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# MACROFAUNAL BENTHIC INVERTEBRATE COMPOSITION OF MERMAID POND, AN ANCHIALINE LAKE ON SAN SALVADOR ISLAND, BAHAMAS

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## ABSTRACT

Mermaid Pond is a component of an interconnected series of inland lakes in southeastern San Salvador Island. As part of a larger investigation of Mermaid Pond, macrofaunal benthic invertebrate assemblages were examined during the spring and summer of 2004 and 2005. Physical conditions (as reported elsewhere in this volume) indicated that water exchange through multiple conduits provides marine conditions that support a totally marine assemblage of flora and fauna. Infaunal invertebrates consisted mainly of bivalve molluscs, polychaetes, and amphipods. The assemblage of living molluscs was initially different from that reported for other anchialine ponds on San Salvador. In addition, gastropod molluscs reported from other inland lakes were only found as dead components of the shell-hash dominated sediments. However, following Hurricane Frances, two additional gastropod species were observed living on the substrate. Epifaunal invertebrates were dominated by the anemone *Aiptasia pallida* and the bivalve *Pinctada imbricata*. The predominance of *A. pallida*, which is primarily a suspension feeder, may be due to the presence of symbiotic zooxanthellae. In general, epifauna were restricted to the shallow pond margins with reduced densities in deeper waters. As in other conduit-fed anchialine bodies of water on San Salvador, invertebrate species diversity was low, suggesting that larval transport through conduits and the seasonal connection to Stouts Lake may be limited. This limited dispersal may be a major factor determining species composition.

## INTRODUCTION

Anchialine ponds and lakes, which are landlocked bodies of water connected to the ocean via subterranean conduits, typically possess distinctive and isolated faunal components. These ecological "islands within islands" often exhibit reduced ecological diversity and may be dominated by just a few groups of invertebrates (Aaronson & Harms, 1985; Brock, 1987; Edwards, 1996).

A central feature of San Salvador Island is the presence of numerous inland lakes and ponds, which are marine to hypersaline in nature (Davis & Johnson, 1989). The extant faunal components of several of these bodies of water have been described and reviewed in previous studies. However, only mollusc-dominated assemblages have been sufficiently examined to permit comparisons between marine lakes (Edwards, 2001). Fossil mollusc assemblages have also been studied to differentiate inland and coastal environments during previous glacial and interglacial sea level stands (Hagey & Mylroie, 1995).

Mermaid Pond, located in southeastern San Salvador, was initially surveyed by Winter (1993), who reported normal marine conditions fed by karst conduits. Similar to other conduit-fed lakes and ponds on San Salvador, Mermaid Pond exhibits a reduced tidal range and tidal fluctuations that lag behind ocean tides (Winter, 1993; Teeter, 1995). Winter (1993) also provided an initial faunal survey of this pond and reported a surface flow connection to Stouts Lake to the north.

The purpose of this study was to examine the species composition of infaunal and epifaunal invertebrate assemblages in Mermaid

Pond. Additionally, the data were compared with that of other anchialine lakes and ponds on San Salvador to better ascertain faunal relationships between these isolated bodies of water.

## MATERIALS AND METHODS

Fieldwork was conducted during May and June 2004, and again in May 2005. The results of physical measurements and the physical features of Mermaid Pond are presented in Button *et al.* (this volume).

### Infaunal Sampling

Fourteen sediment samples were obtained in triplicate with a 15 cm diameter PVC corer to examine infaunal invertebrate composition. Samples were field-sieved through 0.5 mm mesh and sorted in the laboratory. All live material was fixed in Safefix-II for further study and identification. Core samples were restricted to shallow areas around the pond margin where sufficient sediments were present.

### Epifaunal Sampling

Surveys of epifaunal macroinvertebrates were conducted by snorkeling using a 0.25 m<sup>2</sup> quadrat. Six replicates were taken at each of 10 sample sites, with the species abundance data transformed to square meters. Representatives of the dominant epifauna observed were collected for later identification in the laboratory.

## RESULTS AND DISCUSSION

Mermaid Pond is a conduit-fed inland marine lake. More detailed information on the environmental setting and physical characteristics of Mermaid Pond have been reported elsewhere (see Button *et al.* this volume).

## Infauna

Infaunal benthic invertebrates collected included bivalve molluscs, polychaetes, and amphipods. The polychaete *Arenicola cristata* was abundant in soft sediments around the pond margins. Although amphipods were not identified to species level, members of the suborders Gammaridae and Ingolfiellidea were recorded from core samples. The infaunal mollusc assemblage included only the bivalves *Anomalocardia auberiana*, *Codakia orbiculata*, and *Tellina mera*. No living gastropods were recorded as infauna.

