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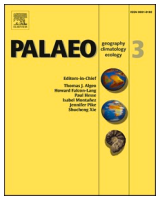

Mytilus galloprovincialis shell growth – Insights from shell geochemistry

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ABSTRACT

Despite the wide geographic distribution of mussels and their importance in fisheries and aquaculture, understanding of temporal and spatial variations of their growth is still limited. This can be, at least partly, attributed to the lack of distinct growth lines in their shells. Our study uses geochemical properties of shells, particularly oxygen ($\delta^{18}O_{shell}$) and carbon ($\delta^{13}C_{shell}$) stable isotope values, to reconstruct mussel growth. *Mytilus galloprovincialis* specimens were collected from two of the most important bivalve aquaculture sites in the eastern Adriatic - Krka River estuary and Mali Ston Bay. The first site has variable environmental conditions, influenced mainly by the Krka River, resulting in a strong temperature and salinity gradient along the estuary. In contrast, Mali Ston Bay is a relatively shallow enclosed bay with more stable conditions. Samples for $\delta^{18}O_{shell}$ and $\delta^{13}C_{shell}$ analysis were acquired by manual microdrilling cross-sectioned shells from three similar sized shells from each site. In addition, analysis of elemental profiles (Mg/Ca, Sr/Ca, and Ba/Ca) in shells from the Krka River estuary was conducted using laser ablation ICPMS. Temperature and salinity values were obtained for each site through research and monitoring projects and used to calculate predicted $\delta^{18}O_{shell}$ values. By aligning the measured $\delta^{18}O_{shell}$ data along the predicted $\delta^{18}O_{shell}$ curve, it was possible to reconstruct the timing and rate of seasonal shell growth. Results show that *M. galloprovincialis* shell deposition slows down and/or ceases during high temperature and low salinity periods. Specimens from the Krka River estuary had faster shell growth rates and were characterised by higher $\delta^{13}C_{shell}$ values. Mg/Ca profiles of *M. galloprovincialis* specimens from the Krka River estuary, confirm growth periodicity data obtained by $\delta^{18}O$ analysis. Ba/Ca peaks were also discussed by comparison with $\delta^{13}C$ time-series and environmental data. Results have potential applications in fisheries studies as well as in palaeoecology and palaeoceanography research.

1. Introduction

The Mediterranean mussel, *Mytilus galloprovinciallis* Lamarck, 1819 is a commercially important mussel species that is widely distributed in many temperate and subtropical regions, as a result of its natural expansions as well as human activities (Westfall et al., 2010). It is an interesting target species from several perspectives, including aquaculture production (e.g., Sarà et al., 2009; Cubillo et al., 2012; Babarro et al., 2020), marine conservation and management (e.g., Forrest and Atalah, 2017; Lins et al., 2021; Puccinelli et al., 2022) as well as provenance proxy (Milano et al., 2020; del Rio-Lavín et al., 2022; Milano et al., 2022). Furthermore, this species is found at archaeological sites along the Mediterranean coast and can provide important insights into the behaviour of past human populations as well as palaeoecological issues (Barut et al., 2016; Cortés-Sánchez et al., 2019; Verdún-Castelló and Casabó i Bernad, J, 2020).

Despite its ecological and anthropogenic importance, high-resolution shell growth pattern data for *M. galloprovincialis* are relatively scarce. Shell growth pattern analysis of mussels is typically challenging, irrespective of whether thin-section or acetate peel replicas are studied (Richardson, 1989). This is because of the steep angle at which the micrometer-sized growth lines are aligned in the outer shell layer relative to the myostracum and outer shell surface. Other sclerochronological methods used for the analysis of the shell material

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