

# Exploring Embryonic Responses of a Migratory Fish to Spawning Grounds Water Quality in a Population Decline Context

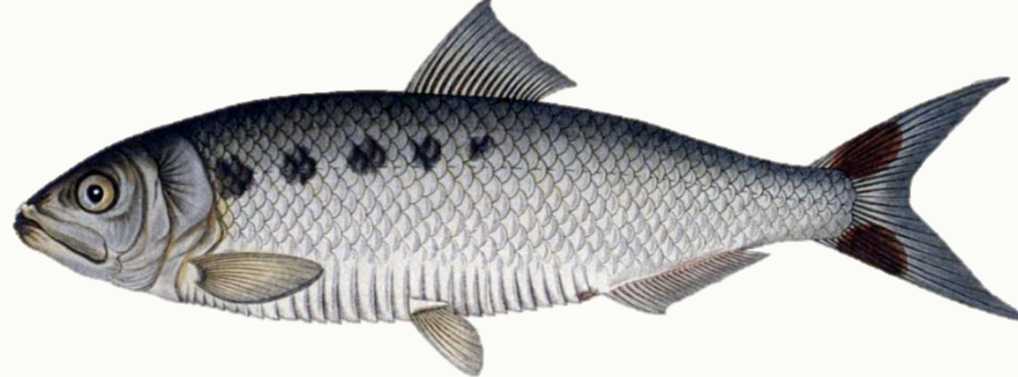
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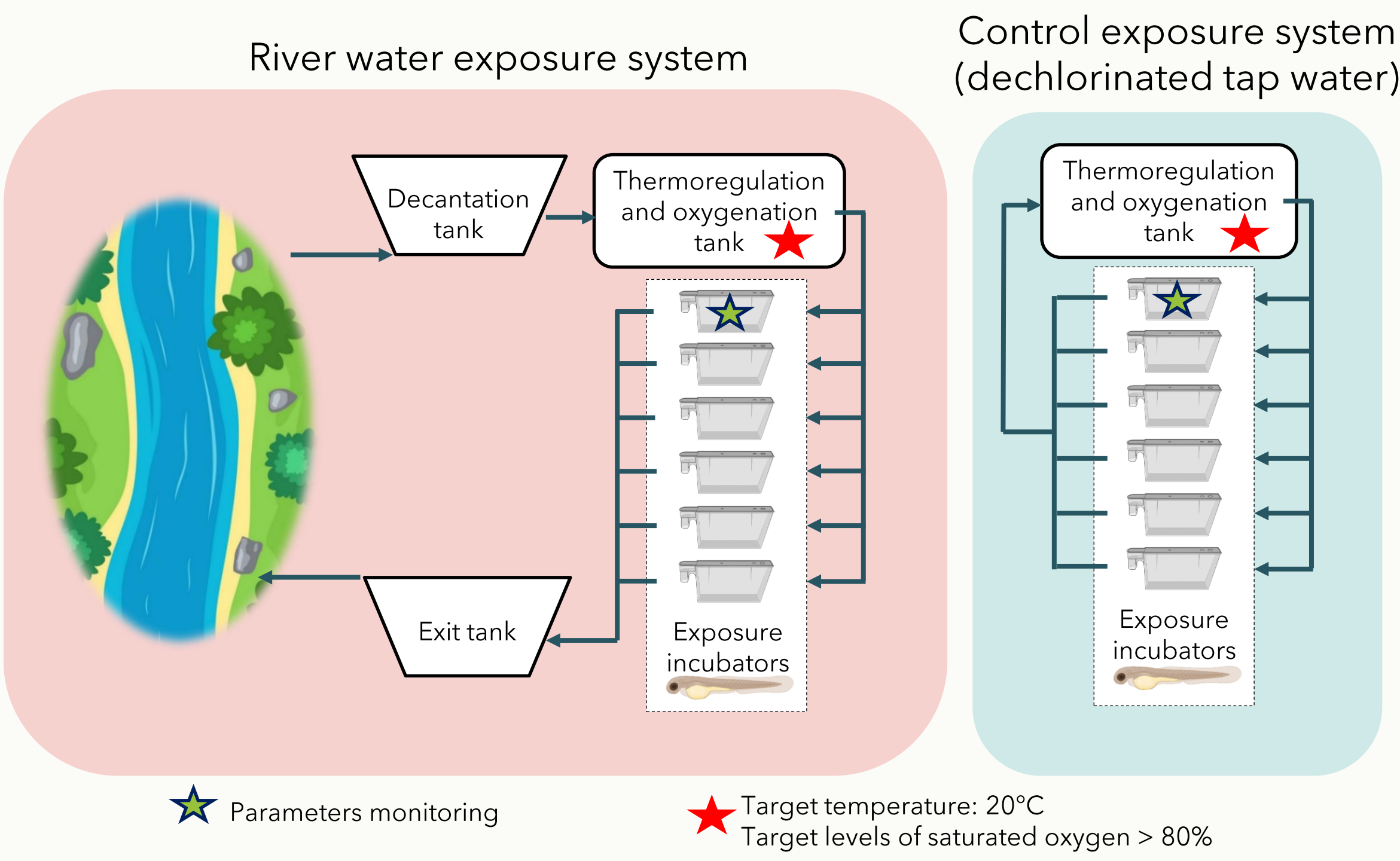
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The allis shad (*Alosa alosa*) is an anadromous fish that is an emblematic species in the Garonne basin, France<sup>1</sup>. Its population size has collapsed at the beginning of the 2000s leading to the adoption of a fishery moratorium in 2008<sup>2</sup>. Since then, a lot of research has been conducted to explain this decline, and one of the remaining work hypothesis is water contamination in spawning grounds. The objective of this work is to assess the potential impact of water quality on the development of early young stages, through an *ex-situ* exposure methodology. This method uses a mobile laboratory to expose organisms to river waters under controlled conditions (flow, temperature, oxygen and photoperiod).

