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ORIGINAL PAPER

Growth and longevity of *Lithophaga lithophaga*: what can we learn from shell structure and stable isotope composition?

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Abstract Longevity of bivalves has been an intriguing issue, especially for those species of interest for human consumption. Reliable age and growth estimates often require the combination of several methods. In this study, we analyzed changes in shell structure including ridges on the external shell surface and growth lines observed in acetate peel replicas of shell sections of the European date mussel *Lithophaga lithophaga*, as well as the oxygen and carbon isotope values (δ^{18}O and δ^{13}C) of the shell. High variations in growth rates between individuals were noted. Ontogenetic ages of analyzed shells varied from 10 to 54 years (30.6–93.6 mm). According to results of generalized von Bertalanffy growth function, L_∞ was 107.6 mm, and k was 0.03 year^{-1}. δ^{18}O results strongly suggest that growth ridges visible on the external shell surface of *L. lithophaga* are formed annually. The δ^{18}O values ranged from −0.2 to 2.7 ‰ ($\bar{x} = 1.15 \pm 0.72$ ‰), which equates to a temperature range of 13 °C. The reconstructed seawater temperatures ($T_{\delta 18Oshell}$) ranged between 12 and 25 °C, a range in good agreement with measured temperature. Stable carbon isotope values decreased through ontogeny and ranged between −2.05 and 2.32 ‰ ($\bar{x} = 0.01 \pm 0.89$ ‰). Results of this study provide the first stable isotope data for *L. lithophaga* shells and show the potential of this species as a geochemical sclerochronological archive.

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Introduction

Bivalves are one of the most ecologically diverse marine taxa. Members of this class live from the intertidal zone all the way to the deep sea hydrothermal vents at depths >3000 m, from sheltered to exposed habitats, and from brackish to saline environments (Gosling 2003). Bivalves range in size from <1 mm (e.g., *Benthocardiella striatula*) to more than 120 cm (*Tridacna gigas*) (Abele et al. 2009; Haszprunar and Wanninger 2012). They exhibit different life styles including being permanently attached to the hard substrate, and burrowing in soft substrates, as well as free swimming (Gosling 2003). Diversity in Class Bivalvia is also evident in extreme variations in longevity between species, from small warm water *Donax* clams that live ~1 year (for review see Powell and Cummins 1985) to *Neopycnodonte zibrowii* (Wisshak et al. 2009) and *Arctica islandica* (e.g., Butler et al. 2013; Schöne 2013) that have been documented to live for over 500 years.

Longevity of bivalves has been an intriguing issue, especially for those species of interest for human consumption. Many commercially interesting bivalves have been studied in great detail, from the ecological stand point, as well as from the stand point of stock management and their potential for aquaculture production. The European date