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Recruitment and Survival of Threatened *Acropora palmata* at Looe Key Reef and Broward County First Reef

EXECUTIVE SUMMARY

The Project Team consisting of Dr. Thomas R. Cuba, Dr. Esther C. Peters, and Lauren Waters in collaboration with Erich Bartels (Mote Marine Laboratory's Tropical Research Laboratory) investigated the spatial distribution and physiological condition of selected specimens or stands of *Acropora palmata* during the period of September 21 to October 2, 2009. Specimens or stands were located at Looe Key and off the east coast of Broward County in Southeast Florida. The summary treats spatial distribution (populations) and physiological condition separately.

PHYSIOLOGICAL CONDITION

The condition of *A. palmata* colonies found in the surveys of Looe Key backreef, forereef, and Broward County was assessed based on a modification of the *Demographic Monitoring Protocols for Threatened Caribbean Acropora* spp. *Corals* (NOAA Technical Memorandum NMFS-SEFSC-543). The length, width, and height above the substrate were measured; estimates were made of the percent live coral tissue cover and presence, extent, and type of recent mortality, growth anomalies, bleaching, and damselfish impacts; and branch breaks were counted by branch diameter size categories.

Looe Key Backreef

The condition of colonies in the Looe Key backreef survey was generally good to excellent. Size of colonies ranged from what appear to be new recruits (less than 2 cm long) to large colonies (greater than 100 cm long) on overturned bases and having either multiple branches or multiple patches of recovering tissue. Percent live coral tissue cover was 95 to 100%. Evidence of recently denuded skeleton was rare and attributed to suspect white pox, white band disease, or snail predation. No growth anomalies were found. Many of the colonies had minimal to moderate bleaching, usually on the upper surfaces of branches and very patchy. Damselfish impacts were extremely rare, but one large, older colony, of which only the base remained, was the home of a dusky damselfish.

Looe Key Forereef Spurs

Few colonies were individually assessed on the Looe Key forereef survey because they were too tightly aggregated and most observations of condition will be developed from the photography. Of note, *A. palmata* in the thicket at Spur Site 11C had patchy bleaching on upper surfaces of the larger colonies. A growth anomaly (calicoblastic epithelioma type) discovered during August of 2008 on one of the colonies at this site had changed by August of 2009 from translucent to pale brown tissue covering the lesion. By September 21 of 2009, the lesion was almost entirely dead and overgrown with green filamentous algae and numerous fish bites. At Spur Site 9A, living *A. palmata* were scattered along the spur among long dead colonies; bleaching was rare. At Spur Site 10A, *A. palmata* were not bleaching, but damselfish lawns and chimneys were often found. On all of these spurs, the smaller colonies were in the best condition.

Southeast Florida

The inshore colony, previously reported to be unaffected, but more recently reported to be affected by suspected White Pox (summer 2009), had 7 patches of tissue on the two bases on an otherwise denuded skeletal frame, but all patches were in good condition, without bleaching or denuded skeleton. The patches had white margins and some had short upright branches, indicating growth.

There were ten *A. palmata* colonies or skeletons found on the Broward County first reef line. Of the ten, seven had living tissue. Of these seven, 5 had 95% to 100% live dark brown tissue cover. One of these seven had only 2 % pale live tissue remaining, consisting of one branch tip of about 4 polyps and a flat basal patch about 14 cm^2. Neither patch had white margins and were pale in color, indicating no active growth. The final specimen was a small fragment consisting of less than 50 polyps which exhibited no sign of bleaching or disease.

The two largest live colonies found had circular or annular suspect damselfish bites over the colonies (up to 70% was affected, with a yellowtail damselfish present). The other colonies were in very good condition, without bleaching and only minimal worm holes or fish bites.

Of the three skeletons, one had died completely in the relatively recent past (only 1 or 2 months). The inference is derived from the observation that it was completely covered with fine filaments of brown and green algae of approximately the same length all over and corallite structure was still visible.

Two of the three skeletons must have completely died months ago but one presumably within the past year (when Broward County staff had tagged and photographed it alive in August 2008) because it was covered by stiff turf algae mixed with encrusting coralline algae and boring sponges bitten by grazing fishes, blending into the surrounding substrate.