## Epifauna

Epifaunal invertebrates in Mermaid Pond were dominated by the bivalve *Pinctada imbricata* and the Cnidarian *Aiptasia pallida* (Figures 1 and 2). Poriferans (not yet identified) were also observed in patchy distributions. We also observed numerous *A. pallida*, *P. imbricata*, *Isognomon alatus*, and *Branchiodontus exustus* attached to prop roots of *Rhizophora mangle*, which supports earlier observations by Winter (1993).

*Pinctada imbricata* was abundant on the surface of the flocculent layer, which was the predominant substrate in the shallower margins of the pond. This flocculent layer was up to 0.5 m in depth and exhibited reduced levels of dissolved oxygen. The utilization of the flocculent layer as a substrate by *P. imbricata* is relatively unique. This distribution pattern has been termed "epibenthic infauna" by Edwards (1996) and may represent an unusual adaptation to local environmental conditions.

*Aiptasia pallida* was also common on the marginal flocculent layer, with reduced abundance in deeper waters. The predominance of *A. pallida*, which is primarily a suspension feeder, may be due to the presence of symbiotic zooxanthellae, which are common in many tropical marine Cnidarians. These photosynthetic symbionts may be nutritionally important to their host species (Day, 1994). The great abundance of *A. pallida*, a Cnidarian, contrasts

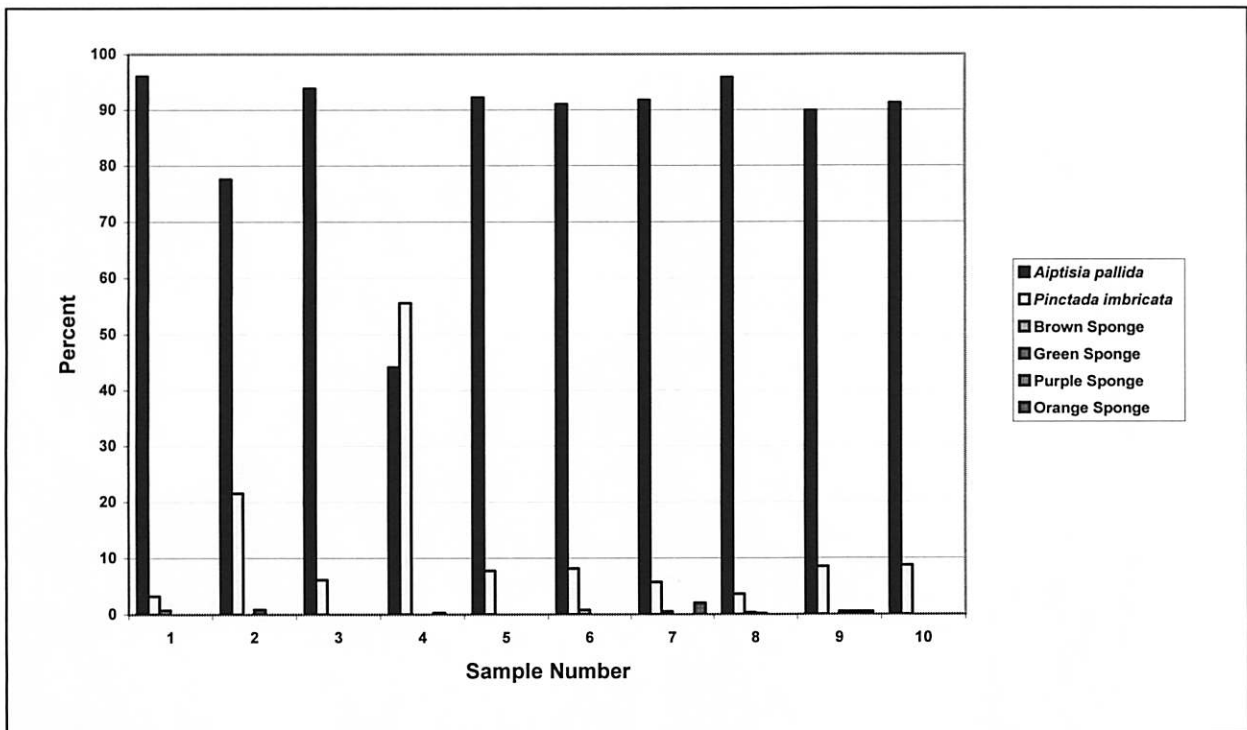


Figure 1. Abundance of epifaunal invertebrates observed in Mermaid Pond.

