- LIFE Potamo Fauna -

Experiments to improve the survival and growth of juvenile *Unio mancus* (Unionidae) during the first months of life

C. Feo-Quer [1], M. Campos [1], Q. Pou-Rovira [1], I. Camós [1], N. Coma [1], A. Vinagre [1] & R. Araujo [2].

[1] Consorci de l'Estany, Banyoles, Catalonia, Spain

[2] Museo Nacional de Ciencias Naturales de Madrid –CSIC (Spain

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CONSORCI DE l'estany

Consorci del TER

Generalitat de Catalunya Departament de Territori i Sostenibilitat

Generalitat de Catalunya Forestal Catalana, SA

AMICS DE LA TORTUGA DE L'ALBERA

eman ta zabal zazu

Universidad del País Vasco

Euskal Herriko Unibertsitatea

4 naiad species in Fluvià and Ter basins

- **Endangered species with a great reduction of their population**

Unio mancus

Potomida littoralis

Anodonta anatina

Unio ravoisieri

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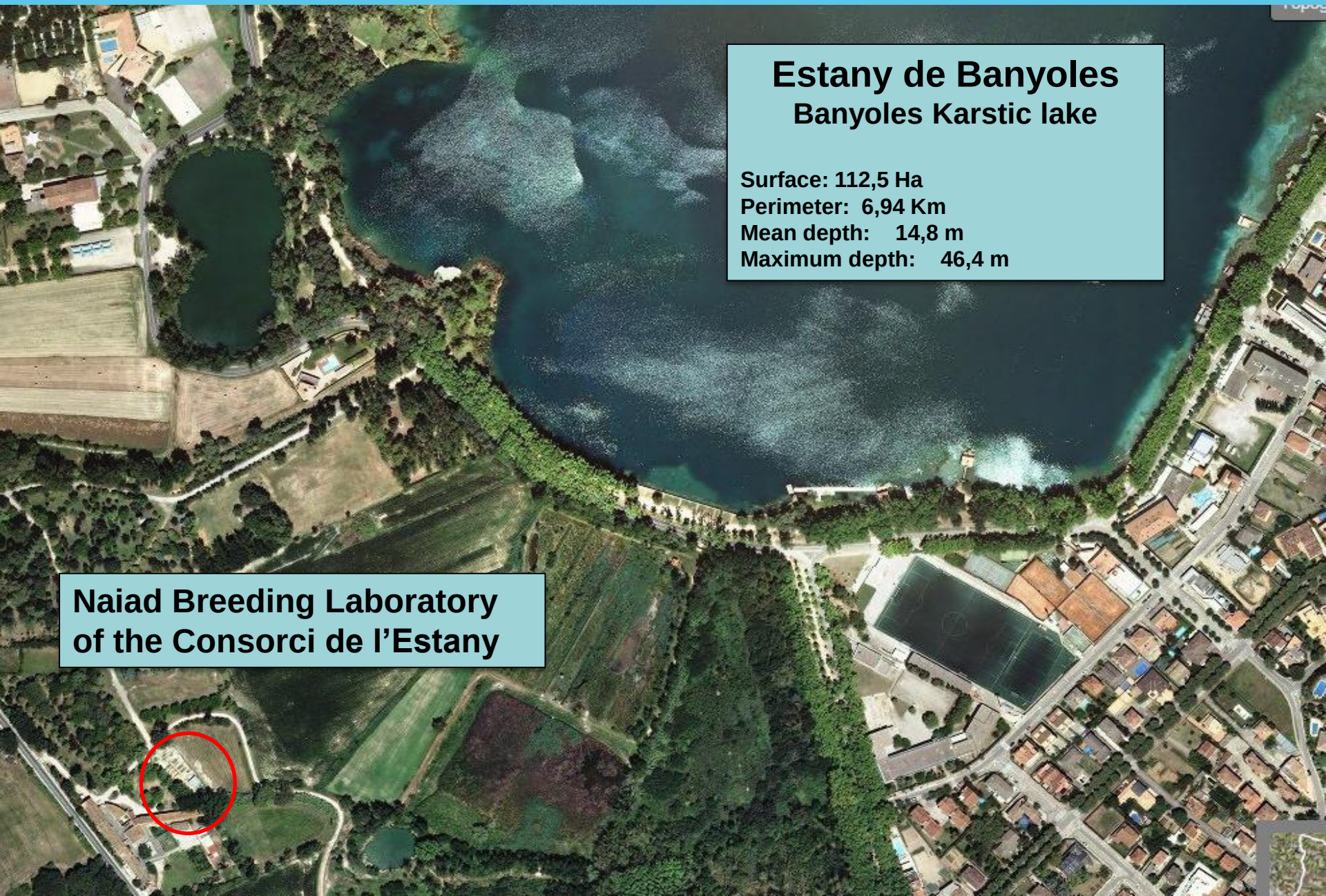
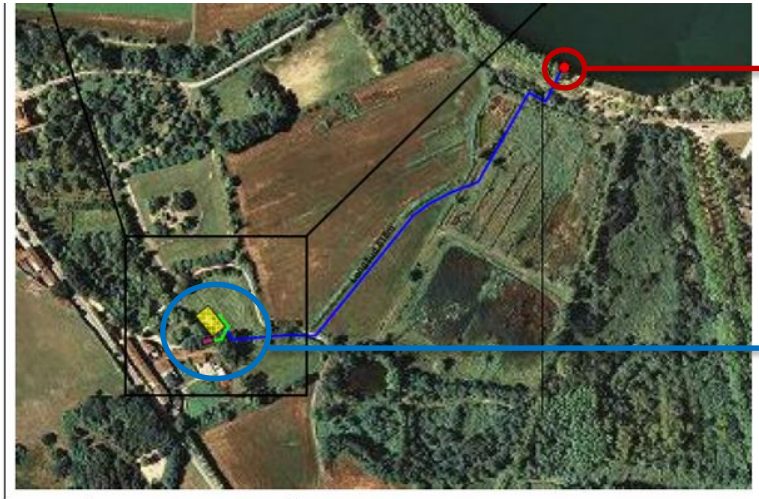

Estany de Banyoles
Banyoles Karstic lake
Surface: 112,5 Ha
Perimeter: 6,94 Km
Mean depth: 14,8 m
Maximum depth: 46,4 m
Naiad Breeding Laboratory
of the Consorci de l'Estany

Naiad Breeding Laboratory of the Consorci de l'Estany

- **Semi-natural breeding system using water and sediment from the mussels' natural environment**