SPATIAL DISTRIBUION

Looe Key Backreef

The Team spent approximately 60 hours in the water and ran transect lines covering 10,295 ft^2. During this effort, 166 specimens were located. In 2008, the Team had examined 4,062 ft^2 and located 54 specimens. A comparison of the condition between years has not been finalized as of this writing and a count of new recruits is pending.

The benthic habitat is formed by loose rubble, most of which is less than a foot in size. Dispersed within the rubble are the larger frames of mature specimens. This rubble lies between a reef crest of hard rock, mostly populated by *Palythoa sp*. and a grassbed located on the deeper northern edge of the rubble. The rubble has an occasional scleractinian such as *Porites astreoides* but larger scleractinian specimens are not encountered except near the reef crest. Gorgonian sea fans are widely scattered and aclyonaria are rare. While some small recruits are noted, larger specimens are seldom seen. Porifera are largely absent.

The rubble field implies that new specimens of *A. palmata* which arrive in the zone will undergo a natural history particular to, and dictated by, the habitat. The new arrival may attach to a single piece of rubble or, as in the case of a fragment, it may attach itself to more than one piece of rubble.

The Team observed that the growth form in the backreef is different than that observed elsewhere. The specimens in this area typically do not form an extensive basal disk, but extend upwards early in the life cycle. Therefor, as the specimen grows upright the center of gravity will rise and create an unstable situation.

The inferred and observed result is that these will topple more frequently. Toppling may, however, be beneficial. As the previously upright branch encounters rubble as a result of toppling, a second basal area can develop, attaching to a new piece of rubble and creating a more stable specimen. In addition, toppling may produce fragments and further increase the numbers in the population. The result of toppling is seen in specimens exhibiting an hourglass or "W" growth form. The long term result of this sequence will be the eventual conversion of a rubble bed into a more solid rock formation.

Looe Key Forereef Spurs

Looe Key is a system in which the seaward edge is characterized by an extensive spur and groove type of formation. The spur crests are well within the surge zone at their northern shallow limit and may be 20 feet deep at their southern deeper limit. Four locations were selected for

documentation. Of these, site 11C was the original site of interest because it is located immediately adjacent to, but on the other side of the reef crest of, the Looe Key backreef site. The specimens at these sites are much more closely packed than those at the backreef site and evidence of sexual recruits was minimal. These constraints, as well as the rugosity of the system, resulted in a modification of the procedure and mosaic photogrammetric mapping was used. At each site, points were set and a tape measure laid in order to form well documented swim lines. These overlapping swim lines formed the guide for the diver who swam at a set depth and collected photographic data in overlapping frames for later treatment.

The total area of reef surveyed using this technique is not yet available. At site 11C the entire spur was surveyed. At sites 9 and 12A approximately half the spur was surveyed. At site 10A, the deeper portion was surveyed and the shallow portion visually examined. Individual specimens cannot be separated easily from the assemblage, but the photos will be useful in determining change over time when compared to results to be generated in 2010.

Southeast Florida

The Florida Department of Environmental Protection asked that the Team examine seven (7) sites which were reported to support *A. palmata*. The Team located all seven sites. Each of these sites supported only one specimen. Of these, one was in a state of recent decline and undergoing recovery. Two were completely dead. Four were alive but two of the four showed signs of pending decline, while the other two were unaffected and showed no sign of disease or damage. Only one organism was in an active state of competition for space (with *Palythoa* sp.). At each site, a 50ft radius area around the original specimen was searched for evidence of other members of the species.

The Team located an additional four (4) specimens, only one of which was associated with one of the above sites (inside the 50ft search radius). Of these four, one was a very small fragment consisting of only about 20 polyps. It was located within the 50ft radius of the targeted organism and the Team was not able to determine if the fragment was derived from the target organism. A second specimen was located off the main reef to the east. The remaining two were skeletons of dead *A. palmata*. They are included in this report because one specimen had died so recently that tissue remained on the skeleton. The other was located in an area of interest as is explained below.

The Team searched a 50ft radius circle around each specimen (86,394 ft^2 or 2 acres) and located only the aforementioned fragment. The implication is that whatever specimens do occur on this system, they are not aggregated and the likelihood of sexual reproduction is greatly diminished.