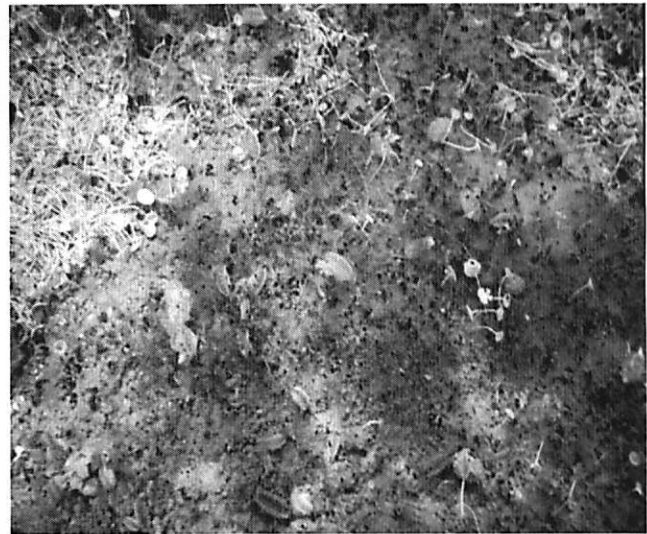
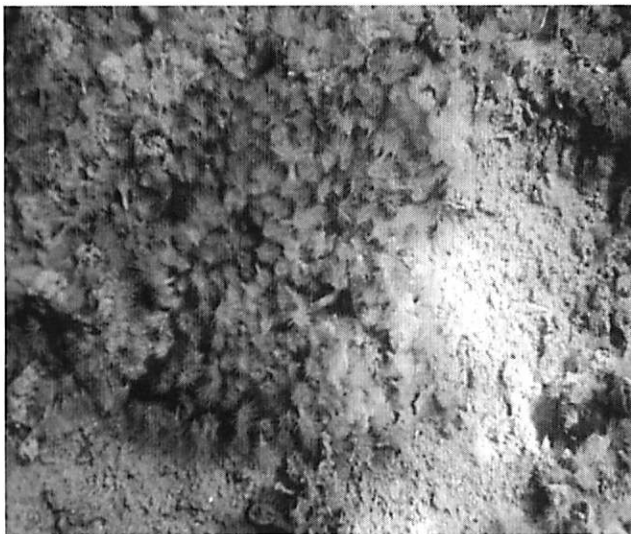


Figure 2. Predominant epifaunal invertebrates present in Mermaid Pond, including *Aiptasia pallida* (above left) and *Pinctada imbricata* (above right).

with Edwards' (1996) observations that molluscs generally dominate invertebrate assemblages in most lakes on San Salvador.

#### Mollusc Assemblages

Six species of bivalves were found to comprise the living assemblage of Molluscs in Mermaid Pond (Figure 3 and Table 1), with *I.*

*alatus* and *P. imbricata* the most abundant of those recorded.

Edwards *et al.* (1990) compared mollusc assemblages among inland bodies of water that exhibited different salinity regimes and identified five species based on occurrence and abundance (*A. auberiana*, *Polymesoda maritima*, *Batillaria minimia*, *Cerithidea costata* and *Cerithium lutosum*) as a core mollusc group



Figure 3. Representative examples of living *Mollusca* present in Mermaid Pond. Above from left: *Pinctada imbricata*, *Tellina mera*, and *Isognomon alatus*. Bottom from left: *Codakia orbiculata*, *Branchiodontes exustus*, and *Anomalocardia auberiana*.

for comparative purposes. Edwards also reported a greater incidence of gastropods from the core group in lakes of marine salinities (Edwards, 2001). Although Mermaid Pond fit this marine classification, no living gastropods were recorded during our initial study (Table 1).

In addition, bivalve representatives of the core group (Edwards, 2001) were also poorly represented in Mermaid Pond (Table 1). We recorded five species of bivalves, only one (*A. auberiana*) of which was a member of the core group. Overall, the molluscan fauna of Mermaid Pond did not correspond to any of the previously reported distribution patterns in other inland marine lakes.

Fossil molluscs have also been used to infer circulation differences in inland and

coastal environments during previous glacial and interglacial sea level stands. Of the living and dead molluscs found in Mermaid Pond, only four species (*A. auberiana*, *B. minima*, *C. costata* and *C. lutosum*) were represented in the fossil *Anomalocardia auberiana* Assemblage proposed by Hagey and Mylroie (1995). This assemblage is indicative of Pleistocene lake environments that did not have direct surface connections to the sea (conduits) and may have been hypersaline to some degree. Members of this assemblage are typically found living in present day lakes and ponds, which may be a reflection of the complex interactions between changing sea levels and preexisting topographies (Hagey & Mylroie, 1995).

Table 1. Comparison of living Molluscs present in Mermaid Pond with the Core Mollusc Assemblage (Edwards 2001) and other mollusks found in other anchialine lakes on San Salvador.