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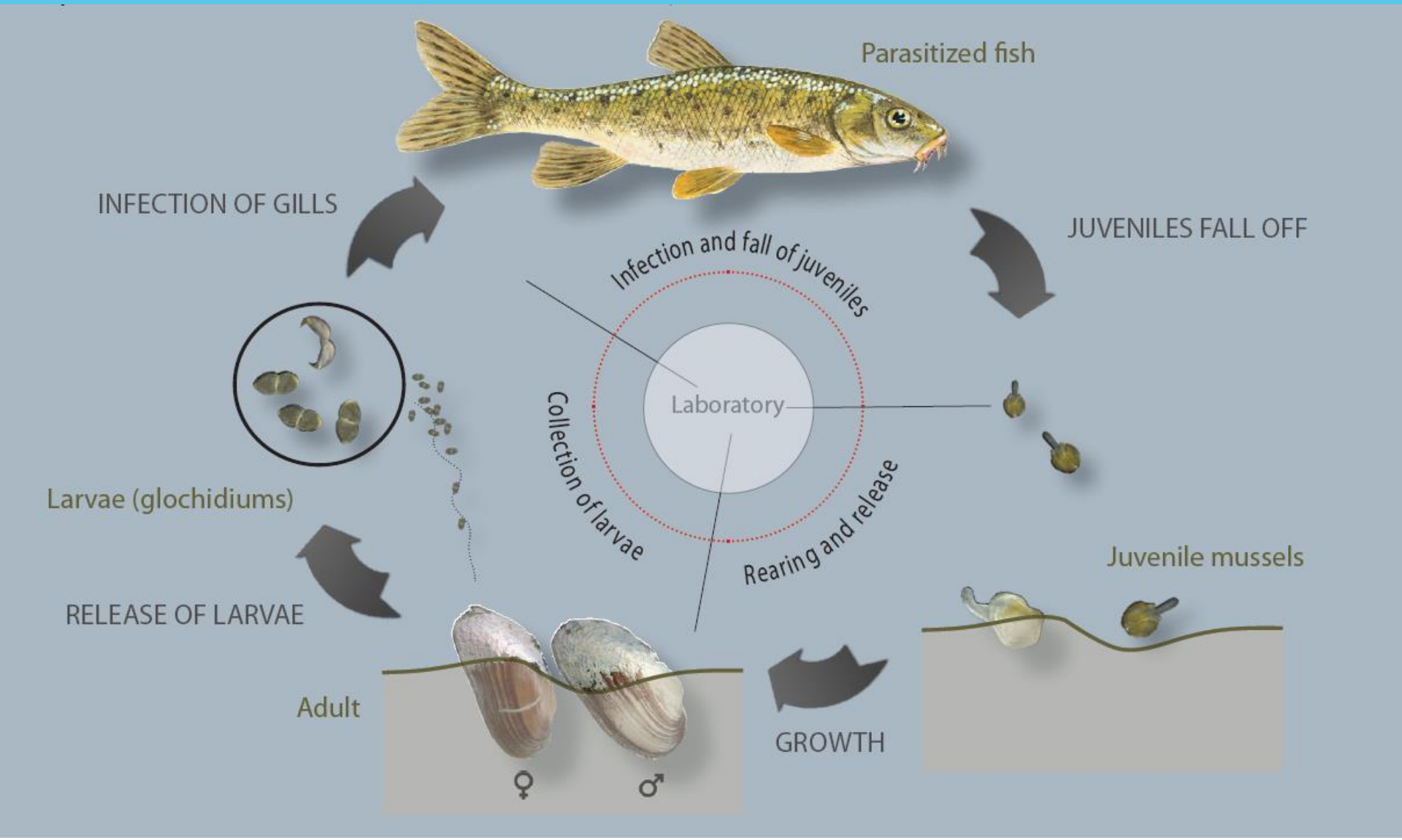
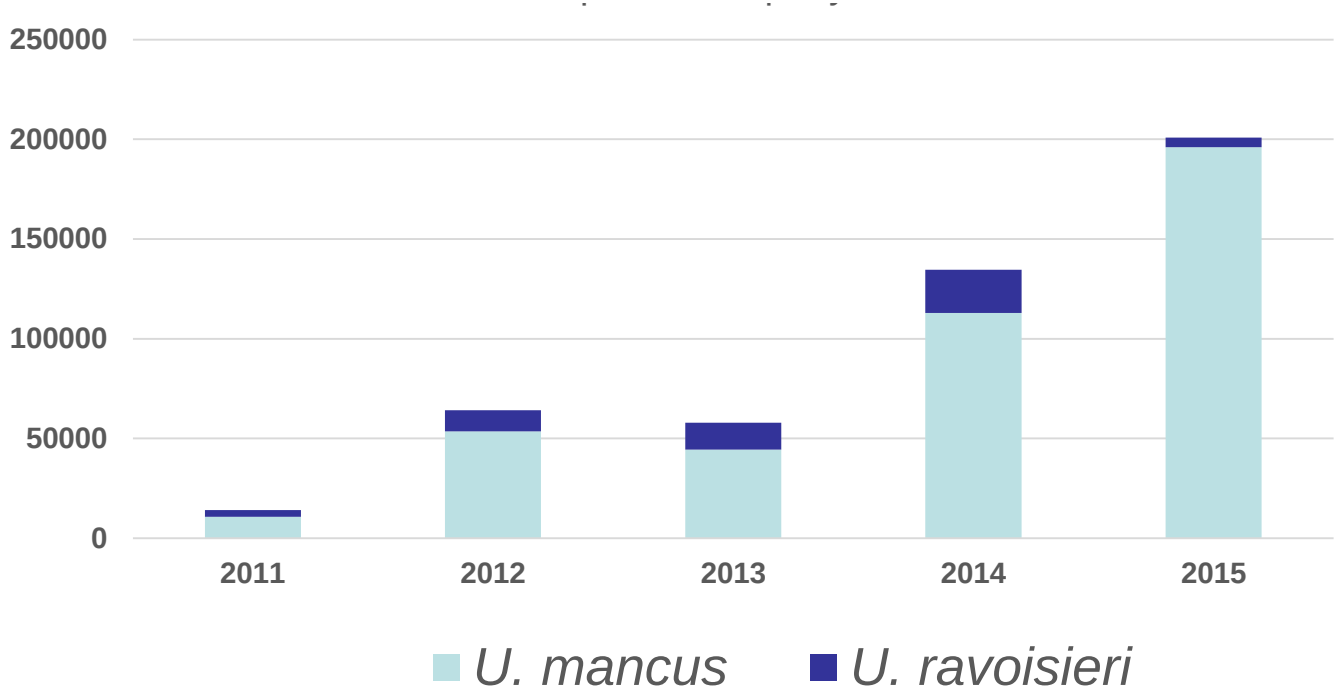


Juvenile production per year

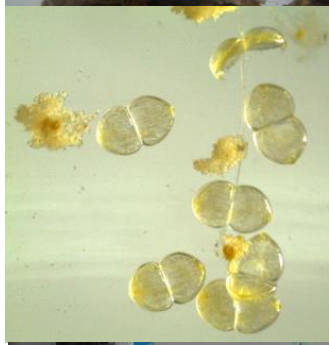


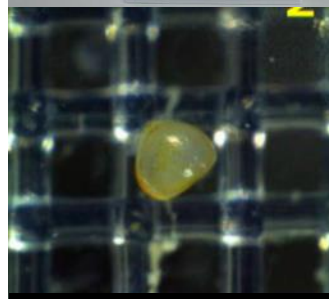
Host fish used:
Barbus meridionalis
Barbus graellsi

Fish length:
10-15 cm.

