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Microbial plankton size matters for mussels

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Summary

The Rías Baixas (NW Iberian Peninsula) are four bays with the highest mussel production in Europe and one of the most important in the world. This high mussel production is related to the presence in the water column of large microbial plankton species, as mussel organic ingestion rate (OIR) and absorption efficiency (AE) are strongly correlated with microplankton carbon content. Dominance of microplankton (mainly diatoms) in the microbial plankton community of the Rías regularly occurs from spring to autumn due to seasonal upwelling. The intrusion and progressive uplift of subsurface nutrient-rich water is enhanced into the Rías Baixas due to their bathymetry, promoting diatom growth. In contrast, microplankton dominance in the adjacent shelf waters is restricted to strong upwelling events. Nanoplankton prevails in these adjacent shelf waters during the major part of the year, with picoplankton attaining higher importance under non-upwelling conditions. A potential future decline in coastal upwelling intensity due to global warming can lead to a decrease in microplankton dominance and consequently a drop in mussel production inside the Rías.

Introduction

Nutrient supply to the photic layer promotes the proliferation of large phytoplankton (mainly diatoms) in coastal zones affected by upwelling. With seasonal and short-term variability characterising coastal upwelling zones, large plankton species are more important during upwelling events. In the NW Iberian margin upwelling favourable northerly winds blow from April to September whereas downwelling favourable southerly winds predominate between October and March. Published data on mussel physiology (Zuñiga et al. 2013) and microbial plankton composition (Froján et al. 2014) in the Rías Baixas were gathered to draw a picture highlighting the strong dependence of mussel production on microplankton abundance.

Materials and Methods

Physiological rates of *Mytilus galloprovincialis* were studied *in situ* at a mussel raft under environmental conditions of food availability (Zuñiga et al. 2013). Organic ingestion rate (OIR, mg h^{-1}) was calculated as the product of clearance rate and food concentration. AE was estimated after determining organic and inorganic content of food and faeces. Microbial plankton composition and biomass in the Rías and in shelf waters were determined through identification and counting species by microscopy (Froján et al. 2014). Particulate organic carbon (POC) and chlorophyll *a* (Chl *a*) were also determined.

Results and discussion

Mussel physiological rates (OIR and AE) displayed an evident dependence on quantity of available food (Fig. 1), and although both rates showed stronger dependence on microbial plankton carbon (PC) it was specifically strongest for AE. At the same time, significantly lower biomass of microplankton (by 46 ± 32%) and nanoplankton (by 35 ± 22%) was observed within rafts when compared to biomass values outside the rafts (Frojan et al. 2014). Picoplankton biomass did not differ between sites. These results clearly point to the importance of food quality and specifically microbial plankton content for mussel growth in the Rías Baixas.

