

# MUSSELS IN AQUACULTURE AS BIOSENSORS OF HEAT STRESS: PARAMETERIZATION IN THE LABORATORY

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Spain: 3<sup>rd</sup> World Mussel Producer

2 main cultivation areas:

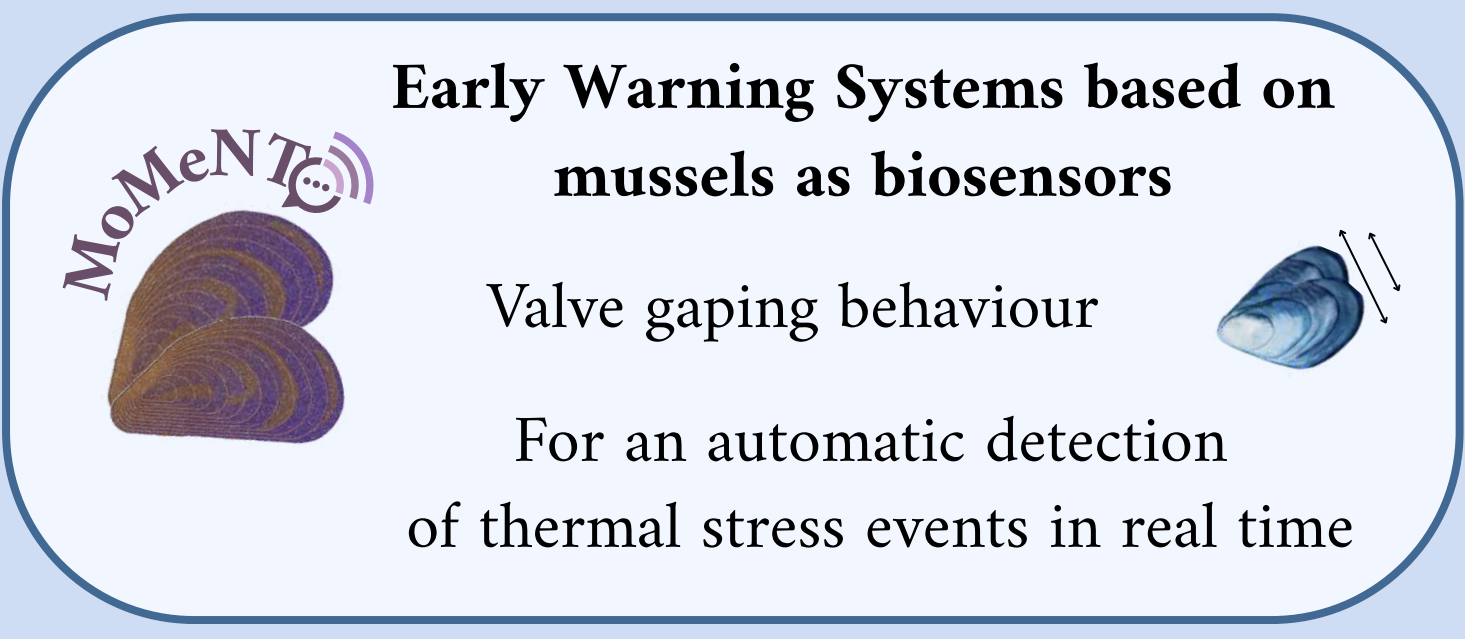
- 1º Galicia (Atlantic)
- 2º Cataluña (Mediterranean)



