Acropora Species Status and Trends in Dry Tortugas National Park

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Dry Tortugas National Park
Acropora Science and Stewardship
Objectives

• Assess the long term ecological status and trends of Acropora species and reefs in the park.

• Encourage and support empirical research to better understand the factors affecting Acropora (e.g., disease, climate change).

• Provide scientific information for more effective park Acropora and marine ecosystem stewardship.

• Develop, implement, and evaluate conservation and restoration actions.
Acropora palmata (elkhorn coral)
ESA Threatened Species
Acropora cervicornis
(staghorn coral)
ESA Threatened Species

Acropora prolifera
(fused staghorn coral)
staghorn - elkhorn hybrid
Focus of this Presentation

• Compare the current spatial distribution and extent of *Acropora* dominated reefs to the last *Acropora* surveys done in 1976 (Davis 1982).

• Current status and recent trends of *Acropora* populations in DTNP: *A. palmata*, *A. prolifera*, and *A. cervicornis*. 
Methods

*Acropora* Spatial Distribution and Extent

- Re-survey areas identified in 1976 as *Acropora* dominated reefs.
- Snorkeling with underwater scooter and GPS. Record survey tract, *Acropora* colony location, number of colonies, and colony size and condition/health (e.g., % live tissue, disease). [Similar to method developed by Williams and Miller, NMFS/NOAA.]
- In deeper water (>8m), paired SCUBA divers with scooters. A boat follows the divers recording their tract using boat GPS.
Methods

Coral Percent Cover: FWRI CREMP Videography

Three fixed continuous video transects per fixed station (replicate). Randomly selected points are analyzed on each image frame. Average of 2000 random points examined per replicate (station); precision to at least 0.1%.
Methods

**Acropora Disease, Bleaching, and Predation Prevalence**

- CREMP Fixed Stations: All colonies $\geq 10\text{cm}$ 2006-2009, $\geq 4\text{cm}$ 2010-future, examined in $2\times22\text{m}$ fixed belt transect (station). One survey per year.

- “Plot-less” Rapid Assessment: All *Acropora* colonies observed during haphazard swim of entire or most of site are examined. Multiple surveys per year.

- Data presented as percent of colonies examined with disease, etc.
Staghorn reefs 55% of total coral reef area.
Today: No Staghorn Reefs
White Shoal (South End)

"A" waypoints identify *Acropora* colony locations. Each yellow highlighted "A" has four or more staghorn colonies.
1976: *Acropora cervicornis* reef west of Loggerhead Key.

[Photo by Gary Davis, NPS]
Today: *Acropora cervicornis* rubble pile west of Loggerhead Key.
2008: *A. cervicornis* rubble field, White Shoal.
Dry Tortugas National Park
Acropora Spatial Extent

<table>
<thead>
<tr>
<th></th>
<th>1881 (Agassiz 1883)</th>
<th>1976 (Davis 1982)</th>
<th>1993 (Jaap and Sargent 1993)</th>
<th>2009 (Morrison et al, in prep)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Acropora</td>
<td>461 ha</td>
<td>478 ha</td>
<td>-----</td>
<td>&lt;1 ha</td>
</tr>
<tr>
<td>A. cervicornis/</td>
<td>417 ha</td>
<td>478 ha</td>
<td>-----</td>
<td>0.54 ha</td>
</tr>
<tr>
<td>A. prolifera</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. palmata</td>
<td>44 ha</td>
<td>0.06 ha</td>
<td>0.14 ha</td>
<td>0.11 ha</td>
</tr>
</tbody>
</table>

>99% decrease in A. cervicornis 1976-2008
Loggerhead Key A. cervicornis patch reef one year prior to Hurricane Charley.

[Photo by Dana Williams, NOAA]
Dry Tortugas National Park

Hurricane Charley Aug 2004
Loggerhead Key *Acropora cervicornis* patch reef about one year after Hurricane Charley (24 Jul 05).
Proximate Causes of *Acropora* Loss

- **1977 Hypothermic (cold water) event.**
  - 90% staghorn loss due to hypothermic stress caused by cold front and cold water mass.

