Developing Culture Techniques to Conserve Coral Reefs in the Florida Keys

March 2005 Progress Report

Submitted to
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Background Prior to ORRGC Funding:

The coral reefs in the Florida Keys are a unique national treasure that need to be protected. The decline of healthy corals has been demonstrated by increased documentation of coral diseases, coral bleaching, and decreased living coral cover. Coral reefs are also impacted by disturbances, such as ship groundings and hurricanes, which occur throughout the Florida Keys. There is a need for new coral colonies to restore a site following a disturbance. Although the number of reef restoration projects in the Florida Keys National Marine Sanctuary and elsewhere is increasing, the status of our knowledge regarding optimal culture methods to produce coral colonies for the wide range of coral species that are impacted by groundings and other disturbances in the Florida Keys is limited. Culture techniques will vary for different species. For example, some corals will require more light and some corals will require more current than other species. In addition, we need to insure that prior to replanting, corals are acclimated to the environment to increase survival. Restoration research efforts will require large numbers of colonies for each coral species impacted by groundings in order to evaluate the effectiveness of the different restoration strategies.

In August 2004, Mote Marine Laboratory (MML) received support from the Ocean Reef Rod and Gun Club (ORRGC) to support our research to develop the culture technology to produce several species of hard corals for reef restoration research. Our efforts to develop coral culture technology for reef restoration are a collaborative research effort between the Florida Keys National Marine Sanctuary (FKMNS), EarthEcho International, and three of MML's research centers:

- Center for Aquaculture Research and Development
- Center for Fisheries Enhancement
- Center for Coral Reef Research.

The ORRGC funds provided some critical bridge funding to MML’s Center for Aquaculture Research and Development to continue the coral aquaculture work we had initiated at the Tropical Research Laboratory (TRL) in Summerland Key with funding from the NOAA Coral Reef Conservation Program in 2003 and 2004. Additional matching funding has been committed by the FKNMS to support the coral aquaculture research and our research consortium is continuing to apply for NOAA, FKNMS and other foundation support to continue this important work.

In 2003 and 2004, damaged coral fragments from 23 different hard coral and 1 soft coral species were rescued from reef environments in the Florida Keys and established in environmentally controlled, recirculating culture systems. These corals were collected, acclimated in open flow-through raceway systems, mounted on disks composed of aragonite and Portland cement, and transferred to the environmentally controlled culture laboratory at MML’s Tropical Research Laboratory. MML and FKNMS staff also collected coral fragments and established a field coral nursery in the lower Florida Keys. Coral fragments were placed at the field site and are monitored throughout the year for growth and survival. This nursery will enable us to compare differences in laboratory and field cultured coral colonies.

The environmentally-controlled coral culture laboratory at MML was redesigned in 2004. Culture tanks and new filtration systems were constructed to be highly flexible and
enable us to experimentally evaluate growth of multiple species under different culture conditions. The new tank design includes a flexible rack system that will allow us to mount the coral fragments on discs where they can be exposed to different light intensities. The tanks also contain powerheads to simulate current or surge conditions. Three tank systems (150 gallons per tank; 200 gallons per system) were completed in April 2004 and the biofiltration systems were seeded with live sand, live rock, jaw fish and prey organisms. The culture tanks were stocked with coral fragments beginning in May 2004.

Progress to date supported by ORRGC Funds:

Since August 2004, our research team in the Florida Keys has continued to maintain the coral fragments in the three 150-gallon tanks at TRL. These corals require optimal light conditions, daily monitoring for water chemistry, feeding, and temperature controlled conditions In January 2005, we completed construction of three additional tank systems (75 gallons per tank; 100 gallons per system) and conditioned the biofiltration systems. In February, we stocked two of the 75-gallon tanks with coral fragments.

The corals in our culture systems are fed 3 times each week with a phytoplankton/zooplankton slurry, which contains a small amount of live, newly hatched enriched Artemia, micropureed dried zooplankton (i.e., copepods and flake zooplankton) and E.S.V. Spray-Dried Phytoplankton®. The spray-dried phytoplankton serves several important roles:

- it provides food for the corals, as well as the fish and other filter feeders in the system, and promotes the production of zooplankton.
- the abundance of highly unsaturated fatty acids found in this particular strain of phytoplankton causes the foam in the protein skimmers to collapse for a few hours, allowing the algae cells longer residence time in the system before being exported by skimming.

The following water chemistry parameters are monitored in the coral culture systems:

- calcium and temperature are checked daily
- pH, salinity and nitrate are checked weekly
- magnesium testing is done only when calcium levels begin to drop, although this has not yet happened in our systems.

In February, a new coral culture system was established at MML's Conch Baby Farm facility in Key West. This system is serving two important goals: it is providing a backup culture site for the corals and it is providing an education/outreach tool for MML's coral culture research. The backup culture site is a safety net for our culture research efforts because the physical separation provides quarantine and physical system backup to our coral systems at TRL. MML’s Conch Baby Farm is open to the public 5-6 days per week and provides the Key West community and local visitors with information about Mote’s research in the Florida Keys.
Upcoming Activities with Existing ORRGC Funds:

MML has developed a technique to monitor growth of the hard corals in our laboratory systems. Growth measurements of all corals in culture are recorded approximately one month after placement in the culture tanks. Additional growth measurements are recorded every 3-6 months to determine growth rates under environmentally controlled conditions. In March 2005, we will be recording growth measurements for the corals in the 150-gallon tanks for comparison with the Fall 2004 growth data.

This spring we will be constructing a 125-gallon quarantine tank in a separate room to hold cultured colonies prior to placing them in the environmentally controlled culture laboratory. This quarantine system will provide an environment that allows us to monitor the health of the coral fragments, prior to introducing them to the controlled environment systems.

New Directions & Funding Needs:

The development of aquaculture techniques for multiple species of hard corals requires a long-term effort and expanded culture facilities. Growth rates, environmental conditions, and feeding requirements vary from one species to the next and the optimal culture parameters need to be identified for the various coral species. Our progress in developing coral aquaculture techniques indicates that the MML systems, which were designed and tested during this project, are providing enough flexibility to make significant progress in the development of large-scale hard coral culture techniques.

Our environmentally controlled coral culture laboratory has open space that we have designated for installation of 2 new coral culture raceway tanks (two 200-gallon raceway tanks per system). These raceway systems will provide needed coral culture space to expand our production efforts and explore the feasibility of producing larger numbers of coral colonies for restoration research. Additional support is requested from the ORRGC to enable us to expand these culture facilities and purchase one of the two new raceway systems, associated filtration and lighting equipment. Our estimated cost for the raceway system is $10,000-$15,000. Matching funds have been requested from FKNMS to support the maintenance of coral colonies (staff time, coral diets, water chemistry supplies, etc.).