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Ecology and shell chemistry of *Loxoconcha matagordensis*

T.M. Cronin [a,*], T. Kamiya [b], G.S. Dwyer [c], H. Belkin [a], C.D. Vann [a], S. Schwede [a], R. Wagner [a]

[a] *926A US Geological Survey, Reston VA, 20192, USA*
[b] *Department of Geological Sciences, Kanazawa University, Kanazawa, Japan*
[c] *Nicholas School of the Environment, Earth and Ocean Sciences, Duke University, Durham, NC, 27708, USA*

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Abstract

Studies of the seasonal ecology and shell chemistry of the ostracode *Loxoconcha matagordensis* and related species of *Loxoconcha* from regions off eastern North America reveal that shell size and trace elemental (Mg/Ca ratio) composition are useful in paleothermometry using fossil populations. Seasonal sampling of populations from Chesapeake Bay, augmented by samples from Florida Bay, indicate that shell size is inversely proportional to water temperature and that Mg/Ca ratios are positively correlated with the water temperature in which the adult carapace was secreted. Microprobe analyses of sectioned valves reveal intra-shell variability in Mg/Ca ratios but this does not strongly influence the utility of whole shell Mg/Ca analyses for paleoclimate application.
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Keywords: Ostracoda; Shell chemistry; Ecology

1. Introduction

The application of ostracode shell trace element chemistry to paleoenvironmental reconstruction requires an understanding of processes that influence the chemical composition of the calcitic shell. In the case of magnesium uptake into the shell (measured by Mg/Ca ratios), the most important factors include water temperature (Cadot and Kaesler, 1977; Chivas et al., 1986; Corrège, 1993; Dwyer et al., 1995; Corrège and De Deckker, 1997), salinity and water chemistry (Engstrom and Nelson, 1991; Wansard et al., 1998; Dwyer and Cronin, 2001; Holmes and Chivas, 2002) and ostracode metabolism (Chivas et al., 1983; De Deckker et al., 1999). Equally important for application to paleoclimate reconstruction is knowledge of a species' seasonal population ecology because this will determine under what conditions the species secretes its adult shell. If both the processes and environmental factors controlling the uptake of magnesium and the timing of adult molting are known, the ostracode can provide a powerful tool for the study of interannual and decadal-scale climate variability.

The genus *Loxoconcha* is potentially an ideal ostracode for paleoenvironmental reconstruction using ecol-

* Corresponding author.
E-mail address: tcronin@usgs.gov (T.M. Cronin).

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ogy and shell chemistry in middle and low latitude coastal environments. *Loxoconcha* first appeared in the Paleogene, is common in Cenozoic fossil assemblages, and today has a cosmopolitan distribution. Kempf (1986) estimates that the genus is represented by more than 150 living species and 350 fossil species. Thus, the development of a quantitative temperature–magnesium/calcium relationship for *Loxoconcha* would be important for shallow-water Cenozoic paleoceanography.

The current paper is an integrated study of the ecology, morphology, and shell chemistry of the epiphytal species *Loxoconcha matagordensis* (Swain, 1955) from Chesapeake Bay (Fig. 1). *Loxoconcha matagordensis* is a dominant species in shallow coastal habitats along the North American Atlantic and Gulf coasts where it lives primarily on blades of the seagrass *Zostera marina* at salinities ranging from ~15 to 30 ppt. This species was first reported from Chesapeake Bay by Tressler and Smith (1948) as *Loxoconcha impressa* (Baird), and formally described by Swain (1955) from Texas bays. It has since been the subject of several ecological studies (e.g., Morales, 1966; King and Kornicker, 1970).

In the first part of this paper, we present ecological (population structure, density) and morphological (carapace length) data from monthly and bimonthly sampling during 1999–2000 from Guinea Marsh and Goodwin Island at the mouth of the York River, a tributary entering southern Chesapeake Bay, Virginia (Fig. 2). Supplementary material from Florida Bay was also used to examine the carapace length–temperature relationship in *Loxoconcha matagordensis*. In the second part, we present evidence for temperature control of magnesium/calcium ratios obtained by direct current plasma (DCP) emission spectrometry for adult *Loxoconcha matagordensis* from the York River samples. In addition to *Loxoconcha matagordensis*, measurements were also made on *Loxoconcha* sp. from the main channel of Chesapeake Bay and the continental shelf off the bay's mouth, and *Loxoconcha impressa* from the continental shelf. We also present evidence for intra-shell variability in Mg/Ca ratios obtained by electron probe microanalyzer (microprobe). In a companion paper the ecological and Mg/Ca shell calibration presented here are applied to the reconstruction of 2200 year temperature record of Chesapeake Bay (Cronin et al., 2003).

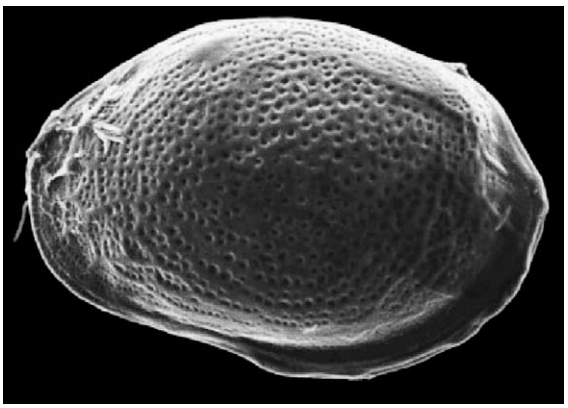

Fig. 1. Scanning electron photomicrograph of female left valve of *Loxoconcha matagordensis*. Shell is about 600 μm in length.

2. Materials and methods

Guinea Marsh and Goodwin Island are located at the mouth of the York River, a tributary to the large partially mixed temperate estuary Chesapeake Bay. The two sites are characterized by healthy beds of the seagrass *Zostera marina* which have been monitored for seagrass and water quality by scientists at the Virginia Institute of Marine Sciences (VIMS) for more than a decade (Moore and Berry-Niekirk, personal communication). Thus, they provide an ideal natural laboratory to examine seasonal variability in ecology, morphology, and shell chemistry of *Loxoconcha matagordensis*.

Sampling of *Zostera* beds living in ~1 m water depth at Guinea Marsh and Goodwin Island (Fig. 2) was carried out from February 1999 to December 2000 by the U.S. Geological Survey (USGS) in cooperation with VIMS. *Zostera* samples were taken monthly during fall and winter and bimonthly during spring and summer. During 1999, *Zostera* was collected either by hand or from material brought up on the ship's anchor. Because some samples did not yield abundant ostracode specimens, a different method was used during 2000, whereby *Zostera* was collected using a post-hole device lowered into the water to scoop up sediment and growing seagrass. After collection, *Zostera* blades were quickly separated from bottom sediment so that epiphytal species could be separated from those living on the bottom. Separate *Zostera* and sediment samples were then shipped overnight in plastic sample bags sealed in cooled containers to the USGS ostracode lab in Reston, VA. Water salinity and temperature were taken at the time of sampling. It is noteworthy that the 2-year