Hey Neighbor: The Role of *Palythoa caribaeorum* on the Florida Keys Reef Tract

Sarah Smith, Dr. Janie Wulff, and Bobbie Renfro MS

Department of Biology, Florida State University

Introduction

- Competition on coral reefs shapes ecological community structure (Ladd et al. 2019)
- Coral coverage is changing due to: (Toth et al 2019, Somerfield et al. 2008)
  - Climate change
  - Anthropogenic disturbance
  - Coral disease
  - Changes in reef-building coral abundance open benthic space and create opportunities for other native sessile invertebrates to expand or colonize (Toth et al. 2019)
- *Palythoa caribaeorum* is an invertebrate species of increasing interest in the Florida Keys:
  - Common in Brazil (Acosta et al. 2005), but understudied in Florida
  - Variable growth rates have been documented ranging between 0.04-0.15 mm/day (Durante et al. 2018)
  - Potentially aggressive space competitor (Ladd et al. 2019)
- Three main objectives to investigate the life history of *Palythoa caribaeorum* in the Florida Keys:
  1. Determine whole colony growth and wounding regrowth rates
  2. Determine ability for asexually produced ramets to attach to bare substrate
  3. Investigate interspecific interactions

Methods

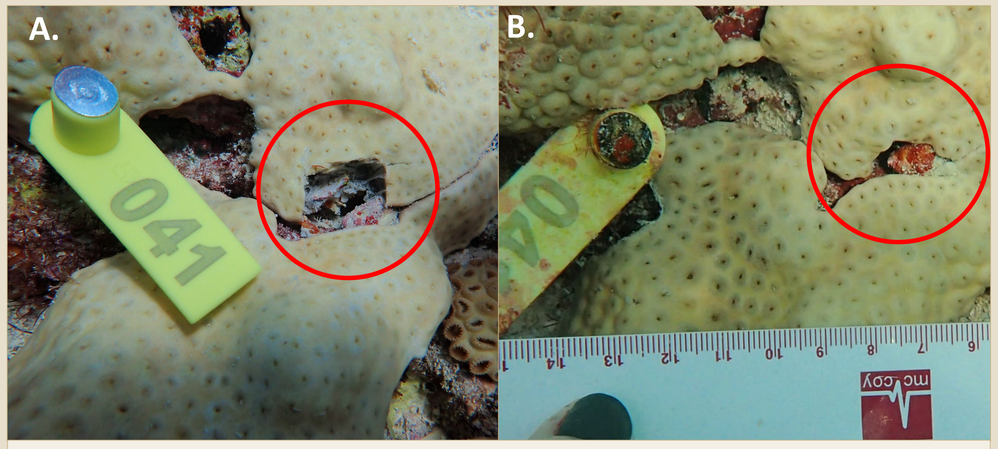

Fig. 1 Photo example of Objective 1, edge polyp removal. **A.** Colony #41 after polyp removal day 0, **B.** Colony #41 after 43 days. Red circles show area of polyp removal

Obj. 1: Growth and Regrowth Rates

- 3 growth treatments: Whole colony, edge polyp removal, middle polyp removal. 20 replicates of each type
- Edge & middle removal: 43 days Whole Colony: 36 days
- For edge & middle treatment, polyps were removed with a flexible blade
- Measurements taken by hand *in situ* and via photos for the ImageJ software once a week

Obj. 2: Survival of Asexually Produced Ramets

- 25 isolated colonies collected to simulate natural production of ramets
- Ramets placed under plastic berry baskets secured face down onto bare substrate (Fig. 2) for 32 days
- Checked weekly for attachment
- Measurements and health assessments taken day 0 & day 32

Fig. 2 Photo example of Objective 2 experimental design

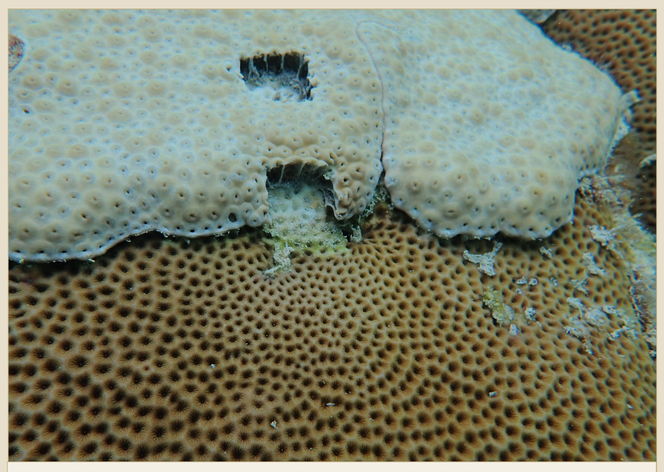

Fig. 3 Photo example of Objective 3: *Palythoa caribaeorum* overgrowing *Siderastrea siderea*

Obj. 3 Interspecific Interactions

- Documentation of all interspecific interactions within a 10 m^2 belt transect
- *P. car* polyps removed along interaction's edge (Fig. 3)
- Observations of interacting species recorded and photographed before and after polyp removal to determine interaction type:
  1. Neutral: seen as a line or gap < 5 mm
  2. Hovering: tissue overgrowth without contact
  3. Overgrowing: tissue overgrowth with contact

