

Management-Oriented Assessment of Corals in Broward County

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National Coral Reef Institute

Nova Southeastern University



INSTITUTIONAL MISSION
CORAL AND CORAL COMMUNITY ASSESSMENT

STRUCTURE AND FUNCTION

Acropora cervicornis
Demographics
Reproduction
Disease

Coral Stress Biology
Tissues
Proteins
Genes

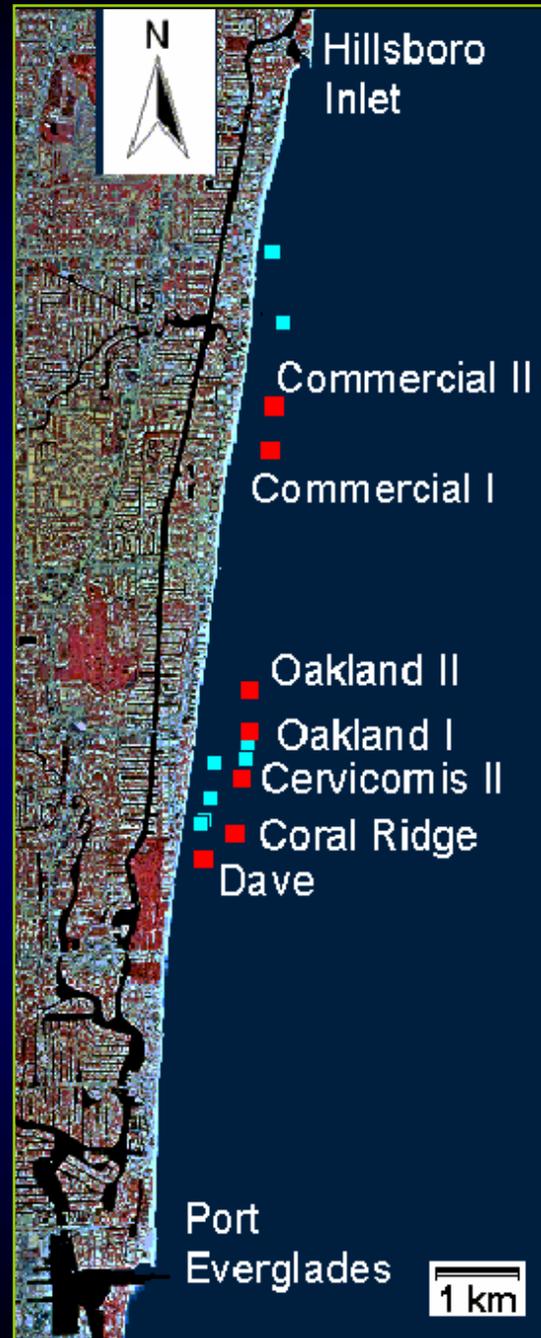
EFFECTIVE MANAGEMENT AND EDUCATION



Significance

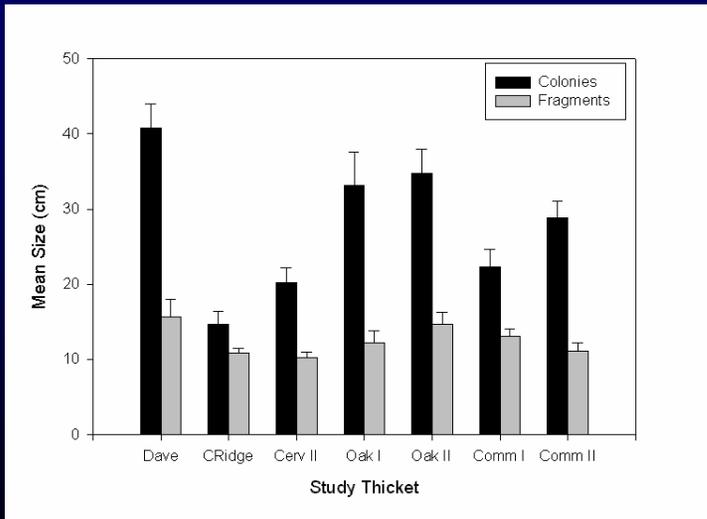
- Unusual occurrence of a thriving *Acropora cervicornis* in Broward County.
- Dramatic population reductions throughout the Caribbean, with losses of up to 98% in the Florida Keys.
- The *Acropora cervicornis* thickets off Broward Co. represent the largest extant population in the continental US.
- These thickets develop in close proximity to highly urbanized area.
- Advancement of scientific research and public awareness regarding the ecological importance of these unique communities.

