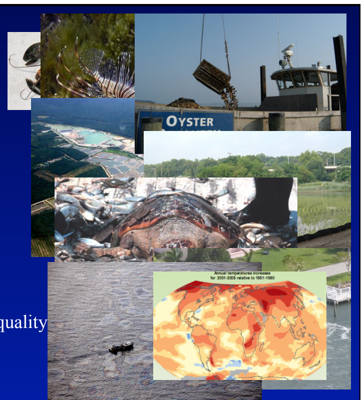
Learning Objectives

1. Become familiar with some of the factors affecting aquatic ecosystem health, specifically in the Everglades and Florida Keys
2. Learn the major marine habitats in the Florida Keys
3. Learn some of the major taxa and their ecological roles
4. Learn how some of these organisms are impacted and the research aimed at understanding the ecological effects

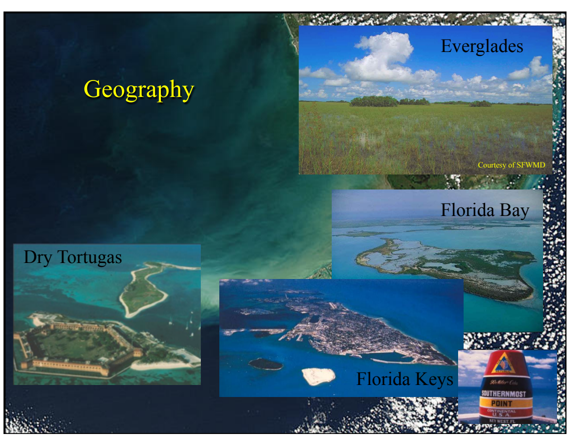
Some of the Impacts

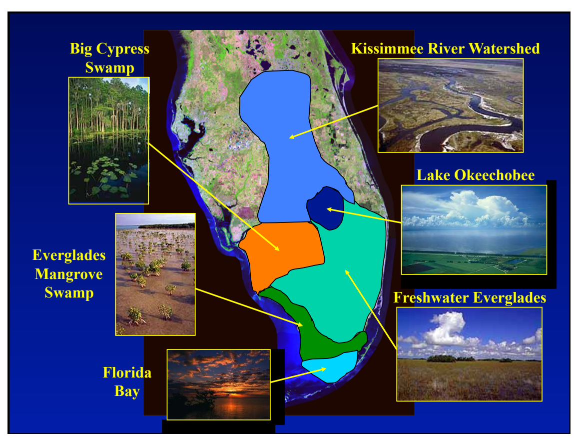
- Disease
- Species introductions
- Habitat restoration
- Aquaculture
- Mitigation
- Fishing
- Bycatch
- Pollution
- Offshore drilling
- Water resources and quality
- Climate change



Outline

- **Overview: Everglades to Florida Keys**
- **Ecosystem Change**
- **Consequences of Everglades restoration**
- **Effects of Recurring Cyanobacterial Blooms on Florida Bay Hard-bottom Communities**
- **Hard-bottom community restoration…in progress**





The Everglades

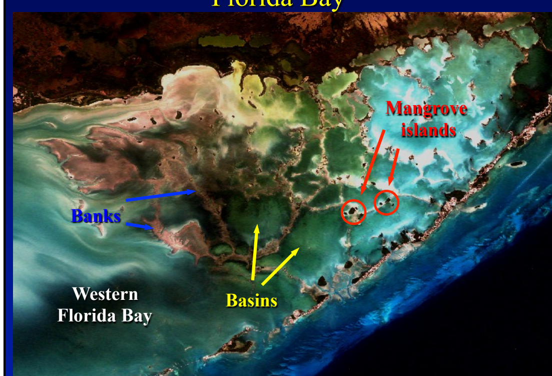
"River of Grass" = Saw grass (*Cladium jamacensis*)

Florida Bay

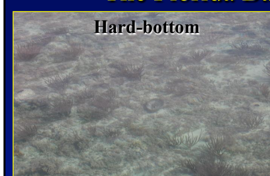
- Transition from the Everglades to Florida Bay is an example of an *ecotone.*

