

Florida's "Redwood of the Reef": Growth, age, demographics and bleaching of the Caribbean giant barrel sponge *Xestospongia muta*

Linking Science to Management
Duck Key, Florida
19-22 Oct 2010

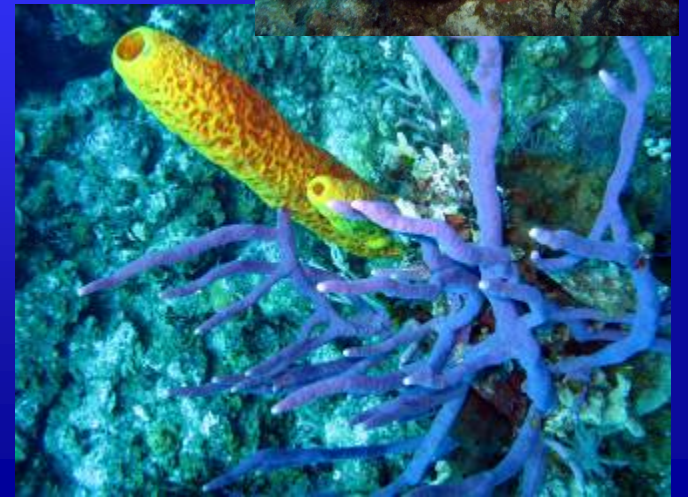
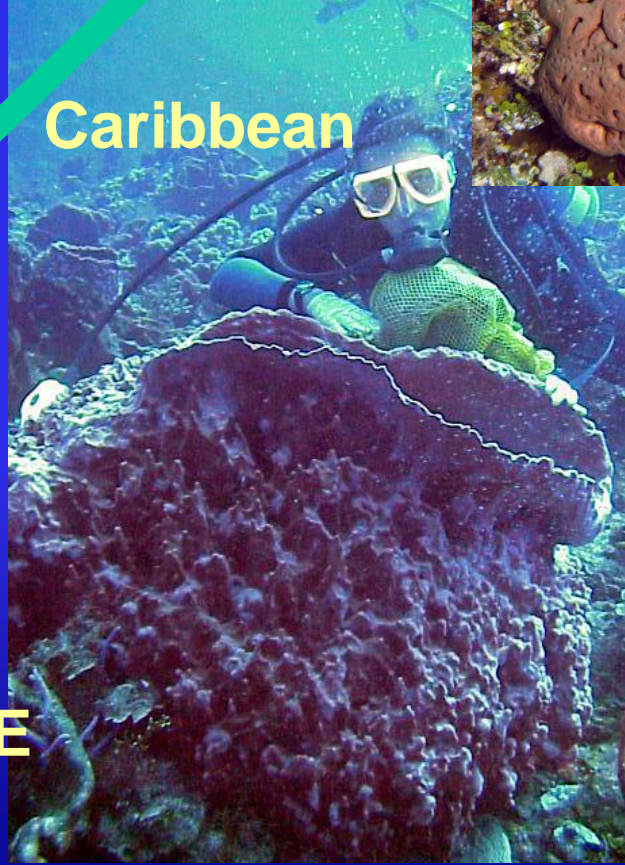
Joseph R. Pawlik
Biology and Marine Biology
Center for Marine Science
UNC Wilmington



GBR - Australia



Caribbean



**Sponges DOMINATE
Caribbean reefs**

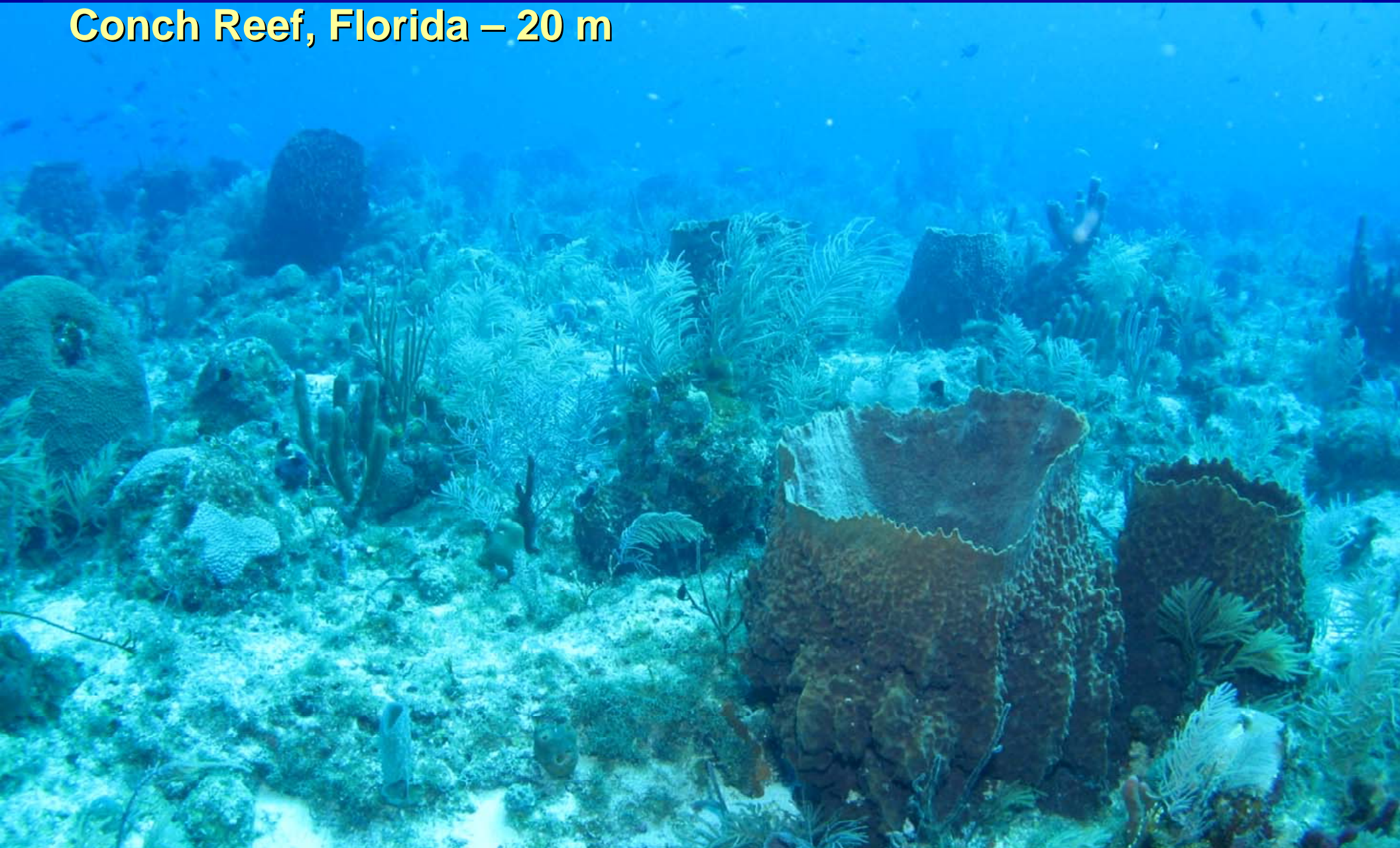


Xestospongia muta
color due to cyanobacteria
primary habitat-forming organism

Conch Reef, Florida – 15 m

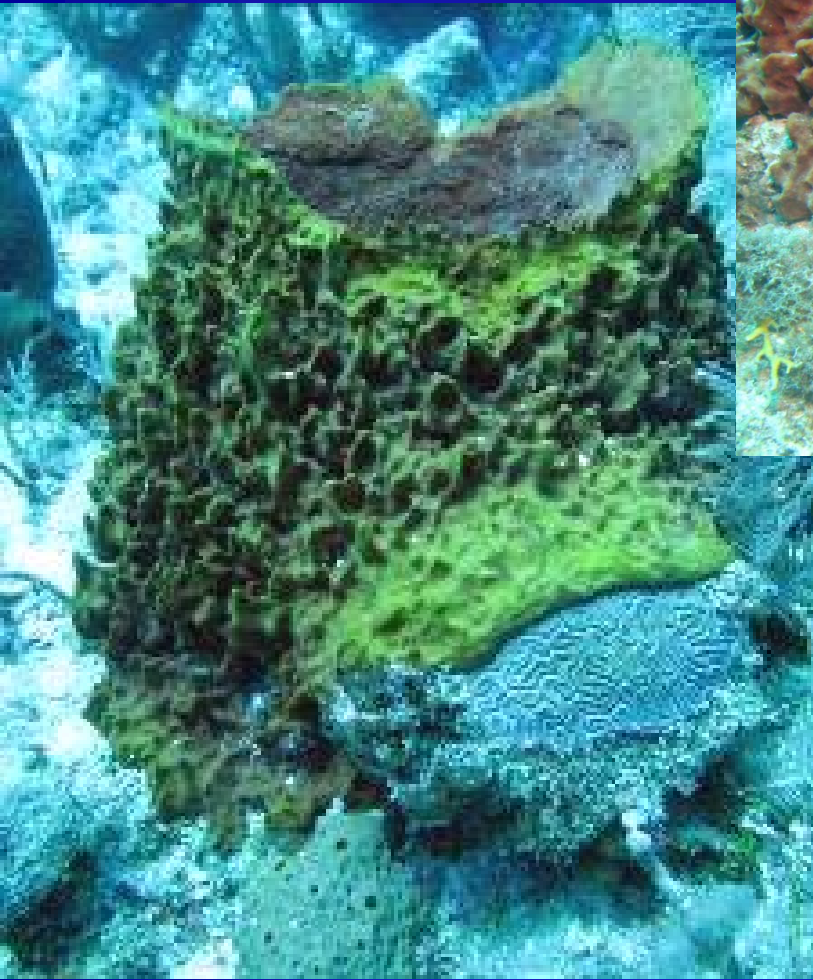


Conch Reef, Florida – 20 m



San Salvador, Bahamas – 30 m





Dominant competitor



1990's:

**Barrel sponges were bleaching
Some were dying**

Similar to coral bleaching?

