NOAA FINAL REPORT

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Final Report NOAA On Funding For Project SECORE

Throughout their range, coral reefs are dying largely due to human influences. Unfortunately, saving coral reef habitat alone will not stop these global patterns of decline. This report details the conservation progress made in 2007 for the NOAA funded grant entitled "Project SECORE: *Ex Situ* Conservation of Caribbean Acroporids". Coral reefs are some of the oldest and most diverse ecosystems on our planet. They are the one of the ocean's main nurseries and feeding grounds for fish and invertebrates. Coral reefs provide natural storm barriers for coastlines, are a potential source for novel pharmaceuticals, and support almost 85% of the economies of their nearby communities through tourism.

Although all of the oceans in the world have corals, reef-building corals in the Caribbean are showing the greatest signs of distress. The massive Elkhorn coral, *Acropora palmata* has historically been the primary and most ecologically important reef-building coral in the Caribbean, but its populations have declined from 90-99% since the mid 1980's. Because of this, *Acropora palmata* has been one of the first two corals listed as 'threatened' under the Endangered Species Act, along with its Caribbean relative, *Acropora cervicornis* (Staghorn coral).

An international conservation network called SECORE (SExual COral REproduction) in collaboration with scientists and aquarium professionals are trying to save these threatened coral species, using '*ex situ*' conservation techniques on these populations by bringing **sexually reared coral larvae into captivity**, and using modern fertility techniques to cryopreserve them and stored them in **genome resource banks**. Thawed samples from the banks could be used to 'seed' shrinking populations. These *ex situ* conservation tools hold strong promise in preventing species extinction for Elkhorn coral.

In 2007, SECORE scientists broadly achieved the following conservation milestones with NOAA funding:

1) successful cryopreservation of *A. palmata* sperm;
2) isolation of donor zooxanthellae strains for cryopreservation and settlement studies;
3) improvements in water quality and larval husbandry;
4) settlement and growth of over 1,000 *A. palmata* in aquaria around the world
5) direct collaborations with NOAA scientists tasked with saving *A. palmata*;
6) increased outreach and training component compared to 2006; and,
7) two submitted papers resulted from this funded research.

SECORE Final Results 2008

1) Cryopreservation:

Elkhorn sperm was successfully cryopreserved during at least two consecutive spawning nights (Hagedorn et al, in preparation), resulting in high (>90%) post-thaw motility for some samples. Due to the mixing of the sperm from the waves, no unfertilized oocyte samples were taken from the ocean. Thus, we could not accurately assess the post-thaw fertility of the frozen samples without these reliable negative controls. We have replicated and expanded these freezing methods on the sperm of a Hawaiian acroporid, *Montipora capitata*, and successfully applied reproductive techniques that allowed us to determine the fertilization rate of the frozen and thawed sperm. Our fertilization rate with frozen/thawed *M. capitata* sperm equaled that of fresh sperm (Hagedorn et al., 2008 in prep.).

***Conclusion**:* These same techniques will be used in on the *A. palmata* in 2008, and will be essential for banking and maintaining the genetic diversity of wild populations.

2) Zooxanthellae:

Zooxanthellae strains were isolated from *A. palmata* donor populations of the Elkhorn coral at the collection site, and preliminary cryopreservation and settlement experiments were performed with these isolates. Infection of primary polyps with zooxanthellae extracted from native *A. palmata* colonies was successfully accomplished by Carl at Omaha Zoo, and was genetically identified as Clade A by Baums.

Conclusion*:* These types of controlled infections with specific native symbiotic algae were successful in the endangered coral, *A. palmata*, and will be crucial for future conservation efforts.

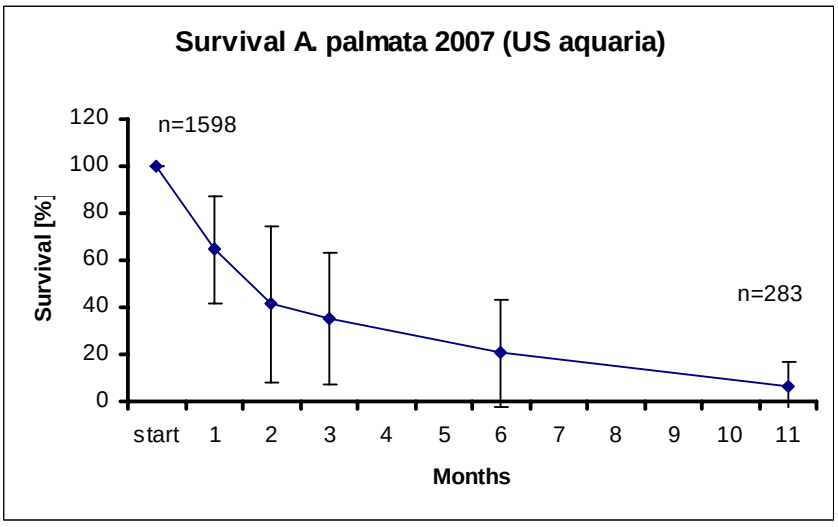
3) Water Quality:

On site, we built a flow-through seawater system to rear larvae naturally, making conditions suitable for larval growth. Then, we paired this system with a novel larval rearing chamber. This device produced excellent water conditions that matched our survival in static bowls.

Conclusion*:* These improved rearing practices resulted in partial data for a paper (see #7).

