

MARINE BIOEROSION AND COMMUNITY ORGANIZATION ON CARONATE HARD SUBSTRATES OF SAN SALVADOR ISLAND, THE BAHAMAS

Celinda E.M. Brandt

Department of Geology, The College of Wooster, Wooster, Ohio 44691

Bioerosion is the active excavation of rock and shell material by the direct action of organisms (Neumann, 1966). Organisms erode hard substrates by mechanical or chemical means resulting in the formation of scrapes marks, borings, and other biological features. Bioerosion on marine carbonate hard substrates has intensified from the Paleozoic into the Cenozoic. Increased bioerosion, specifically boring activities, may result in substrate environments that are too unstable for most skeletal encrusters. This can effect the development and diversity of modern marine carbonate hard substrate communities. These communities are commonly dominated by a large number of fleshy, short lived algae that can endure the degradational processes. Bioerosion is a common process on the modern marine carbonate hard substrates of San Salvador Island, The Bahamas.

Four locations were studied on San Salvador Island: Man Head Cay, North Point, Fernandez Bay, and French Bay. The study sites were chosen depending on the origin and mineralogy of the carbonate hard substrate (calcitic and aragonitic beach rocks and eolianites), and the intensity of wave activity. Sampling at these locations was conducted along transect lines within the intertidal and subtidal zones. Quadrate countings were completed at Man Head Cay and North Point to estimate the abundances of vagrant grazing organisms within the intertidal zone.

A variety of algal species are primary encrusters on these hard substrates. Chlorophytes (green algae), phaeophytes (brown algae), and rhodophytes (red algae) are all found within the intertidal and subtidal zones. The most common chlorophyte is *Cladophoropsis membranacea*, the most common phaeophyte is *Padina*, and the most common rhodophyte is *Neogoniolithon affine*. The most abundant vagrant organisms in the intertidal zones of North Point and Man Head Cay include the gastropods *Littorina mespillum* and *Nerita versicolor* and the chiton *Acanthopleura granulata*.

Chiton fecal pellet composition and production rates were studied. Chitons may enrich the carbonate material that passes through their guts with aragonite. The range of sediment production by chitons in this study, between 445 gm/m²/year and 5321 gm/m²/year, is considerably more than the average sediment contribution of the boring sponge *Cliona*, which can amount to 250 gm/m²/year (Rützler, 1975). Neumann (1966) estimated intertidal *Cliona* bioerosion rates at 23700 gm/m²/year. When Neumann's (1966) data is compared to actual intertidal erosion rates calculated by Donn & Boardman (1988), it appears he overestimated the sediment production of *Cliona* by at least a factor of four.

These modern carbonate hard substrates can be compared to ancient carbonate hard substrates from the Paleozoic, Mesozoic and Cenozoic. The prominent evolutionary trend in community organization and distribution on carbonate hard substrates is the rise of infaunalization. A secondary trend may be an increase in seasonal fleshy algal growth associated with substrates destabilized by bioerosion.

References:

- Donn, T.F. & M.R. Boardman. 1988. Bioerosion of rocky carbonate coastlines on Andros Island, Bahamas. *Journal of Coastal Research* 4: 381-394.
- Neumann, A.C. 1966. Observations on coastal erosion in Bermuda and measurements of the boring rate of the sponge, *Cliona lampa*. *Limnology and Oceanography* 11: 92-108.
- Rützler, K. 1975. The role of burrowing sponges in bioerosion. *Oecologia* 19: 203-216.