- also -

How old are barrel sponges?

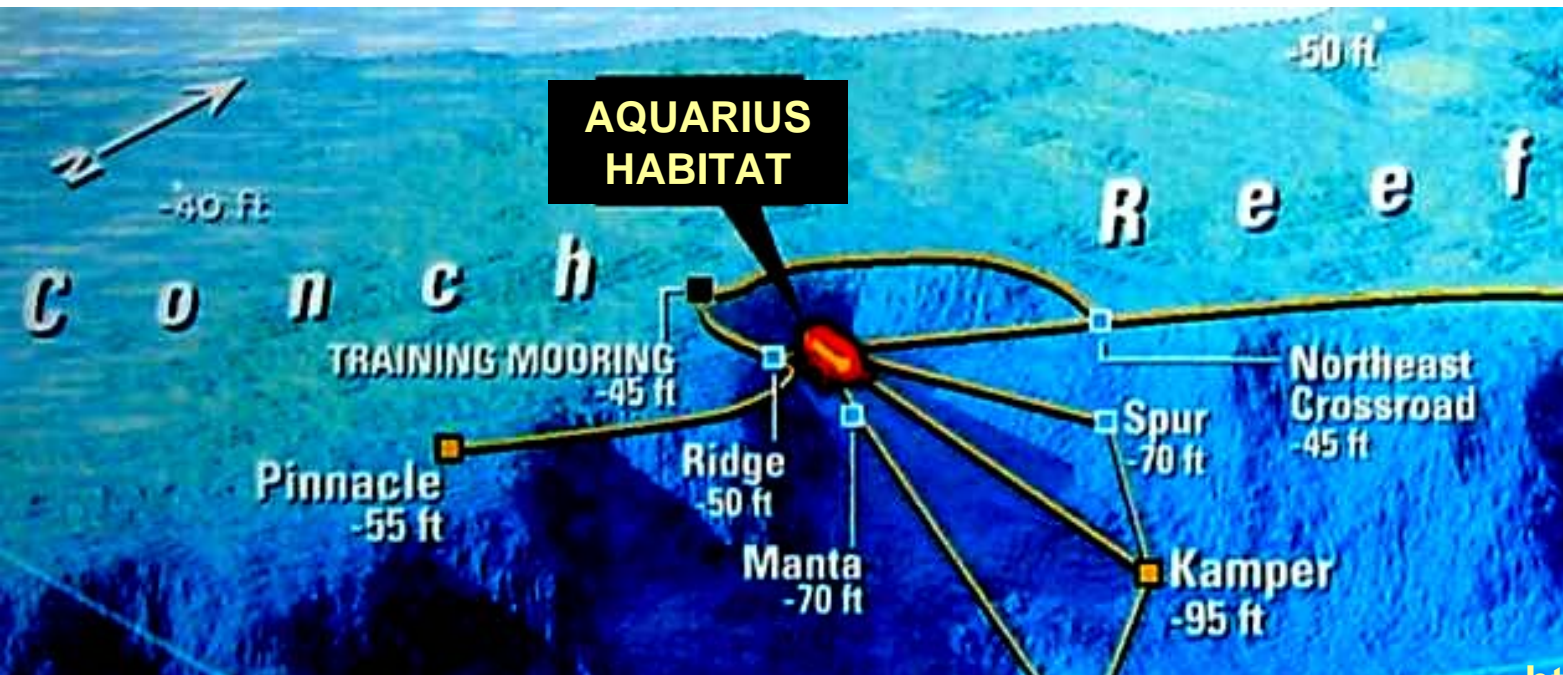
Mortality?

Recruitment?

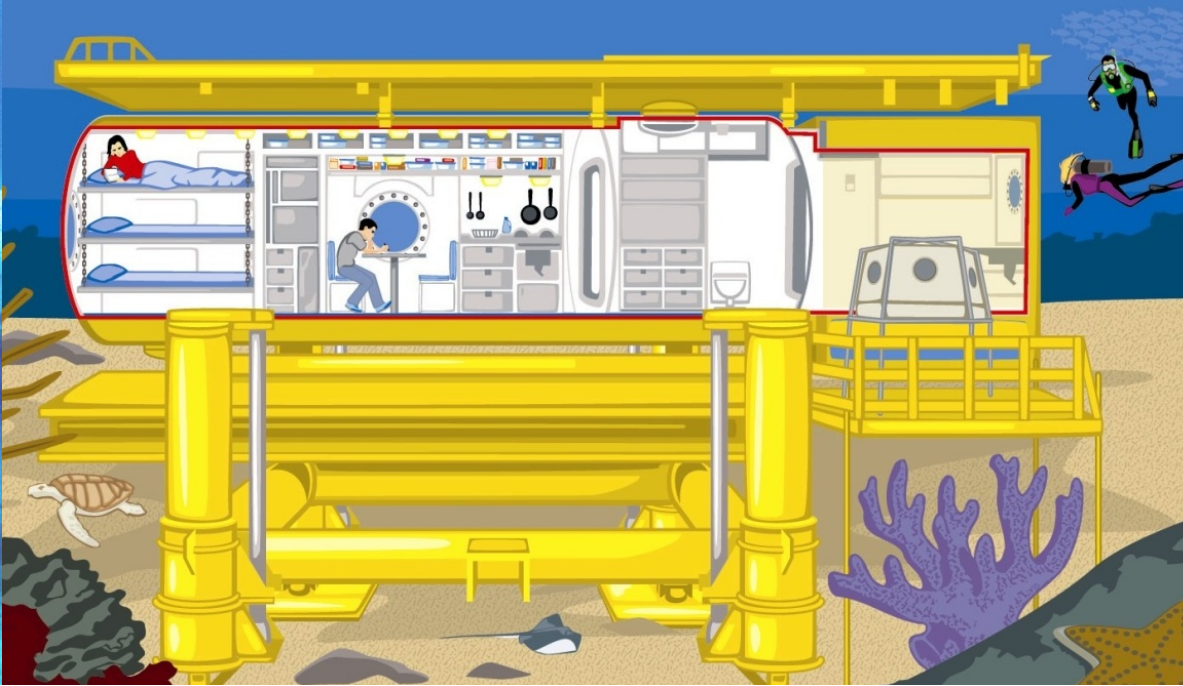
Growth?

Regeneration?

**\$\$ when lost in groundings
and for remediation and
restoration?**



<http://aquarius.uncw.edu/>



Monitoring *Xestospongia muta*

- 1997-present

- Circular 16m diameter plots

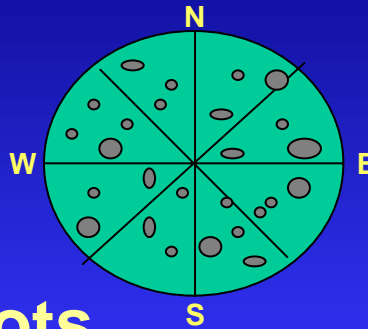
- 3 at 15, 20, 30 m depths (Conch Reef)
- 3 at 15 m depth (Pickles Reef)

- Sites surveyed twice-yearly

Monitoring:

Condition, bleaching, disease, predation, mortality, recruitment

- Photographed from above and in profile (since 2001)



smallest recruits

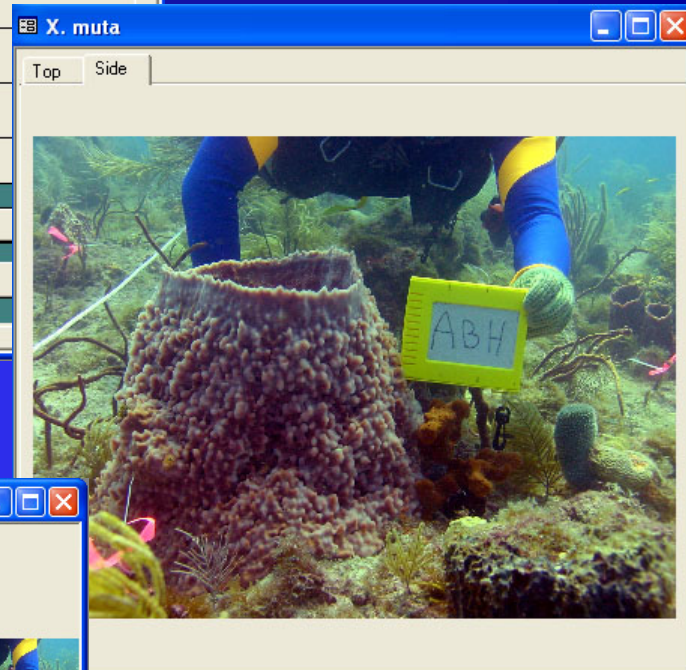


Sponge Data

Tag	Field Season	Size	Bites	Condition	Bleaching	Oscules	Fouled	Eroded	Recruit	Dead	Pic	LookUp	Remarks
ABH	October 2003	L	F	G	Y		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
AED	October 2003	M	F	G	Y	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
AEZ	October 2003	L	N	G	Y		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
BPU	October 2003	B	N	G	Y		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Find Sponges: Site: Size: Bleaching: Recruit:
 Transect: Bites: Fouled: Dead:
 Field Season: Condition: Eroded: Picture:

Record: 1 of 4 (Filtered)



>9000 photos of >700 sponges!!

