Returning the Keystone Herbivore, *Diadema antillarum*, to Florida Coral Reefs

Martin A. Moe, Jr.1, Ken Leber2, David Vaghan2, Tom Capo3
1Adjunct Scientist, Mote Marine Laboratory, Islamorada, FL, USA
2Mote Marine Laboratory, Tropical Research Laboratory, Summerland Key, FL, USA
3University of Miami, Miami, FL, USA

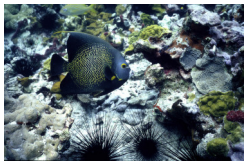
Why *Diadema*?

Succinctly…

"Through direct effects on algal communities or indirect effects on other benthic reef organisms, grazing by *Diadema* is a major factor controlling the community structure of coral reefs. ….. Perhaps no other single species in the coral reef environment has such profound effects on the other organisms composing the reef community." Ogden and Carpenter (1987) U.S. Fish Wild. Serv. Biol. Rep. 82 (11)

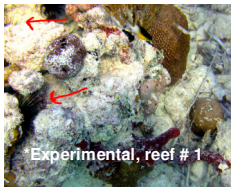
Recently… March 22, 2010

Recovery of the sea urchin, *Diadema antillarum*, promotes scleractinian coral growth and survivorship on shallow Jamaican reefs
J. A. Idjadi, R. N. Haring, W. F. Precht,
Mar Ecol Prog Ser, Vol. 403: 91-100, 2010



Coffins Patch, pre plague, 1980

Caloosa Rocks, 2001



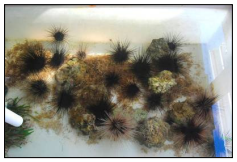
*** Photos from the Nedimyer and Moe 2001 – 2002 project on translocation of rubble zone *Diadema* juveniles to two patch reefs to study results of the return of ecologically functional *Diadema* populations to two Upper Keys patch reefs.**

***Diadema* have not returned to our coral reefs in ecologically functional populations since the great plague of 1983. Without the herbivory provided by *Diadema* our reefs will continue to be dominated by macro algae, and coral settlement, survival, and reef growth will not return. Obviously it would be a good thing to return the function of herbivory and substrate conditioning that was historically provided by *Diadema*. This may be possible, but research and restoration will depend on a large supply of "reef competent" juvenile *Diadema*. And this can be provided only through successful large scale hatchery culture of *Diadema*.**

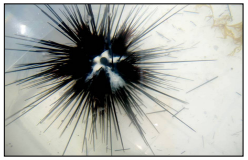
Diadema Culture

Sea urchins, *Diadema* in particular, are not easy to culture in the laboratory and certainly not at the hatchery level. Mote Marine Laboratory, Tom Capo of The University of Miami, and the Florida Fish and Wildlife Research Institute, have helped Martin Moe, a retired marine biologist, to work on developing this technology over the last four years. Much has been accomplished and although there is still much to do, the basic elements of large scale culture technology have been established.

Brood Stock maintenance

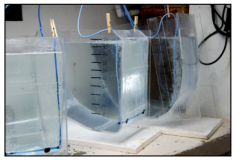


Spawning

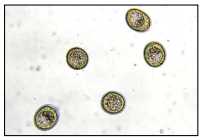


45 adult *Diadema* brood stock urchins are maintained in an 830 liter system and fed wild collected benthic macro algae. Spawning is effected by temperature manipulation. Immersion in water 4o C above the ambient, usually 25 to 29 degrees C stimulates spawning if the urchins reproductively capable.

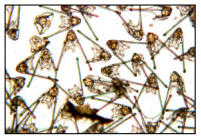
Larval culture, 35 to 60 + days



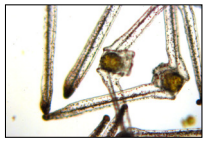
A half kreisel, acrylic culture vessel was developed to provide the current velocity required by the larvae. An aeration pulse set at 4 seconds on and 30 to 60 seconds off provides the intermittent energy pulse that drives the current into a circular gyre and limits turbulence.



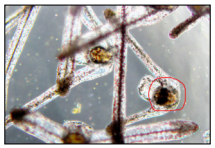
Day 2, blastula



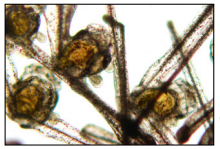
Day 5, feeding well



Day 19. arms elongating



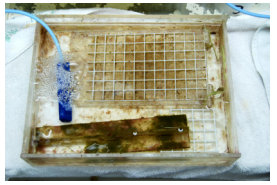
Day 24, early rudiment development



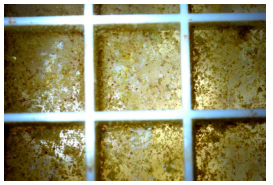
Day 36, large external rudiments

Day 30 larvae with pedicellariae and ready to settle

Settlement

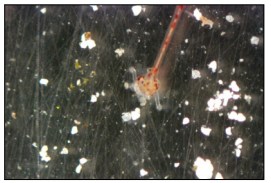


Settlement plates with settled larvae from larvae culture vessel



Settlement plate with metamorphic larvae and early juveniles

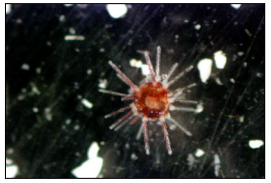
Metamorphosis



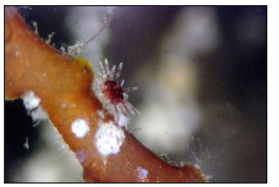
Day 44, early metamorphosis

Day 37, mid metamorphosis

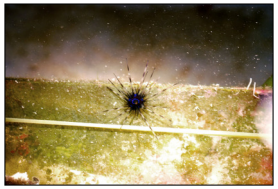
Juveniles



Day 52, 5 days post settlement



Day 57, on alga



Day 73, juvenile on acrylic strip

Day 102, 58 days post settle

Diadema Restoration

Some possibilities for successful methods of *Diadema* restoration

Placement of substrates on the reefs with early juveniles already established
Behaviorally trained and conditioned juveniles released on selected reef areas
Protected (cages) placement of large juveniles contained for spawning
Combined coral and *Diadema* placement on high value reef areas

This research was funded in part by a grant awarded from Mote Marine Laboratory's Protect Our Reefs Grants Program, which is funded by proceeds from the sale of the Protect Our Reefs specialty license plate. Learn more at www.mote.ort//4 reef