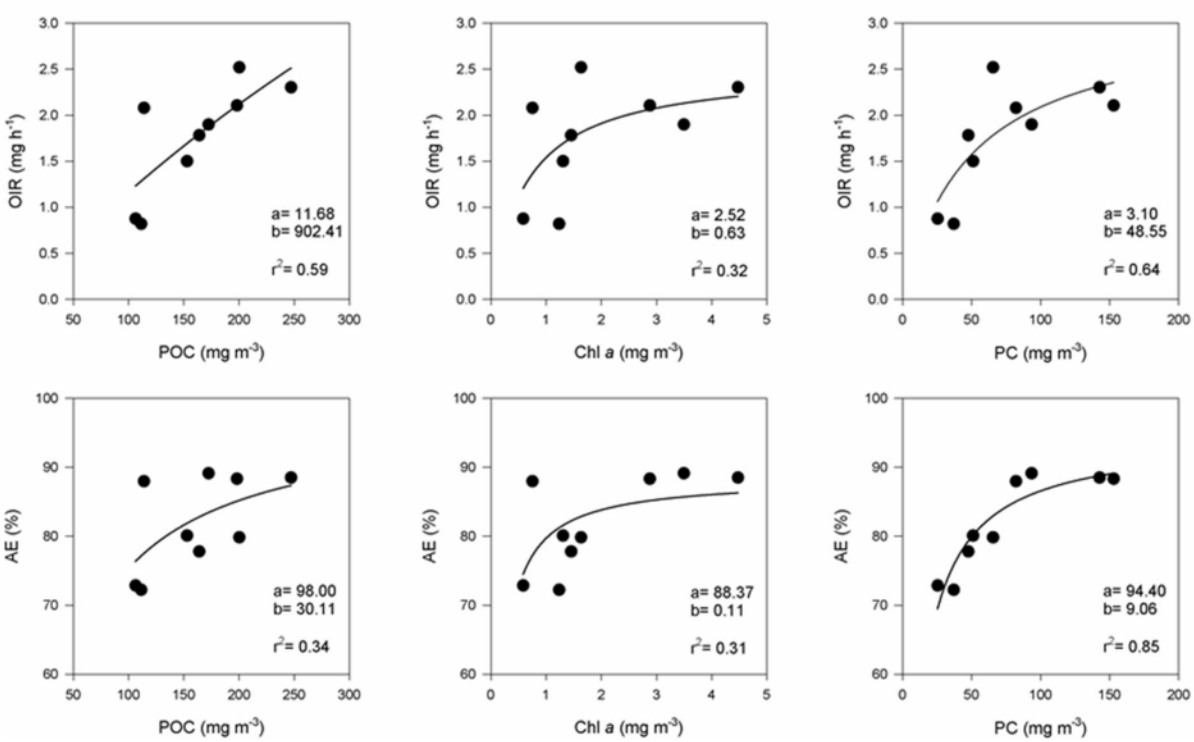

Figure 1. Relationships of organic ingestion rate (OIR) and absorption efficiency (AE) of mussels with particulate organic carbon (POC), chlorophyll *a* (Chl *a*) and microbial plankton carbon biomass (PC) recorded in the Ría de Vigo. Data were adjusted by the hyperbolic equation $y = ax / (b + x)$.

In the Rías Baixas micro- and nanoplankton (Fig. 2a) are abundant during the upwelling season, while picophytoplankton is always present in very low abundance (Fig. 2b). This contrast with the situation commonly found in the adjacent shelf waters where nano- and picoplankton prevails over the year with microplankton increasing their abundance only during upwelling events. According to these results it sounds convincing to hypothesise that under a probable future scenario with lower upwelling intensity and frequency (Álvarez-Salgado et al. 2008) mussel food (micro- and nanoplankton) should decline and mussel production would be considerably reduced.

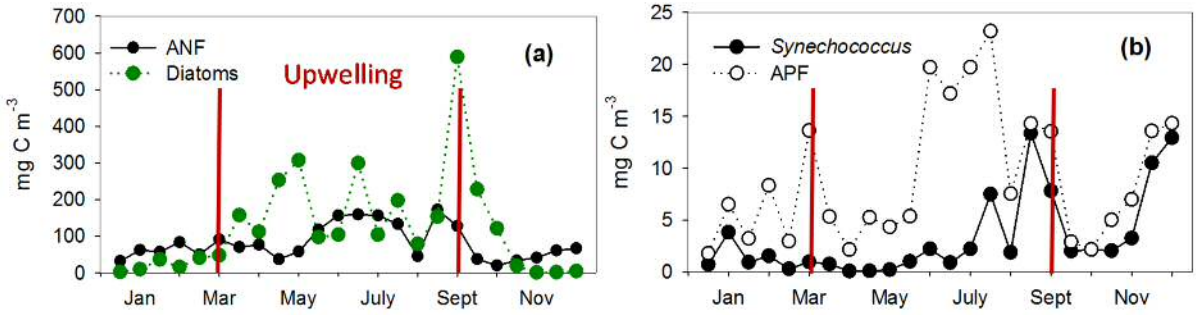

Figure 2. Seasonal variability of (a) micro- and nanophytoplankton biomass and (b) picophytoplankton biomass in the Ría de Vigo. (ANF) autotrophic nanoflagellates; (APF) autotrophic picoflagellates. Upwelling season is denoted by vertical red lines.

References

Álvarez-Salgado, X.A., Labarta, U., Fernández-Reiriz, M.J., Figueiras, F.G., Rosón, G., Piedracoba, S., Filgueira, R., Cabanas, J.M. 2008. Renewal time and the impact of harmful algal blooms on the extensive mussel raft culture of the Iberian coastal upwelling system (SW Europe). Harmful Algae 7, 849-855.

Froján, M., Arbones, B., Zúñiga, D., Castro, C.G., Figueiras, F.G. 2014. Microbial plankton community in the Ría de Vigo (NW Iberian upwelling system): impact of the culture of *Mytilus galloprovincialis*. Marine Ecology Progress Series 498, 43-54

Zúñiga, D., Froján, M., Castro, C.G., Alonso-Pérez, F., Labarta, U., Figueiras, F.G., Fuentes-Santos, I., Fernández-Reiriz, M.J. 2013. Feedback between physiological activity of *Mytilus galloprovincialis* and biogeochemistry of the water column. Marine Ecology Progress Series 476, 101-114.