Distribution and Mapping



Coral community surveys to understand changes in space and time

Structure and Abundance

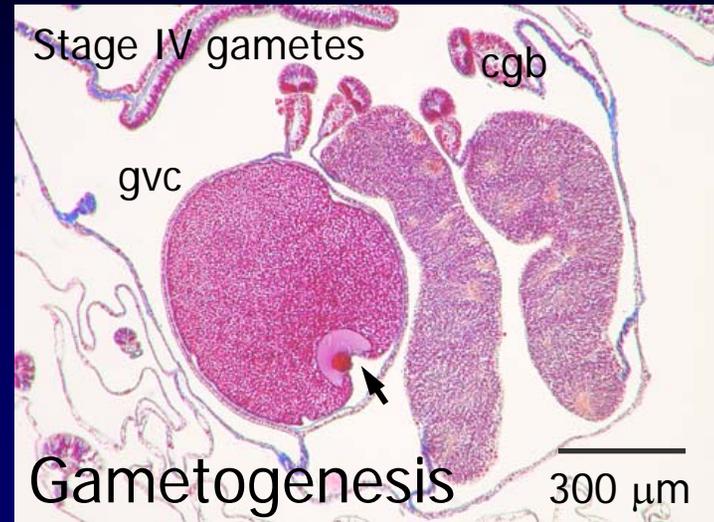


Summary statistics (mean % cover) of coral community structural parameters at the study sites (surveys May 2001–2002).

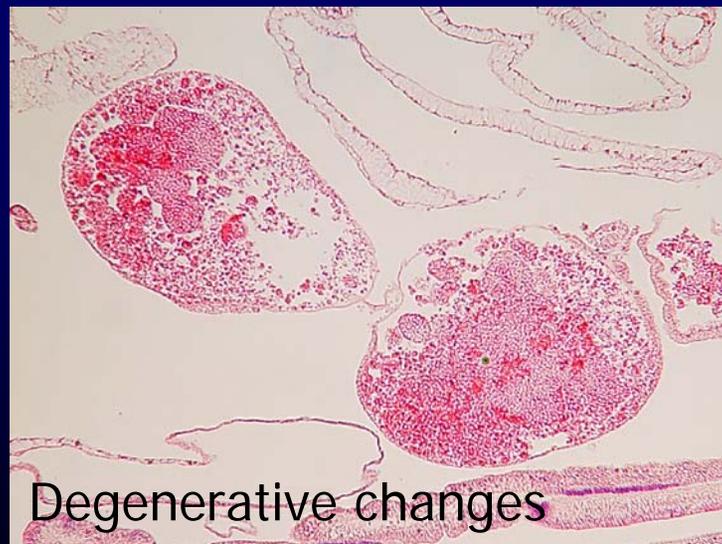
Site	% coral cover	% <i>Acropora cervicornis</i>	% Non- <i>Acropora</i>	% macro algae	% dead cover	% hard bottom
Dave	27.7	25.9	1.8	4.9	11.9	44.5
Coral Ridge	7.8	7.5	0.3	1.0	38.2	21.1
Cervicornis II	5.5	4.9	0.6	5.1	3.6	63.6
Oakland I	14.9	14.4	0.5	2.8	1.1	76.3
Oakland II	10.5	9.9	0.6	5.5	2.3	75.2
Commercial I	15.2	14.6	0.6	16.3	2.2	55.7
Commercial II	18.6	16.3	2.3	7.8	5.05	60.9
Average	14.3	13.4	0.9	6.1	10.0	53.7

Reproductive Biology

Spawning activity



Coral Diseases



Fireworm Predation



Prevalence of *Acropora cervicornis* predation by the corallivore polychaete *Hermodice carunculata* at the study sites (surveys July-August 2002).

Site	Prevalence (% quadrats affected)	Mean number scars m ⁻²	Size of scars (cm)
Dave	25.0	1.4	4.8
Coral Ridge	17.1	0.4	3.2
Cervicornis II	29.3	0.5	3.1
Oakland I	28.9	1.5	4.4
Oakland II	35.3	1.0	4.5
Commercial I	65.2	2.3	3.9
Commercial II	4.7	0.1	4
Average	29.3	1.0	3.9

Management Implications

- Assessment of Broward Co. population abundance, structure, and reproductive potential.
- Means to evaluate the potential for natural recovery of previously impacted populations.
- Provided advice to local managers (status and long-term monitoring).
- Dissemination: national and international conferences.
- Effective education: Master's Thesis, interns.
- Training: Coral reproduction.

Coral Stress Biology

Goal

- Use higher resolution tools to quantify thresholds of sedimentation stress in scleractinian corals in Broward.

