Ecological Succession within a Holocene Oyster Reef: An Indicator of Estuary Development in Southwest Florida

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Abstract

Southwest Florida’s coastal geomorphology and estuarine ecology depend upon the proliferation of oyster reefs; yet little is known about timing and environmental detail of coastal development. This study considers the paleontological and taphonomical history of the Holocene development of a vermetid gastropod-estuarine oyster (Crassostrea virginica) reefal succession within an archipelagic region of Estero Bay. Six stratigraphic cores, spanning 2710 years of history, were studied stratigraphically and sedimentologically; one core’s paleontological and taphonomical characteristics were analyzed intensively. reef construction is dominated through much of history (~2700–500 ybp) by sessile vermetiform gastropods; oysters co-occur with gastropods so as buildings begin at ~2100 ybp; ultimately systems build reefs exclusively from ~500 ybp until present. Patterns in faunal assemblages and in taphonomy support a shift from more marine, higher energy settings during the vermetiform-only phase to more brackish and protected conditions through the successional change to oyster-only frame building. Assemblages during the oyster-only phase contain euryhaline species, while the vermetiform-only and mixed phases contain stenohaline, marine taxa. The taphonomic grade of vermetiform gastropods improves upsection, supporting a more protected embayment through time. Patterns in oyster taphonomic grade are more equivocal, though there was a preservational quality improves upsection. Analysis of biocorrosion and bioencrustation, characteristics indicative of marine conditions, does not support the transition to more estuarine conditions, while those indicative of time averaging (margin loss, coloration, luster) suggest increasingly lower energy conditions throughout. Finally, development of marine to estuarine transition is supported by the modern distribution of vermetids and C. virginica. A core taken more distally and behind the current barrier island indicates that Estero Bay existed as an open coast in the recent past. The reef succession in the barrier island’s wake monitors the timing of estuarine development and perhaps the timing of island formation. This research demonstrates the value of studying proximal depositional settings to infer the history of estuaries.

Stratigraphic Analysis

Two core sites (Core A and C) were selected from Oyster Reef Cores. Horseshoe Keys is located off the coast of Florida, between latitude 26°20’N, longitude 81°45’W, and 24°30’N, longitude 85°00’W. Distance from the coast in the easternmost site is 1.5 km, the depth of water in the area is 1.5 m. The outcrop is 1.3 km wide, 1 km long, 0.4 m thick, and 0.3 m wide. The core suggests calmer energy conditions indicative of a more protected setting.

Taphonomic Analysis

Oysters > 3 cm in length and vermetiform gastropods > 2 cm in length were selected from the harvested material for taphonomic analysis.

• Specialized taphonomic grading scales were developed for oysters and vermetiform gastropods.

Grades range from one for the best preserved shells to four for the worst preserved shells for both oysters and vermetiform gastropods.

• Each oyster shell was evaluated for individual characteristics as well as for overall condition.

• Vermetiform gastropods were categorized into large cluster, small cluster, individual, and hash and then overall grades were assigned to large and small clusters and individuals only.

Vermetid Taphonomy: Percent Clumps Within a Horizon

Pit diagrams showing the transition of reef building organisms within core 0602-1 from vermetiform-dominated facies (C1) to an mix of vermetiform gastropods and oysters (facies C2) to facies that contain exclusively oysters (facies A and B). Bar graph showing the transition of reef building organisms within core 0602-1 from vermetiform-dominated facies (C1) to an mix of vermetiform gastropods and oysters (facies C2) to facies that contain exclusively oysters (facies A and B).

Discussion

Stratigraphy

The stratigraphy of Core 0602-1 illustrates a transgressive environmental progression through time from supratidal uplands, to intertidal swamp, to subtidal mudflat, and finally to protected estuarine sediments. The lower three horizons of core 0602-1 display supratidal to intertidal environmental conditions, and the upper three horizons are characterized by a sequence of intertidal to shallow subtidal environments.

Taphonomy: a more protected embayment through time. Patterns in oyster taphonomic grade are more equivocal, though there was a preservational quality improves upsection. Analysis of biocorrosion and bioencrustation, characteristics indicative of marine conditions, does not support the transition to more estuarine conditions, while those indicative of time averaging (margin loss, coloration, luster) suggest increasingly lower energy conditions throughout. Finally, development of marine to estuarine transition is supported by the modern distribution of vermetids and C. virginica. A core taken more distally and behind the current barrier island indicates that Estero Bay existed as an open coast in the recent past. The reef succession in the barrier island’s wake monitors the timing of estuarine development and perhaps the timing of island formation. This research demonstrates the value of studying proximal depositional settings to infer the history of estuaries.

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