Demonstrating effective Caribbean acroporid population enhancement: all three nursery-grown, out-planted taxa spawn August 2015 & 2016 in Belize

Lisa Carne[1] and Iliana Baums[2]
[1]Fragments of Hope, Ltd., Placencia, Belize;
email lisasinbelize@gmail.com
[2]Department of Biology, The Pennsylvania State University,
208 Mueller Lab, University Park; email PA baums@psu.edu

Successful *in situ* coral cultivation has been demonstrated in multiple regions with multiple methods (Young et al. 2012), but information is sparse on the survivorship and effectiveness of outplanting nursery-reared corals to reefs. In Belize, *Acropora palmata* fragments were transferred to Laughing Bird Caye National Park in 2006 after bleaching, disease and hurricanes (1998 and 2001) had extirpated the local population. Based on their survival, the experiment was scaled up in 2009 by adding eight *in situ* nurseries. Host and symbiont genotypes were determined for 23 acroporids (Bowden-Kerby & Carne 2012; Baums et al. 2005, 2014). Host genotypes were established to ensure genet diversity of nursery-grown out-planted corals and allow for sexual reproduction to enhance the restored acroporid populations (Baums 2008). Large scale out-planting of *Acropora* began in 2010 and continues. Different genets of each taxon were out-planted close to each other with distances apart of 50cm-10m for *A. cervicornis* and 1m-10m for *A. palmata,* so that subsequently successful cross-fertilization could occur.

Figure 1. Spawning in nursery reared, outplanted *Acropora palmata* (above) and *A. prolifera* (below). Photos: Annelise Hagan.

In August 2015, all three nursery-grown acroporid taxa out-planted in December 2010 spawned: *A. palmata* (two genets), *A. prolifera* (one genet) (see Fig. 1) and *A. cervicornis* (two genets) (Fig. 2). Although nursery grown, out-planted *A. cervicornis* have previously been observed spawning in Florida (K Nedimyer, pers. comm.) and Belize, this is the first documentation of nursery-reared *A. palmata* and *A. prolifera* showing gamete release. Spawning of nursery-reared, outplanted acroporids was documented again in August 2016. These colonies had been outplanted from between 14 months and four years before

spawning was observed. Two additional *A. cervicornis* genets showed gamete formation 19 months aftert out-planting (Carne et al. 2016 in review). Spawning times for both years (2015-2016) were around 20:50-21:20 hrs (Belize time) and spawning dates and times coincided with the spawning of wild acroporids at Carrie Bow Caye, Belize (N. Fogerty pers. comm).

Figure 2. Spawning in nursery reared, outplanted *Acropora cervicornis.* Photo Annelise Hagan.

Documenting these spawning events is an essential monitoring tool to illustrate the success of the use of *in situ* cultivation and outplanting of genetically diverse acroporid populations. In future work, the proximity of outplanted corals should be manipulated to investigate optimal spacing for successful larval production. Cultivation followed by outplanting is an effective management strategy to enhance endangered acroporid populations.

Acknowledgements
Documentation of the 2015 -2016 spawning events was completed for the IDB's Coral Reef Restoration Program. The work was also possible thanks to collaboration with the Belize Fisheries Department and Southern Environmental Association and with the assistance of vessels donated by the Moorings, Belize. Genotyping was performed by Meghann Devlin Durante in the Baums laboratory at the Pennsylvania State University.

References:

Baums IB (2008) A restoration genetics guide for coral reef conservation. Mol Ecol 17:2796-2811

Baums IB (2008) A restoration genetics guide for coral reef conservation. Mol Ecol 2008, 17:2796-2811.

Baums IB, Devlin-Durante MK, LaJeunesse TC (2014) New insights into the dynamics between reef corals and their associated dinoflagellate endosymbionts from population genetic studies. Mol Ecol 23:4203-4215

Bowden-Kerby A, Carne L (2012) Thermal tolerance as a factor in Caribbean *Acropora* restoration. Proc 12th Int Coral Reef Symp 1-5

Carne L, Kaufman L, Scavo K (2016) Measuring success for Caribbean acroporid restoration: Key results from ten years of work in southern Belize. (ICRS Proceedings in review)

Young CN, Schopmeyer SA, Lirman D (2012) A review of reef restoration and coral propagation using the threatened Genus *Acropora* in the Caribbean and Western Atlantic. Bull Mar Sci Vol 88:1075-1098

[1]