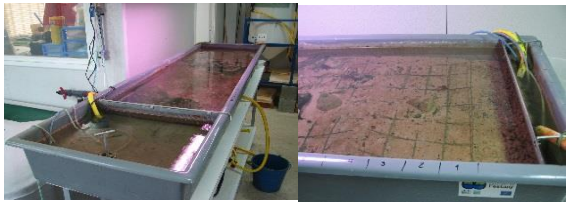
Juveniles/fish:
302,9 (107 – 729)

More information about juvenile production and breeding system in the poster:
"Ex-situ breeding of native unionids in Lake Banyoles (Spain) as part of a LIFE project"




Seeding system survival rate after 365 days during the period 2011-2014



	% Survival rates
Pools	0,64 - 21%
Trays in pools	0 - 26%
Indoor tray or channel	0 - 12,2 %
Aquaria	0 %
Channels Tubes	0,22-0,97 % (only 2014)

High survival rates variation in outdoor systems

Minimize problems & Improve breeding systems

Threats to the juvenile survival

Predators inside the breeding centre:

- *Salaria fluviatilis*
- *Procambarus clarkii*
- Other unknown factors

- Overgrowth of benthic algae
- Falling leaves

Solutions

- Working in darkness
- Use of mesh

Experiments to improve the survival and growth of juveniles during their first months of life

1st - Methodological trials (2011-2012)

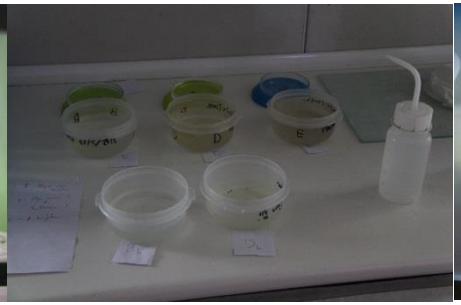
Although the aim of the breeding laboratory is to use the natural diet (food from water and sediment) in raising the mussels, an experiment involving an external food source was also designed in 2011 inspired by the reports and videos of LIFE05 NAT/L/000116 Restauration des populations de moules perlières en Ardennes 2005-2011.

Over two years we carried out a trial with several food supplies for naiad juveniles. Individuals were stocked in small tanks without sediment to allow frequent monitoring.

5 treatments / 2 replicates

- **Marine algae:** 2 mg/l Easy reef. Composition: *Nannochloropsis*, *Phaeodactylum* and *Tetraselmis*.
- **Leaf extract** was obtained by washing the leaves and stems of *Salix* sp.
- **Biofilm extract** was prepared from 200 g of the Diatom biofilm of the pools washed in 2 l of lake water
- **Mixture** includes an extract of marine algae, leave, biofilm, *Chara* sp. and macrophytes (*Thypha* sp.)

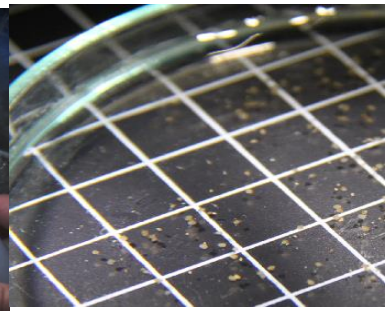
All the food was filtered and frozen in doses of 0.8 ml.

Methodology

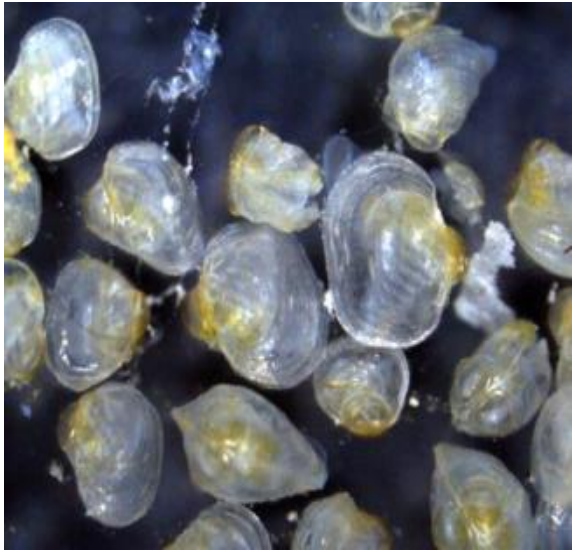
- All containers were cleaned every 3-4 days; and food and water were renewed.
- Once a week dead juveniles were removed and live juveniles were measured.
- The experiment ran between May 2012 and July 2013 for a total of 400 days



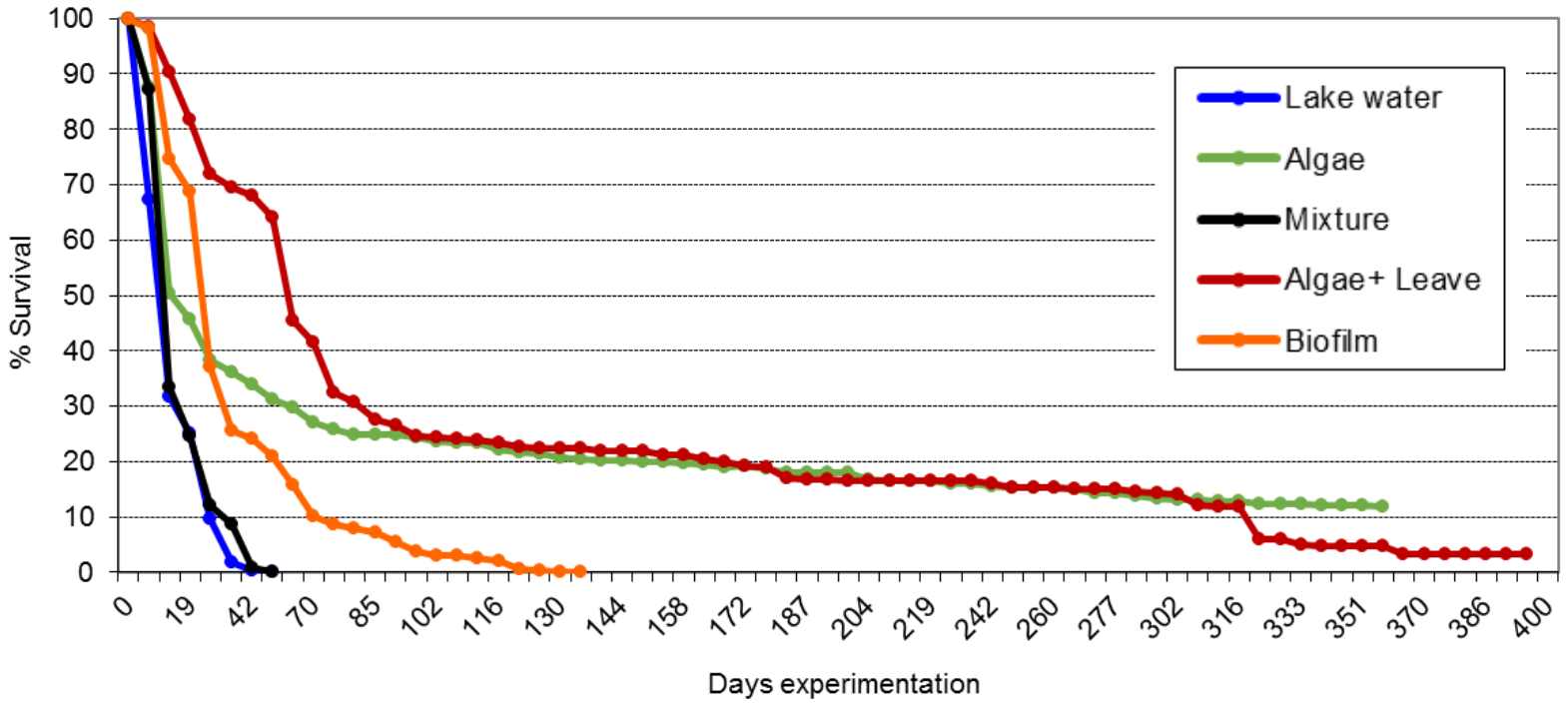
Araujo, R, C. Feo, M. Campos and Q. Pou. 2015. Conservation of two endangered European freshwater mussels (Bivalvia: Unionidae): A three-year, semi-natural breeding experiment. *The Nautilus* 129(3): 126–135, 2015.