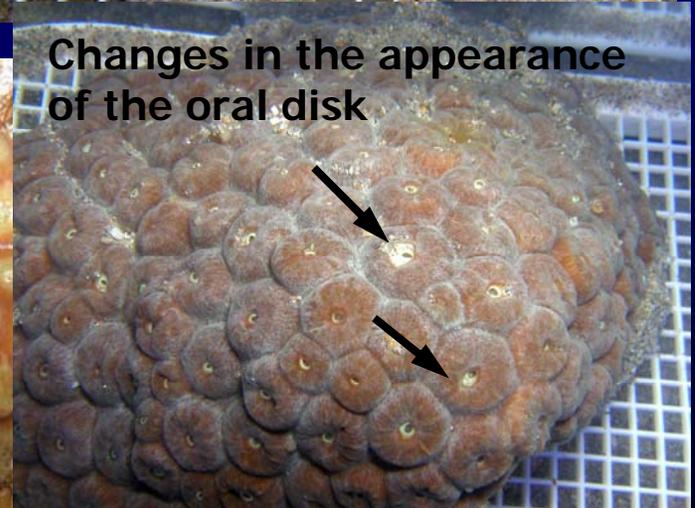
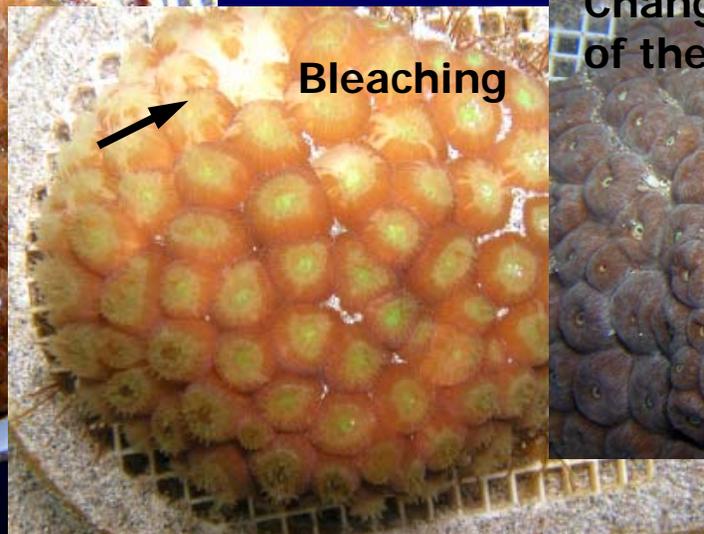
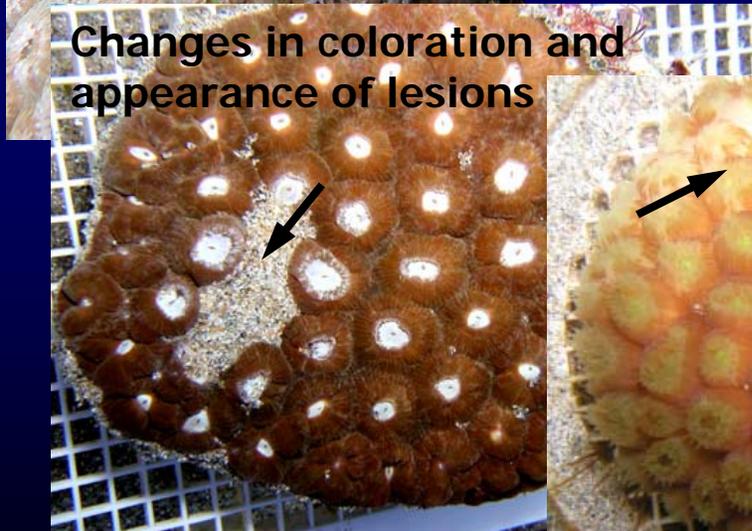
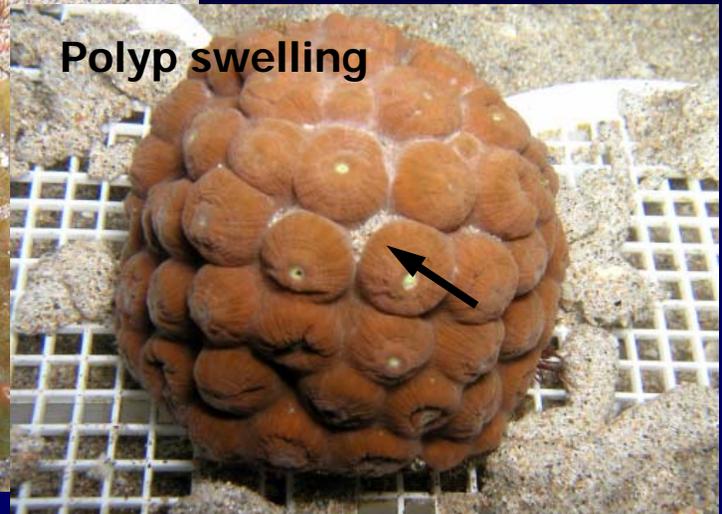
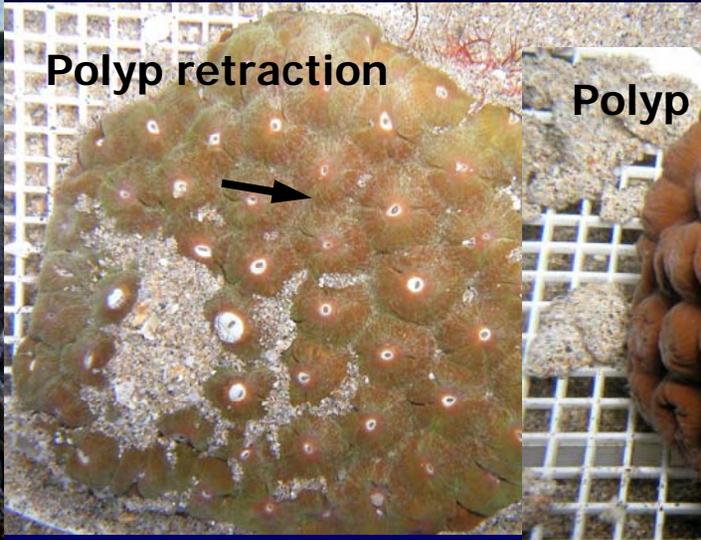
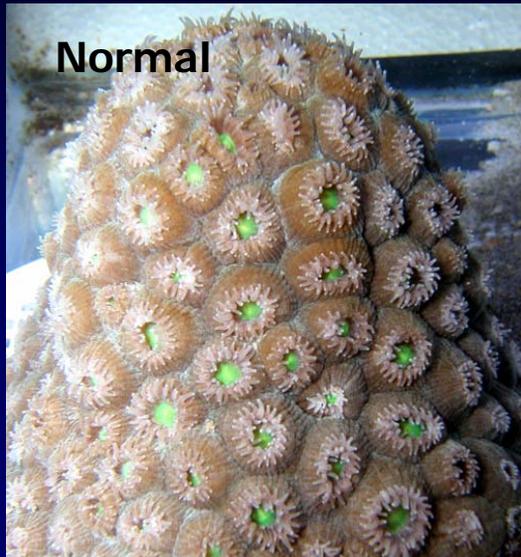
Endpoint

