The Role of Macroalgae in Perpetuating the Degraded State of Coral Reefs in the Florida Keys

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Prior to the 1980's, macroalgae were fairly inconspicuous members of most coral reef communities. During the last three decades, coral reef degradation resulting from a multitude of stressors has occurred on a global scale, usually manifested as a decrease in live coral, followed by a lasting proliferation of algae (termed a phase shift). A Florida Keys-wide monitoring program of 40 sites showed that coral cover declined by 38% between 1996 and 2000 (Porter et al. 2002). During this same period, the brown macroalgae *Dictyota* spp. became the dominant benthic organisms at depths between 0 and 25 m on many of these reefs, covering up to 56% of the bottom during the summer months. While increased competition between corals and algae is often assumed on reefs that have undergone phase shifts from coral to algal dominance, there is very little evidence that macroalgae are competitively dominant over adult scleractinian corals. Competitive interactions during early life history stages remain largely unexplored.

Coral recruitment is a key process in the maintenance and recovery of coral reef ecosystems, and recruitment failure could be a major reason why reefs in the Florida Keys remain degraded despite conservation efforts. While based at the Keys Marine Laboratory in Layton, FL, we conducted a series of field and outdoor seawater table experiments to test the hypothesis that some weedy species of macroalgae and cyanobacteria can inhibit coral recruitment. We studied the larvae of the hard coral *Porites astreoides* and the octocoral *Briareum asbestinum* from the time of release through to successful recruitment when subjected to treatments with various weedy algae. Specially designed larval recruitment chambers (n = 10 per treatment) were deployed in the field, supplying coral larvae with access to suitable settling habitat (conditioned terra cotta tiles) in a contained environment, while allowing natural water circulation via the 180 μm mesh sides, and natural solar irradiance through the clear, extruded acrylic tubing. Successfully settled larvae were further tested by attaching algae (or a mimic control) to the tiles to examine their prospects for survival and growth.

Six out of seven species tested caused either settlement inhibition or an avoidance behavior in larvae of the hard coral *Porites astreoides*. Further, *Lyngbya confervoides* and *Dictyota menstrualis* significantly increased mortality rates of *P. astreoides* recruits. Exposure to *Lyngbya majuscula* reduced survival and settlement in larvae of the octocoral *Briareum asbestinum*. These findings indicate that competitive interactions beyond simple space occupation between weedy primary producers and coral larvae could be important in perpetuating phase shifts from coral dominated communities, allowing algae to persist as the dominant benthic organisms. Thus, on Florida Keys reefs that are experiencing phase shifts or temporary algal blooms, coral settlement rates may be reduced despite the availability of appropriate substrate.