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Shell Growth History of Geoduck Clam (*Panopea abrupta*) in Parry Passage, British Columbia, Canada: Temporal Variation in Annuli and the Pacific Decadal Oscillation

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An assemblage of geoduck clam shells from the marine environment of coastal British Columbia was studied. Shells were cut and the widths of internal shell growth increments, annuli, were measured from the hinge plate. The largest shells showed more than one hundred annual increments. Shell growth exhibited juvenile maxima at ontogenetic ages 3–6 years. The growth maximum was followed by a distinct decline that continued until the death of each individual. Further, this ontogenetic growth trend was mathematically removed from the data in order to examine growth variations other than ageing. The longest growth records from the oldest shells were compared to monthly indices of the Pacific Decadal Oscillation (PDO). It was found that the PDO exerts the strongest influence on the shell growth during the very start of the growing season, in February and March. We also detected increased magnitude of growth variations towards the end of the 20th century. Similar trends were apparent in the PDO record. Moreover, the shell specimen displaying the strongest trend of increasing variance had the strongest PDO-linked regional growth signal. Our results support the view that PDO exerts a governing influence on the biological and ecological system along Northeast Pacific coastal areas. Incorporation of geoduck shell growth increment analyses into multi-disciplinary studies dealing with palaeoceanography and archaeology is suggested as a promising future approach.

Keywords:
· Biological oceanography,
· climate,
· Bivalvia,
· growth rate,
· variability.

1. Introduction

The climate influences ecological processes in time and space. It may cause notable variations in growth and population dynamics at the regional scale, and may synchronize the variations of distant populations (Post and Forchhammer, 2002; Post, 2003; Ottersen *et al*., 2004). In the North Pacific sector, the primary climatic forcing of ecological processes comes from the Pacific Decadal Oscillation (PDO) (Mantua *et al*., 1997; Zhang *et al*., 1997; Mantua and Hare, 2002). The PDO is a spatiotemporal pattern of sea surface temperature variations in the North Pacific. The warm phases of the PDO tend to be anomalously cool in the central North Pacific but are accompanied by warming along the west coast of the Americas. This phase is also associated with the low sea level pressure anomalies over the North Pacific and high sea level pressures over the northern subtropical Pacific (Mantua *et al*., 1997; Zhang *et al*., 1997; Mantua and Hare, 2002). As a consequence, the PDO strongly influences marine ecosystems. In their principal component analysis, Hare and Mantua (2000) analyzed a matrix of 100 climatic and biological time series from the North Pacific. Their climatic series represented the atmosphere and ocean across the North Pacific with the biological time series ranging across all trophic levels. The study concluded that the dominant principal component had the same time trajectory as the PDO, thus implying a common climatic forcing of various ecological processes due particularly to the PDO.

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