- Provide evidence to identifying cause-and-effect relationships between sedimentation stress and the responses of individual reef-building corals.

Objectives

- To develop a histological rating scale of sedimentation stress in scleractinian corals to help assess coral health condition during dredging for beach restoration activities in Broward County, FL.

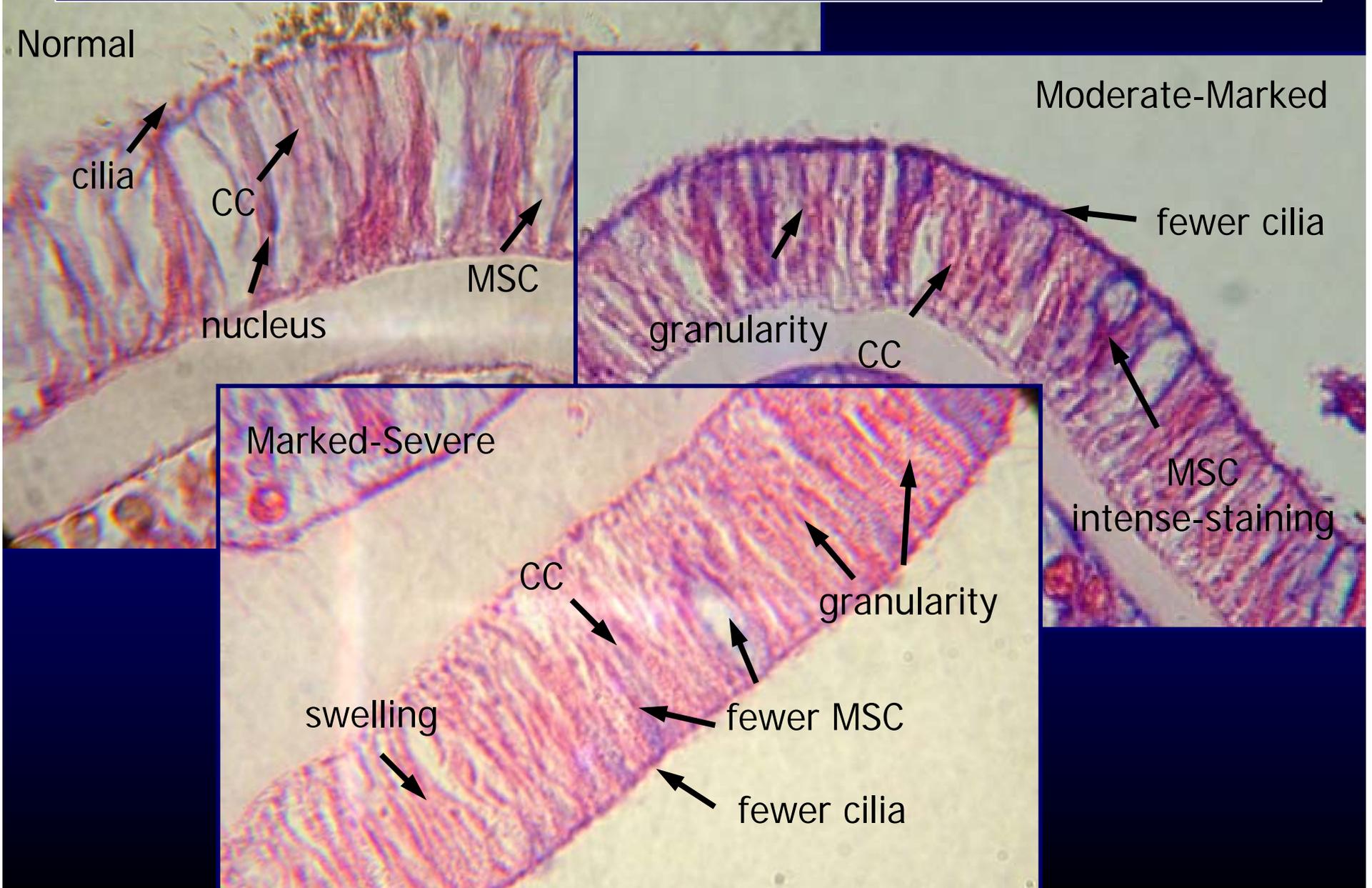
Morphological integrity



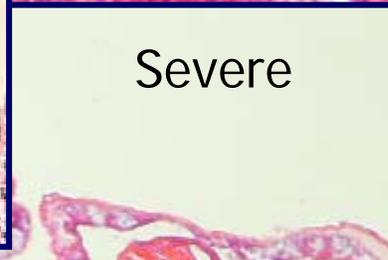
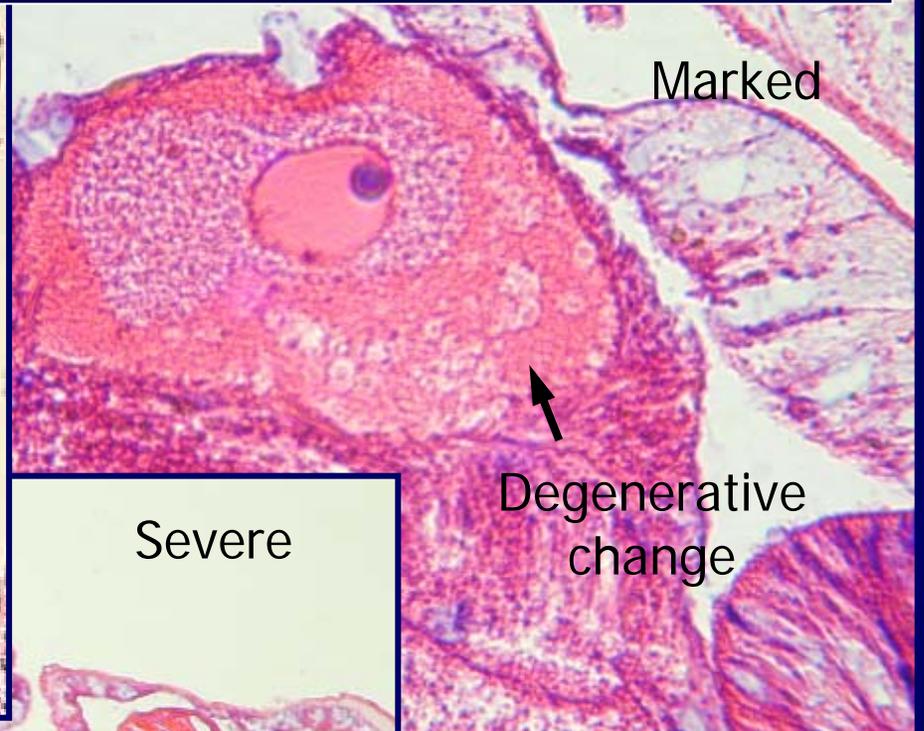
Provisional rating scale for changes in gross morphology observed on experimental specimens of *Montastraea cavernosa* exposed to increased levels of sedimentation.

Range	Diagnosis
Normal	Color appears normal, and natural texture lines. Polyps fully extended or loosely retracted. No swelling.
Mild	Same + possible presence of small sand accumulations between polyps. Slight swelling
Moderate	Slight changes in coloration (darker, possible focal bleaching). Normal texture lines may begin to disappear. Evident polyp swelling. Changes in the appearance of the oral disk. Possible extrusion of mesenterial filaments. Presence of mucous sheets, sand accumulations between polyps.
Severe	Same + polyps tightly retracted, or looking deflated/flattened, with sunken-in oral disk areas. Appearance of lesions. Presence of mucous sheets; inability to remove excess sediments.

