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POPULATION STABILITY OF CRINOIDS AT SNAPSHOT REEF, SAN SALVADOR, BAHAMAS

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ABSTRACT

Among its many other attractions, Snapshot Reef, Fernandez Bay, San Salvador, has long been known for its abundant population of comatulid crinoids (feather stars). Snapshot is unique in supporting abundant crinoids at shallow (5-6 m) depths, because West Indian crinoids usually occur on shelf-edge reefs at about 10 m and deeper. An ongoing population census of crinoids has been conducted for four years, beginning in 1987, at Snapshot Reef, within an area of 2500 m². *Nemaster rubiginosa* has been 3-5 times as abundant as *Nemaster discoidea* during the census period. Over the first three years, the crinoid population increased by 25-32% per year. From 1987-88, the increase occurred in *N. rubiginosa*, while from 1988-89, *N. discoidea* showed almost a twofold increase and *N. rubiginosa* showed a smaller increase. From 1989-90, *N. rubiginosa* again increased while *N. discoidea* was unchanged. Population density at Snapshot, measured in 1990 at 0.17/m², is low compared to surveys taken across forereef slopes elsewhere in the West Indian region, reflecting the low density of coral cover. Density on individual coral formations at Snapshot is actually very high. Two additional comatulid species occur at San Salvador only along the shelf edge: *Analcidometra armata* clings to gorgonians and *Comactinia echinoptera* extends its arms from cryptic nooks by night. The uniqueness of the crinoid population at Snapshot, in terms of abundance and accessibility, makes it an exceptionally valuable educational resource whose conservation should have a high priority.

INTRODUCTION

Snapshot Reef is a patch reef located in Fernandez Bay on the western shelf of San Salvador Island, Bahamas, at about 6 m depth. Snapshot has been a popular location for sport divers, students, and researchers for many years

by virtue of its diverse reef biota and accessibility. Among its many attractions is an abundant population of comatulid or unstalked crinoids. The abundance of crinoids at such a shallow depth is unusual because crinoids in the West Indies usually are abundant only around 10 m or below (Meyer et al., 1978). Furthermore, crinoids have been abundant here for many years, at least since 1979 when one of us (DLM) first observed the population. Because very little information is available concerning the long-term stability of crinoid populations, we initiated a census of the Snapshot Reef population in 1987 which permits monitoring of its fluctuations and well-being.

METHODS

The census was facilitated by the use of a detailed map of Snapshot Reef produced by H. A. Curran and his students and kindly provided to us for use as a base map. This map covers an area 50x50 m and shows outlines of the major coral formations. The crinoid census is done by SCUBA divers swimming systematically over the map area, marking the location of crinoids on outlines of the major coral formations. Great care is taken to distinguish crinoid individuals in close proximity and to avoid disturbance of the crinoids. Because individuals cannot be effectively tagged, it is not possible to monitor individuals, but total numbers residing on a particular coral formation can be recorded and compared from one census to the next. The census was done on the following dates: May 21, 1987; June 17, 1988; June 5, 1989; and June 21, 1990.

RESULTS

This paper reports the results of four censuses of the Snapshot Reef crinoids, carried out in 1987, 1988, 1989, and 1990. Two

comatulid species were recognized at Snapshot upon the first visit in 1979 and the same two species have continued to be present during each census. The dominant species is *Nemaster rubiginosa*, characterized by orange arms and pinnules and a median black arm stripe, followed by the morphologically similar, but more delicate, *Nemaster discoidea*, typically with yellow arms, white pinnules with black tips and a broken median black arm stripe (Table 1). [Recently, both species have been placed in a new genus, *Davidaster*, by Hoggett and Rowe (1986), but *Nemaster* is retained here because the name is more familiar to readers of the West Indian crinoid literature.] Both species live semi-cryptically, extending the arms from crevices or nooks. *N. rubiginosa* tends to perch higher on large coral formations than does *N. discoidea*, although both can occur side by side. Illustrations of both species and further details of their autecology and morphology can be found in Meyer (1973a,b) and Macurda and Meyer (1977).

Census data for the four years are shown in Figure 1. The totals given do not represent the entire 50x50 m map area, but rather indicate results for the portion of the area that was censused each of the four years. Only during the 1987 census was the entire map area not covered. Table 2 presents the totals for the three censuses which covered the entire reef. *N. rubiginosa* is consistently more abundant (by 3-5 times) than *N. discoidea*. Over the four years, the total number of crinoids increased until 1989 then decreased slightly in 1990 (Fig. 1). However, this decrease may be only a small fluctuation of an overall increasing trend as shown for the 1988, 89, and 90 censuses for the entire area (Table 2). *N. discoidea* was stable from 1987 to 1988, but showed almost a twofold increase in 1989 and virtually no change the following year (Fig. 1, Table 2). Thus most of the change in overall numbers is attributable to fluctuations in *N. rubiginosa*.