Results for survival



- Survival rates of 3–12 % were obtained after 12 months of feeding with marine algae and leaf extract.
- Higher survival have been observed when there's a guaranteed food supply, except when we combined more than two kinds of food.
- The surviving juveniles were placed in cages with sediment in the lake

Survival of the mussel juveniles fed with extra food



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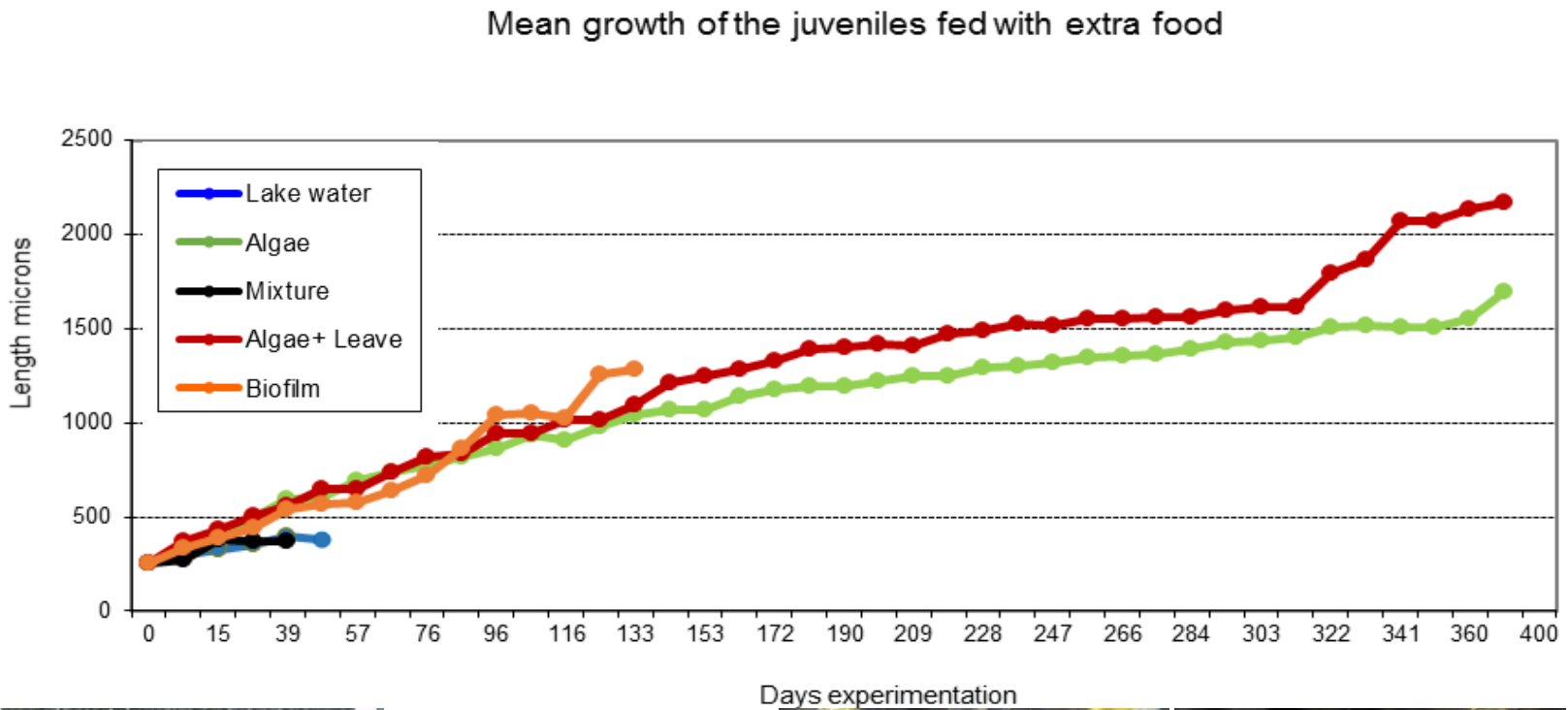
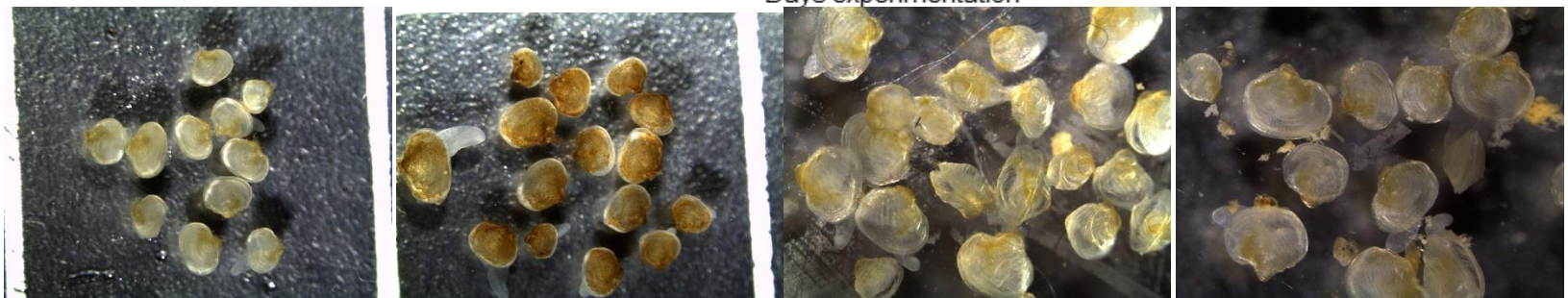
Growth results

- Lengths of 1.6–2.2 mm were obtained after 12 months of feeding with marine algae and leaf extract. These two treatments were the most successful.
- In any case, growth is higher in outdoor pools and channels (4-6 mm) than in the indoor experiments.





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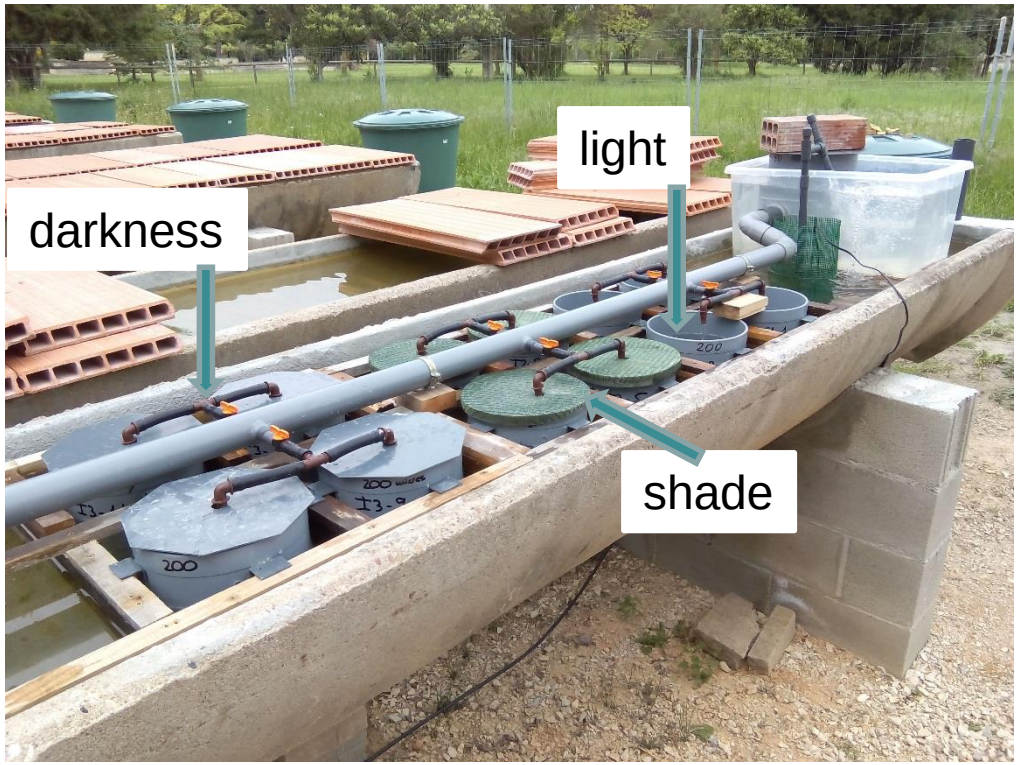
2nd Methodological experiment 2015

Objective

- Try a new system of maintenance and monitoring of juveniles outdoors.
- Study the response of naiad juveniles (growth, survival, ...) to three treatments of light with regular water circulation from the lake in a channel.