Pic Timeline

Tag: ABH Transect: CR1 Site: Conch Reef

May 2001 October 2001 May 2002 June 2003 October 2003

Oct-2003 Picture:

Bites: Condition: Bleaching: Oscula:

Recruit: Remarks:

Dead:

1 of 1



Site: Pickles Reef Transect: PR1

Tag: AFV Directional: NE Radius Mark: 1.7

Top Side



C:\Muta Project\Pictures\May 2001\AFVtM01.jpg

Date: Jun-2001

Picture:

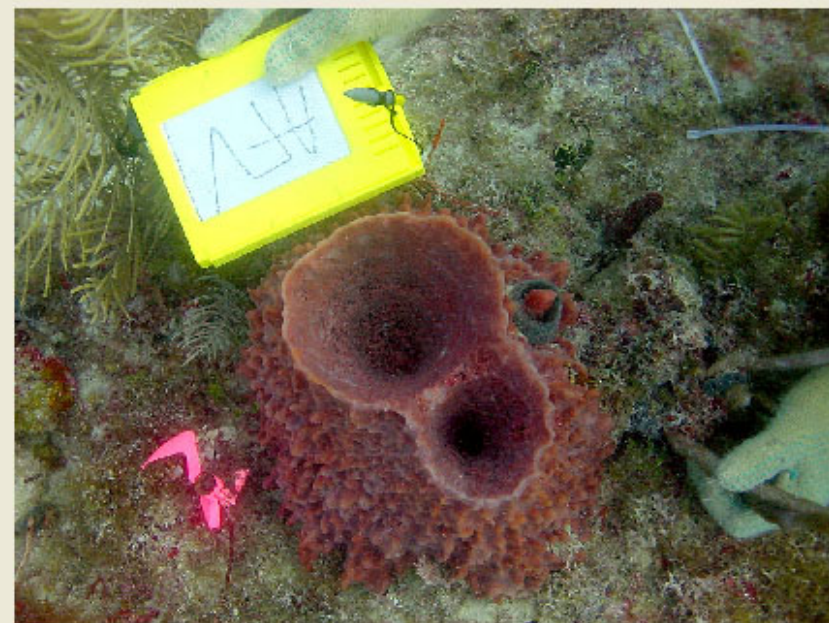
Size: M Bites: N Condition: G Bleaching: L Oscula:

Eroded: Recruit Remarks: light bleaching, dual osculae

Fouled: Dead

Record: 5 of 10

Top Side



C:\Muta Project\Pictures\October 2003\AFVtO03.jpg

Date: Oct-2003

Picture:

Size: M Bites: N Condition: F Bleaching: L Oscula: 2

Eroded: Recruit Remarks:

Fouled: Dead

Record: 10 of 10

View Data Table

View Image Timeline

Site: Conch Reef

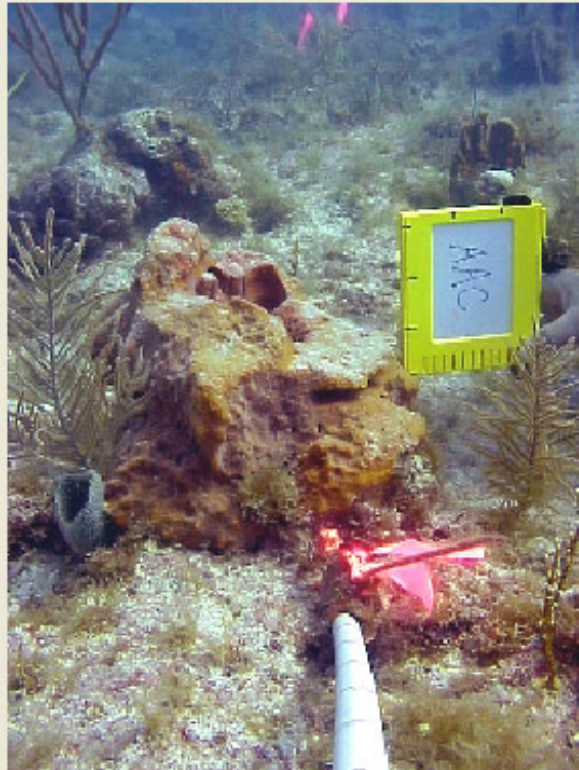
Transect: CR2

Tag: AAC

Directional: N

Radius Mark: 3.6

Top Side



Date: May-2000

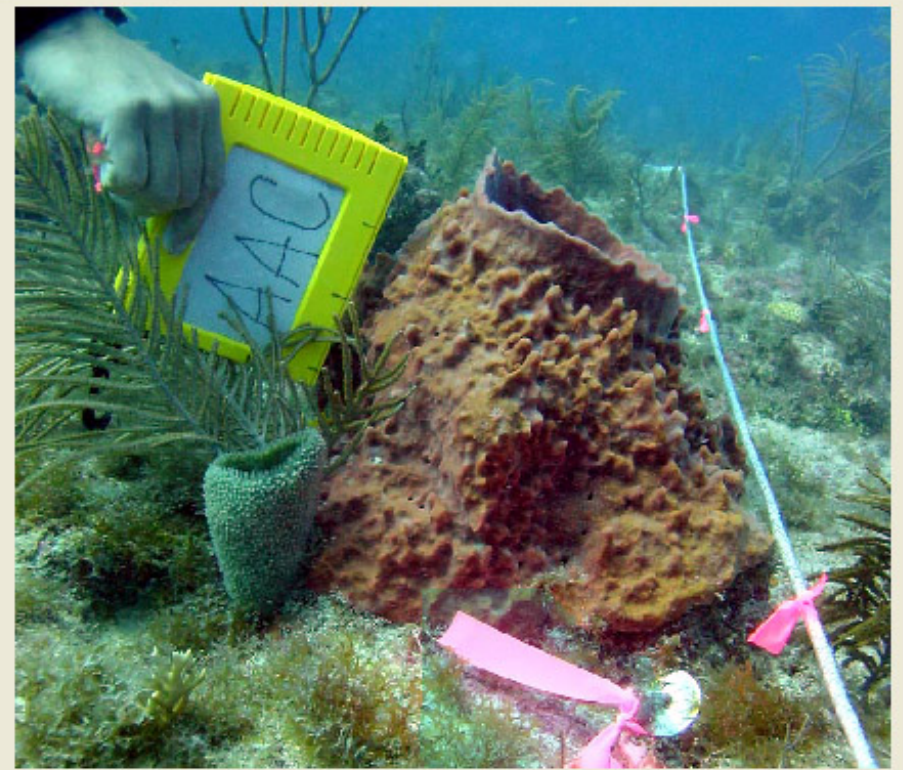
Picture:

Size: Bites: Condition: Bleaching: Oscula:

Eroded: Recruit Remarks: less bleaching, fouled, sample 305
Fouled: Dead

Record: of 12

Top Side



Date: Oct-2001

Picture:

Size: Bites: Condition: Bleaching: Oscula:

