Relationship between water quality and densities of the sea urchin *Diadema antillarum*

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Introduction

Diadema antillarum was once the most abundant and important herbivore on the coral reefs of the western Atlantic and Caribbean. It was the keystone herbivore- the grazer that maintained the balance of growth and production between the coral and the algae. The mass mortality of this keystone species is described as the largest known marine mortality which resulted in catastrophic long-term ecological effects. Caribbean wide, *D. antillarum* mortality was greater than 97% (Lessios *et al.* 2001) and as a result, many Caribbean reefs have been dominated by macro-algae thereby smothering corals and inhibiting scleractinian recruitment.

In this study, physical-chemical variables, that according to EPA are necessary to maintain a good water quality, and abundances of the *D. antillarum* were evaluated in three reefs in Puerto Rico. The objective was to assess if there was a significant relationship between water quality and abundances of the sea urchin.

Method

This study was carried out in three sites in the north cost of Puerto Rico, Vega Baja, Luquillo and Escambron (Fig.1). These sites are characterized by shallow waters with a 3-5 m depth and hard bottom. All three sites are exposed to wave action generated by the easterly trade winds.

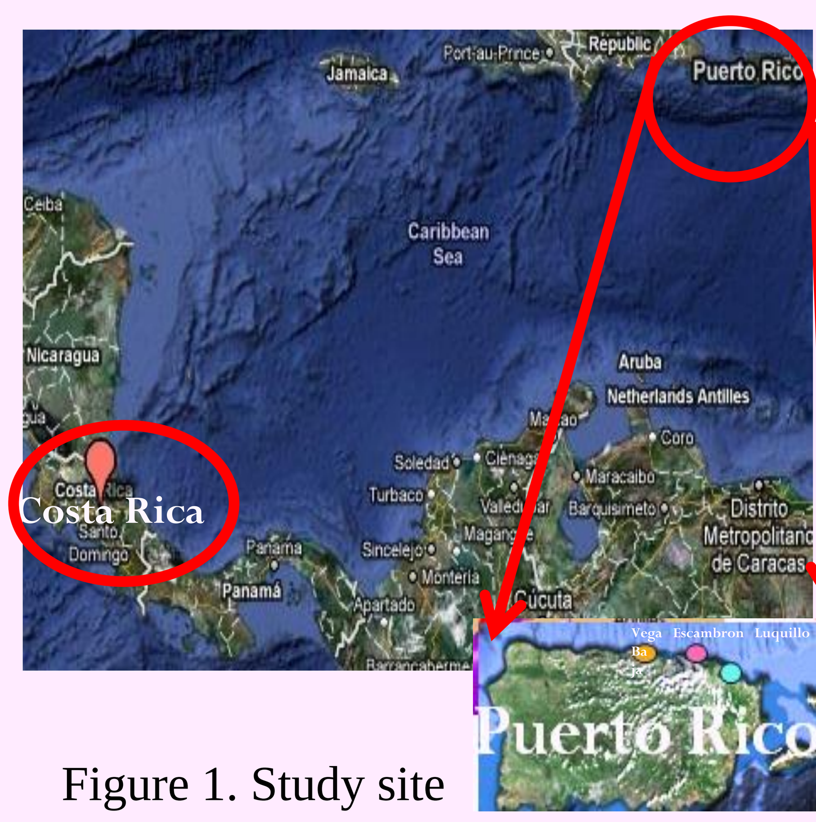

Figure 1. Study site

Figure 2. Water collection and analysis

Water sample were taken at weekly basis for six months (September 2010- February 2011). Physical-chemical variables were analyzed using the titration technique It is a precision dispensing device fitted with compact cartridge in a carefully regulated flow. The variable tested to assess water quality were alkalinity, NH_3, NH_4, Dissolved Oxygen, and CO_2.

Meanwhile *E. coli* concentrations were calculated by counting bacteria colonies growing on a membrane saturated with the Coliscan–MF liquid medium in a Petri dish.

Abundances of *D. antillarum* were estimated by counting all individuals within five $20\ m^2$ (10 m x 2 m) belt transects placed randomly at 3-5 m in depth. This count was made once every three month.

Results

Concentrations of all physical-chemical parameters and *E. coli* concentrations tested differed significantly among sites. In contrast, dissolved oxygen was the only parameter differing significantly among sampling time. To way ANOVA.

Sea Urchin abundances did not differ significantly among different sites but they did differ among time. Two way ANOVA, P>>0.05. There were not significant relationship between sea urchin abundances and the physical-chemical variable tested (Pearson product test. P>> 0.05). . *E. coli,* concentrations increased slightly during the study period reaching the maximum in February 2011; nevertheless, concentrations did not differ significantly among sampling time or study sites.

