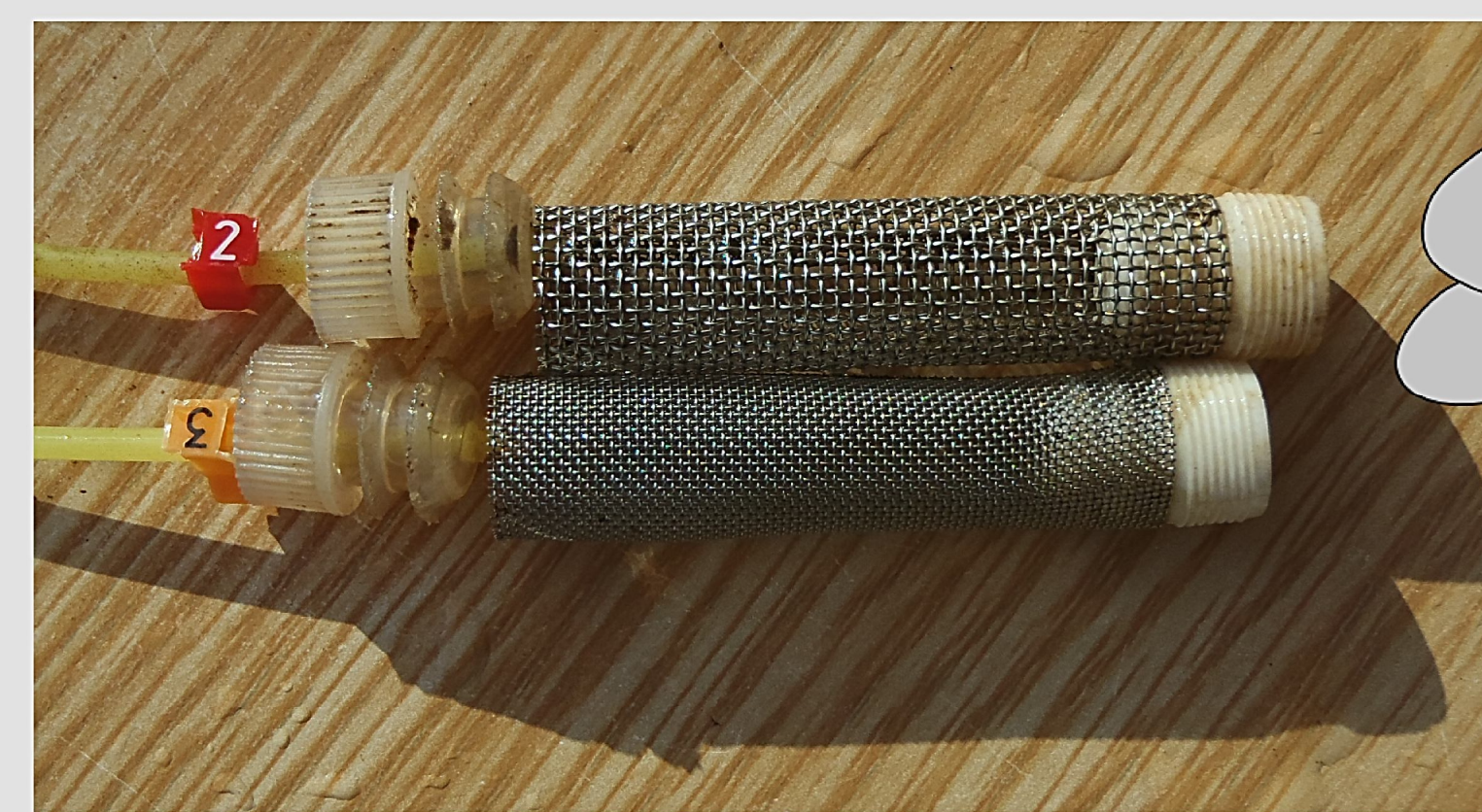
360 1+ young mussels in July 2014

Survival rate from 0% to 43.3% in September 2015

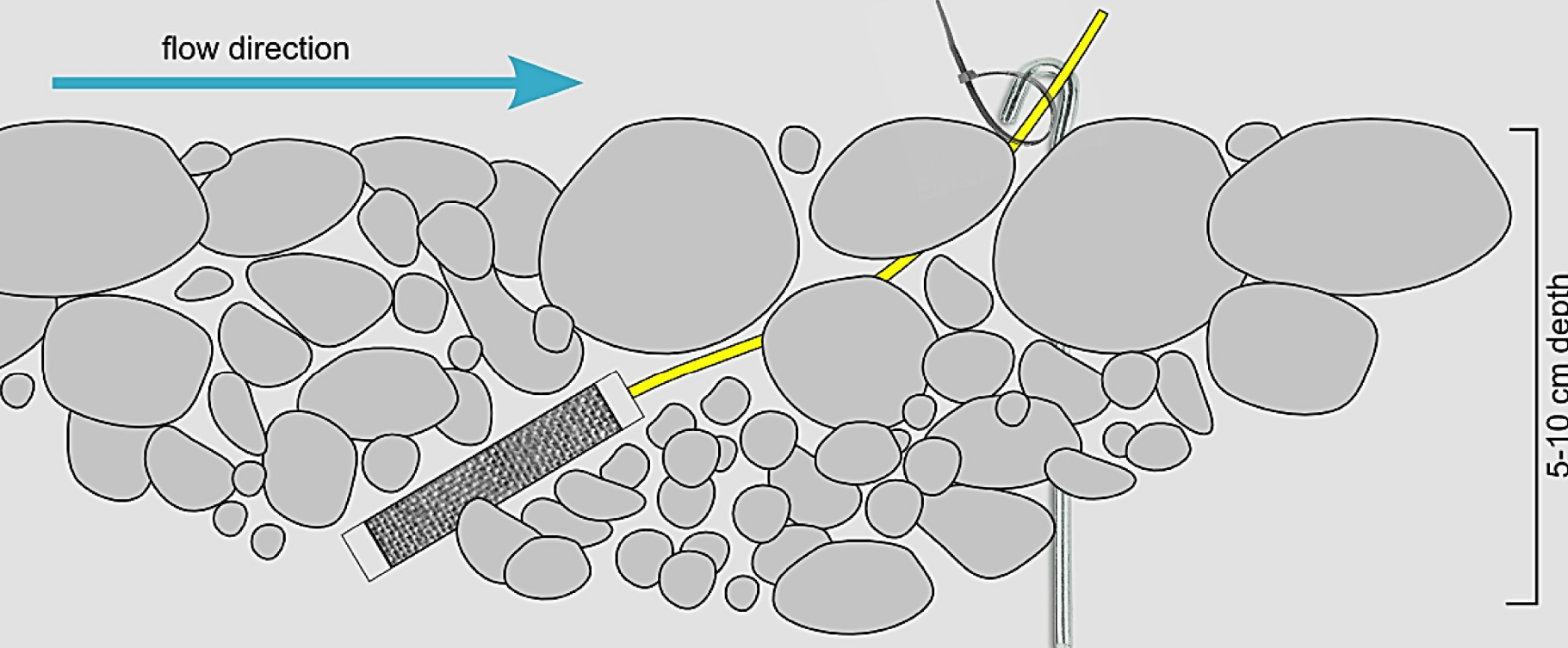
Growth rate from 1.26 to 1.77mm in September 2015



Whisker box of the mussel length for each river during the experience 1 (t0, t+3, t+9, t+12, t+14 months)



Tubes with a mesh size of 0.80 (top) and 0.42mm (bottom)