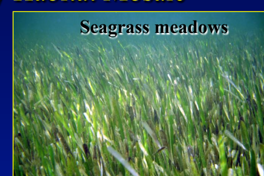
  - here freshwater vegetation (e.g., sawgrass) gradually gives way to salt-tolerant plants such as mangroves
  - Extensive shrimp and stone crab fisheries
  - Highly productive nursery habitat for spiny lobsters, crabs, and fish (e.g., snapper and grouper).
- Northeastern Bay more estuarine; western Bay more marine
  - communities reflect salinity characteristics
  - dramatic salinity variation within basins

Florida Bay



The Florida Bay Habitat Mosaic





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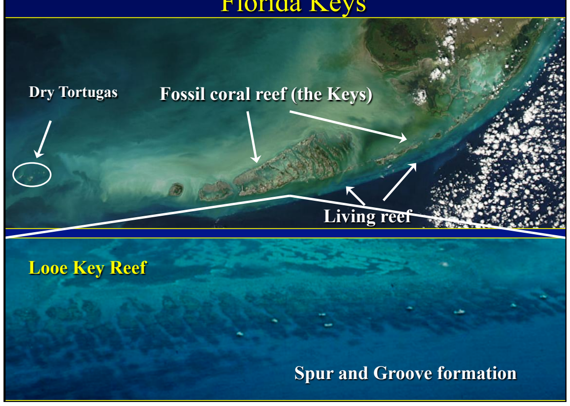
Florida Keys



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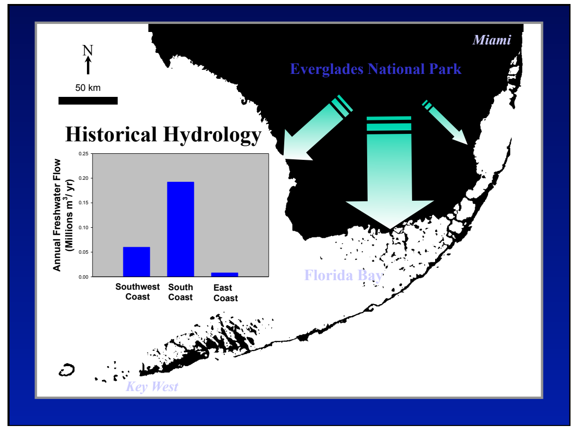
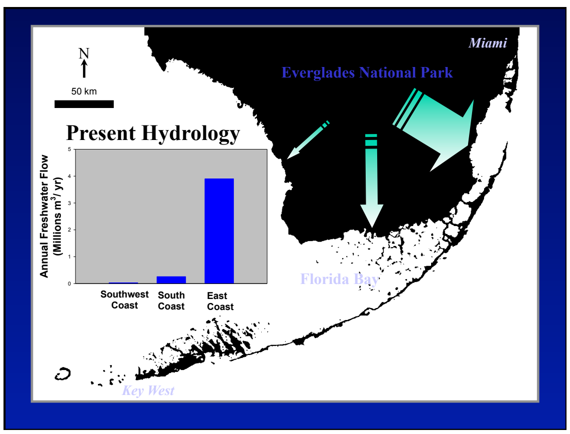
An Imperiled Ecosystem


N
50 km
Miami
Everglades National Park
Historical Hydrology
Annual Freshwater Flow (Millions m^3/ yr)
Southwest Coast
South Coast
East Coast
Florida Bay
Key West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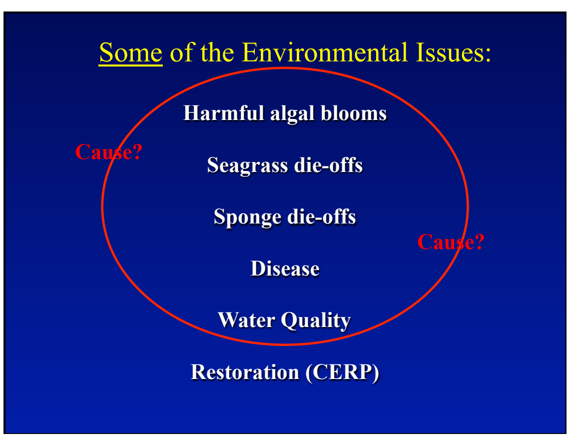
Some of the Environmental Issues:
Harmful algal blooms
Cause?
Seagrass die-offs
Sponge die-offs
Cause?
Disease
Water Quality
Restoration (CERP)


