



Fig. 1

Comparatively high densities of the long-spined sea urchin in the Dry Tortugas, Florida

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Historical population densities of the long-spined urchin *Diadema antillarum* (Fig. 1) in the Florida Keys were relatively similar to those on Caribbean reefs (Bauer 1980), and like many areas have not recovered to pre-1983 densities, even suffering a second mass mortality in 1991 (Forcucci 1994). As part of a large-scale study of coral reefs and hard-bottom communities in the Florida Keys National Marine Sanctuary, we conducted surveys of *D. antillarum* at 158 sites during 1999 and 2000. In 1999, 640 transects, each 10 m² in area, were surveyed at 80 sites representing offshore patch reef, shallow fore reef (4–7 m), and deeper fore reef (8–12 m) habitats from Key Largo to Key West. *D. antillarum* was recorded from 11 of the 80 sites (13.8%) and only 16 individuals were found. The maximum site-level density was only 0.05 individuals/m² and test diameter (TD) measurements showed a mean size of 2.1 cm TD, a range of 1.2–5.0 cm TD, and a modal size class of 1.1–2.0 cm TD (75% of all individuals). The following year, surveys were extended to include nearshore and offshore habitats, in which 360 transects at 45 sites from Key West to Big Pine Key were sampled. *D. antillarum* was absent from 73% of the sites, and the maximum site-level density was only 0.03 individuals/m². The 14 individuals recorded yielded a mean size of 2.4 cm TD, a range of 1.0–5.4 cm TD, and a modal size class of 1.1–2.0 cm TD (64% of all individuals).

Interestingly, in the Dry Tortugas region, as part of a regional survey we found several locations with relatively abundant and large *D. antillarum* during June 2000. The Dry Tortugas are an island group 117 km west of Key West and consist of an elevated atoll-like rim of Holocene coral measuring about 27 km from southeast to northeast and 12 km wide. Deep channels (10–20 m) separate three major banks within what is now Dry Tortugas National Park. Urchin surveys included both the National Park (19 sites) and the deeper (> 15 m) Tortugas Bank (14 sites) to the west. While 53% of the sites in the National Park yielded no *D. antillarum*, mean densities at some sites were as high as 0.33 individuals/m², an order of magnitude greater than any location surveyed in the Florida Keys. Several locations had abundant and large *D. antillarum*, with clear grazing effects on the substratum such as substantially reduced macroalgal cover (especially *Dictyota* spp.) and exposed substrate (top panel). Two sites in particular, both near Loggerhead Key, yielded high urchin densities and large test sizes. The first site, a low-relief hard-bottom community at 4–5 m depth (24°37.611'N, 82°54.510'W), was characterized by abundant gorgonians (mean density of 46.1 colonies/m²), especially *Pseudopterogorgia* sea plumes



Fig. 2

(bottom panel), as well as sparse macroalgal cover (<30%), some large patches of staghorn coral (*Acropora cervicornis*) rubble, and small (<10 cm diameter) corals. *D. antillarum* densities were as high as 0.8 individuals/m², with sizes ranging from 2.4–7.1 cm. The second site, further north (24°38.808'N, 82°53.788'W), was a large patch reef capped with cemented staghorn coral rubble.

D. antillarum densities were as high as 0.4 individuals/m², with a mean size of 4.6 cm TD and a size range of 1.0–7.2 cm TD. The modal size class for both sites was 5.1–6.0 cm TD and 50% of the individuals were probably at least 2 years old. In contrast, most individuals were half as large and an order of magnitude lower in density in the Florida Keys.

We are not aware of any published records on urchin density and size distribution for the Dry Tortugas, but relative to the Florida Keys, these data indicate that *D. antillarum* has attained relatively high densities at several locations. It is not known whether the 1983–1984 mass mortality affected this area, and, if so, the factors that are responsible for relatively greater survivorship. While *D. antillarum* appears to be recruiting to the Florida Keys (Forcucci 1994), the majority of individuals appear to not survive past 1–2 cm TD. Based on surface circulation patterns in the Dry Tortugas and the lower Florida Keys (Lee et al. 1994), it is possible that the Dry Tortugas represent one of presumably several sources of urchin larvae. The density and size patterns observed provide fruitful areas of investigation concerning source-sink dynamics, connectivity of coastal ecosystems, and the importance of larval supply and post-settlement mortality processes.

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