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		alkalinity mg/L	ammonia mg/L	ammonium mg/L	carbon dioxide mg/L	dissolved oxygen mg/L
September	Luquillo	190(14.30)	8.83x103	2.07	46(1.63)	10(1.46)
	Escambron	109(17.00)	8.28x103	1.94	67(2.88)	11(0.65)
	Vega Baja	136(21.63)	8.83x103	2.07	60(7.22)	12(1.50)
Octouber	Luquillo	129(16.37)	8.83x103	2.07	51(7.00)	10(0.17)
	Escambron	109(18.02)	8.28x103	1.94	66(3.55)	12(0.62)
	Vega Baja	133(9.04)	8.83x103	2.07	63(1.63)	12(0.10)
November	Luquillo	179(14.00)	8.83x103	2.07	47(2.65)	10(0.60)
	Escambron	123(7.41)	8.28x103	1.94	64(1.00)	13(0.90)
	Vega Baja	140(15.55)	8.83x103	2.07	61(2.52)	13(0.85)
Diciembre	Luquillo	179(14.00)	8.83x103	2.07	47(2.65)	10(0.60)
	Escambron	123(7.41)	8.28x103	1.94	64(1.00)	13(0.90)
	Vega Baja	140(15.55)	8.83x103	2.07	61(2.52)	13(0.85)
Febrero	Luquillo	179(14.00)	8.83x103	2.07	47(2.65)	10(0.60)
	Escambron	123(7.41)	8.28x103	1.94	64(1.00)	13(0.90)
	Vega Baja	132(15.55)	8.83x103	2.07	61(2.52)	13(0.85)
Enero	Luquillo	170(14.00)	8.83x103	2.07	47(2.65)	10(0.60)
	Escambron	120(7.41)	8.28x103	1.94	64(1.00)	13(0.90)
	Vega Baja	142(15.55)	8.83x103	2.07	61(2.52)	13(0.85)

Table 1. Measures of physical-chemical variables in three sites trough time. Numbers represents means values.. (N)= Standard Deviation.