Design of the experiment

- 1 channel with continue water circulation from the lake and entry of water from above
- 3 treatments with 4 replicate with light, shade and darkness.
- Each replicates with 200 naiad juveniles per container
- Each container had a 200 micron mesh at the bottom



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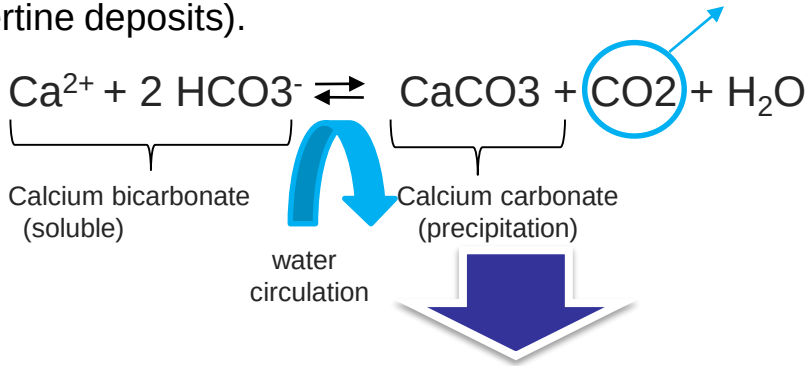
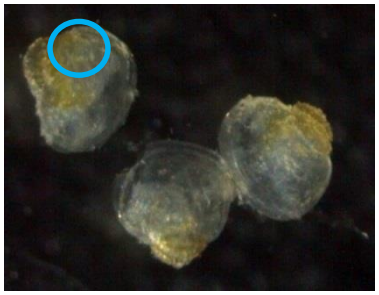
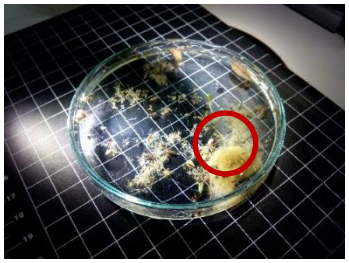
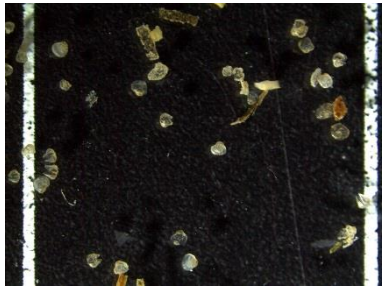
Outdoor experiment results

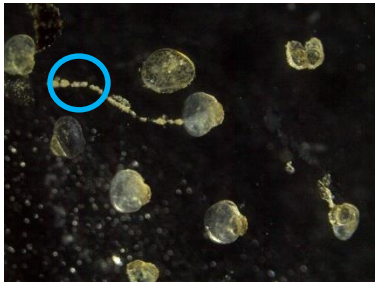
- **Very poor results : 0 % survival rate at 45 days, 500 microns maximum length**
  - Problems with fiber of Eastern cottonwood (*Populus deltoides*)
  - Algae growing inside the channels and in the container
  - Calcification of the shells and the fibers due the hard water of Banyoles lake with a high content in calcium carbonate (travertine deposits).











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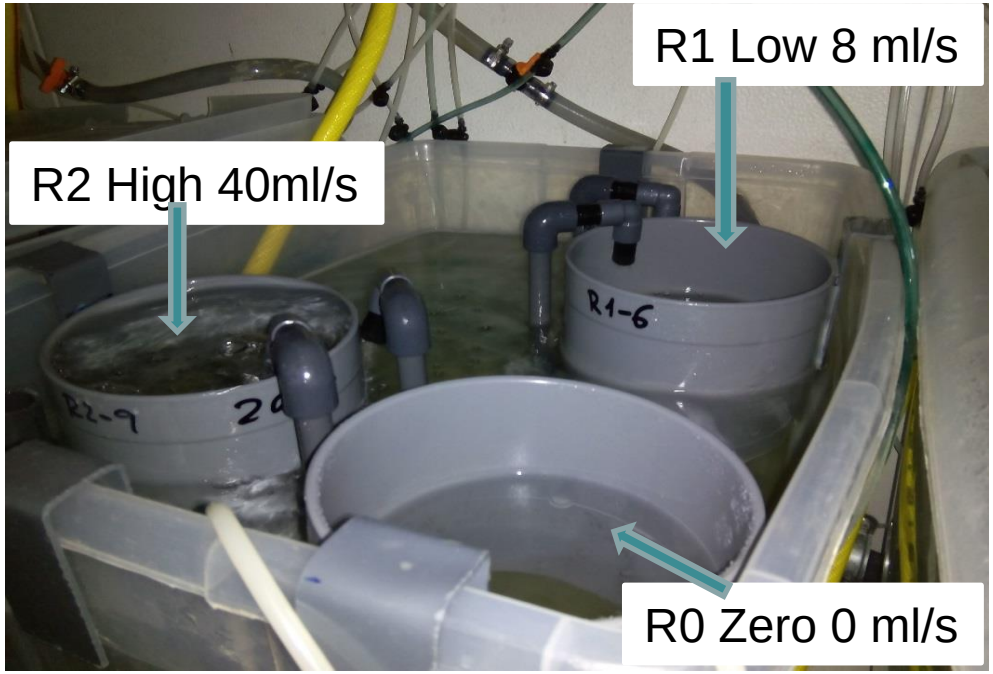
3rd Methodological experiment 2015

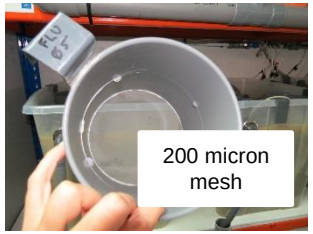
Objectives

- Try a new system of maintenance and monitoring of juveniles **indoors**.
- Study the response of naiads juveniles (growth, survival, ...) to three treatments with contrasting rates of water circulation.