Eroded: Recruit Remarks: light bleaching
Fouled: Dead

Record: of 12

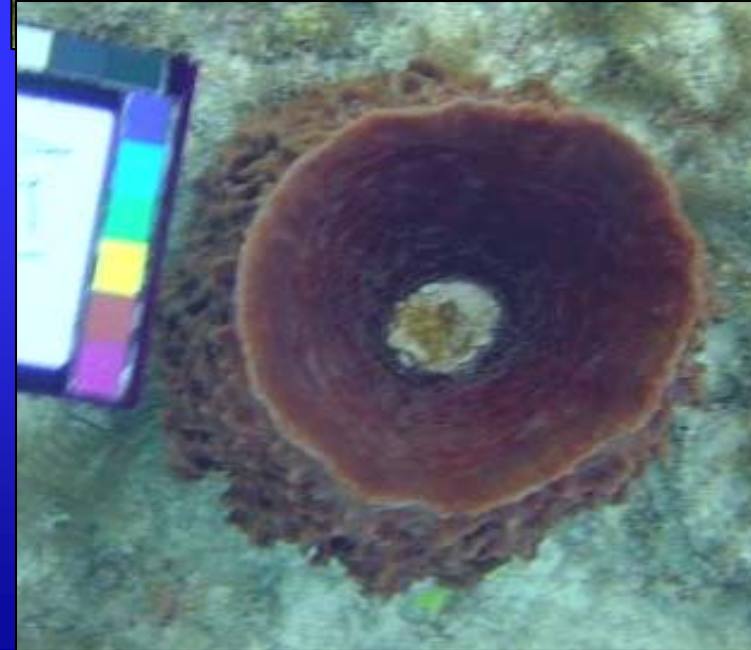
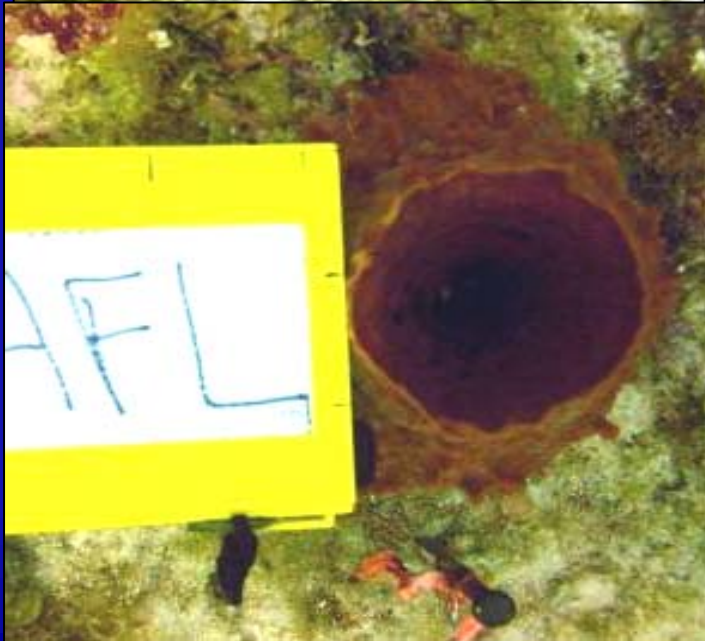
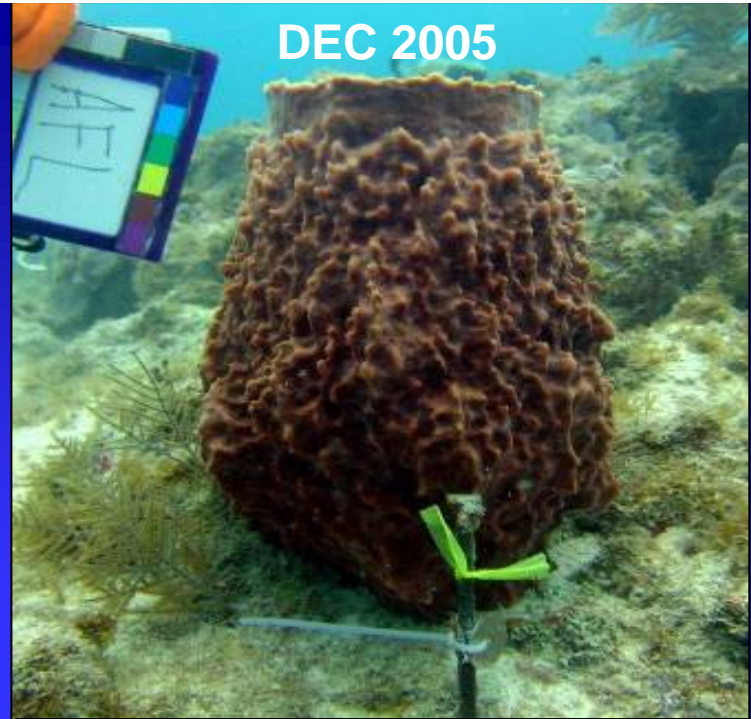
View Data Table

View Image Timeline

MAY 2001



DEC 2005

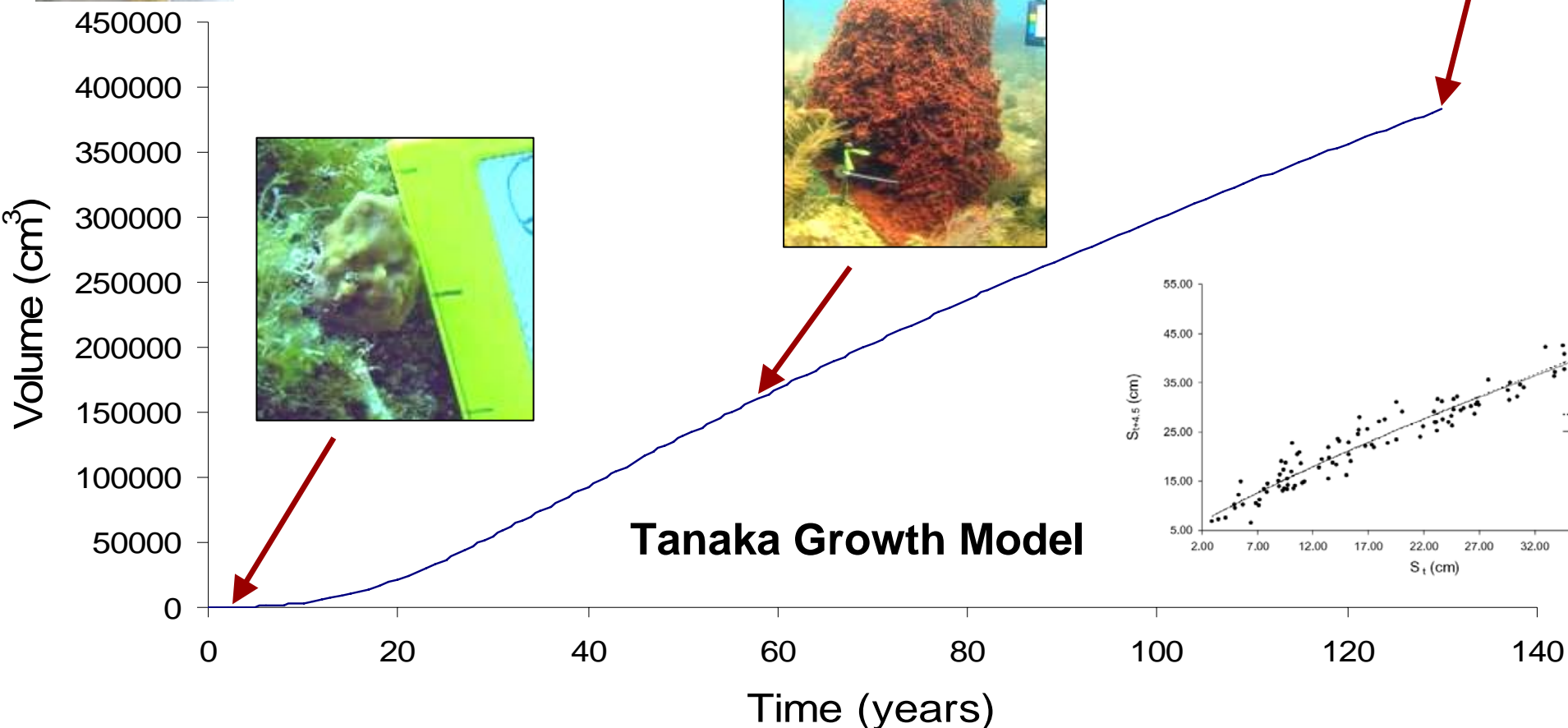
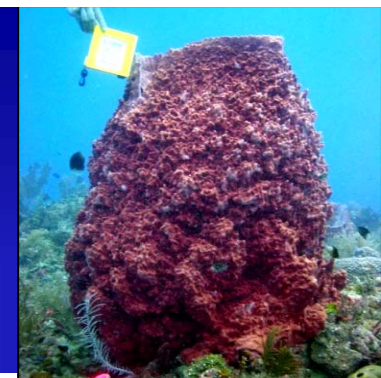




Growth and age of *X. muta*

Mean growth of 52% per year - range: 2- 404%

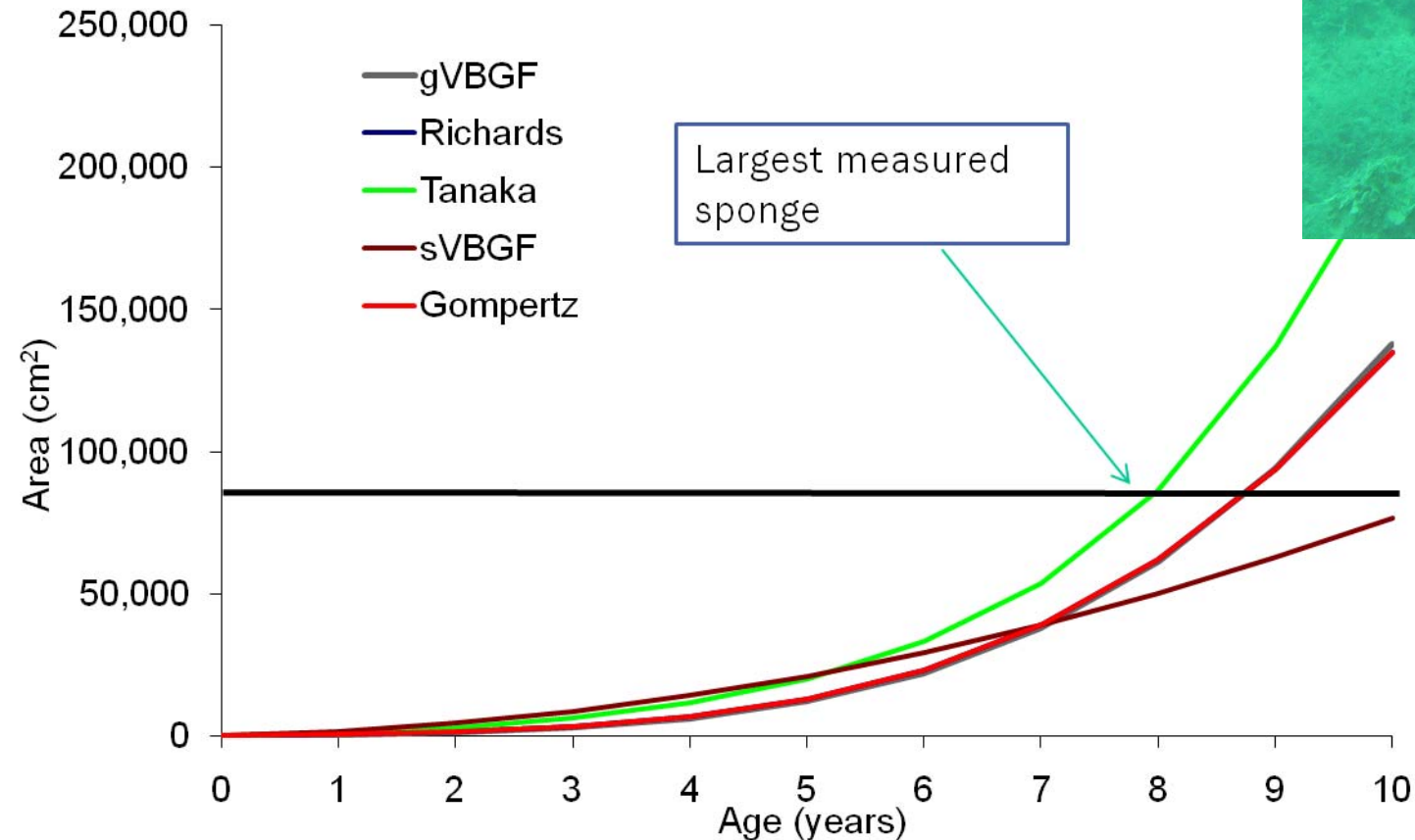
Faster growth in summer, no effect of depth