Heatwaves: ↑ Frequency and intensity

Significant production losses

Need for new management tools

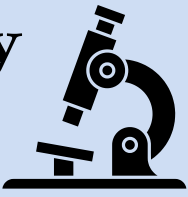


Early Warning Systems based on mussels as biosensors

Valve gaping behaviour

For an automatic detection of thermal stress events in real time

Parameterization in the laboratory before going to the field



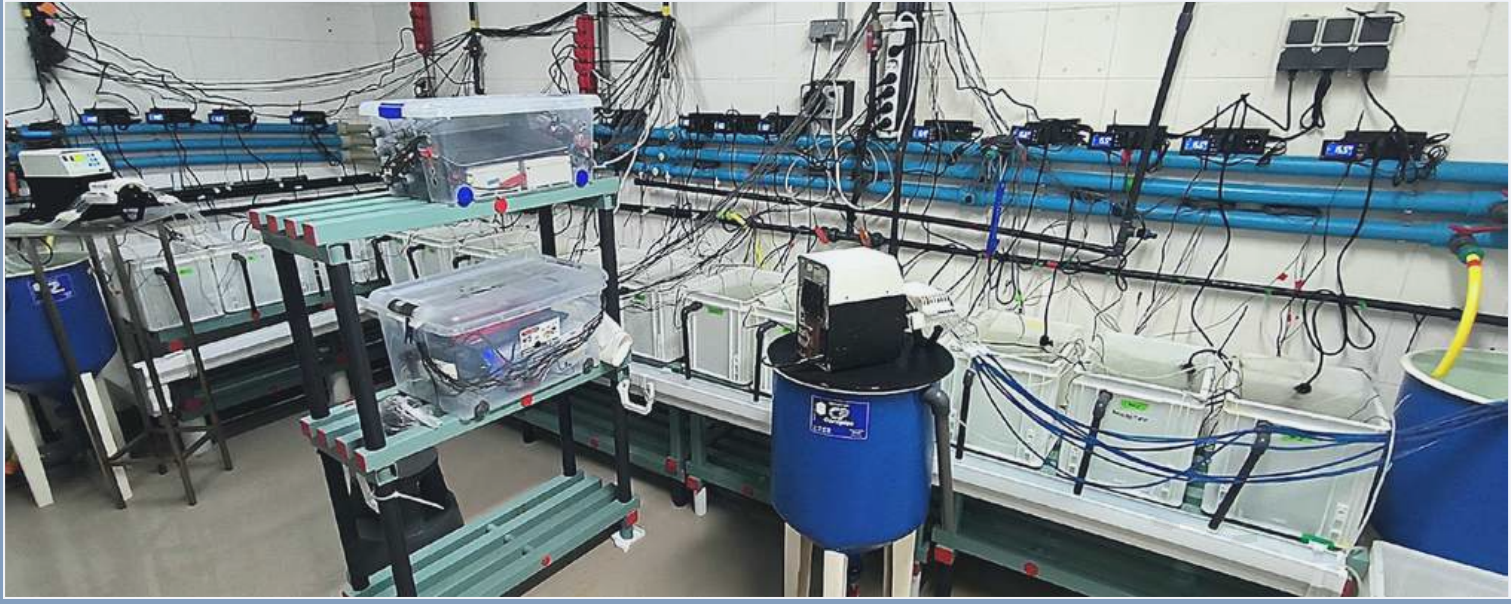


Fig. 1 Experimental setup in the laboratory

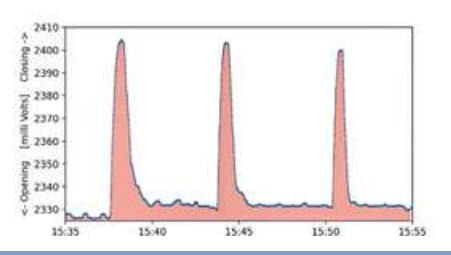
- 8 Temperatures: 16, 18, 20, 22, 25, 27, 29 and 31°C
- 2 Origins: Atlantic and Mediterranean
- 15 Days of exposure

Valve gaping behaviour recorded continuously



Hall Sensor

Magnet



Other classical stress indicators

Feeding Behaviour → Clearance rate (CR)