4) Settlement and Growth:

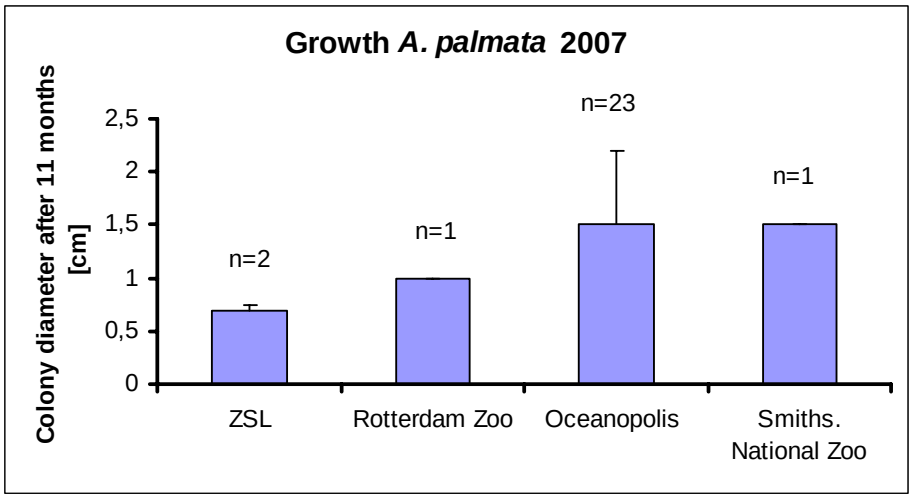
In 2007, we experienced lower larval settlement rates than in 2006. However, most groups collecting *A. palmata* larvae throughout the Caribbean during the 2007 spawn did not produce any settled larvae (Baums and Miller, Paul, and Szmant, pers. communications). So in comparison, our efforts were quite successful. According to Baums and Miller (personal comm.), one potential reason for this unusually low settlement rate was low larval fitness due to the split spawn in 2007. Approximately. 10% of the colonies located in the study area spawned compared to ~ 90% in August 2006. The total number of larvae collected by SECORE was 57,000 resulting in 1598 settled larvae at 6 public aquaria with 283 individuals surviving the initial 11 months (see figure below). Nevertheless, despite declining survival, is relatively high compared to current known settlement rates in the wild.



Three hundred juvenile corals from recruits were transported from Omaha's Henry Doorly Zoo to Rotterdam Zoo in April 2008 with no losses during transport. The corals were distributed to 4 different public aquaria within the EU. However, due to unusually low ambient temperatures for that time of year, the recruits arrived at their destination with temperatures below 20 ºC, resulting in a much greater

mortality in the EU recruits over the remaining 3 months (~92% decrease in these months) compared to the US recruits (~30% decrease in these months). These studies resulted in a paper, see # 7.

Growth of recruits in 2007 (diameter: 1.4 ± 0.7 cm, mean ± SE; d = 11 months) was slightly less than in 2006 (1.6 ± 0.4 cm).



***Conclusion**:* After two years of work, SECORE has produced over 1,000 juvenile corals now growing in aquaria around the world. This *ex situ* collection represents at least as many individuals as the number of colonies now extant in the Tres Palmas Reserve.

5) Collaborations:

A direct collaboration with a NOAA scientist (Dr. Margaret Miller) was initiated. SECORE assisted Drs. Miller and Baums in their work on rearing coral larvae in Florida. The SECORE kreisel worked very well for rearing two additional species of coral larvae, *Montastrae faveolata* and *Diploria strigosa*. Larvae from these species are currently being reared at Columbus Zoo and Aquarium with 3-month rearing rates as high as 65 and 45%, respectively. In the Florida experiments, submersible water pumps in large shipping bins were used instead of a flow-through system, temperature was monitored and 75% of the water changed at least daily.

Conclusion: Our rearing practices have already modified the husbandry and maintenance of a wide variety of coral larvae.

6) Outreach:

SECORE improved its NOAA-funded outreach and training components in a number of areas, such as:

i. SECORE collaborated with Dr. Manon Laterveer de Beer of Blue Imprint.nl who photographed and produced a daily weblog of events in Puerto Rico. In addition, the blog was combined with a newly redesigned website for SECORE (www.secore.org);

ii. Press articles about SECORE's work in appeared in the last 6 months in international and national news, such as Science Magazine, Science Daily Magazine, Discover Magazine, Columbus Dispatch, Columbus Zoo and Aquarium Conservation Report and Omaha World Herald;

iii. Shedd Aquarium assisted SECORE in recording underwater footage to produce a teaching video for coral restoration for the Department of Land and Natural Resources (DLNR) in Puerto Rico;

iv. Shedd Aquarium took still and underwater film to document SECORE's coral conservation for an upcoming exhibit at the aquarium;
v. SECORE connected with local non-governmental organizations, such as the Surfrider Foundation, to help spread the message of coral conservation. In 2008, Surfrider will help us connect with the local community by arranging public lectures and onsite tours.
vi. SECORE visited with DLNR in San Juan to update them on our progress and plan future work. ;
vii. A local graduate student from the University of Puerto Rico was identified to work with SECORE in 2008;
viii. SECORE trained 11 new aquarium and 2 science professionals in coral conservation; and,
ix. Each participant (~20) gave public lectures on SECORE's work at national and international venues to scientific and lay audiences.

7) Submitted Papers:

This NOAA-supported research resulted in three papers:

Petersen D, Carl M, Borneman EH, Brittsan M, Hagedorn M, D. Laterveer M, Schick M. (2008) Noah's ark for the threatened Elkhorn coral *Acropora palmata*. Coral Reefs 27 (3):715.

Hagedorn M, Carter VL, Krupp D, Leong JC, Kanno R, Borneman EH, D. Petersen D, Laterveer M, Brittsan M, Schick M. (2008) *Ex situ* coral larvae culture using flow-through chambers. (submitted Smithsonian Institution Scholarly Press).

Hagedorn M, Carl M, Schick M, Petersen D, Laterveer M, Borneman E, Brittsan M, Meyers SA, Tiersch TR. (2008) *Ex situ* conservation of an endangered coral species. AZA Connect Magazine (in press).