Growth of *lanthella basta* invasive in Apra Harbor, Guam

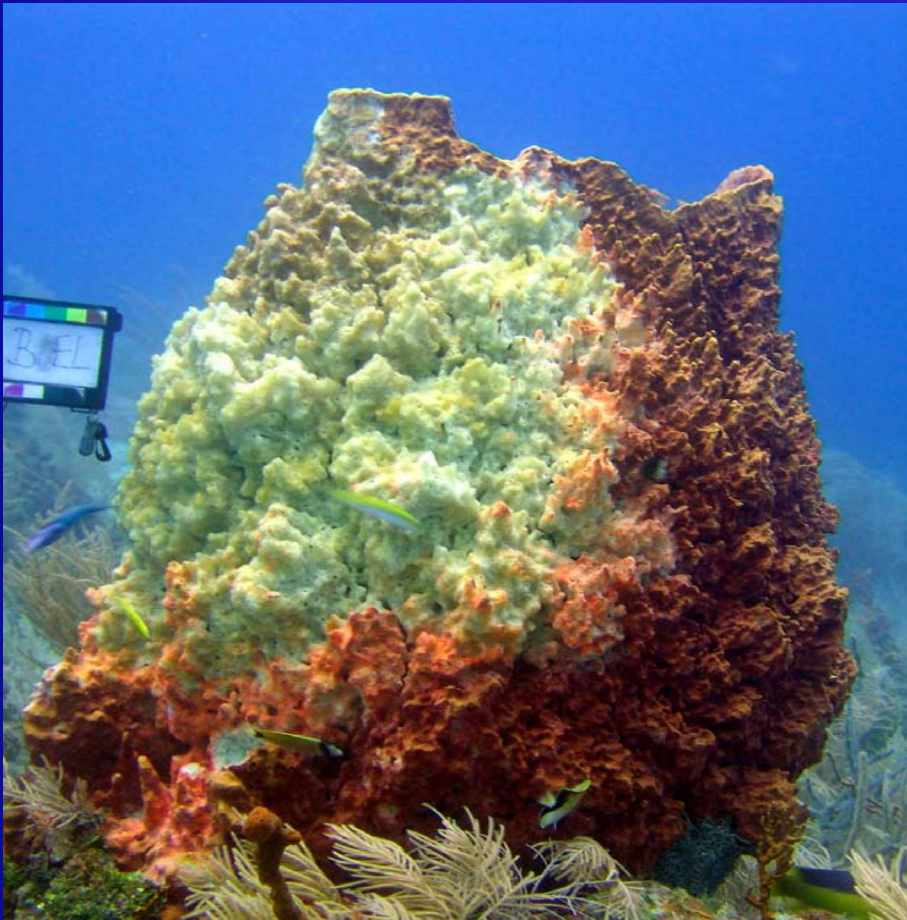
1 m diameter in ~8 years!!



Data from:
Sven Rohde and Peter Schupp,
University of Guam Marine Lab

Sponge Orange Band (SOB) = fatal bleaching

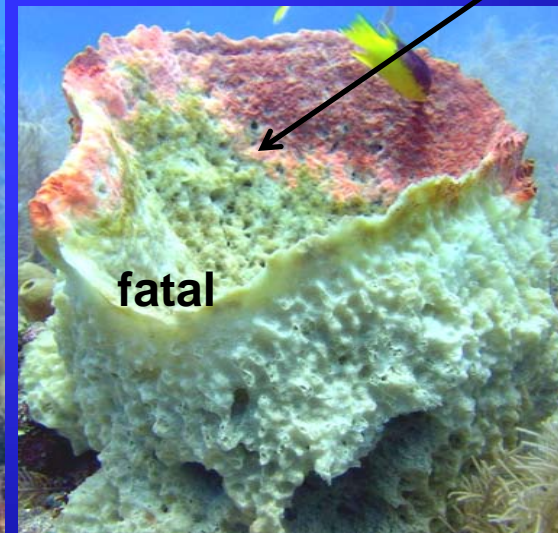
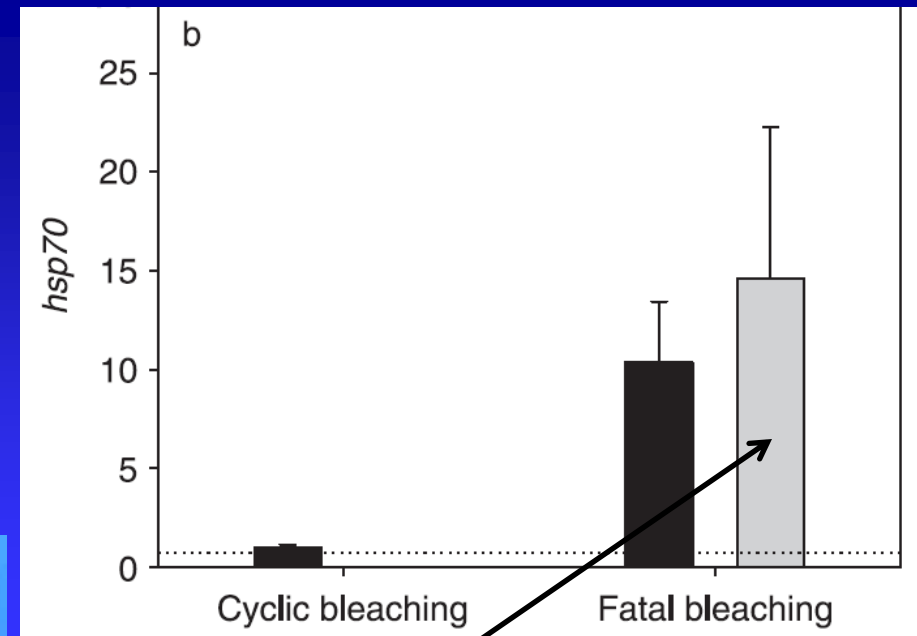
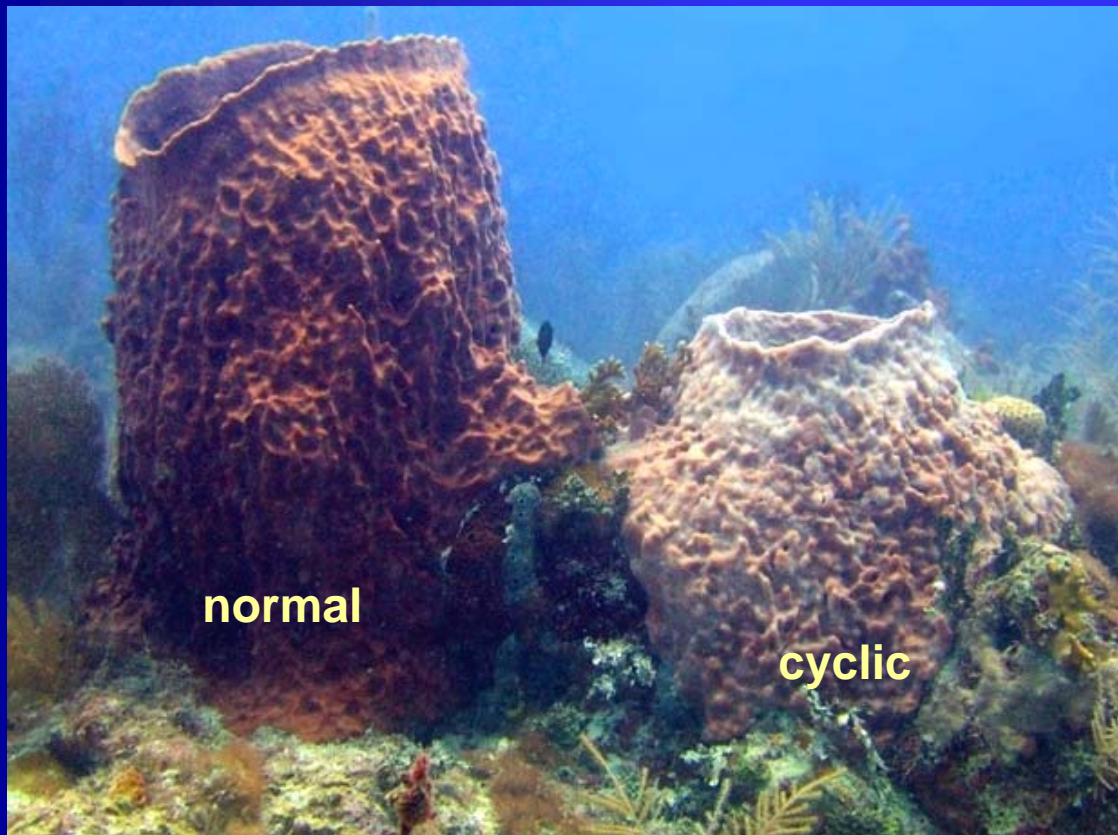
not the same as cyclic bleaching



