

Rearing long spined sea urchins (*Diadema antillarum*) as a step towards ecological restoration in South Eleuthera reefs

Crianza de erizos de mar de espinas largas (*Diadema antillarum*) como un paso hacia la restauración ecológica de arrecifes en el Sur de Eleuthera

Élevage d'oursins à longues épines (*Diadema antillarum*) comme une étape vers la restauration écologique dans les récifs de South Eleuthera

NATALIA HURTADO, MSc.^{1,2} and SILIA WOODSIDE¹
¹ Cape Eleuthera Institute, PO Box EL-26029, Eleuthera, The Bahamas
² Perry Institute for Marine Science
nhurtado@perryinstitute.org, siliawoodside@islandschool.org

EXTENDED ABSTRACT

Keystone species that helped healthy reefs thrive across the Caribbean were once abundant, but today their long-term survival is threatened unless successful active restoration is applied by assisting their recovery (Lessios, 2015). The grazer *Diadema antillarum* is a critical herbivore and one such keystone species on coral reefs, keeping algal growth in check when present in healthy populations (Bodmer et al., 2021). However, *D. antillarum* - also known as the long-spined sea urchin - suffered a massive die-off in the early 1980s (Hylkema et al. 2023), from which local populations in The Bahamas have still not recovered (Lessios, 2015). The drop in their population resulted in a lack of functional reef herbivory and an ecological shift in local reefs, with macroalgae dominating over coral species and a decline in the reef's ability to provide habitat and other ecosystem services (Bodmer et al., 2021, Williams, 2021).

Rearing long-spined sea urchins could alleviate the pressures wild populations face in reproducing and maintaining healthy densities, and therefore influence a transition from current macroalgae dominated local reefs back to historic stony coral dominated environments (Williams, 2021). Based on *D. antillarum* reproductive strategies and life cycle, after the spawning season, collectors will be deployed in areas where populations are still abundant. The main goal will be to collect post-larval individuals (post-larvae), rear them in controlled conditions at land-based facilities, and release them onto local reefs once they become juveniles. Post-larval stages of *D. antillarum* will be collected in South Eleuthera, and the project will be guided by methodologies described by Pilnick. (2021). Organisms will be aggregated using five post-larval collector devices of various designs, which themselves will be tested to determine highest aggregation capabilities. The collectors will be deployed in three shallow water locations (>5m) in South Eleuthera, where strong currents run directly along exposed rocky outcroppings already known to provide habitat for *D. antillarum*.

Collectors will be deployed in November 2023 and will be checked monthly. Since this will be done after spawning, the animals will be developed to post-larvae, providing high settlement rates. Post-larval settlers found will be transported to Cape Eleuthera Institute wet lab facilities via seawater-filled coolers. Once at the wet lab facilities, post-larval settlers will be transferred to an indoor recirculating aquaculture system and kept at a temperature of approximately 26°C. Conical tanks with medium densities will be used, in order to best mimic wild social behaviors while not overcrowding juveniles (Pilnick et al. 2021). Nutrients will be provided through algae wafers and by placing algae covered rocks into the system, and exposed to a sunlight-mimicking light schedule. After growing under controlled conditions, individuals will be checked and measured and size categories will be used in order to move them to reefs nearby, their survival will be monitored monthly.

If conditions in the facility allow, some simple behavioral conditioning experiments will be run to expose lab-reared individuals to wild social and predatorial cues. Initial trials could include exposing juveniles to a variety of local predators, including triggerfish, while separated and protected by a mesh barrier. Upon release, *D. antillarum* survival and growth will also be analyzed by size class, and observations of ideal release size will be compiled.

The main outcomes of the project will be developing a protocol detailing how to maintain and rear long-spined sea urchins from post-larvae to juveniles in controlled wet lab conditions, identify the most successful collector for post-larvae and create a booklet with detailed information about how to use them in other Bahamian islands. Additionally, to determine optimal release size of juvenile *D. antillarum* to be moved onto South Eleuthera coral reef systems

KEYWORDS: Ecological restoration, long spined sea urchins, *Diadema antillarum*, The Bahamas

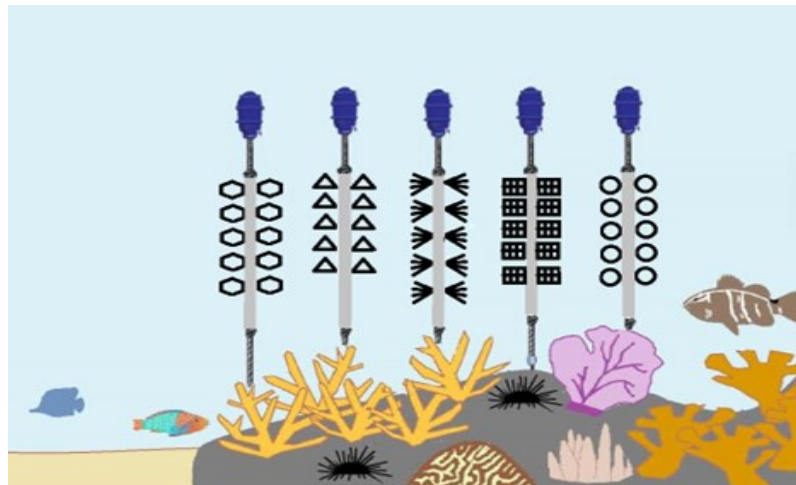


Figure 1. Post-larval collectors to be disposed of on South Eleuthera sites where *D. antillarum* is abundant.

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