Montastraea cavernosa: Epidermis



Montastraea cavernosa: Reproduction



Rating scale for tissue changes seen in histopathological examinations of experimental specimens of *Montastraea cavernosa*, based on the relative condition of tissue and selected cellular elements (mucous secretory cells, mucoid material, zooxanthellae, and nuclei), stained with Harri's hematoxylin and eosin (abbreviations: EP, epidermis; CE, calicoblastic epithelium; GD, gastrodermis; MS, mesenteries; MSC, mucous secretory cells; ZOOX, zooxanthellae).

Range	Epidermis and coenosarc	Middle polyp region	Lower polyp region
Normal	Good integrity and structure. Distinct nuclei. No swelling, MSC more numerous around oral disk.	Abundant clear-staining MSC in MS. MSC in GD not swollen. MS and CE intact, clear structural integrity.	Scattered MSC. GD thick with clear structural integrity. CE intact, clear structural integrity.
Mild	Same + slight swelling of MSC. Mucoid material staining more intensely.	Same + increase in MSC size and abundance of mucoid material.	Same + slight increase in mucous in GD, and changes in staining properties (darker).
Moderate	Widespread swelling of MSC. Change in staining properties. Possible increase in ZOOX densities.	Increased number of MSC, color intensifying. Increased mucoid material. Presence of granularity and cell debris in GD and CE.	Same + Presence of cell debris and biogenic accumulations in GD and CE. Increased mucoid material. Apparent ZOOX degradation.
Marked	Cell atrophy, increased cell debris. Swollen MSC. EP appears flattened, cilia not discernible. Possible localized necrosis.	Cell atrophy. MSC begin to coalesce, Increased debris, and biogenic accumulations in gastrodermal cells and MS. Atrophy of CE. Decrease in mucoid material. Possible localized necrosis.	Increased cell debris, and biogenic accumulations in gastrodermal cells and mesenterial filaments. Atrophy of the CE. Possible gamete degradation. Possible localized necrosis.
Severe	Atrophy; possible loss of cells. Clear loss of tissue integrity. Localized to widespread necrosis.	Atrophy. Increased cell debris and clear loss of tissue integrity. Possible localized to widespread necrosis.	Atrophy. Increased cell debris and clear loss of tissue integrity. Possible localized to widespread necrosis.