Cowart , Henkel, McMurray & Pawlik 2006.
Coral Reefs 25:513

Quantified *hsp70* expression Correlated with content of Chl. *a*

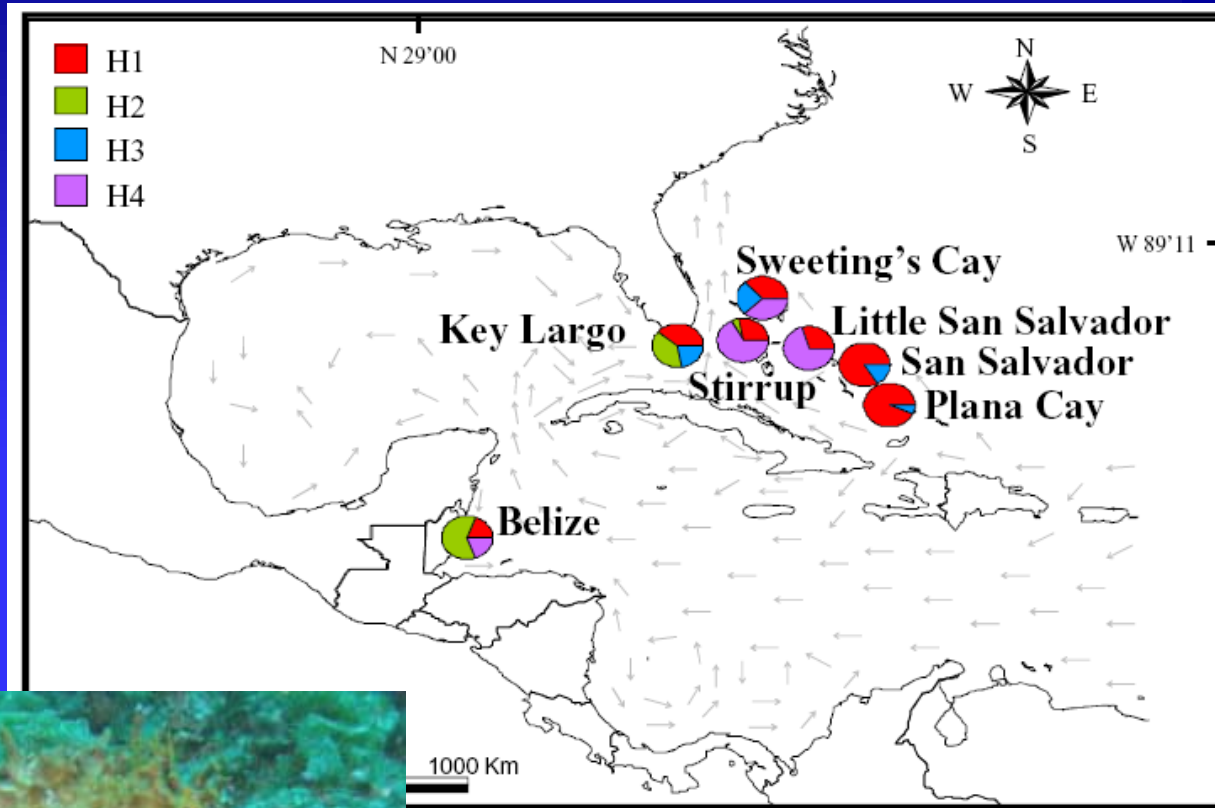
- no enhanced *hsp70* in cyclic bleached
- strongly enhanced *hsp70* in fatal bleached
- *hsp70* expression induced in 1.5 hrs
- *Synechococcus* is a commensal, not a mutualist!



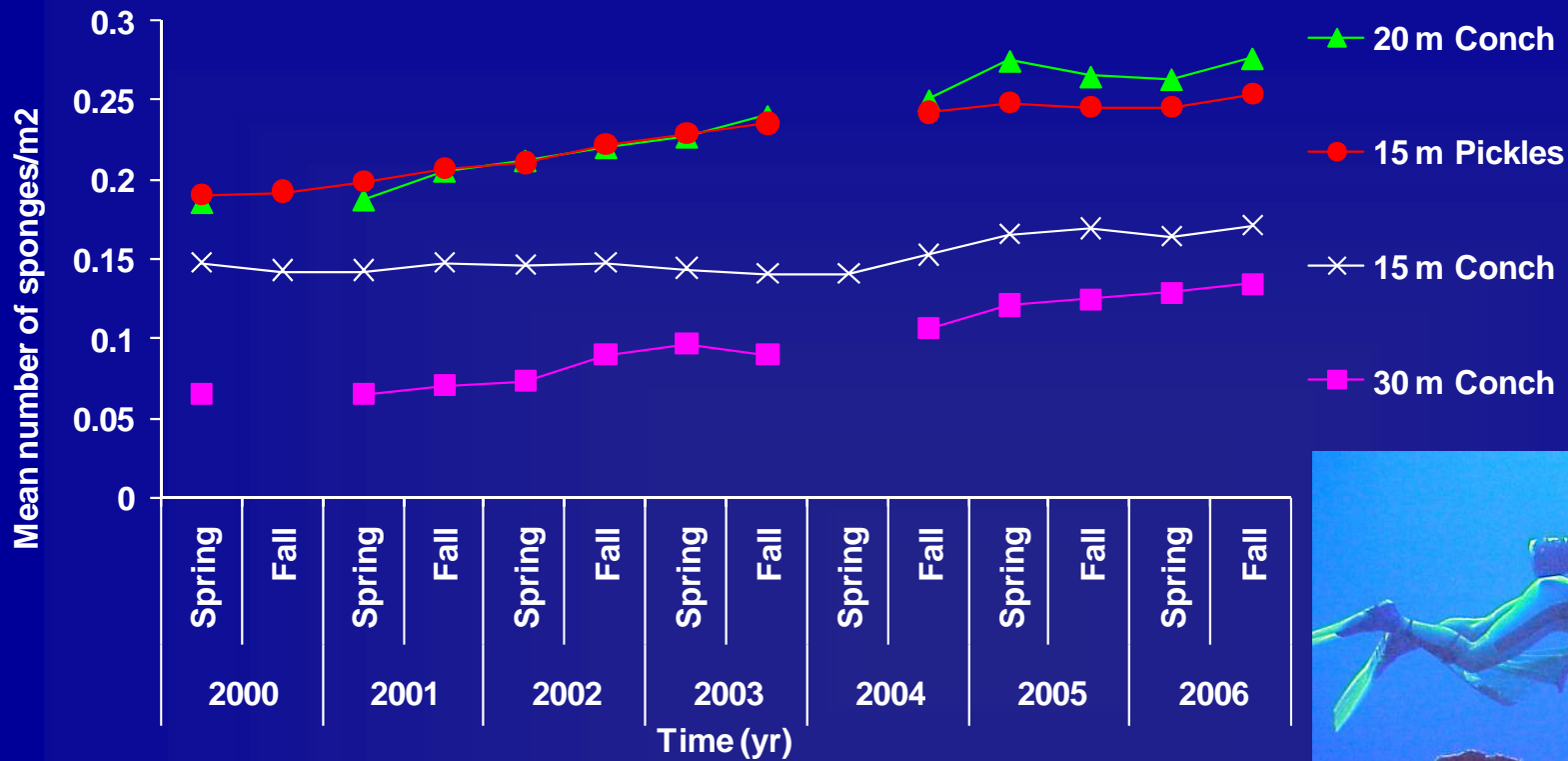
López-Legentil, Song, McMurray & Pawlik 2008
Molecular Ecol 17:1840-1849
López-Legentil, Erwin, Pawlik & Song 2010
Microb Ecol online early

Genetic structure from I3-M11 partition of COI

- most divergent morphologies had different haplotypes
- common morphology is a mixture of haplotypes
- genetic structure correlated to prevailing currents



López-Legentil & Pawlik 2009
Coral Reefs 28:157-165

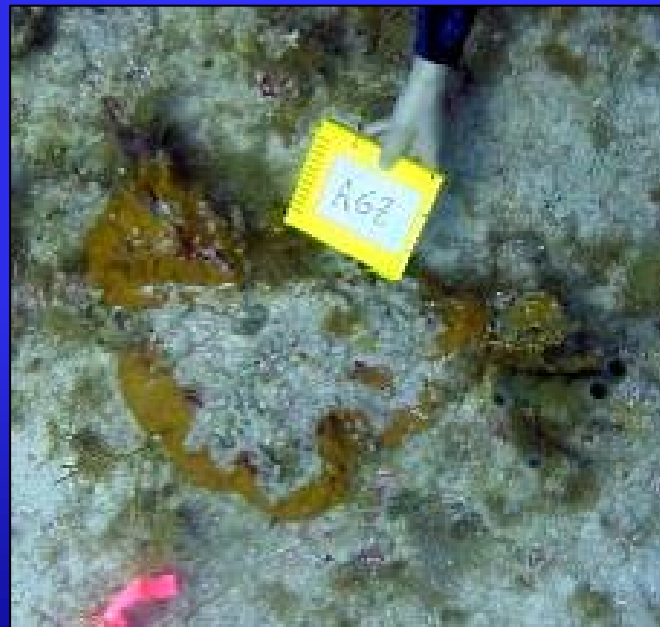


Demographics: populations of *X. muta* are increasing!