The Team also searched habitats similar to that occupied by the seven targeted units using a power scooter and drift diving techniques. Approximately 264,000 ft^2 (6 acres) was searched.

The search area was defined as a result of observations made during the initial examinations.

The habitat to which the Team was directed is based on a wide, very flat platform of limestone known as the "first reef." The reef is not heavily or even notably populated by other scleractinians. This pavement type formation is fractured and rather linear cracks run in a fairly uniform pattern of north-south fractures and east-west interconnection fractures. At the eastern limits of the feature, the easternmost block has separated from the parent pavement along a very uniform north-south running fracture line.

Upon examination, the structure of the pavement could be seen to be composed of two apparent layers of material. The material beneath the surficial block has been subjected to solution and the layer beneath is a honeycomb of remaining rock and supporting columns or blocks.

At the eastern edge where the underlying material is more eroded or dissolved than under the flat pavement of the main reef structure, the loss of supporting material has allowed the upper layer of the block to fall away from the parent block at an angle. The fallen blocks normally lie at 30 to 45 degrees in declension and the fracture opens into a feature which is v-shaped in cross section east to west. At several points the fallen block has been moved further away, most likely as a result of storm activity.

What makes this worth describing in such detail is the fact that of the 11 specimens of *A. palmata* located, whether live or recently dead, 9 were located at this fracture line and all but one of the nine was located on the shore side (platform side) of the gap. The Team has yet to develop a potential explanation for the observed site specificity.

East Coast specimens were robust in branch and trunk with large expansive basal disks. The branch tips typically did not have fine extending fingers but were blunt. The majority of the specimens appeared to be in the 3 to 6 year age class, based on size and typical growth rates. The impression is that the species is capable of colonizing during years when the habitat is suitable (pulsed colonization) but that colonization density is very low and survival beyond a few years is unlikely.

Special Note

During the exploration of the area, on several dives, the Team ascended through a bolus of warm, brown, less dense water, floating on the marine waters. The mirage-like shimmer indicated salinity differentials were present and the water is suspected to be of terrigenous origin. It is noteworthy because, when it accidentally was taken into the mouth of divers, it left a pasty film on the teeth and mouthpieces of the regulators. Camera housings were so fouled with an almost paraffin like coating that simple rinsing in freshwater was insufficient and mild soaps were required to clean the equipment.