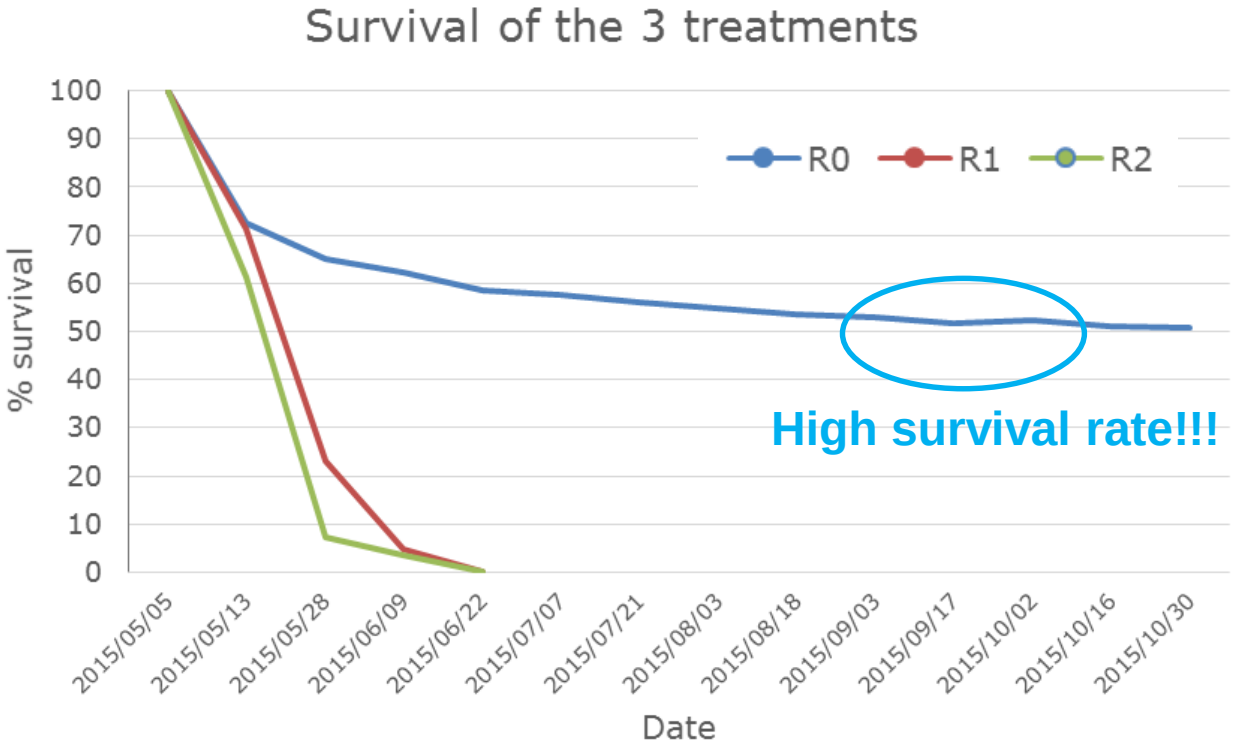
Design of the experiment

- 3 tanks with 3 circulating water treatments (high, low and zero water rates).
- 3 replicates with 200 naiad juveniles per container.
- Water circulation from bottom up through an air injection system inside the tanks.
- Complete water change and food supply every two days with 5.4 mg/l of seaweed uniformly applied " Easy Algae Reefs".
- Fortnightly review (cleaning, counting, measurement)

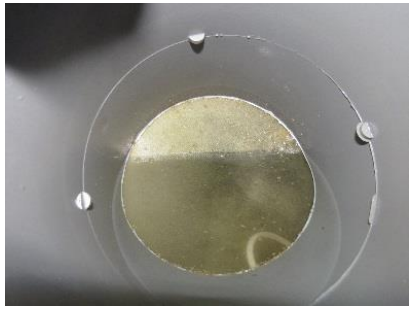




Results



- R0 Treatment with zero water recirculation had survivals near 50% at 178 days after the beginning.
- R1 treatment with low water recirculation and R2 with high water recirculation had a high mortality, and with a minim survival rate at forty days.



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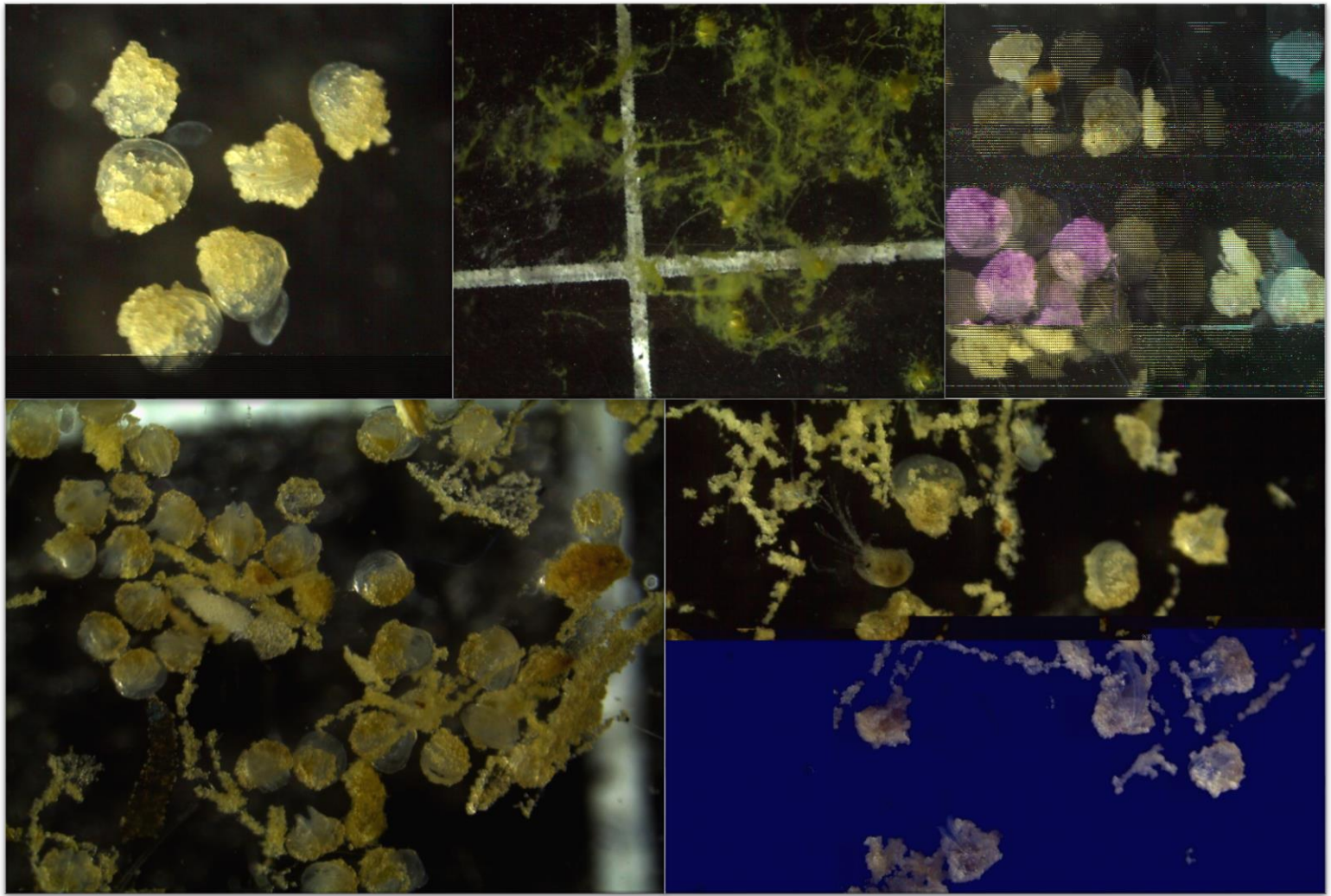
Problems in R1 and R2

