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## Population Densities of *Diadema antillarum* Philippi at Cahuita National Park (1977-2003), Costa Rica

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**ABSTRACT.**—Population densities of *Diadema antillarum* are lower than what they were at Cahuita National Park, Limón, Costa Rica. Before 1983, densities of 4-33 indv/m<sup>2</sup> were found in the reef. After the 1983 massive Caribbean-wide death of *Diadema*, their densities dropped to 0.25-2 indv/m<sup>2</sup>. Very low densities were observed in 1992 (0.01 indv/m<sup>2</sup>) and between 1999 and 2003 densities oscillated between 0.3 and 0.7 indv/m<sup>2</sup>. In the last five years adults and juveniles of *Diadema antillarum* were observed in other Caribbean coral reefs of Costa Rica.

**KEYWORDS.**—Caribbean, population density, sea urchin, Cahuita Park

*Diadema antillarum* is a well-known keystone species of the Caribbean Sea and At-

lantic Ocean (Karlson 1999). It plays a significant role in stabilizing over fished coral communities (Hughes 1994), controlling the populations of algal and the establishment of new recruits of corals (Sammarco et al. 1974).

In the early 1970's, *Diadema antillarum* was a common sea urchin at Cahuita National Park and it was found in high densities almost everywhere on the reef (Wellington 1974; Valdez and Villalobos 1978; Cortés 1981), associated with *Thalassia testudinum*, several macro-algae and in competition with the sea urchin *Tripneustes ventricosus* (Valdez and Villalobos 1978). But in 1983, a high mortality of *Diadema* was observed at Cahuita and the rest of the Caribbean coast of Costa Rica affecting seriously the population (Murillo and Cortés 1984).

The objective of this study was to compare the historical densities of *Diadema antillarum* at Cahuita National Park with data collected from 1999 to present as part of the CARICOMP program in Costa Rica.

Cahuita National Park (Fig. 1) is located on the south Caribbean coast of Costa Rica

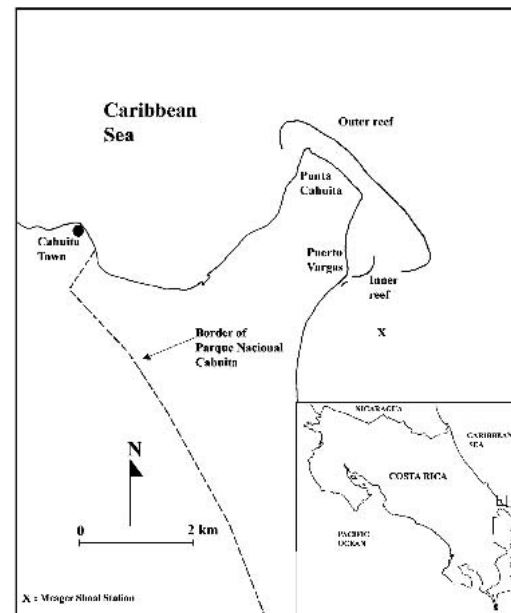


FIG 1. Map of Cahuita National Park, Caribbean Costa Rica.

(9°45'N, 82°48'W) and is the largest fringing reef of the Caribbean of Costa Rica, and one of the most studied reefs in the country (Cortés and Jiménez 2003).

Five 10 m transects, each one 5 m apart, were established parallel to the coast, in accordance with methodology outlined by CARICOMP (2001). The total number of urchins was recorded within an area of 1 m to either side of each transects, and all the holes and overhangs were explored for *D. antillarum*. The study was done at the CARICOMP Meager Shoal permanent station (9°43'50"N, 82°48'32"W; Fig. 1) a carbonate platform (10,000 m<sup>2</sup>) with an average depth of 7 m. This information was compared with studies done in the 1970's, 1980's and 1990's.

Decrease in population density was observed in 1983 (Table 1) due to the Caribbean-wide mass mortality (Lessios et al. 1984). Since then, the populations of this sea urchin show low densities and stayed low for the last 20 years; with little recovery.

Today, population densities of *Diadema antillarum* at Cahuita National Park are low compared to the 1970's. Before the mass mortality, it was seen in different parts of the Park. But after the mass mortality, it was only observed in a small population in Meager Shoal reef. Here *Diadema* is common and several individuals were seen spawning and they appeared to exert more control on benthic macroalgae than other areas of the Park (Fonseca 2003). The drop in *Diadema* density, together with overfishing, and an increase in dead coral at Ca-

huita has caused an increased in algal cover (Cortés 1994). Since Meager Shoal was studied for 20 years by different researchers, is small area, and is the only place in Cahuita National Park that *Diadema antillarum* is present: we think that the data show herein represents the population real state at Cahuita National Park.

The low recovery observed could be due to little recruitment because of low adult density. This low density affects the success of encounters of sperm and eggs, diminishing the population (Levitán 2002). Also, because of the Caribbean-wide massive death of *Diadema* there is probably no external source of larvae. *Diadema antillarum* prefers to settle on reefs with higher adult density (Hunte and Younglao 1988) because higher adult densities generate the clean substrata preferred by the larvae (Bak 1986). In Cahuita National Park live coral coverage decreased from 40% in the early 1980's to 10% in the mid 1990's (Cortés 1994) this could play an important role in the recovery of the species. Adults and juveniles of *Diadema* are being observed in other reefs on the Caribbean coast of Costa Rica. In some of those reefs no individuals were observed for several years (Cortés 1992; Cortés and Jiménez 2003).

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TABLE 1. Densities, total individual, individual/transect and standard deviation of *Diadema antillarum* at Cahuita National Park, 1977–2003.

Year	Number of transect	Total indiv.	Individual/transect	Density (ind/m <sup>2</sup> )	Reference
02–09/1977	5	90–211	NA	3.6–8.8	Valdez & Villalobos 1978
1980	16	NA	NA	4.33	Cortés 1981
6/18/1983	2	4–8	NA	0.25–2	Murillo & Cortés 1984
1992	16	NA	NA	0.001	Cortés 1994
9/15/1999	5	37	7.4 ± 2.7	0.7	This study
6/4/2003	5	17	3.4 ± 2.9	0.3	This study

NA: Not Available

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*National Cahuita*. San José, Costa Rica: Subdirección de Parques Nacionales, Ministerio de Agricultura y Ganadería.

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