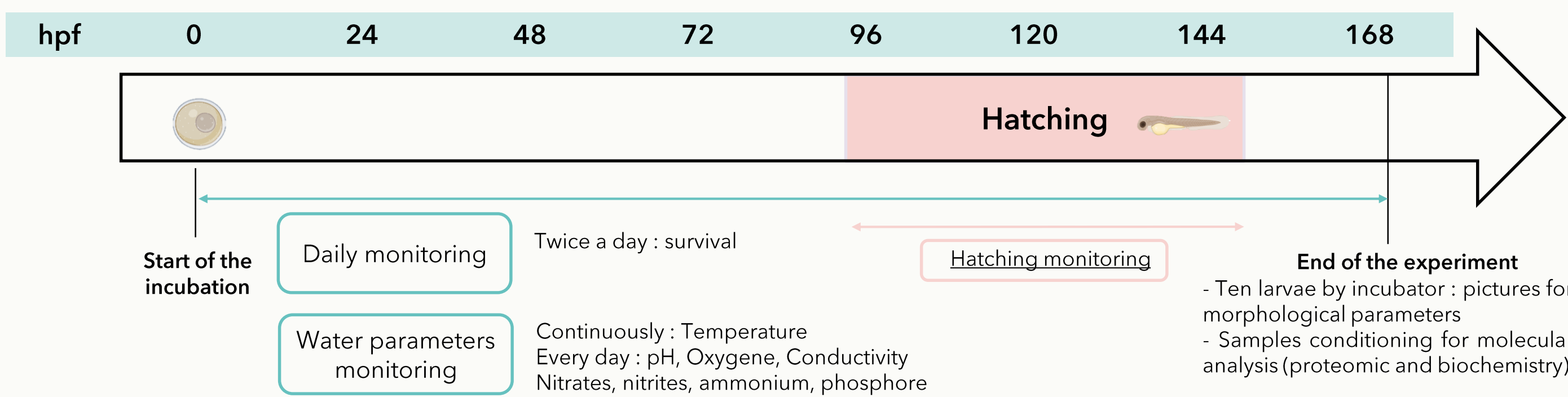


The allis shad (*Alosa alosa*)