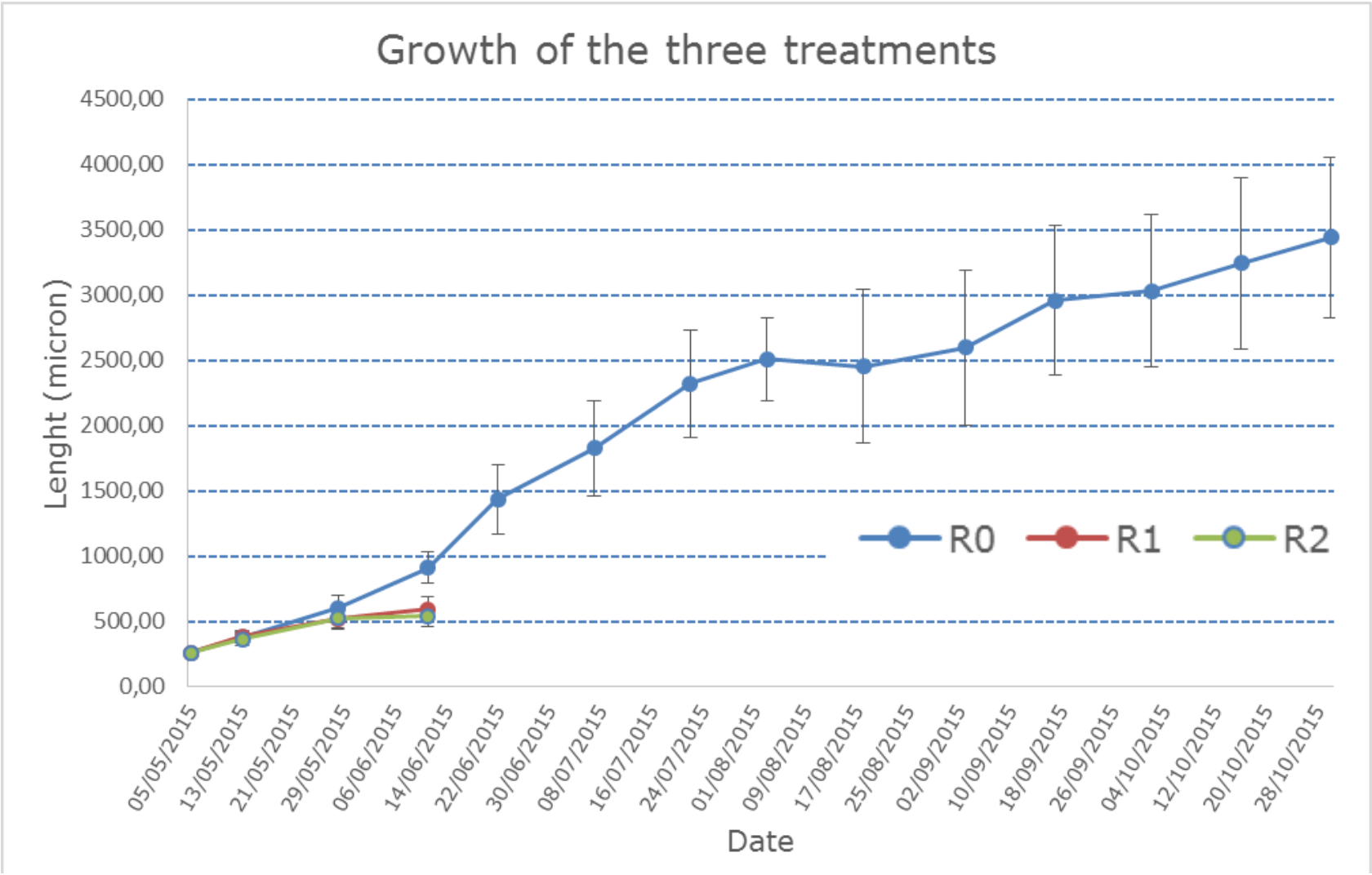
R1 treatment with low water recirculation and R2 with high water recirculation have a high mortality due to:

- Calcification
- Presence of fibers where remain attached



Growing of the three treatments indoor 2015

- The R0 (zero water rate circulation) naiad juveniles growth to 3.5 mm at 178 days
- R1 and R2 (with low and high circulation) growth to 0.6 mm at 40 days
- 21,5 TºC average (lake water: 19ºC in May, maximum 27ºC in July, 17ºC October)



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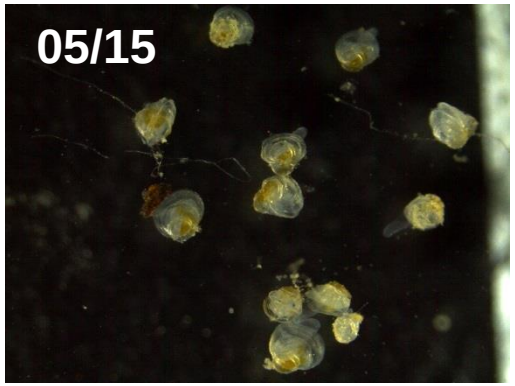
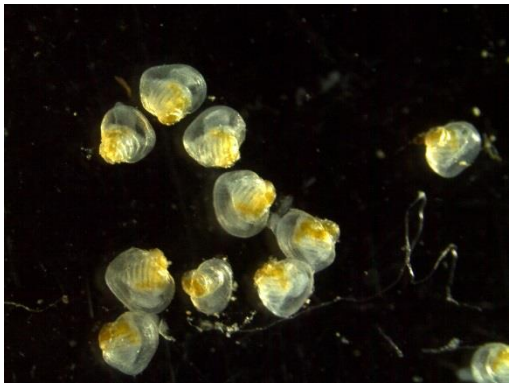
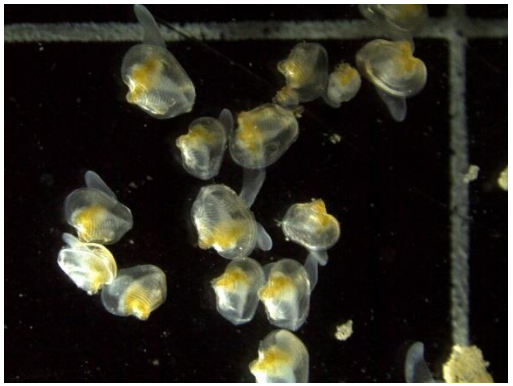
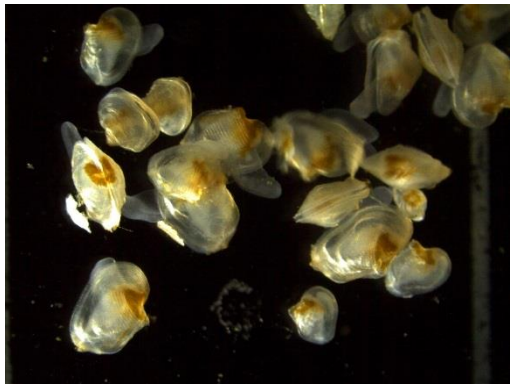
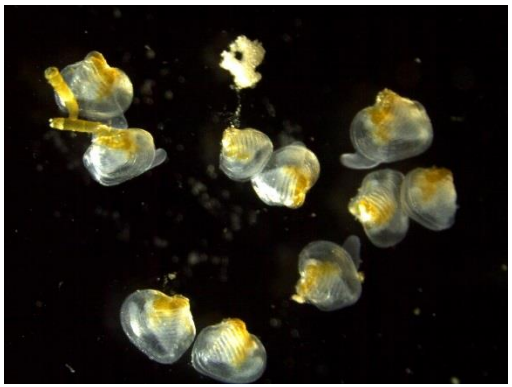
The pictures of naiad from R0 May - September