Everglades Restoration Plan
Kissimmee River
Restore water flow to former flood plain & a more meandering river system
Redirect Water
Reduce freshwater flows into coastal rivers & canals to restore freshwater to public land
Stormwater Treatment Areas
Filtration marshes to reduce Nutrient load of water Entering public land
Florida Bay
Reestablish historic timing & distribution of freshwater to restore natural estuarine system
Modify Water Delivery
Increase water delivered and improve timing & distribution of water to better mimic historic conditions
www.evergladesplan.org

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Objectives

Will changes in salinity resulting from Everglades restoration alter hard-bottom communities in Florida Bay?

Focus on "ecologically prominent" animals:

- Structure-forming:

  sponges and octocorals

- Abundant & economically important:

  spiny lobster

Sponge - Octocoral Experiment Design

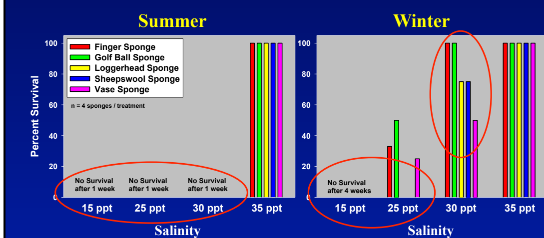
Treatments:
Salinity: 15, 25, 35, 45 psu
Season: winter & summer

Response: survival & healing

1) **Sponges**
   - 5 species
2) **Octocorals**
   - 2 species

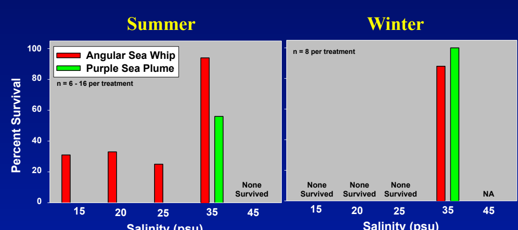
Sponge Survival fnc Salinity

Laboratory Experiments



Octocoral Survival fnc Salinity

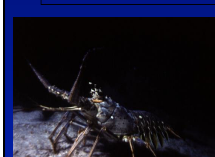
Laboratory Experiments



Lobster Salinity Tolerance Experiments

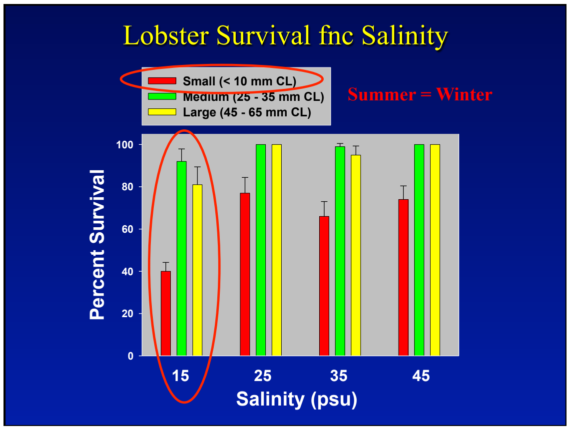
(1) Survival – Growth Experiment

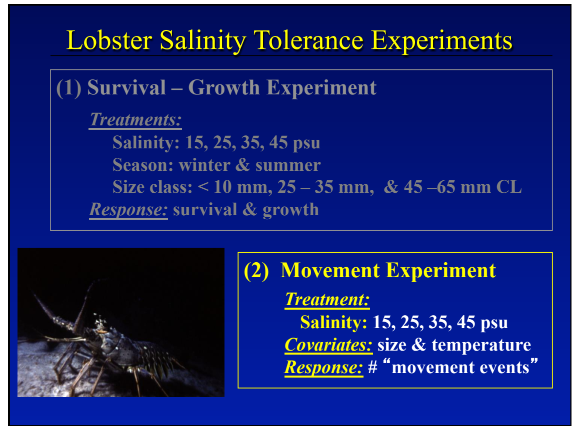
Treatments:
Salinity: 15, 25, 35, 45 psu
Season: winter & summer
Size class: < 10 mm, 25 – 35 mm, & 45 –65 mm CL
Response: **survival & growth**