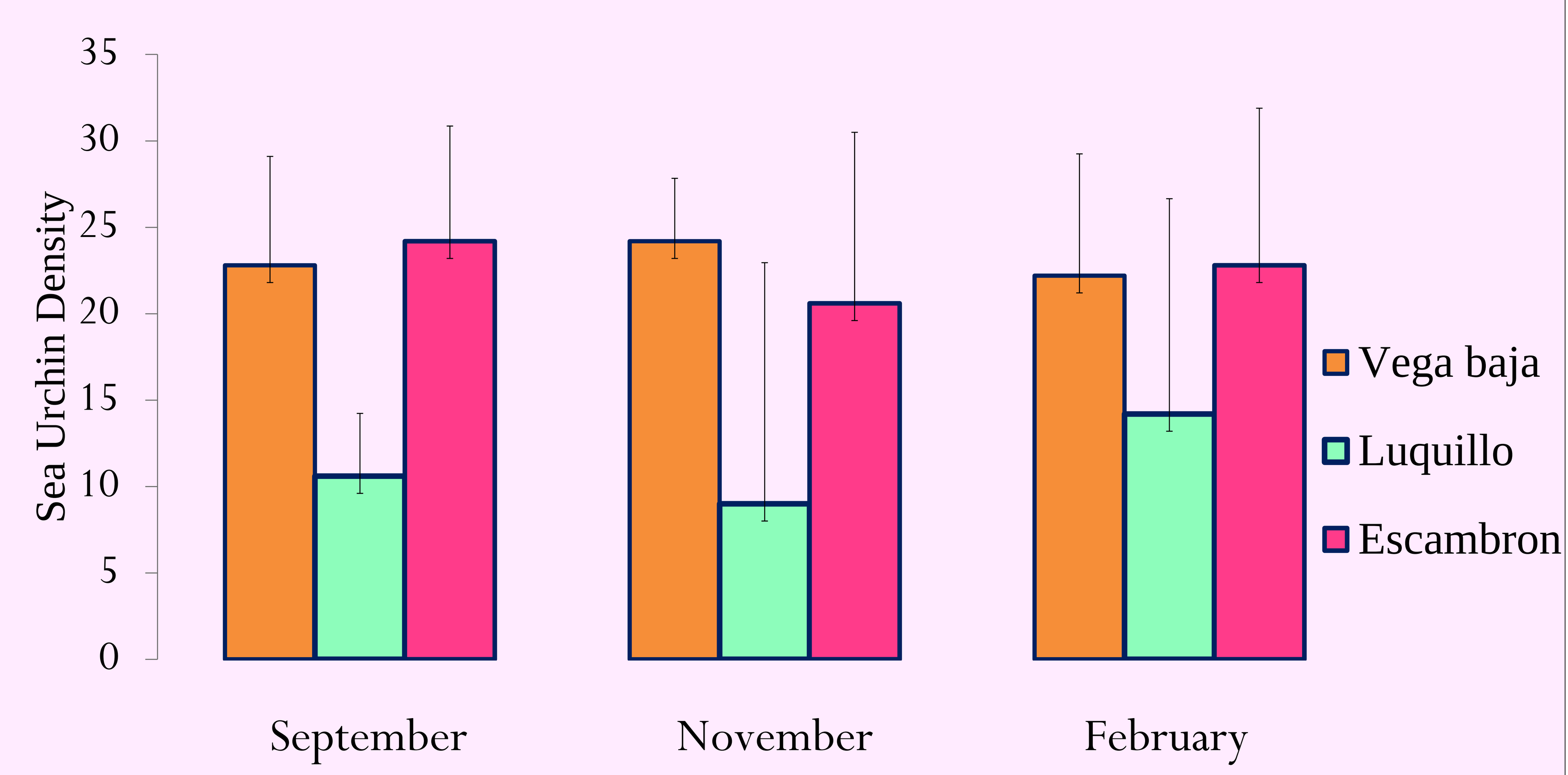

Figure 3. Sea Urchin Density among different during a three month period.

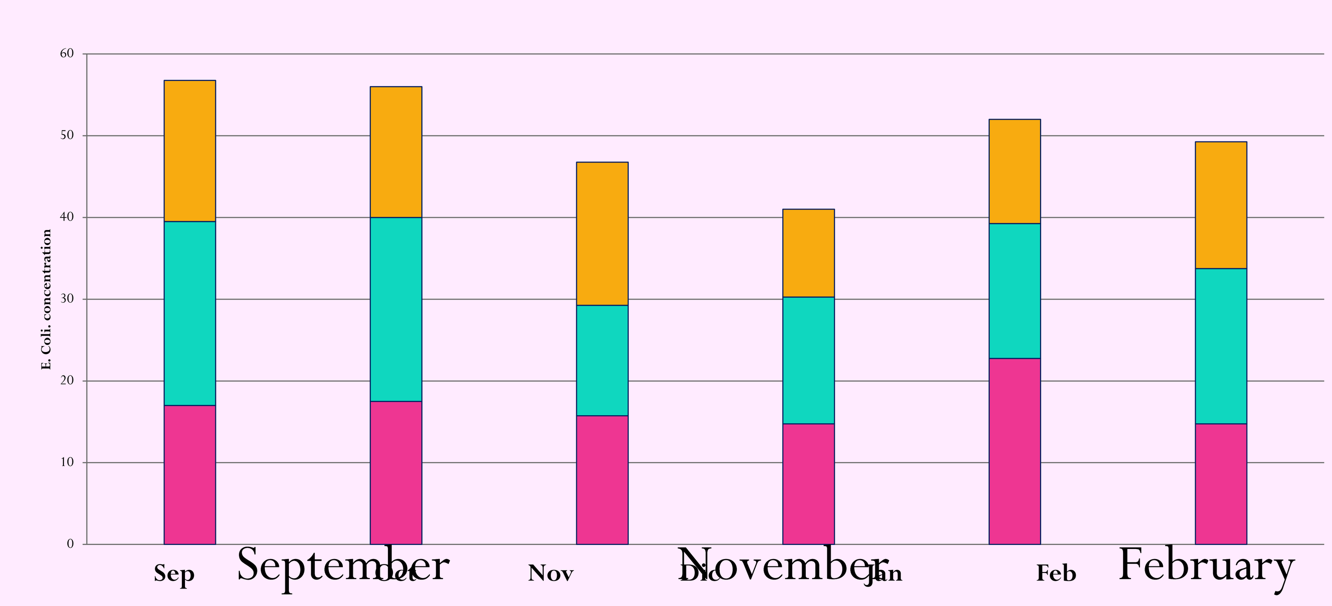

Figure 4. E.coli concentration in three sites amog diferent time

Discussion

Results indicate that there is no a clear relationship between water quality and the abundances of sea urchin but low level of CO_2 and DO found at the site with the lower abundances (LUQ) may indicate that these parameters may be related to abundances of to *D. antillarum.* Differences in sea urchins abundances may be related to other aspects of spatial and temporal variability such as food availability or recruitment rates (among others). Nevertheless, this study was limited to six months and a long term monitoring program and greater number of study sites may be necessary in order to get a better understanding of the relationship between water quality and *D. antillarum*. Similarly, other water quality parameters such as sedimentation rates and water turbidity may provide valuable information. In order to strengthen this study we will continue studding this areas and analyzing other factors that may affect the abundance of this organism.