STRESS

STRESS

Corals

Altered Gene
expression profile
to protect cell
structure and repair
damage

Cell & tissue
alterations and
dysfunction

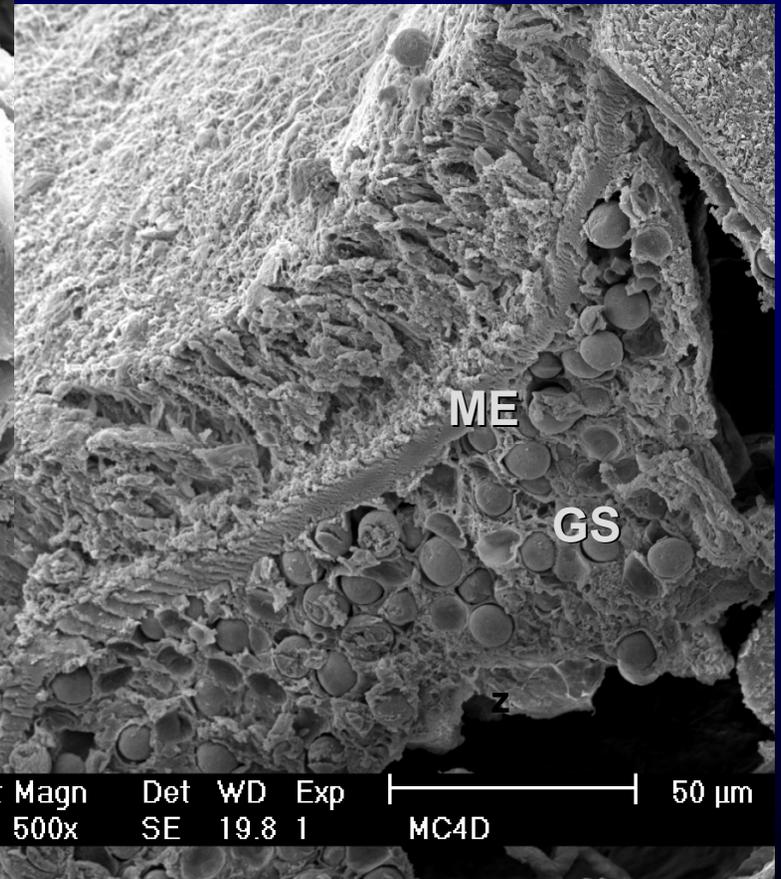
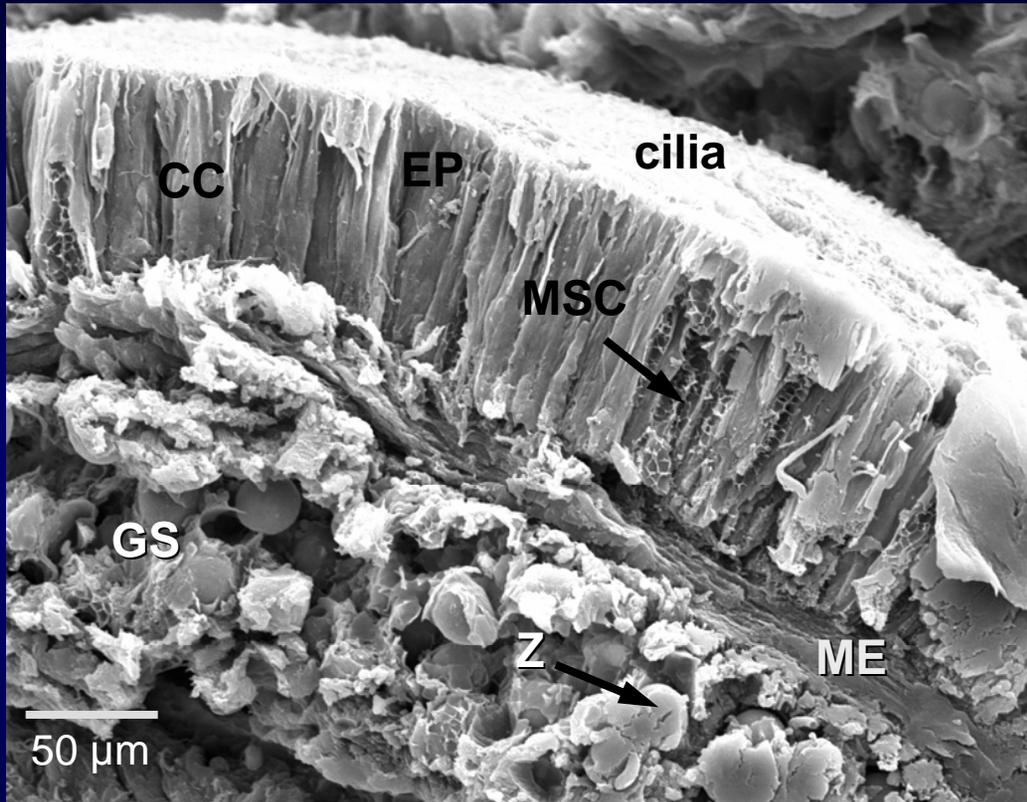
Toxicogenomics

