

Cultivation effects in *Diadema antillarum*: the key to understanding population recovery and restoration?

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ABSTRACT: The sea urchin *Diadema antillarum* is a keystone herbivore on coral reefs of the Caribbean. Functional extinction of *D. antillarum* due to an epidemic in the early 1980s had a marked effect on coral reef health. Recovery of *D. antillarum* has been associated with improvements in reef health where it has occurred. However, recovery has been localized and the populations persist at low abundance throughout much of the Caribbean. Here we investigate possible reasons for the low and variable recovery of *D. antillarum* and the potential for active restoration measures by reviewing current understanding of population processes in *D. antillarum* and exploring their implications for recovery and restoration. There is empirical evidence for compensatory density dependence in fertilisation success, larval settlement and predation mortality. The latter two processes are partially mediated by a reduction in habitat cultivation by adult *D. antillarum*, which reduced habitat quality for larval settlement and juvenile recruitment. Population modelling shows that these cultivation processes can give rise to alternative, low and high abundance states in *D. antillarum* populations. Population growth and recovery are driven by predation risk and the availability of predation refuges, while larval supply and settlement determine extinction risk. Translocation of wild or release of hatchery-reared *D. antillarum* could potentially aid recovery but due to poor habitat quality and the need to re-establish cultivation effects such measures are likely to require either, release of large-bodied urchins or manipulations of predation risk or refuge availability concomitant with releases of small urchins. We close by outlining avenues for further research to resolve remaining uncertainties about processes affecting *D. antillarum* recovery and restoration potential.