DISCUSSION

Nemaster rubiginosa and *N. discoidea* are the most common reef-dwelling comatulid crinoids throughout the tropical Western Atlantic region (Macurda & Meyer, 1977; Meyer *et al.*, 1978). At other localities, *N. rubiginosa* is more numerous than *N. discoidea* at depths of 6-15 m, but *N. discoidea* becomes more abun-

dant below about 15 m (Meyer, 1973a,b). The peak development of *N. rubiginosa* usually occurs at the edge of shelf-margin reefs at 6-10 m depths. Thus the abundance of both species at Snapshot, at depths less than 6 m and at some distance shoreward from the shelf-margin reef, is unusual. Interestingly, another patch reef, Telephone Pole Reef, located 1 km north of Snapshot, has similar coral development but crinoids are not as abundant as at Snapshot. Shelf margin reefs along the western side of San Salvador show *N. rubiginosa* along the shelf break at approximately 10-15 m, and *N. discoidea* becoming more common along the forereef escarpment below. Thus, the distribution of both species at San Salvador is similar to that seen at Discovery Bay, Jamaica, where they occur along the shallower forereef escarpment from about 10-25 m, and recur along the deeper forereef escarpment at about 30 m and deeper (Meyer, 1973b). Crinoid occurrence at Snapshot suggests that factors other than depth alone may control crinoid distribution.

With only four years' data, it is premature to consider the question of stability of the crinoid population at Snapshot. Both species appear to be on the increase, but this increase may be only a minor fluctuation over a long term. An increase in the numerically dominant *N. rubiginosa* does not appear to result in a decrease in *N. discoidea*. Furthermore, there does not appear to be any evidence that the prolific growth of algae at Snapshot, especially the green alga *Microdictyon*, which may be increasing in the absence of the echinoid grazer *Diadema antillarum*, limits the crinoid population. Algal growth could potentially restrict the crinoids because many of the algae attach within coral reef crevices and fill intervening space where crinoids extend their arms.

If the census can be continued, it can in time provide the only detailed long term data on crinoid population stability. There is some evidence that other crinoid populations in the West Indian region are undergoing change. In 1967, Meyer (1973a) found that a population of the comatulid *Tropiometra carinata* was present at Buckoo Reef, Tobago, where it had been first reported by Mortensen in 1917. This species was also found to be abundant along beachrock shores on the western coast of Barbados, and subsequently was found to extend northward to Guadeloupe and westward to Colombia (Meyer, 1973a, Meyer *et al.*, 1978). More recently,

Table 1. Reef-dwelling crinoids of San Salvador Island, Bahamas, their distinguishing features and life habits.

Nemaster rubiginosa: orange arms and pinnules, arms with median black stripe, arms extend from crevices, pinnules form tetrad.

Nemaster discoidea: arms yellow or black, pinnules white or beaded, with black tips, arms with median black stripe, arms extend from crevices, pinnules form tetrad.

Comactinia echinoptera: arms and pinnules banded red and white, 10 arms only, arms extend from crevices by night.

Analcidometra armata: arms and pinnules banded red and white, 10 arms only, <10 cm long, clings to gorgonians along wall, swims.

Table 2. Number of crinoids within Snapshot Reef map area, 2500 m² (census of entire area).

	<i>N. rubiginosa</i>	<i>N. discoidea</i>
1988	292	58
1989	307	108
1990	321	108

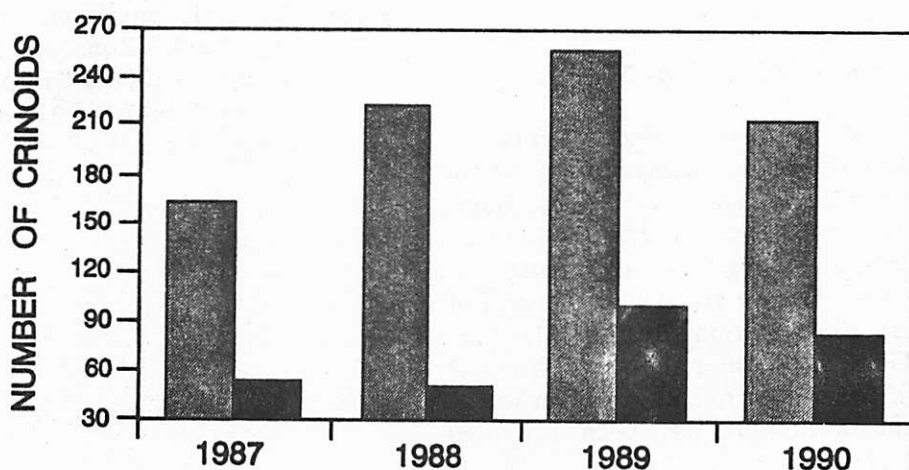


Fig. 1. Number of individuals of *Nemaster rubiginosa* (grey) and *Nemaster discoidea* (black) censused within the same portion of Snapshot Reef census area, 1987-90. Table 2 gives census for entire map area for 1988-90, while this figure is limited to totals for that portion of the map area which was covered in 1987 census.

Liddell (1979) reported that this species had markedly declined in numbers at Barbados, and in 1990 one of us (GL) was unable to find any specimens at all on Barbados reefs and beachrock shores. The factors responsible for this decline are unknown, although development and pollution have increased along the Barbados coast in recent years. With the effects of both natural perturbations such as hurricanes and thermal fluctuations and those of human activities becoming more and more evident in tropical reef environments, the monitoring of reef biotas becomes essential for assessment of environmental impacts.

The unique shallow water crinoid population at Snapshot Reef should be conserved, free from collecting and other disturbance of the habitat, so that the reliability of this ongoing census can be maintained. Snapshot Reef, its crinoids, and other reef biota provide an exceptional educational resource because of good accessibility to the Bahamian Field Station and divers visiting San Salvador. No other locality known to us in the tropical Western Atlantic provides an opportunity for students to see crinoids in such great abundance at snorkeling depths.

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