McMurray, Henkel & Pawlik 2010. Ecology 91:560-570

McMurray, Henkel & Pawlik 2010. Ecol Arch E091-040-A1-A10

BASE



OCTOBER 1999

MAY 2000

MAY 2006

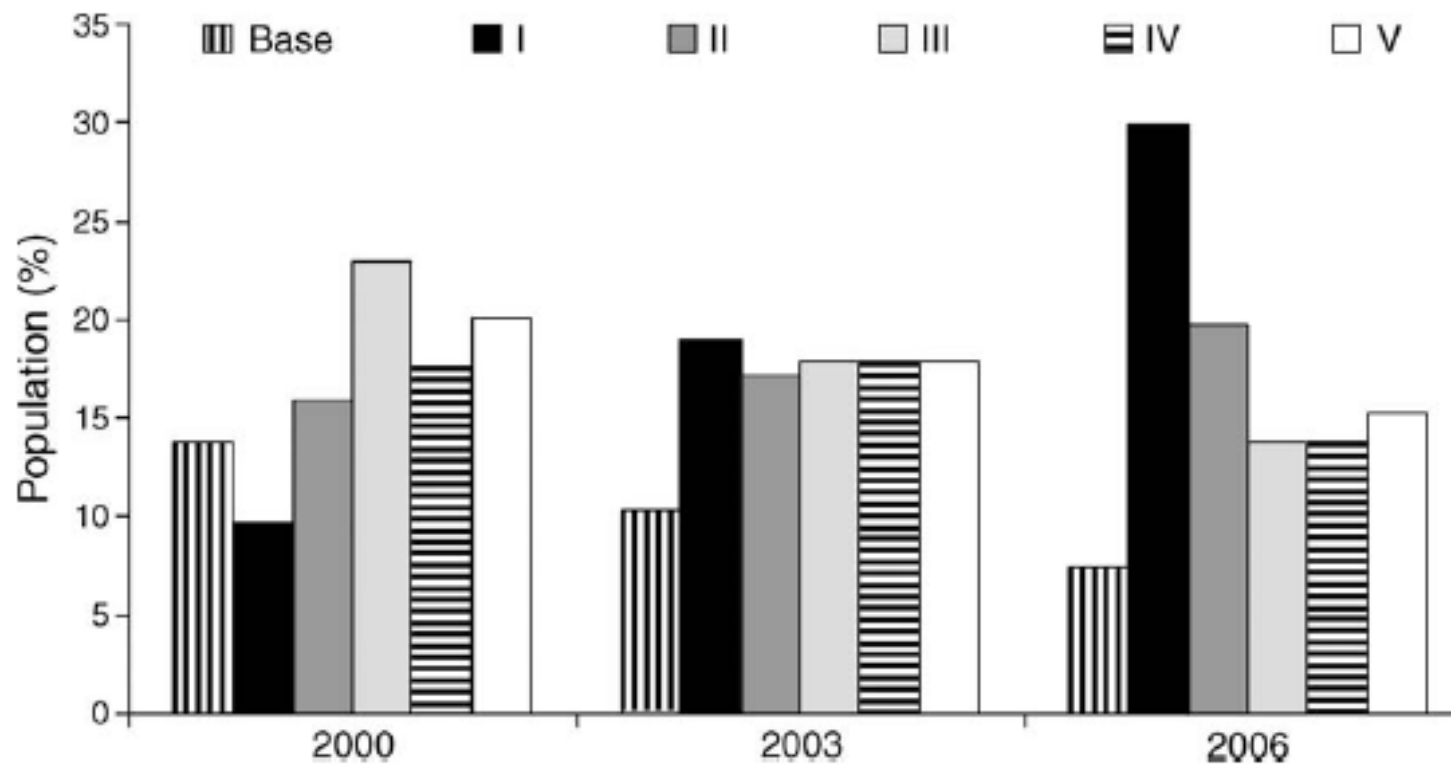


FIG. 2. Size–frequency distributions of *Xestospongia muta* over all sites on Conch Reef in 2000, 2003, and 2006. Sponges were assigned to one of six stages based on volume or stage: base (see Appendix B), size class I ($\leq 143.13 \text{ cm}^3$), size class II ($>143.13 \text{ cm}^3$ but $\leq 1077.13 \text{ cm}^3$), size class III ($>1077.13 \text{ cm}^3$ but $\leq 5666.32 \text{ cm}^3$), size class IV ($>5666.32 \text{ cm}^3$ but $\leq 17\,383.97 \text{ cm}^3$), and size class V ($>17\,393.97 \text{ cm}^3$).