Electron Microscopy

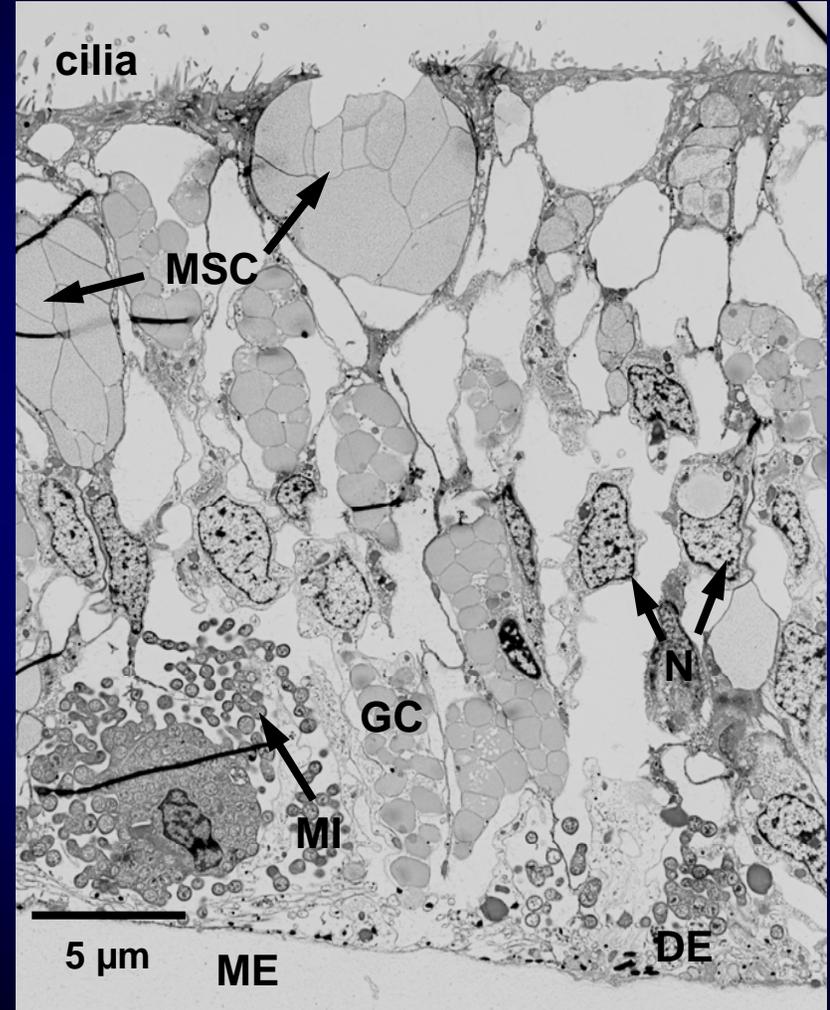
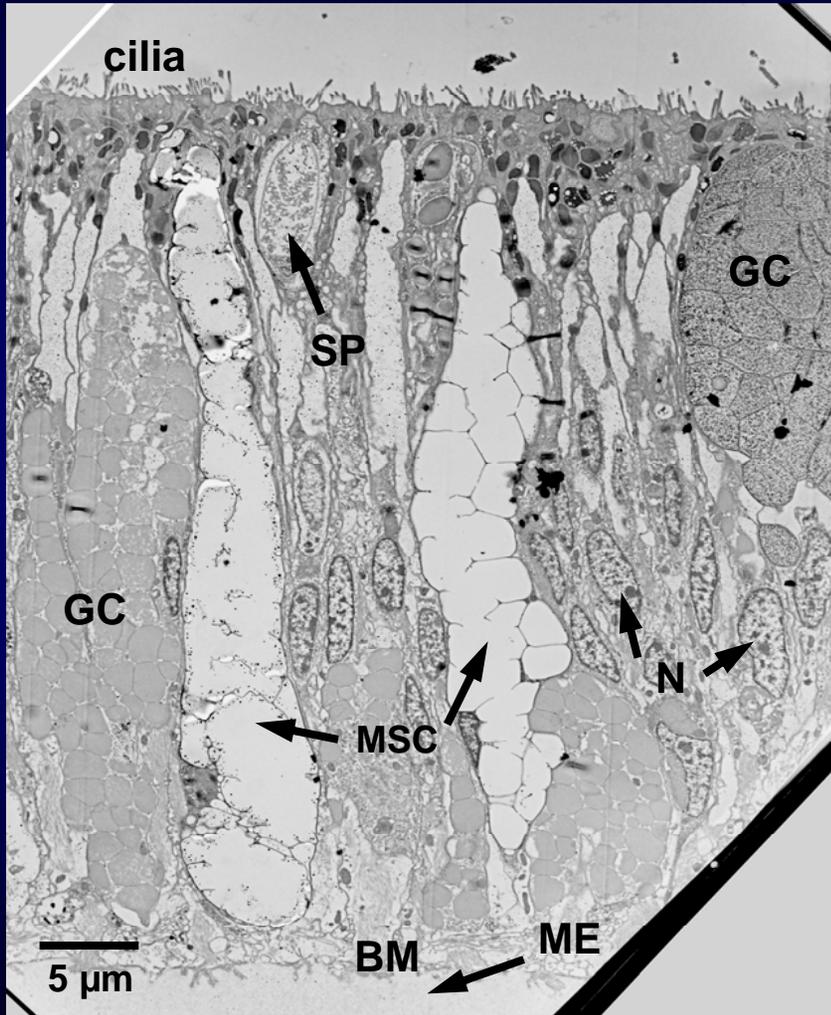
Histopathology

Gross morphology

Montastraea cavernosa: Epidermis



Montastraea cavernosa: Epidermis



Enzymatic Biomarkers

- Monitor exposure to environmental stress and assess its physiological and biological effects.
 - Exposure (e.g., metallothionein, heat shock proteins).
 - Physiological effect (e.g., lipid peroxide, ubiquitin).
 - Potential risk (e.g., manganese superoxide dismutase).

Coral DND and RNA Gene Expression

- cDNAs (or gene fragments) isolated using various molecular methods
- Classes of Genes on Array:
 - responsive to xenobiotics (a chemical compound that is foreign to a living organism).
 - metals & pesticides.
 - cellular integrity.
 - oxidative stress.
 - Respiration.
 - post-translational processing.
 - Apoptosis.
 - Ribosomal.

Endpoints: Coral stress biology study

- To determine if health of individual colonies varies among sites, with those impacted by dredging.
- To identify effects on coral health.
- Advance our understanding in coral ecotoxicology.
- Tool for managers to assess specific impacts (threat-based testing).

Management Implications

- Effective education, instruction, and dissemination.
- Provided a tool to assess stress during dredging operations.
- Collaborative projects: University of Miami, Broward Co., UCF, College of Charleston, Georgia Tech,