(2) Movement Experiment

Treatment:
Salinity: 15, 25, 35, 45 psu
Covariates: **size & temperature**
Response: **# "movement events"**


Lobster Survival fnc Salinity
Small (< 10 mm CL)
Medium (25 - 35 mm CL)
Large (45 - 65 mm CL)
Summer = Winter
Percent Survival
100
80
60
40
20
0
15
25
35
45
Salinity (psu)


Lobster Salinity Tolerance Experiments
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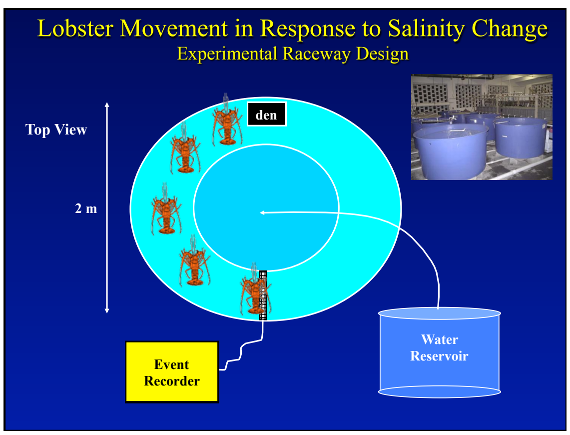
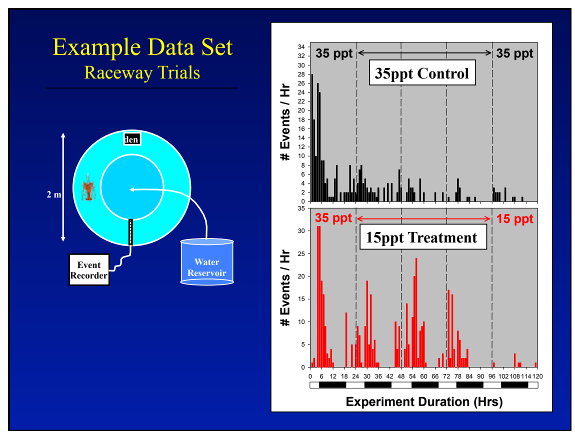
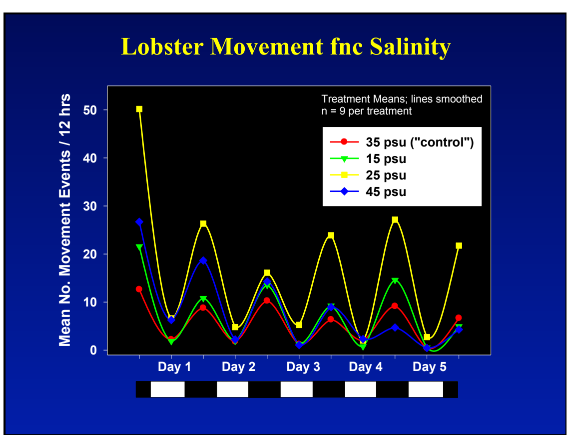
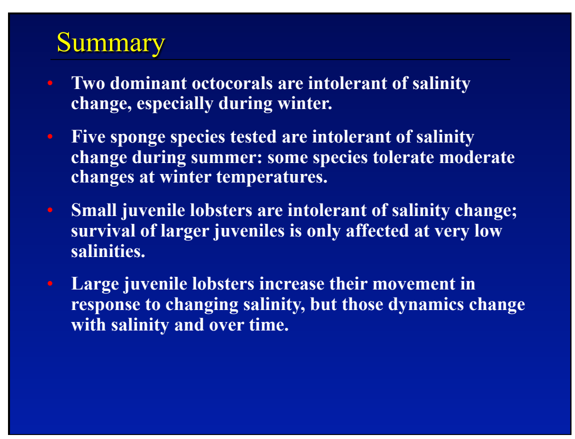
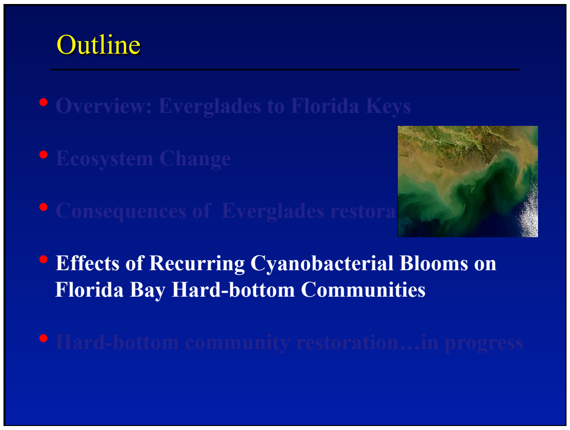
(2) Movement Experiment
Treatment:
Salinity: 15, 25, 35, 45 psu
Covariates: size & temperature
Response: # "movement events"