McMurray, Henkel & Pawlik 2010. Ecology 91:560-570

McMurray, Henkel & Pawlik 2010. Ecol Arch E091-040-A1-A10

Stage-based Matrix Model

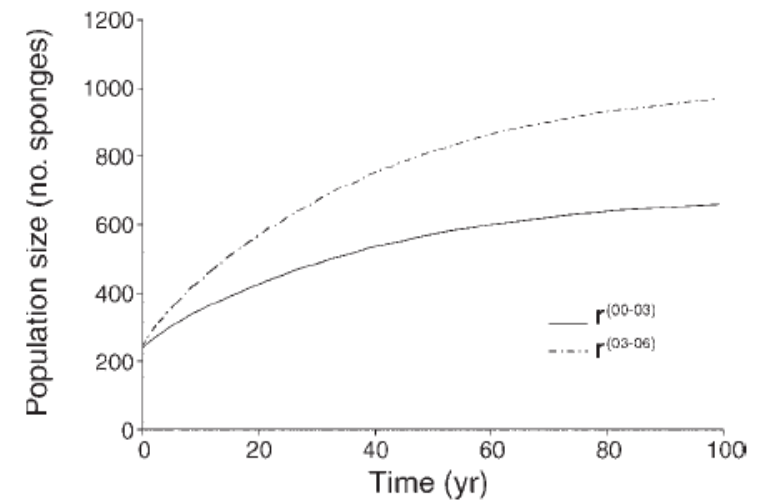
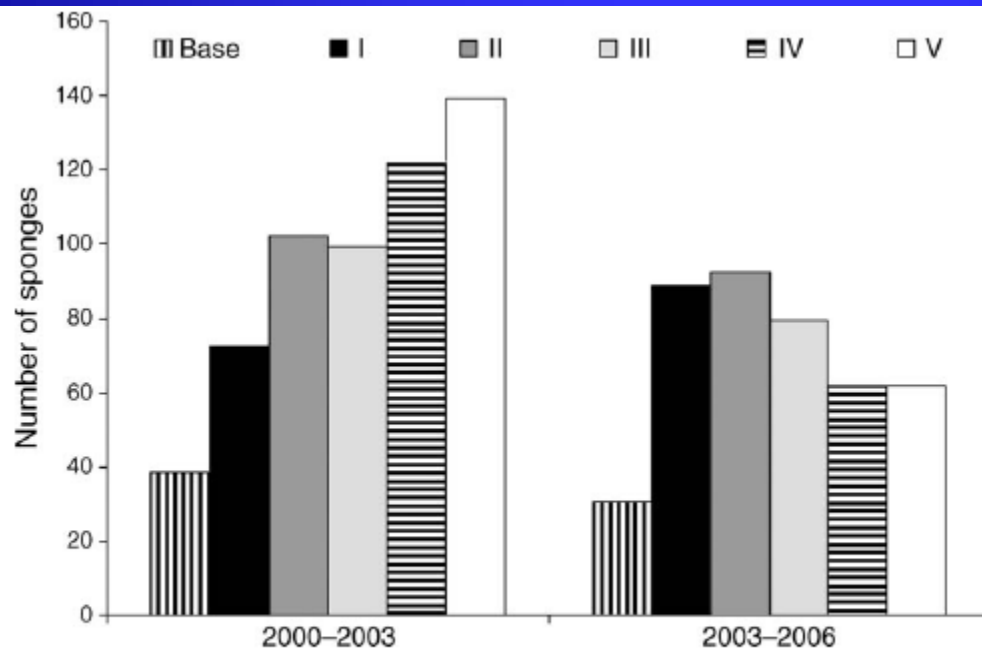
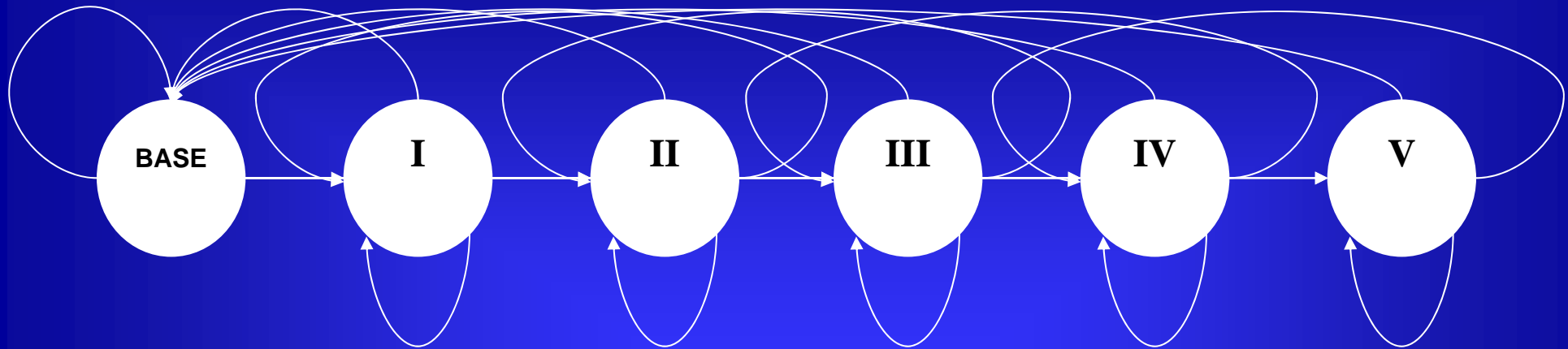
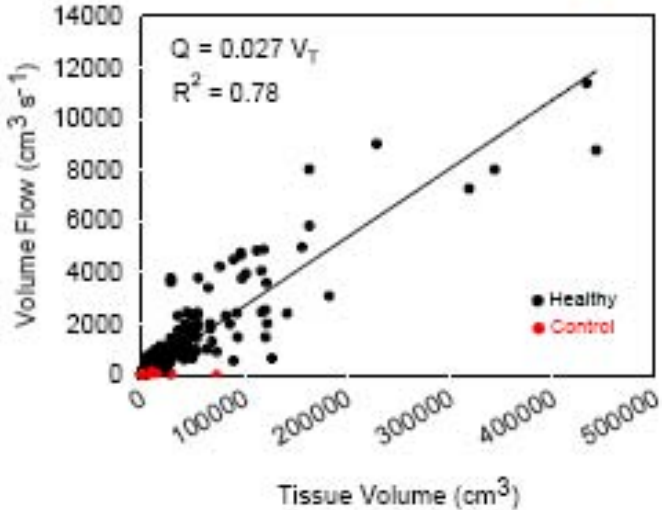
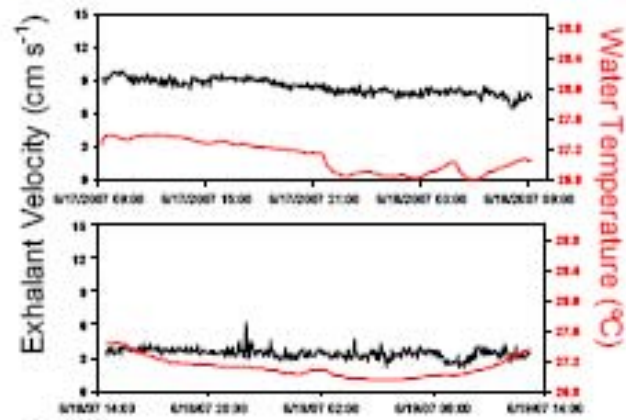
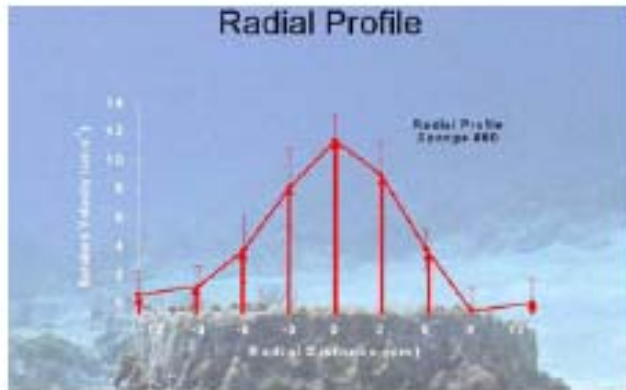


FIG. 5. Projections of $A^{(00-03)}$ over 99 years with addition of $r^{(00-03)}$ and $r^{(03-06)}$. Projections demonstrate regulation of the population size of *Xestospongia muta* by recruitment.

FIG. 4. Resulting population structure of *Xestospongia muta* after 51-year projections of $A^{(00-03)}$ and $A^{(03-06)}$ with addition of the same recruitment vector, $r^{(00-03)}$. Projections demonstrate the effect of contrasting mortality regimes (2000-2003 compared to 2003-2006) on population size and the distribution of sponges in each size class.

Impacts of demographic changes on filtration, benthic-pelagic coupling -- Dr. Chris Finelli - UNCW

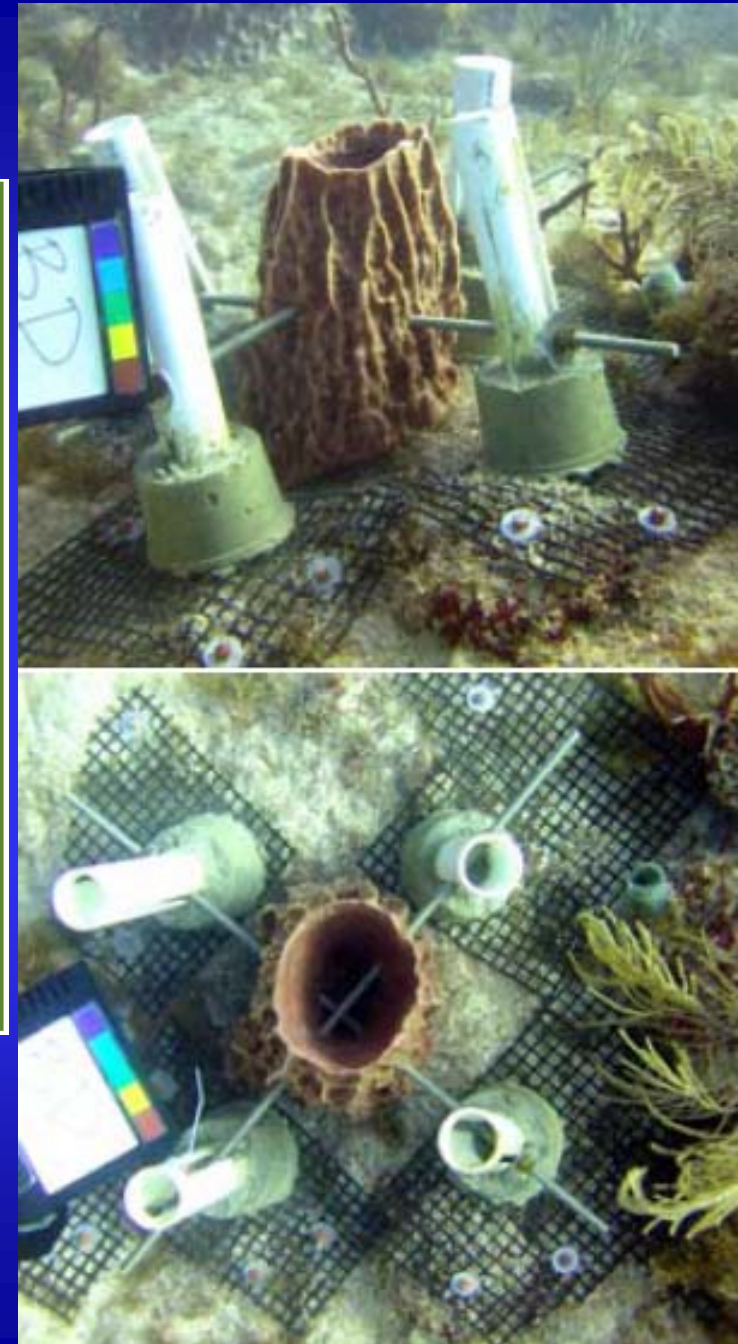


Novel method for re-attaching barrel sponges

- Reciprocal transplants to 15 m and 30 m
- 90% of deep and 35% of shallow transplants survived, despite 3 hurricanes (2005).



McMurray & Pawlik 2009.
Restoration Ecol 17:192-195



Acknowledgements:

FUNDING and SUPPORT:

National Science Foundation - Biological Oceanography
Aquarius Reef Base/UNCW (NOAA-NURC) - Key Largo, Florida

- * Aquarius and Dayboat support missions
- * Technical diving training and support missions

NOAA's Coral Reef Conservation Program

FKNMS – permission to conduct research in SPAs



**Smart and
dedicated
STUDENTS!**

All publications available as PDFs at:
<http://people.uncw.edu/pawlikj/pubs2.html>