Metabolism → Biomarkers activity

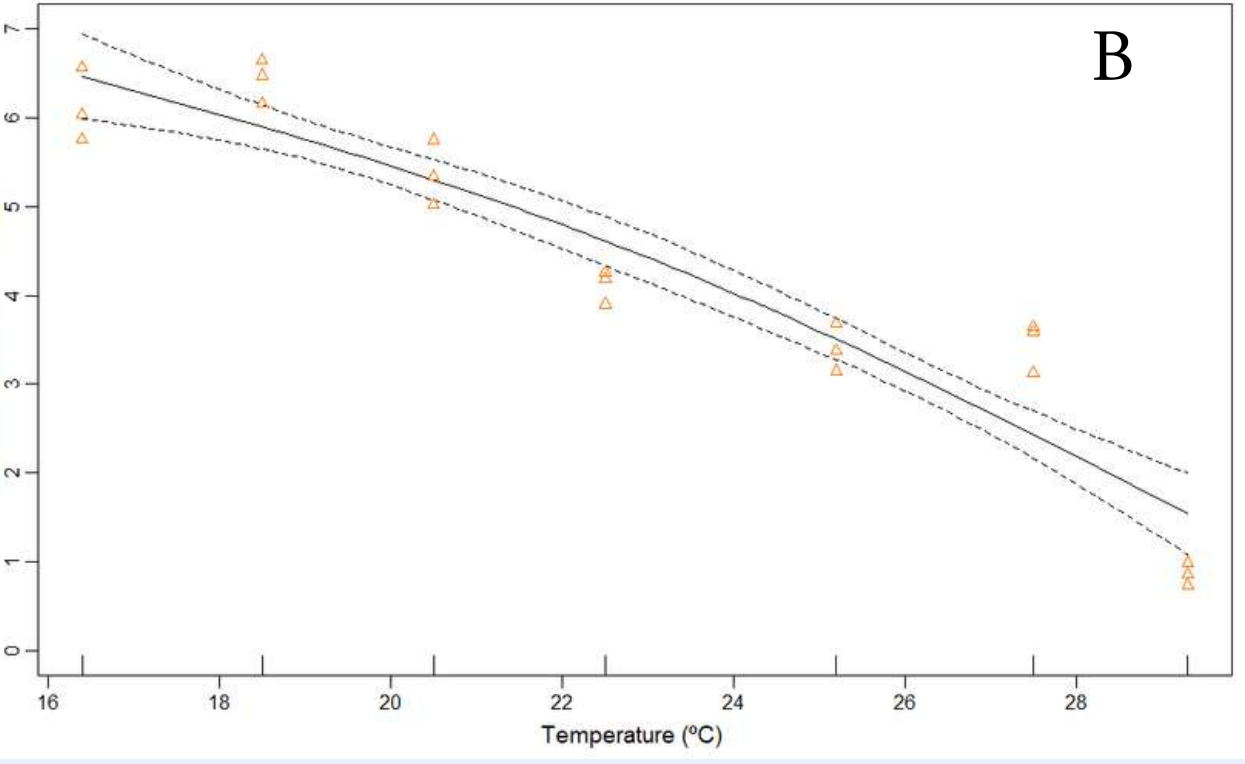
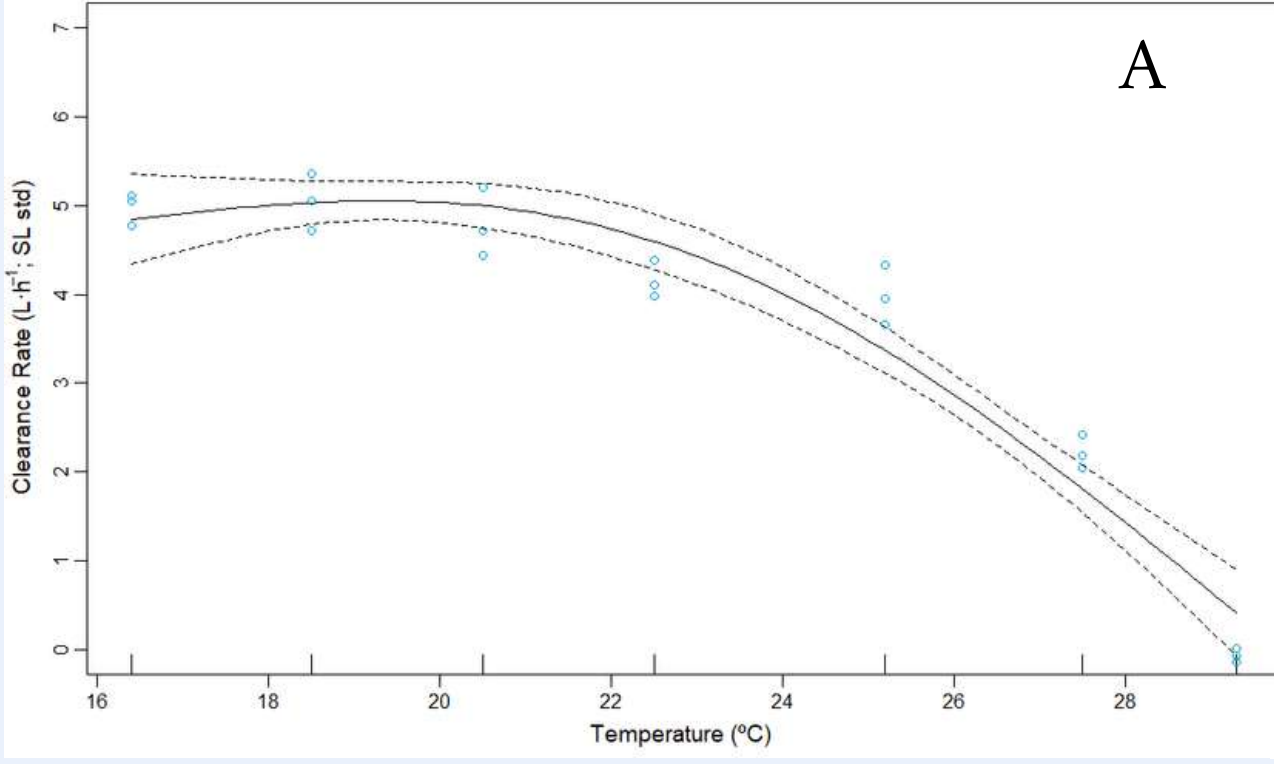