Lobster Movement in Response to Salinity Change
Experimental Raceway Design
Top View
2 m
den
Event Recorder
Water Reservoir


Example Data Set
Raceway Trials
den
2 m
Event Recorder
Water Reservoir
Events / Hr
35 ppt
35 ppt
35ppt Control
35 ppt
15 ppt
15ppt Treatment
Experiment Duration (Hrs)


Lobster Movement fnc Salinity
Treatment Means; lines smoothed
n = 9 per treatment
35 psu ("control")
15 psu
25 psu
45 psu
Mean No. Movement Events / 12 hrs
50
40
30
20
10
0
Day 1
Day 2
Day 3
Day 4
Day 5


Summary
Two dominant octocorals are intolerant of salinity change, especially during winter.
Five sponge species tested are intolerant of salinity change during summer: some species tolerate moderate changes at winter temperatures.
Small juvenile lobsters are intolerant of salinity change; survival of larger juveniles is only affected at very low salinities.
Large juvenile lobsters increase their movement in response to changing salinity, but those dynamics change with salinity and over time.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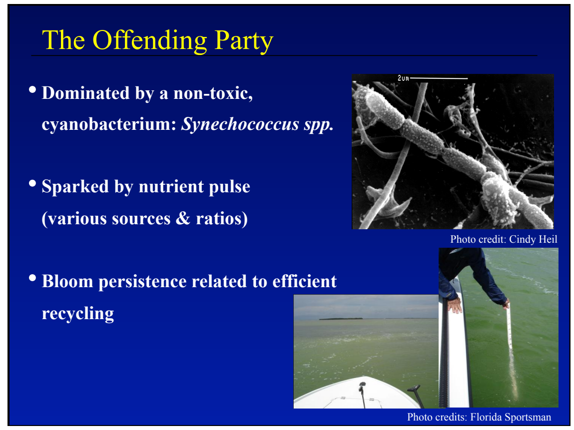