Results & Discussion

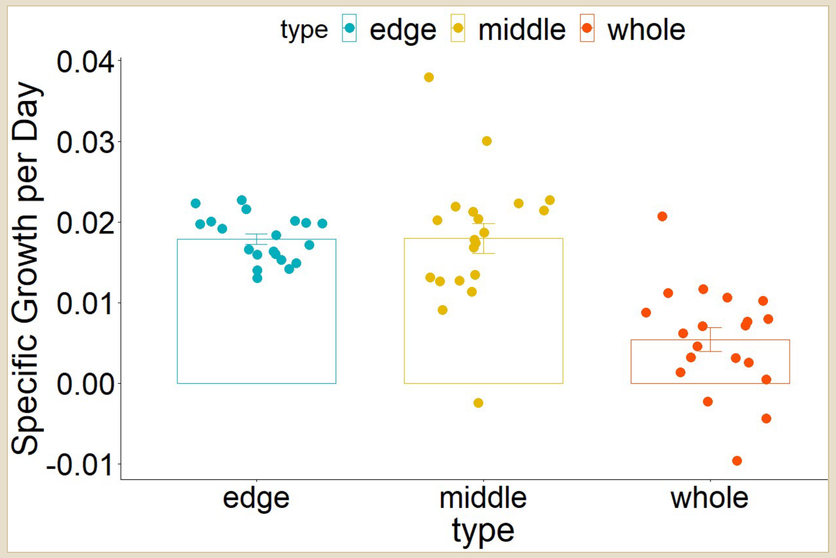

Fig. 4 Specific growth per day of *Palythoa caribaeorum* in the Florida Keys, USA. Three different growth types represented: blue = polyp removal along colony's edge ($\bar{x}$=0.0179, SD=0.00290), yellow = polyp removal in colony's middle ($\bar{x}$=0.0179, SD=0.00819), red = whole colony growth ($\bar{x}$=0.00539, SD=0.00659). Data are $\bar{x} \pm SE$.

Obj 1: Growth and Regrowth Rates

- Difference in wounding regrowth and whole colony growth was significant. Regrowth rates are greater than 2 times whole colony growth rates (Fig. 1)
  - Post-hoc pairwise comparisons:
    - No significant difference between edge wound and middle-of-colony wound regrowth rates (Tukey multiple pairwise-comparisons: p-value = 0.9992157)
    - Both edge and middle of colony regrowth rates were significantly faster than whole colony growth rate (Tukey multiple pairwise-comparisons: p-value =0.0000002, 0.0000001, respectively)
- Our mean whole colony growth rates (0.005 mm/day) & wounding regrowth rates (0.0179 mm/day) were not as fast as the 0.04-0.15 mm/day rate in circulating literature (Durante *et al.* 2018)
  - Some *P. caribaeorum* growth rates have been calculated by wounding colonies and measuring regrowth (Silva *et al.* 2015; Guilhem, Masi & Creed 2020)
  - Data suggests that wounding experiments may be an inaccurate way to investigate whole colony growth rates

Obj 3: Interspecific Interactions

- 36 total interactions documented among 15 different species:
  - 41.7% standoff, 19.4% hovering, 38.9% overgrowing
- 50% of interactions were with the order *Scleractinia*:
  - 22.2% standoff, 27.8% hovering, 50% overgrowing
- *P. caribaeorum* interactions with reef building corals are a topic of increasing interest in the Florida Keys (Ladd et al. 2019). 50% of *P. caribaeorum* interactions were with the order *Scleractinia*
- More data collection on interspecific interaction on different patch reefs are necessary to determine the frequency of interactions across the Florida Keys

Obj 2: Survival of Asexually Produced Ramets

- Experimental design adjustments due to storm action:
  - 20% deployed for 32 days, 30% for 24 days, 50% for 7 days
- No fatalities, 70% healthy, 30% unhealthy at the end of the experimental period
- Acosta et al. (2005) reports that if all ramets recorded for 1 year (n=1304) survived and reattached, it could increase population size by 225%. This study recorded ramet dispersal but not attachment and survival
- Long term studies to quantify percent of attachment are required to investigate population increases by asexual ramets

As coral reefs face large scale composition changes (Toth et al. 2019), it is important to understand the life history of the native invertebrates on Florida Keys reefs. Knowledge about *Palythoa caribaeorum's* growth rates, modes of reproduction, and interspecific interactions can aid researchers and habitat managers in understanding the health of our reefs.

Citations

Acosta A, Sammarco PW, and Duarte LF (2005) New fission processes in the zoanthid *Palythoa caribaeorum:* description and quantitative aspects. Bulletin of Marine Science. 76(1): 1-26

Durante LM, Cruz ICS, Lotufo TMC (2018) The effect of climate change on the distribution of a tropical zoanthid (Palythoa caribaeorum) and its ecological implications. PeerJ. 5: 1-26

Guilhem IF, Masi BP, and Creed JC (2020) Impact of invasive *Tubastraea* sppp. (Cnidaria: Anthozoa) on the growth of the space dominating tropical rocky-shore zoantharian *Palythoa caribaeorum* (Duchassaing and Michelotti, 1860) Aquatic Invasions. 15(1):98-113

Ladd MC, Shantz AA, Burkepile DE (2019) Newly dominant benthic invertebrates reshape competitive networks on contemporary Caribbean reefs. 38:1317-1328

Silvia FS, Gomes PB, Santana EC, *et al.* (2015) Growth of the tropical zoanthid *Palythoa caribaeorum* (Cnidaria: Anthozoa) on reefs in northeastern Brazil. nais da Academia Brasileira de Ciências. 87(2): 985-996

Somerfield PJ, Jaap WC, Clarke KR, *et al.* (2008) Changes in coral reef communities among the Florida Keys, 1996-2003. Coral Reefs. 27(4): 951-965

Toth LT, Stathakopoulos A, Kuffner I, *et al.* (2019) The unprecedented loss of Florida's reef-building corals and the emergence of a novel coral-reef assemblage. Ecology 100(9)