Fig. 2 Relationships between the CR and temperature for mussels coming from the (A) Atlantic and the (B) Mediterranean.

- In mussels coming from the Atlantic, CR values remained nearly constant until temperatures exceeded 25 °C (Fig. 2A), whereas Mediterranean mussels showed an inverse linear relationship (Fig. 2B). However, **feeding ability of Mediterranean mussels was less affected, even at higher temperature, since they exhibited higher CR values than Atlantic ones.**





- Some biomarkers, as the activity of the **Electron Transporter System (ETS; Fig 3)** showed also a sharp decline as temperature surpasses the 25°C, suggesting some kind of **threshold** around this temperature.

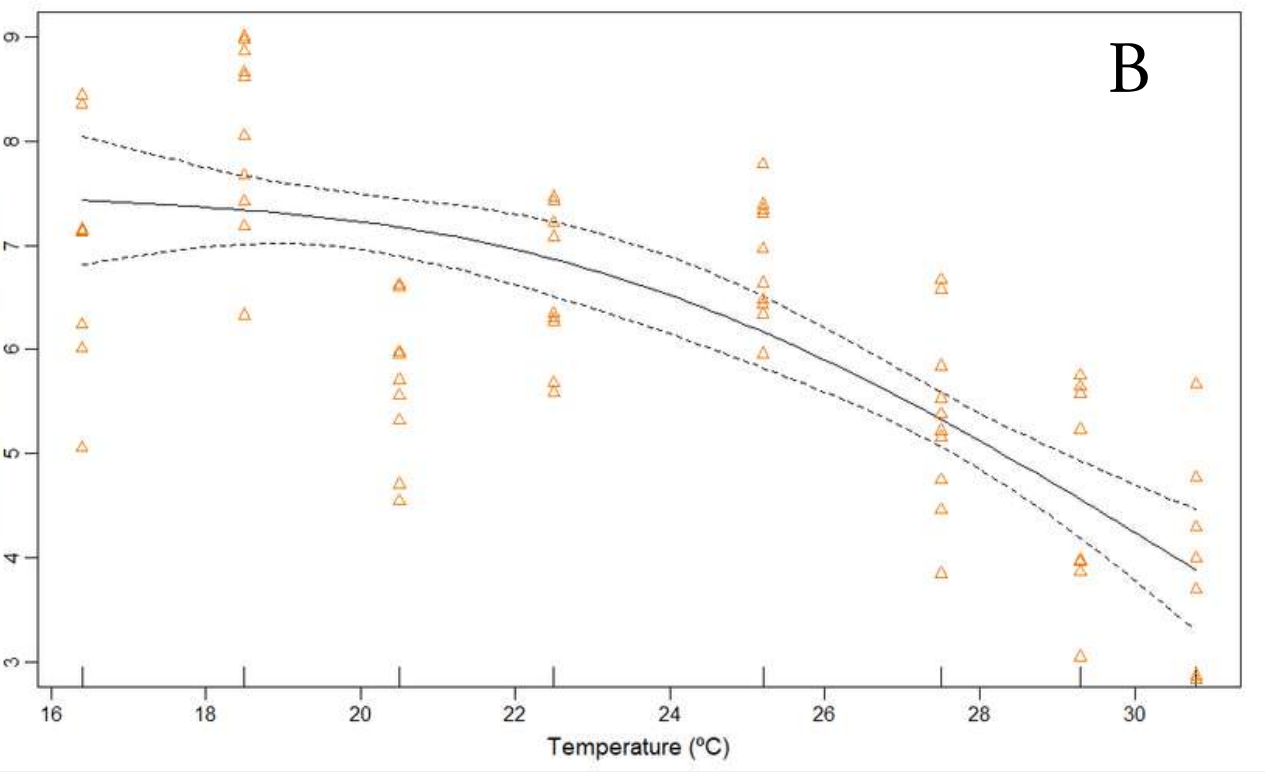
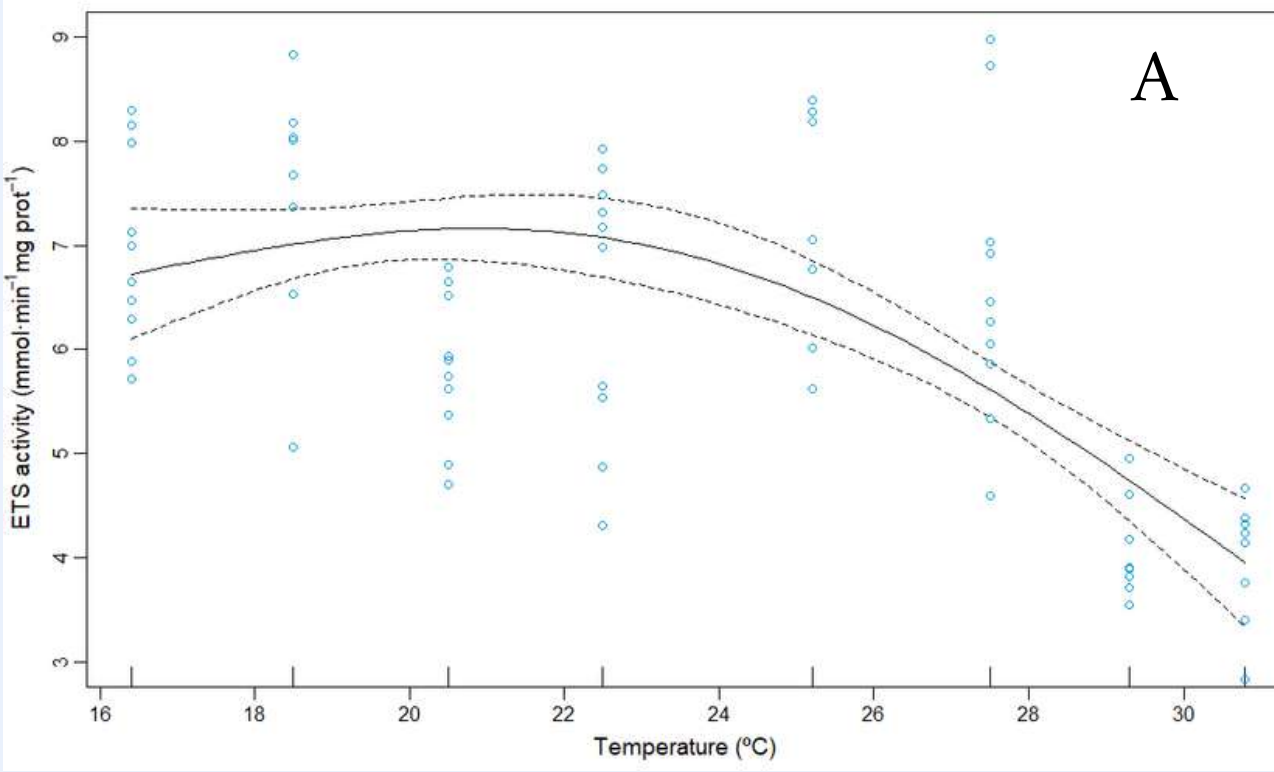


