

EFFECTS OF CLIMATE CHANGE WARMING ON THE PERFORMANCE OF AQUACULTURED MUSSELS (*MYTILUS GALLOPROVINCIALIS*) IN THE EBRO DELTA (NW MEDITERRANEAN)

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INTRODUCTION

In the context of climate change, the warming of the Mediterranean Sea, poses a high significant risk to mussel farming. High water temperatures (above 28°C) lower the physiological performance and may result in mass mortality events. Mussels (*Mytilus galloprovincialis*) cultured in enclosed environments are especially vulnerable to climate change, compromising ecosystem goods and services such as good water quality, food provision and the socioeconomics in the area. This research aims to investigate the effects of temperature in the performance of *M. galloprovincialis* in the Ebro Delta (NW Mediterranean Sea).

MATERIAL AND METHODS

Field experiments were carried out monthly from March to July 2025 in the mussel farms from Fangar Bay (Ebro Delta, Fig. 1) following the expected increase of temperatures from spring to summer. The feeding behavior of mussels was determined using the biodeposition method as described in Galimany et al., 2011 (Fig. 2). Samples for histopathological studies were taken in March, May and July. Temperature was recorded continuously and water quality (i.e., organic and inorganic particulate matter) was evaluated. Linear models and Generalized Additive Models (GAMs) were used to model the feeding behavior response to temperature, and number of histopathological conditions were correlated with temperature through Generalized linear model (GLM).

RESULTS

The water temperature increased from 14.4°C in March to 27.6 °C in July. In response to this increase, mussels reduced both their clearance (CR) and absorption rates (AR). The CR exhibited a pronounced decline as temperature increased, followed by a stabilization around 20°C, suggesting a non-linear physiological response to thermal stress (Fig. 3A).



Figure 1. Map of the study area.



Figure 2. Filter feeding device for the physiological studies.

Nonetheless, the AR which is dependent on the organic content of the water, decreased linearly with rising temperatures, indicating a consistent negative physiological response when water quality is also considered (Fig. 3B).

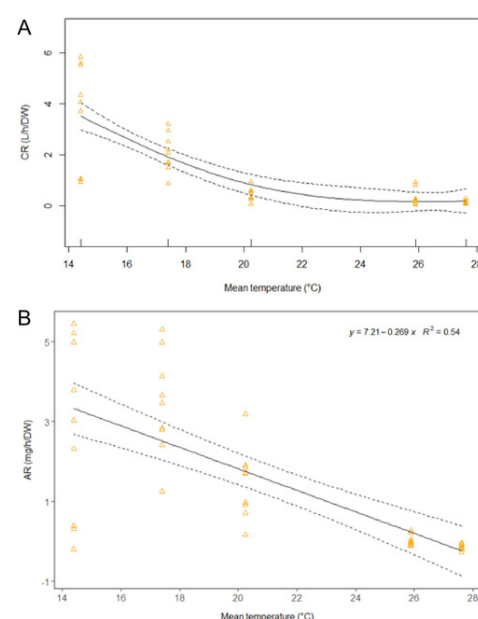


Figure 3. Clearance rate (CR) related to the temperature (A). Absorption rate (AR) related to the temperature (B).

The health condition of mussels worsened with increasing temperatures ($p < 0.001$). Baseline histopathological conditions were presence of diapedesis (infiltration of hemocytes in the digestive gland and gills; Fig. 4A), parasites (Fig. 4B), ceroidosis (accumulation of lipofuchsin pigment), and degeneration of the digestive gland, which prevalence increased in the month of July being diapedesis and ceroidosis the most common ones (Fig. 5).

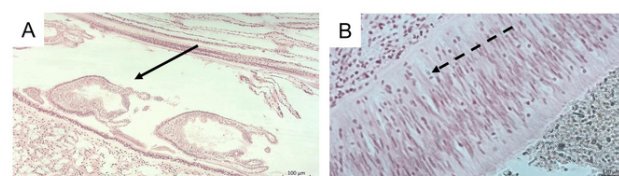


Figure 4. Section of mussel tissue. Gills, solid arrow pointing at parasites (A). Digestive gland, dashed arrow pointing at diapedesis (B).

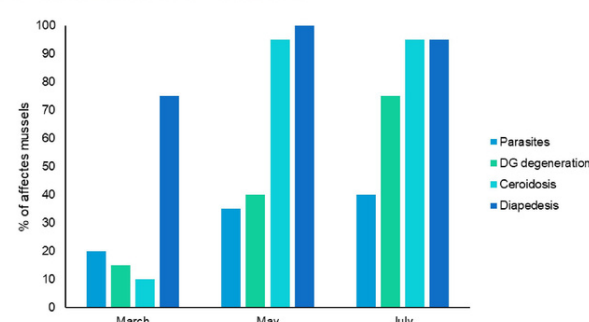


Figure 5. Proportion of mussels affected by different histopathological conditions throughout the experiment. DG: Digestive gland.

DISCUSSION

These results are similar to what found for the same species and specific area (Galimany et al., 2011) about 20 years ago, where physiological performance decrease significantly when temperatures exceed 20°C. The novelty of the finding is the determination of the several histopathological conditions which increase in time as temperature rises. In a context of climate change, these findings highlight the sensitivity of mussels' behavior to thermal stress, emphasizing the potential impact of rising temperatures on the species' performance, survival and aquaculture production.

Bibliography: Galimany et al. (2011). Aquaculture, 314(1–4), 236–243. <https://doi.org/10.1016/j.aquaculture.2011.01.035>

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