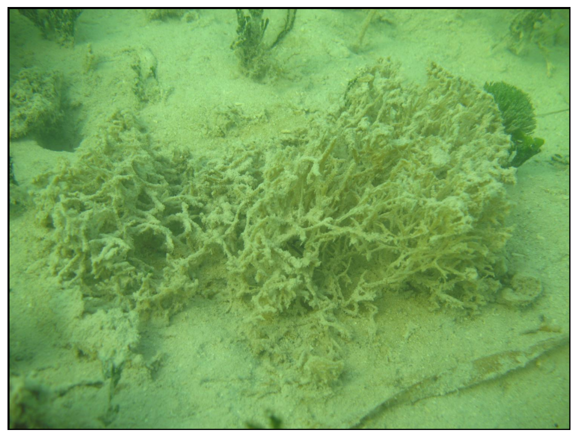
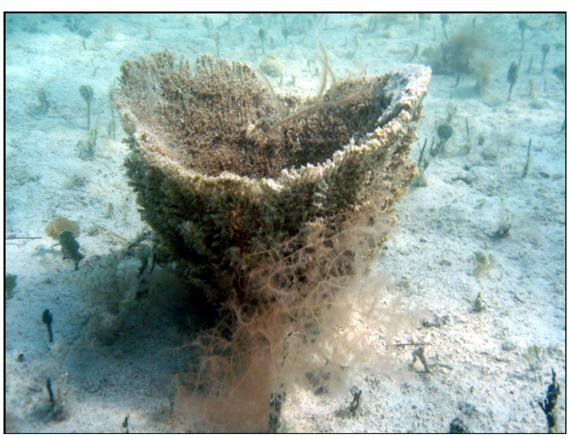
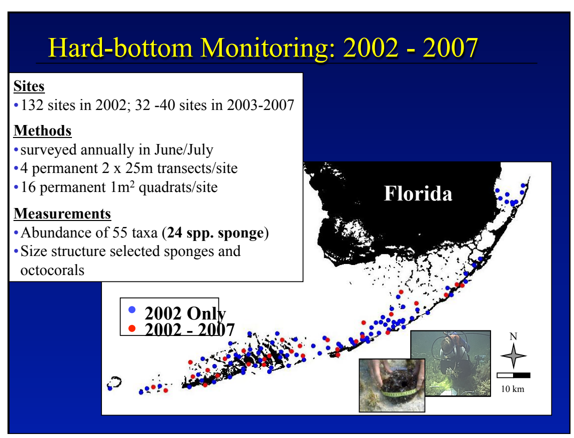
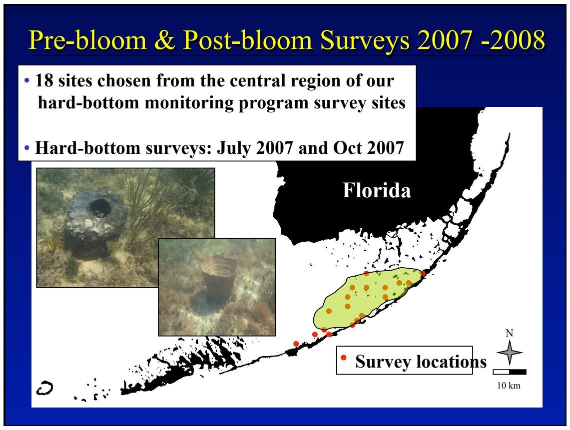
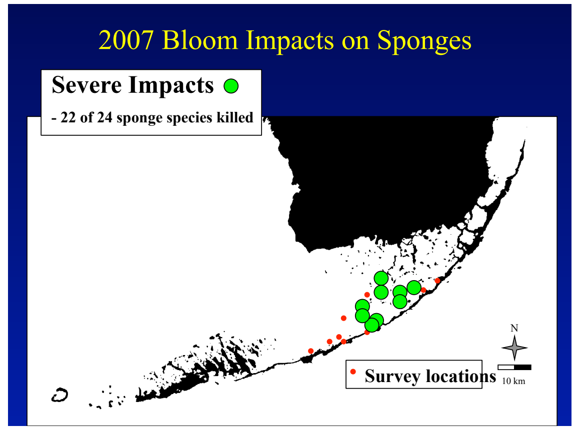

The Offending Party
Dominated by a non-toxic, cyanobacterium: *Synechococcus spp.*
Sparked by nutrient pulse (various sources & ratios)
Bloom persistence related to efficient recycling
Photo credit: Cindy Heil
Photo credits: Florida Sportsman






Hard-bottom Monitoring: 2002 - 2007
Sites
• 132 sites in 2002; 32 -40 sites in 2003-2007
Methods
• surveyed annually in June/July
• 4 permanent 2 x 25m transects/site
• 16 permanent 1m² quadrats/site
Measurements
• Abundance of 55 taxa (24 spp. sponge)
• Size structure selected sponges and octocorals
Florida
2002 Only
2002 - 2007
N
10 km


Pre-bloom & Post-bloom Surveys 2007 -2008
• 18 sites chosen from the central region of our hard-bottom monitoring program survey sites
• Hard-bottom surveys: July 2007 and Oct 2007
Florida
Survey locations
N
10 km


2007 Bloom Impacts on Sponges
Severe Impacts
- 22 of 24 sponge species killed
Survey locations
N
10 km