		Edwards, 2001						Present Study
		Fully Marine S ≈ 35.0 ‰				Hypersaline S ≈ 45.0 ‰		
		Moon Rock Pond	Pain Pond	Crescent Pond	Oyster Pond	Osprey Pond	Reckley Hill	Mermaid Pond
Core Mollusc Assemblage	<b>Bivalvia</b>							
	<i>Anomalocardia auberiana</i>			R	C	A	A	C
	<i>Polymesoda maritima</i>						A	
	<b>Gastropoda</b>							
	<i>Batillaria minima</i>	R	R	A		C	C	*
	<i>Cerithidea costata</i>	C	A	R	A	R	C	
	<i>Cerithium lutosum</i>	A	A	C	C	C	A	*
Other Molluscs	<b>Bivalvia</b>							
	<i>Brachiodontes exustus</i>	C			A			C
	<i>Codakia orbiculata</i>	C	R	C				C
	<i>Tellina mera</i>	A		R	C			C
	<i>Gemma gemma</i>	R						
	Unknown <i>Abra</i> ?		R					
	<i>Isognomon alatus</i>				A			A
	<i>Pinctada imbricata</i>				C			A
	<b>Gastropoda</b>							
	<i>Bulla sp.</i>	R						
<b>Number of Species Present</b>		<b>8</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>4</b>	<b>5</b>	<b>6</b>

A = abundant (> 50 individuals); C = common (10-50 individuals); R = rare (<10 individuals)

\* = recorded post-Hurricane Frances

### Hurricane Effects

Brief observations on the faunal composition of Mermaid Pond were made in early May 2005, eight months after Hurricane Frances passed across San Salvador Island. In the southern portion of the pond, the flocculent layer was removed and clean shell hash sediment was visible. Ropes on surface floats that were deployed in June 2004 were heavily fouled with the bivalves *I. alatus* and *P. imbricata*. We observed numerous individuals

of the bivalves *I. alatus* and *B. exustus* inhabiting areas of clean sediment as “epifaunal infauna”. In our previous observations (discussed above), we recorded these species as epifaunal components only on the prop roots of *R. mangle*.

The gastropod *B. minima* was also common on the surface of the flocculent and on clean sediments where this layer had been removed. Additionally, the gastropod *C. lutosum* was observed on the flocculent layer in January 2006 (Eric Cole, pers. comm.). With the

exception of numerous dead shells, we did not record these species in our initial study.

With the addition of these two species, four of the five species that comprise the core mollusc assemblage typical of lakes with marine salinities are present in Mermaid Pond. This suggests that ecological conditions in the pond are suitable for rapid growth of these species.

Mermaid Pond was named for the abundance of *Acetabularia crenulata*, which was rare in our initial studies. Following the hurricane disturbance, *A. crenulata* was found in extensive carpets and covered a large area of the pond bottom. Although inconclusive, these observations suggest that pronounced weather events (such as hurricanes) might provide sufficient spatial disturbance to permit rapid colonization and succession of the resident invertebrate species.

## CONCLUSIONS

Infaunal invertebrates present in Mermaid Pond include bivalve molluscs, polychaetes, and amphipod crustaceans. The Cnidarian *A. pallida* and bivalve *P. imbricata* are the dominant invertebrate epifauna on the flocculent layer surrounding the pond margins. In this distribution, *P. imbricata* occupies an unusual position as "epifaunal infauna". Both species exhibited a decline in abundance in the deeper areas of the pond and were rare or absent in the areas surrounding the conduit mouths. Invertebrate species diversity is low and comparable to other marine ponds on San Salvador Island (Edwards, 2001; Whitelaw, 2001).

Initially, six species of living molluscs were collected in Mermaid Pond, but this increased to eight species following the hurricane event of 2004. Of the living and dead molluscs present, four species belong to the fossil *Anomalocardia auberiana* assemblage, which is indicative of Pleistocene lake environments that lack a free connection to the sea (Hagey & Mylroie, 1995).

The spatial distribution of organisms present in Mermaid Pond may be impacted by

the location and flow of the karst conduits, as has been observed in other conduit-fed ponds on San Salvador (Whitelaw, 2001). Turbulence from the conduits has removed the sediment layer from around the openings, allowing for exposure of the hard substrate surface, resulting in shell hash scattered around the far edges of the conduits. Additionally, even though conduit flow in Mermaid Pond is adequate to maintain marine conditions throughout the pond, the magnitude of the flow is insufficient to impact the flocculent layer comprising the pond margins.

The conduits probably play an important role in affecting the species composition of invertebrates in San Salvador's marine lakes. Further studies of conduit flow are needed to determine larval recruitment patterns and if larval residence times can be established within the conduits (Iliffe, 1986). Further, the change in species composition observed following the passage of Hurricane Frances suggests that episodic weather events might also promote dispersal between ponds of close proximity.

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