## Material and methods



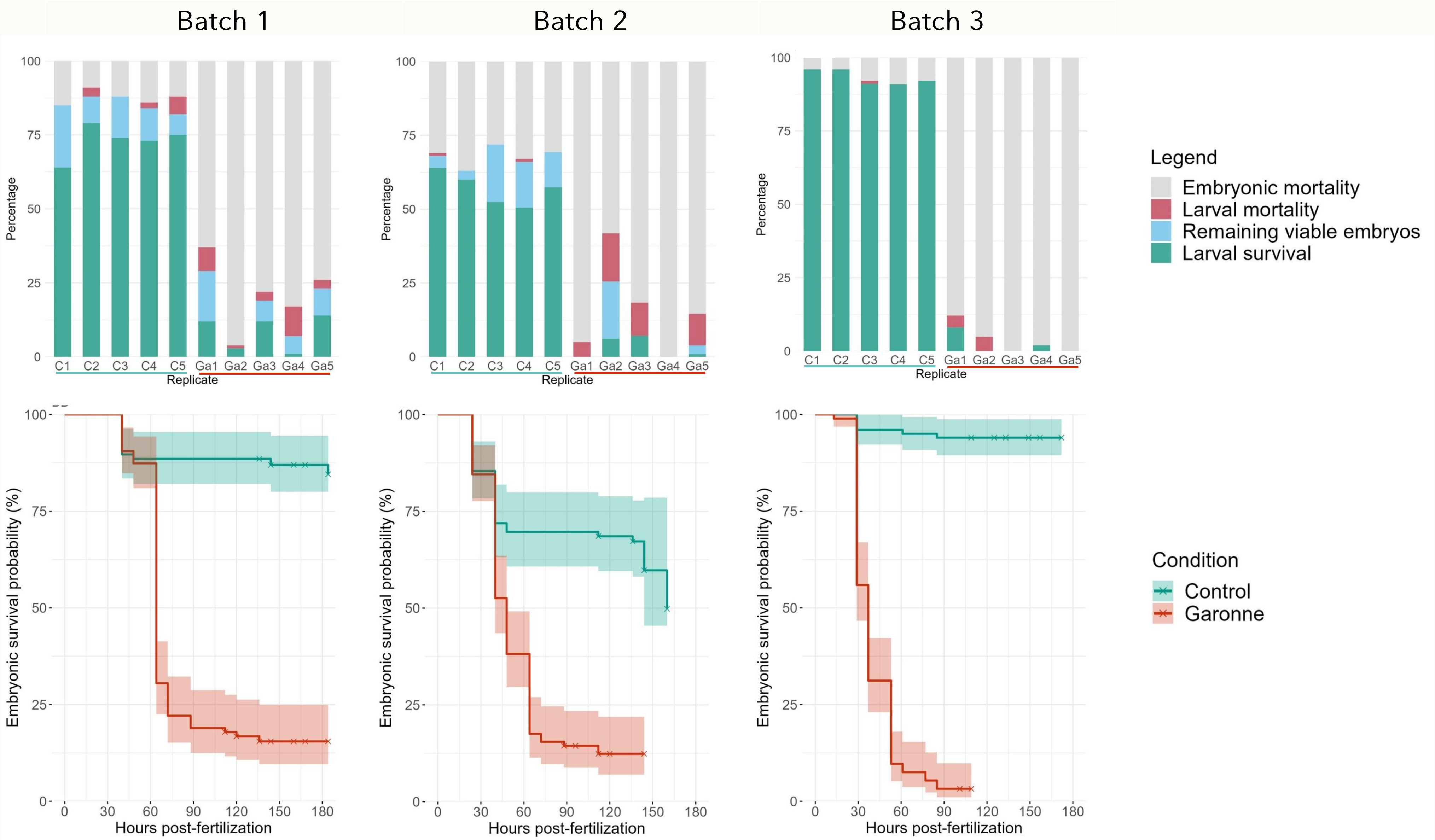
Embryos of allis shad were provided by the NGO MIGADO from assisted spawning of wild spawners (three batches). Exposure temperature was 20°C<sup>3</sup>.



Embryos and larvae responses studied were survival, hatching success and kinetic, morphometry, developmental malformations and molecular biomarkers.



## Results and perspectives



Responses of allis shad embryos after one week exposure to Garonne spawning ground water in 2022 and 2023. **First line:** Final fates of embryos at the end of the experiment. Results are cumulated percentages: mortality of embryos and larvae, number of viable larvae and number of viable embryos. C: control. G: Garonne. **Second line:** Survival probability of embryos. Batch 1: 26/05/22. Batch 2: 04/06/22. Batch 3: 13/05/23. Statistics on embryonic survival probability between conditions (Kaplan-Meier analysis): pvalue <0.05.

Values of the main physicochemical parameters in the incubators (control and Garonne) during experiments. Temperature and oxygen levels were controlled.

|         | Control                 | Garonne      |
|---------|-------------------------|--------------|
| Batch 1 | T°C (mean ± sd)         | 20,7 ± 0,35  |
|         | O2 (%) [min; max]       | [95,6; 97,9] |
|         | pH [min; max]           | [8; 8,7]     |
|         | Conductivity [min; max] | [244; 300]   |
| Batch 2 | T°C (mean ± sd)         | 20,9 ± 0,50  |
|         | O2 (%) [min; max]       | [97,4; 99,0] |
|         | pH [min; max]           | [8,1; 8,2]   |
|         | Conductivity [min; max] | [248; 255]   |
| Batch 3 | T°C (mean ± sd)         | 20,2 ± 0,2   |
|         | O2 (%) [min; max]       | [97,7; 99,9] |
|         | pH [min; max]           | [8,1; 8,3]   |
|         | Conductivity [min; max] | [303; 315]   |

- ✓ Target temperature (20±1 °C) maintained.
- ✓ Nitrogen forms (not shown here): non toxic for early young stages.

- ✓ Controls: good survival and replicability among incubators.
- ✓ Variability between batches.
- ✓ High impact of the Garonne water on embryos survival compared to Control.
- ✓ Mortality occurs mostly during the embryonic period, and more precisely during organogenesis.

## What's next ?

- > Chemical toxicity or pathogens ? Cocktail effect ?
- > The favourability of spawning grounds water appears compromised for the species.
- > What of other fish species of the basin ?