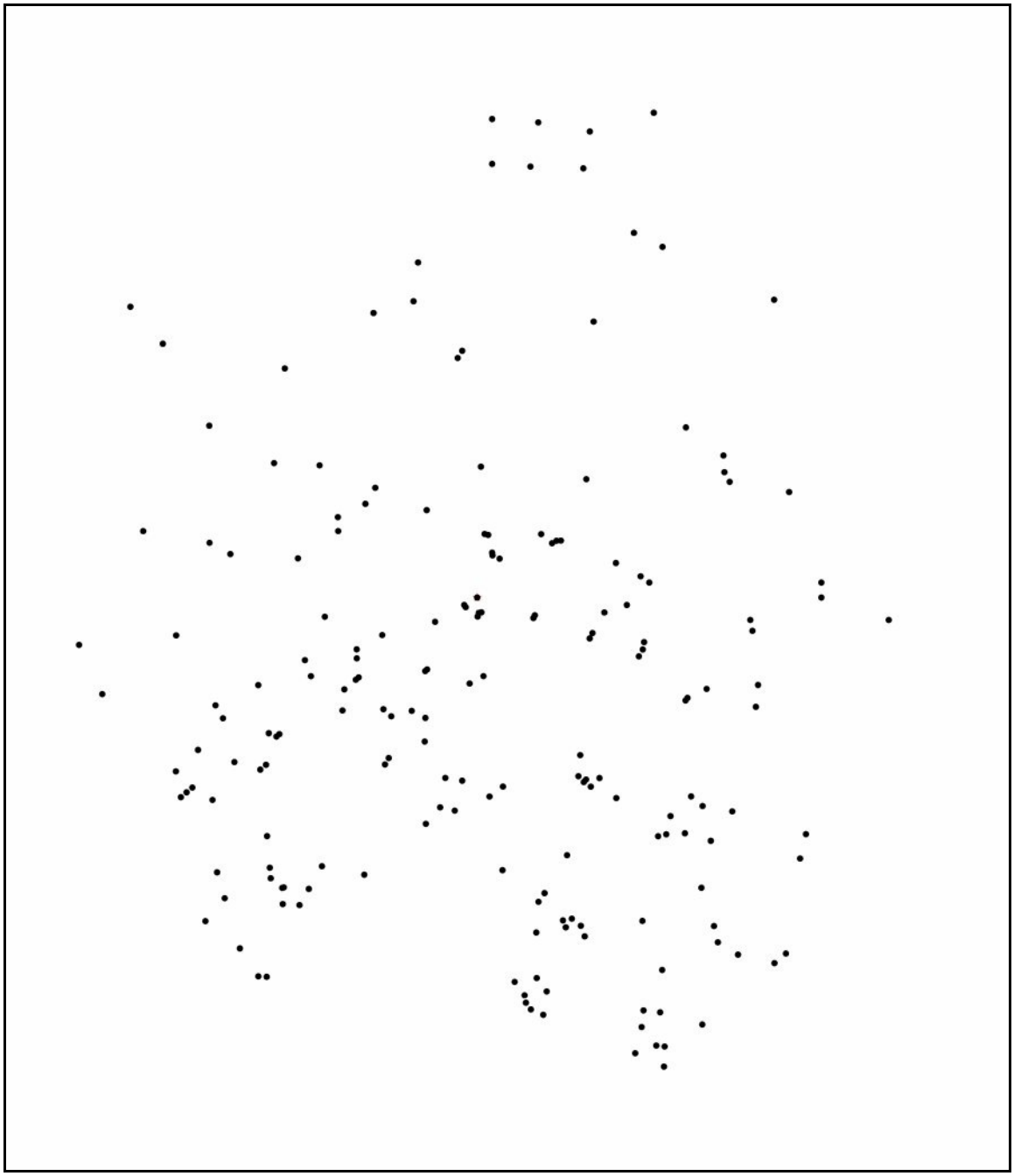
CONCLUSION

Of the three sites visited, each expressed unique, if implied, population dynamics. The Looe Key backreef is actively expanding its population. The forereef is an older population and recruitment is low. The Broward County *A. palmata* specimens are scattered, occasional, and short lived.

The principal value of this research is the documentation of location and condition of each of the 183 specimens or 7 areas examined. From this map the SRG team or other teams can conduct change based analyses allowing for a greater understanding of the overall populations. Studies such as this can also play an important role in understanding the limits to the range of the species. In sessile species, perhaps more so than in mobile ones, the normal, semi-cyclic expansion and contraction of habitat suitability coupled with local survival or extirpation of inhabitants can be useful in directing future management and conservation efforts. In areas where these fluctuations are not seen or are less dramatic, the habitat can be presumed to be more suitable for longer periods of time. Such habitats can be interpreted to be included within the core range of the organism and as such represent a more complete cross section of the population.

For example, genetics, and the derived genetic diversity, in those specimens taken from the fringe of the range cannot be expected to be the same as that of the core population and to infer otherwise would be potentially misleading. Still, genetic understanding is the next logical step in data collection and genetic data set is a primary data need. In the Looe Key study area genetic data could help differentiate the source of recruits to the backreef area and tie or sever connections with the populations (of breeding size) on the forereef spurs. Since the continued mapping will allow researchers to know that a particular recruit is a new member, the genetics of that new member compared to the existing population can guide scientists in understanding larval transport pathways and parent populations.

Of critical importance is the annualization of the mapping effort. The backreef has been mapped three times, each time covering more area. The forereef is mapped in mosaic and while new recruits will only be discovered at site 11C (subjected to special techniques: see text of report), the annual records of condition in the forereef will be invaluable. The East coast work needs to be expanded. While the Team conducted a thorough examination of the habitat of interest, local knowledge indicates that there are other specimens worth examining, particularly within the inshore boulder fields and further south into Biscayne Bay. Extending the effort into Biscayne would be valuable in defining the dynamics in the inter annual expansion and contraction of habitat suitability and range.



Map of Looe backreef occurrence of *Acropora palmata* 2009. North is up.