I. CHLOROPHYTA (GREEN ALGAE)

Acetabularia crenulata
Anadyomene stellata
Caulerpa racemosa
Cladophoropsis membranacea
Dictyosphaeria cavernosa
Halimeda favulosa
Halimeda tuna
Monostroma ocyspermum
Penicillus capitatus
Udotea conglutinata
Udotea flabellum
Valonia macrophysa
Valonia ventricosa

II. PHAEOPHYTA (BROWN ALGAE)

Dictyota divaricata
Ectocarpus siliculosus
Lobophora variegata
Padina sp.
Sargassum sp.
Styopodium zonale

III. RHODOPHYTA (RED ALGAE)

Amphiroa fragilissima
?Botryocladia pyriformis
Botryocladia cuspidata
Gracilaria verrucosa
Laurencia microcladia
Laurencia obtusa
Laurencia poitei
Lithophyllum sp.
?Lithophyllum intermedium
Neogoniolithon affine
Neogoniolithon decutescens
Neogoniolithon spectabile
Wurdemannia miniata

IV. SARCODINA (FORAMINIFERA)

Homotrema rubrum

V. CNIDARIA (CORALS)

Order Actiniaria
Astrangia solitaria
Diploria sp.
Diploria strigosa
Gorgonia sp.
Gorgonia ventalina
Manicina areolata
Monastrea annularis
Porites porites
Siderastrea siderea
Millepora alcicornis

VI. BRYOZOA (MOSS ANIMALS)

Synnotum aegyptiacum

VII. MOLLUSCA (CLAMS, SNAILS)

Brachidontes domingensis
Isognomon bicolor
Dendropoma annulatus

VIII. ARTHROPODA (BARNACLES)

Chthalamus angustitergum
Tetraclita stalactifera

IX. ANNELIDA (SEGMENTED WORMS)

Filograna implexa
Hydroides parvus
Spirorbis formosus

X. CHORDATA (SEA SQUIRTS)

Eudistoma obscuratum

XI. PORIFERA (SPONGES)

Ircinia felix

Table 1. Taxonomic list of species occurrences at the individual sites studied on San Salvador Island, The Bahamas.

FRENCH BAY

SPECIES PRESENT	FB - 1 21M	FB - 2 26.5M
	Intertidal	
<i>Caulerpa racemosa</i>	●	
<i>Valonia ventricosa</i>	●	
<i>Ectocarpus siliculosus</i>	●	
<i>Brachiadantes domingensis</i>	●	●
<i>Filagrana implexa</i>	●	●
<i>Hamatreme rubrum</i>	●	●
<i>Spirorbis farmasus</i>	●	●
<i>Dendropoma annulatus</i>	●	●
<i>Cladopharopsis membranacea</i>		●
<i>Isagnoman bicolor</i>		●
<i>Valonia macrophyse</i>		●
<i>Manastrama oxypermum</i>		●
<i>Tetraclita stoelectifera</i>		●

KEY

- Abundant
- Common
- Rare

The columns represent distance measurements, in meters, from a land stake to a sampling area.

Abundance graph of species present at the French Bay location.

MAN HEAD CAY

SPECIES PRESENT	MHC 3M	MHC 6M	MHC 12M	MHC 15M	MHC 18M	MHC 21M	MHC 24M	MHC 27M	MHC 30M
	Intertidal		Subtidal						
<i>Valonia macrophysa</i>	●	●	●				●		
<i>Podina</i>	●	●		●	●		●	●	●
<i>Cladopharopsis membranacea</i>	●	●	●	●		●			
<i>Homotrema rubrum</i>		●		●	●	●	●	●	●
<i>Anadyomene stellata</i>		●			●	●		●	
<i>Amphiraa fragilissima</i>		●		●	●		●	●	●
<i>Neogoniolithon spectabile</i>			●						
<i>Neogoniolithon affine</i>			●				●	●	
<i>Laurencia microcladia</i>			●						
<i>?Botryocladia pyriformis</i>				●					
<i>Dictyota divaricata</i>				●			●	●	●
<i>Lithophyllum</i>				●	●	●	●	●	
<i>Halimeda tuna</i>					●		●	●	●
<i>Wurdemannia miniata</i>					●		●	●	●
<i>Labophara variegata</i>					●		●	●	●
<i>Dictyosphaeria cavernosa</i>					●	●	●	●	
<i>Laurencia obtusa</i>						●	●		
<i>Ectocarpus siliculosus</i>							●		
<i>Ulatea cyathiformis</i>									●