Drawing of in-situ tubes installation during the experiences 1 and 2

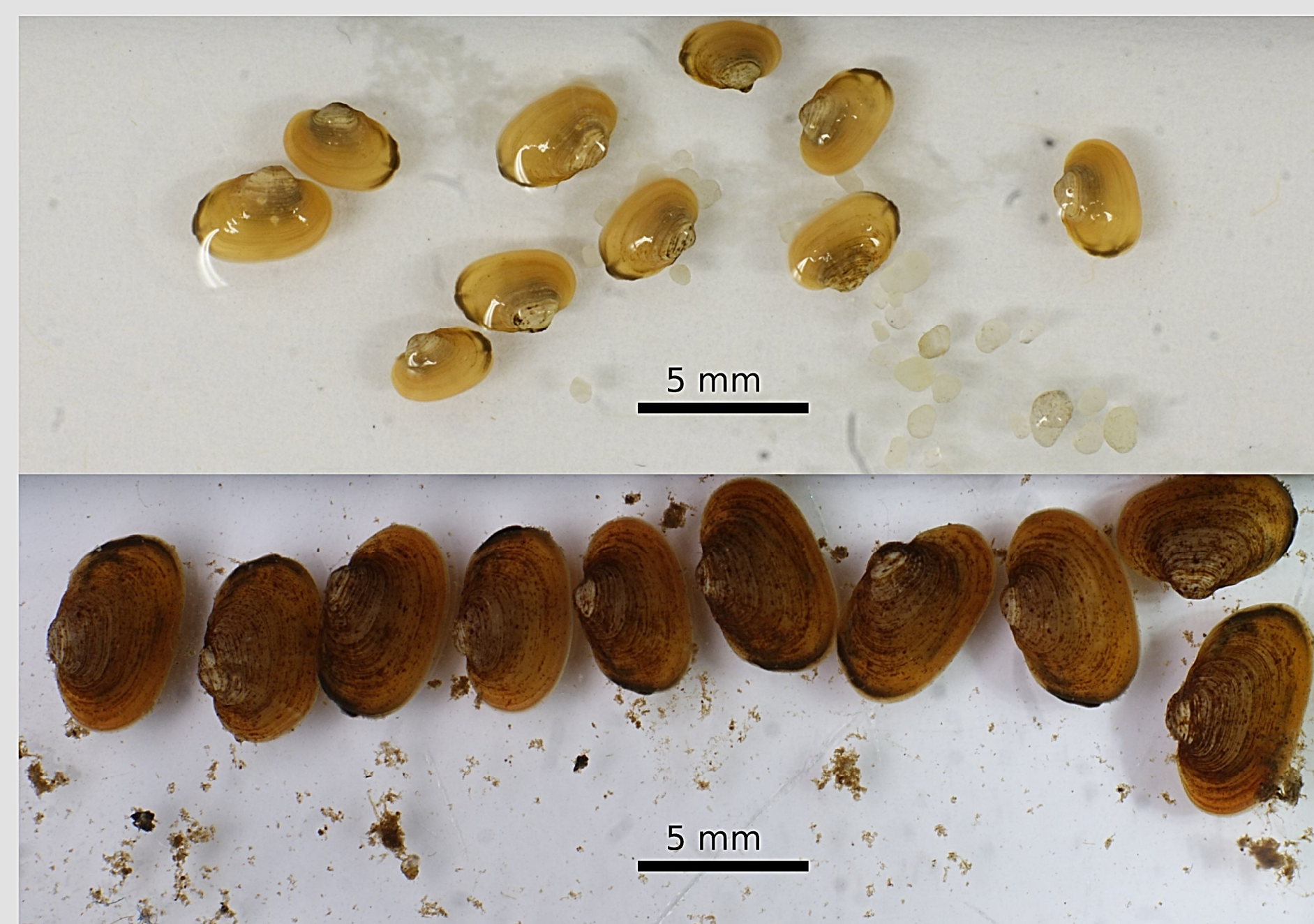
Experience 2

Tubes (172 tubes)

1,720 1+ young mussels in July 2015

Survival rate from 65% to 100% in September 2015

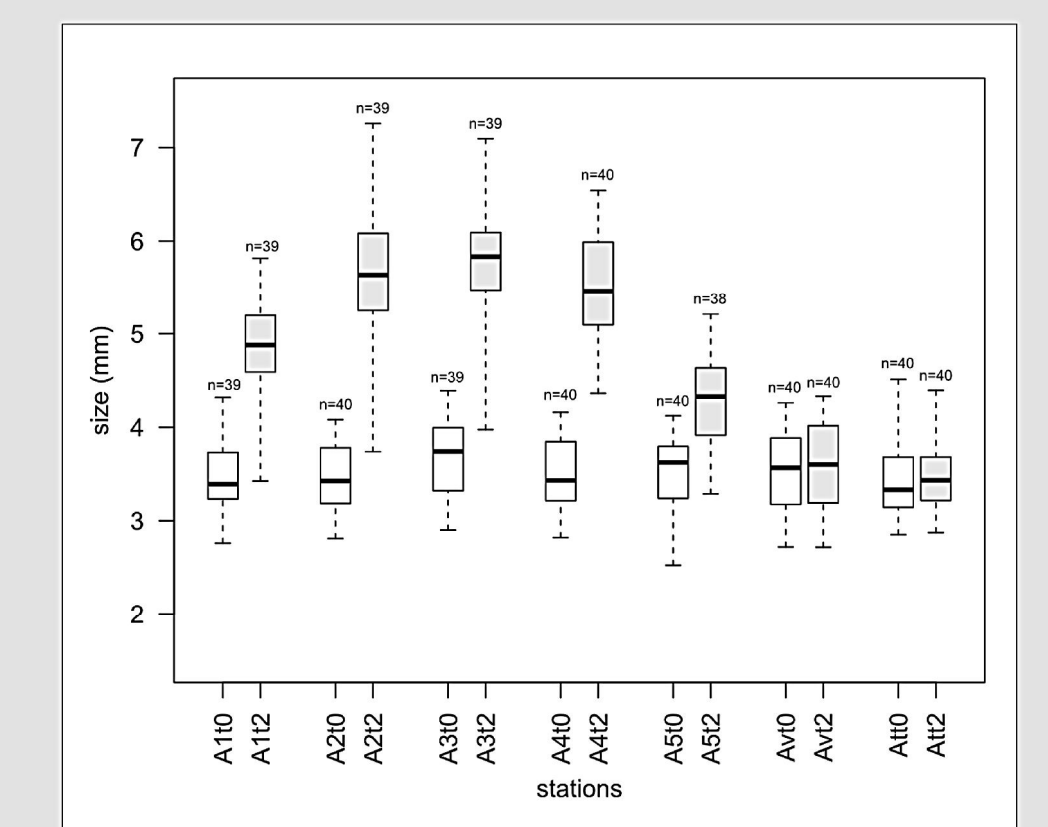
Growth rate from 0.05 to 2.15mm



Freshwater pearl mussels at t0 and t+2 months (river A, tube A21)