- **Mid 1980’s to 2003: Disease occurrences.**
  - 1995-2000: Multiple significant disease events.

- **2004-2005: Five hurricanes affected DTNP in 14 months, unprecedented in 130 year history of Tortugas science.**

- **2009-2010: Substantial localized staghorn white band disease outbreaks.**
DTNP Acropora CREMP Sites: Acropora Cover

- A. cervicornis (White Shoal) N=4, P<0.001
- A. prolifera (A. prolifera patch) N=3, P<0.05
- A. palmata (A. palmata patch) N=2, P=0.08
- A. cervicornis (Loggerhead Key patch) N=2, P<0.05

2009: Acropora ≤7% at all sites
DTNP Acropora prolifera Patch: Percent Cover

CREMP Station Data

RM ANOVA on transformed data:
F=17.06; df=3,11; P=0.002
Pairwise Multiple Comparisons (P<0.05):
2004=2005>2006<2007
2007=2004=2005 (recovery)

2009: CREMP vs Random Photo Transects

CREMP Stations
Mean=7.1; N=3

Random Photo Transects
Mean=4.5; N=10
Acropora cervicornis Disease Frequency at DTNP Staghorn Monitoring Sites

Percent of Colonies Diseased

- Acer WTR (Aug10 vs Sep10: NS)
- Acer OR (Aug10 vs Sep10: NS)
- Acer PER
- Acer HAU

Date: 2009-May, 2009-Jul, 2009-Sep, 2010-May, 2010-Aug, 2010-Sep

Values: 0 0 0 0 0 0
**Acropora cervicornis** Colony Size Distribution at Acer-WTR in DTNP

- 2009 (N=53)
- 2010 (N=79)

\[ X^2 = 10.60, \text{ df} = 4, \text{ P} = 0.03 \]
**Acropora palmata and Acropora prolifera**
Disease Prevalence in DTNP

<table>
<thead>
<tr>
<th>Month</th>
<th>A. palmata</th>
<th>A. prolifera</th>
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<tbody>
<tr>
<td>Sep06</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jun07</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oct08</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>May09</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Sep09</td>
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<td>0</td>
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<tr>
<td>Dec09</td>
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<td>Feb10</td>
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<tr>
<td>Aug10</td>
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</tr>
<tr>
<td>Sep10</td>
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Summary/Conclusions

• >99% loss of DTNP staghorn reefs since 1976 (>50% loss of park coral reefs).

• Only two known Acropora reefs in DTNP.

• Acropora species live cover ≤7% on remaining reefs.

• 1977 cold water event caused 90% mass mortality of staghorn.

• More recent Acropora loss due to multiple major disease occurrences.
Summary/Conclusions

• 2004-2005 hurricanes caused *Acropora* decline; but *A. prolifera* and *A. palmata* recovering.

• 2010 cold water event had no observed effects on DTNP *Acropora*.

• Staghorn white band disease outbreaks in 2009 and 2010.

• Coral decline is the most significant and challenging DTNP resource stewardship issue.
Additional *Acropora* Science Actions

- *Acropora* population demographics and colony fate tracking by FWRI and UGA (DTNP and NOAA funded).
- *Acropora* disease research by USGS and UGA (NPS and USGS funded).
- Shallow and deeper water benthic surveys using remote video (ATRIS) by USGS.
- Major USGS coral reef research program in DTNP focusing on climate change and disease.
**Acropora Stewardship Actions**

- Installed more effective waste treatment facilities. Ferry visitors required to use restrooms on ferries. Less viral and bacterial contamination (Griffin et al). Nearby *Acropora* disease frequency decreased.

- Created no access Coral Special Protection Zone to protect *Acropora* reefs from anthropogenic physical impacts.

- *Acropora* restoration project with The Nature Conservancy.

- NPS working other agencies/partners and through U.S. Coral Reef Task Force to address regional and global causes of coral decline.
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