Fertilization Ecology and Early Life Stages in Threatened Caribbean Acroporid Corals

Nicole D. Fogarty
Smithsonian Marine Station
Fort Pierce, Florida

Acropora palmata
Elkhorn coral

Acropora cervicornis
Staghorn coral
Acroporid decline

Study species

Photo credit: Eric Borneman
Threats to acroporids

Study species
Acroporid restoration/ natural recruitment

Asexual propagation

and

Natural Sexual recruitment
Caribbean acroporid life cycle

Development

Larvae (2-3 days)

Settlement (4-7 days)

4-8 years to reach sexual maturity
Caribbean acroporid life cycle

Development

Larvae (2-3 days)

Settlement (4-7 days)

4-8 years to reach sexual maturity
Spawning Times

- A. palmata
- A. cervicornis

Days after full moon vs. minutes after sunset.
Caribbean acroporid life cycle

Development

Larvae (2-3 days)

Settlement (4-7 days)

4-8 years to reach sexual maturity
Methods

Fertilization Ecology

Photo: R. Ritson-Williams
Methods

Fertilization Ecology

Photo: R. Ritson-Williams

Photo: R. Ritson-Williams
Individual crosses

![Graph showing the proportion of eggs fertilized against log sperm concentration per mL for A. palmata and A. cervicornis.](image)

- **A. palmata**
  - Linear fit: $R^2 = 0.27$
  - Poly. fit: $R^2 = 0.24$

- **A. cervicornis**
Selfing

Fertilization Ecology

![Proportion of eggs fertilized](chart.png)

**A. palmata** vs **A. cervicornis**

* T-test
p< 0.05
Gamete aging

Fertilization Ecology

Proportion of eggs fertilized

- Fresh gametes (A. palmata)
- 4 hrs old gametes (A. cervicornis)

Significance levels:
- P < 0.001
- P = 0.05
Gamete aging

Fertilization Ecology

Proportion of eggs fertilized

log sperm/mL

Fresh gametes
Old gametes
Poly. (fresh)
Poly. (old)

A. cervicornis

p = 0.05
Conclusions

1) *A. cervicornis* eggs are easily fertilized making them susceptible to polyspermic and self fertilization, but this ease of fertilization allows them to remain viable for a longer period of time.

2) *A. palmata* eggs are more difficult to fertilize and fertilization decreases significantly when gametes age.
Caribbean acroporid life cycle

- Development (2-3 days)
- Settlement (5-7 days)
- Larvae (2-3 days)
- 4-8 years to reach sexual maturity
Caribbean acroporid life cycle

Development

Larvae (2-3 days)

Settlement (4-7 days)

4-8 years to reach sexual maturity
Methods

Settlement
Settlement and Metamorphosis

![Graph showing comparison between A. palmata and A. cervicornis in terms of proportion of coral settlers. The graph indicates a statistically significant difference with * p < 0.001.]

**T-test**

* * p < 0.001
## Conclusions

1) *A. palmata* and *A. cervicornis* are very different at many of the early life history stages.

<table>
<thead>
<tr>
<th><strong>A. palmata</strong></th>
<th><strong>A. cervicornis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• more difficult to fertilize</td>
<td>• easy to fertilize</td>
</tr>
<tr>
<td>• fertilization decreases</td>
<td>• gametes viable after 4 hours</td>
</tr>
<tr>
<td>with age</td>
<td>• can self fertilize</td>
</tr>
<tr>
<td>• does not self</td>
<td>• susceptible to polyspermy</td>
</tr>
<tr>
<td>• slightly higher larval</td>
<td>• low settlement rates</td>
</tr>
<tr>
<td>survival and significantly</td>
<td></td>
</tr>
<tr>
<td>higher settlement rates</td>
<td></td>
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</tbody>
</table>
Management Strategies

1) Protect existing stands of genotypically diverse *A. palmata*.

2) Focus on restoration efforts that use genotypically diverse asexual fragments to create thickets of *A. cervicornis* and strive to protect herbivores that clean the substrate to encourage natural recruitment.
Acknowledgements

Funding:
National Geographic Society
PADI Foundation
American Academy of Underwater Science
Lerner-Gray
Smithsonian Institute
FSU Short Fellowship
FSU Bennison Fellowship
FSU International Dissertation Research Fellowship

Folks that helped:
Don Levitan
Steve Vollmer
Val Paul
Raphael Williams
Susie Arnold
Bob Steneck
Margaret Miller
Alina Szmant
Carl Safina
Randi Rojan
Beth Stauffer
Jeanne Brown
Mike Carpenter
Brendan Biggs
Casey ter Horst
Wade Cooper
Dave Ferrell
Nate Jue
Peter Bouwma
Todd Hitchins
Levitan Lab