Fig. 3 Relationships between the Electron Transporter System (ETS) activity and temperature for mussels coming from the (A) Atlantic and the (B) Mediterranean.

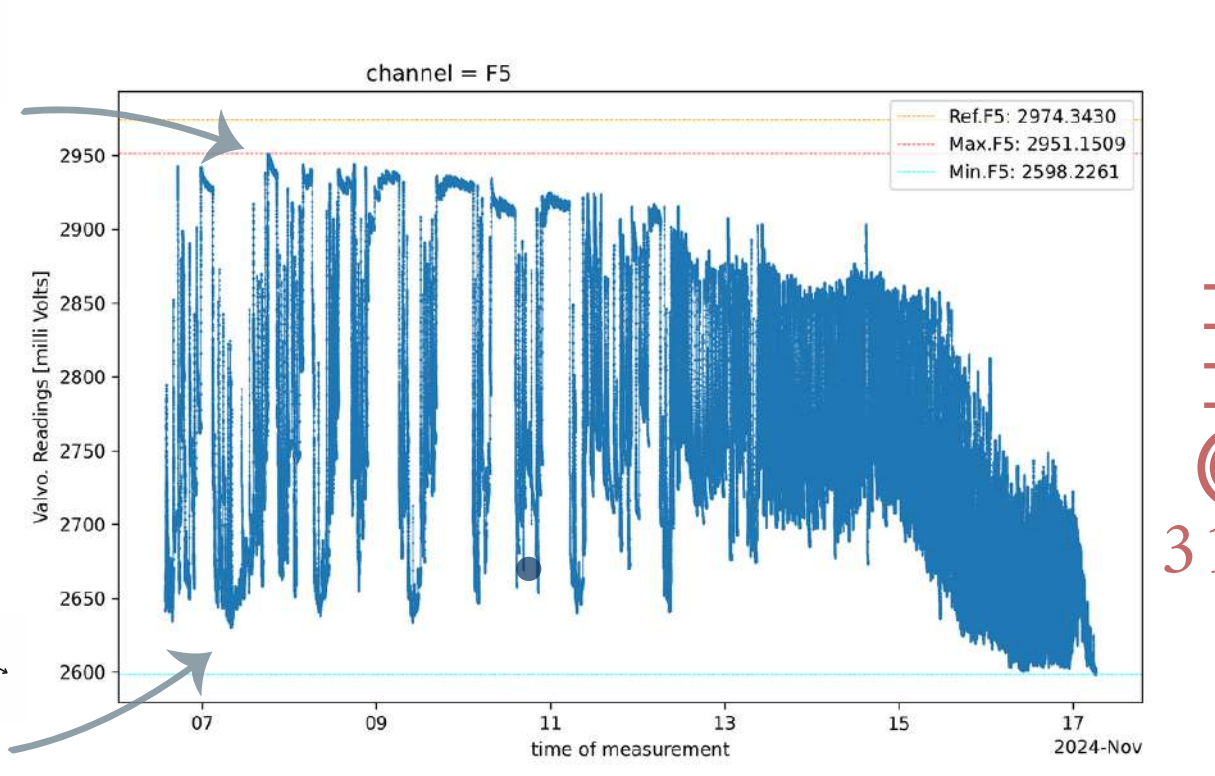
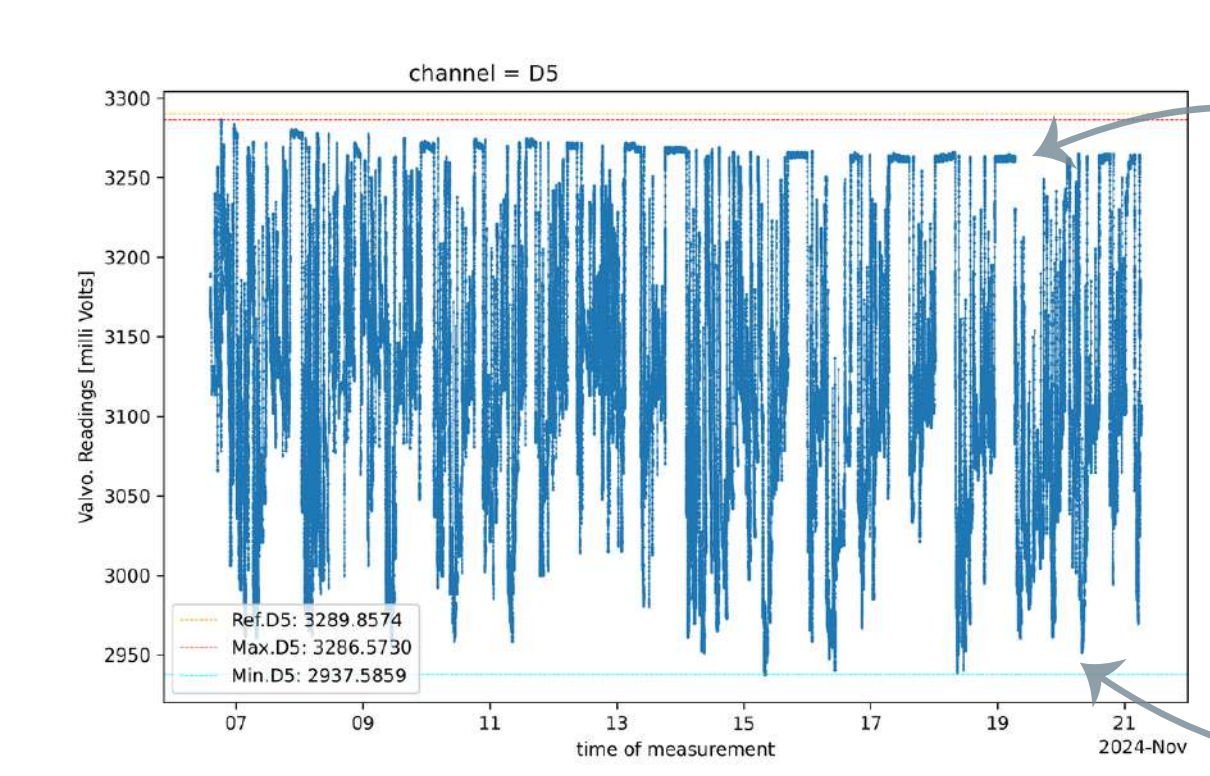
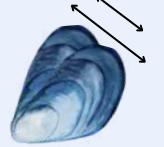


Fig. 4 Example of the valvometry output from tanks kept at (A) 18°C and (B) 31°C.



- Behaviour is also altered by **temperature, changing valve amplitude, opening time and circadian cycles (Fig 4).**

“Ecological memory” or the original habitat conditions of the mussels determine their response to stress. Relationships between valve gaping behaviour and other indicators of stress are being analyzed to develop **machine learning algorithms** for the automatic detection of thermal stress episodes based on mussel behaviour, both in the Atlantic and the Mediterranean.