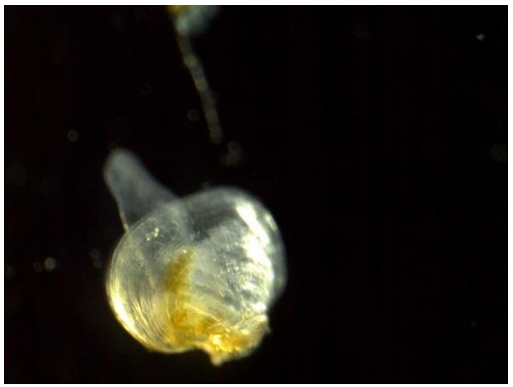


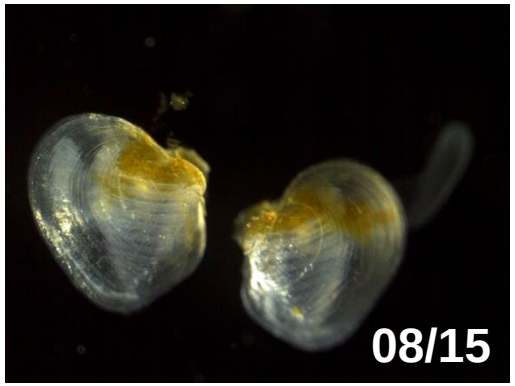


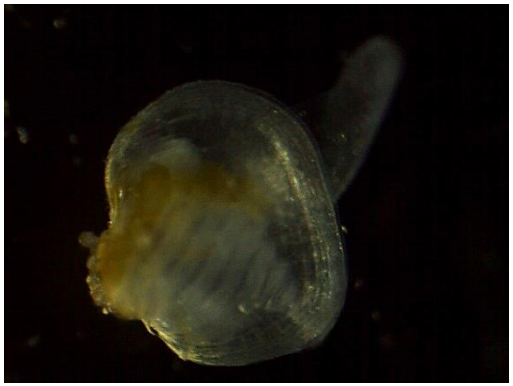


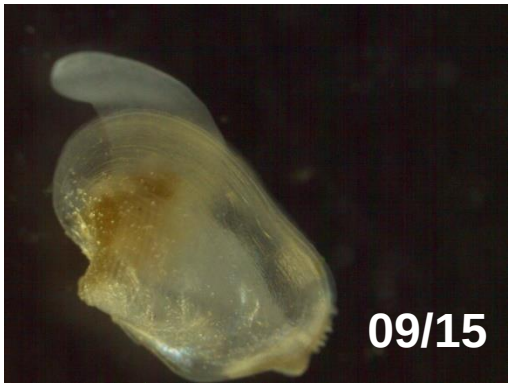












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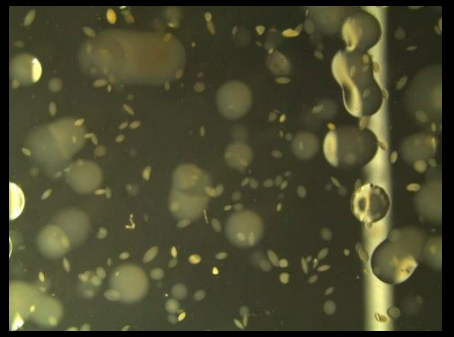
Other aquatic organisms growing inside the containers

Ostracods



Bacteria culture from the tanks water

Copepods

Daphnia sp.

Planarian eating ostracods.

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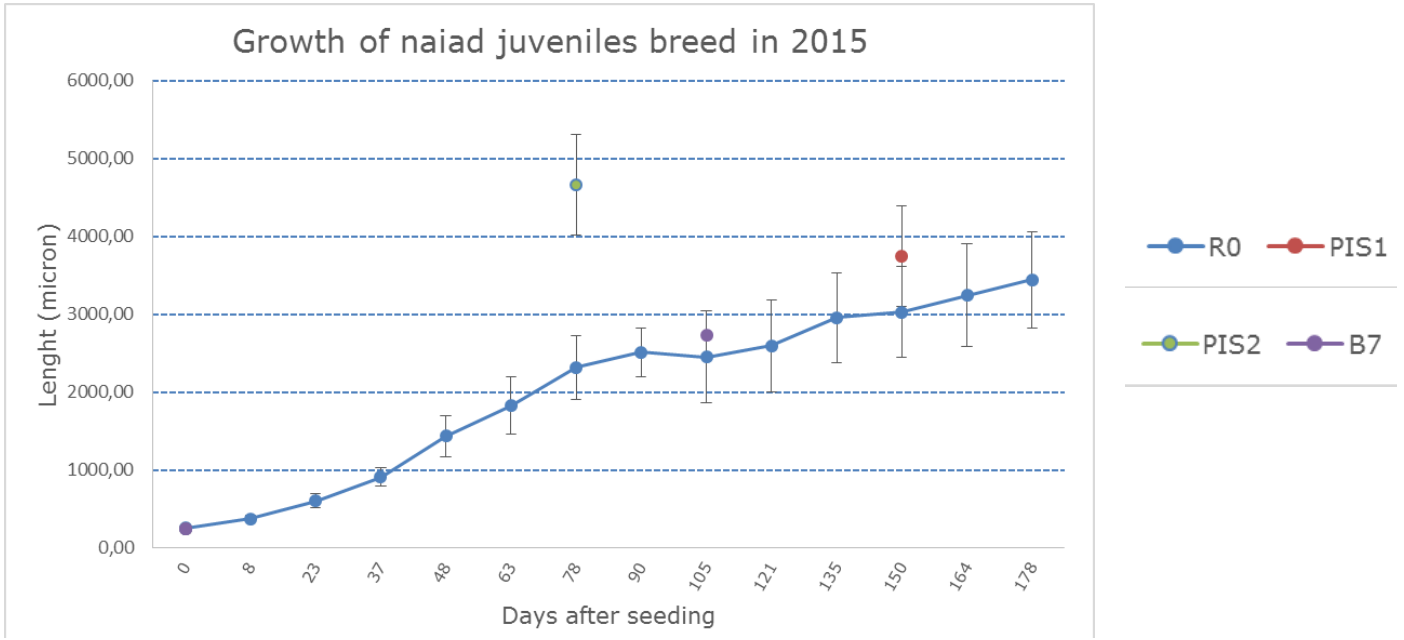
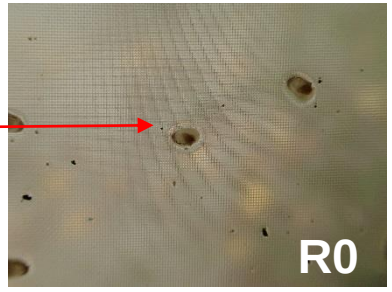
Growth of mussels born in 2015 during the first months

Comparison of naiad juvenile bred in 2015 growth that have been seeded into Pools (PIS1 and PIS2) and channels (B7) with sediment or into containers with a mesh inside a tank (R0 - feeding experiment)

- Naiad juvenile growth in R0 was not so different from those in PIS1 and B7, only slightly lower





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At present, the main laboratory challenge is to improve first-year naiad survival as we have found that mortality after the first year drops significantly.

Conclusions

- It is necessary to work in darkness
- We have to avoid water circulation that causes the precipitation of calcium carbonate
- We should also cover the containers to prevent the entry of dust and fibers from the air
- Most mortality (40-100%) occurs during the first 40 days after seeding in different replicas and treatments
- The indoor system used in 2015 indoor has been useful for fortnightly monitoring of naiad juveniles
- The breeding system in indoor containers with supplementary algae feeding has been a very effective way to overcome the death in the first 40 days of life (50% survival) of seeded juveniles. However, the growth has been slightly lower than other outdoor fattening systems in pools and channels with natural sediment.
- We probably need to increase the algae dose to increase growth.
- This system will be studied to apply it to more juveniles from 2016 to overcome initial stages of mortality, in order that we can then transfer the surviving individuals to outdoor fattening systems where growth is higher..


Thank you