Muscle number per river, mean length, survival percentage and mean growth between t0 and t+2 months during experience 2 (standard deviation into brackets)

River	t0		t+2 months			
	Nb of mussels	Mean length (mm)	Nb of mussels	Survival %	Mean length (mm)	Mean growth (mm)
E	239	3.12 (0.33)	231	96.7%	3.64 (0.38)	0.52 (0.14)
L	400	3.83 (0.45)	349	87.3%	4.31 (0.47)	0.53 (0.16)
M	240	3.37 (0.34)	233	97.1%	3.56 (0.35)	0.19 (0.06)
A	278	3.52 (0.39)	275	98.9%	4.72 (0.52)	1.21 (0.16)
R	280	3.45 (0.31)	271	96.8%	4.09 (0.44)	0.66 (0.24)
S	280	3.40 (0.37)	271	96.8%	3.89 (0.40)	0.47 (0.12)

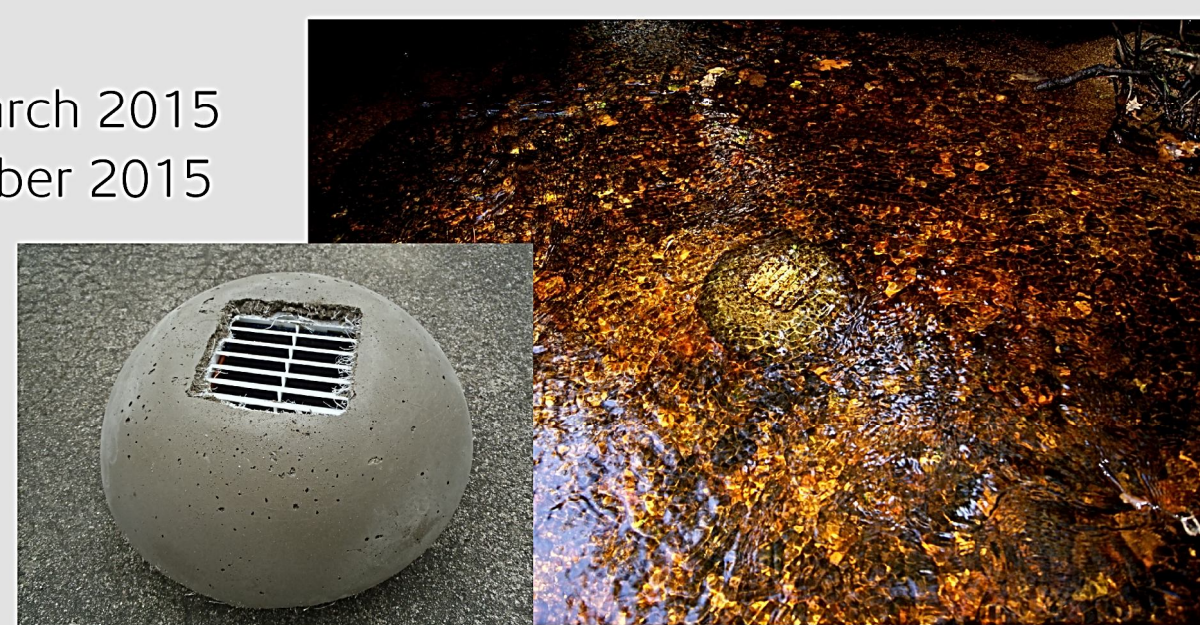


Whisker box of mussel length for the Airou river and for the breeding farm (V and T)

Silos (1 silo)

200 1+ young mussels in March 2015

Survival rate of 43% in October 2015



Boxes (2 boxes)

200 2+ young mussels in March 2015

Survival rate of 23% in October 2015



Conclusion

The analysis of all the data is not over. However, these first results seem to be encouraging. The technique of tubes seems to be appropriate to test survival and growth of young mussels in-situ. In Europe, most of the in-situ tests of survival and growth have used the Buddensiek cages (Buddensiek, 1995). This technique needs a regular cleaning which is time-consuming whereas it is not necessary for the tubes. Moreover, living conditions of mussels during the tubes experiences seem to be closer to wild individuals, and of young mussel from the breeding farm directly released in the river without any control.

Bibliography

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