Awareness Training for Compliance and Enforcement of Coral and Hardbottom Resource Permitting

Overview of Corals and Hardbottom Resources in Southeast Florida

(Awareness Training - Unit 1, file 1 of 3)

Southeast Florida Coral Reef Initiative (SEFCRI),
Maritime Industry & Coastal Construction Impacts (MICCI) Team

Project 4, 21, 23, 24 – Phase 2
March 2011

NOAA CORAL REEF CONSERVATION PROGRAM

Southeast Florida Coral Reef Initiative

DEPARTMENT OF ENVIRONMENTAL PROTECTION FLORIDA

UF UNIVERSITY of FLORIDA

FLORIDA INSTITUTE OF TECHNOLOGY 1958

Overview of Corals and Hardbottom Resources in Southeast Florida

Contents:

- Introduction
- General Biology & Ecology of SE Florida Reefs
- Threats to SE Florida Reefs
- Identification Resources for SE Florida Corals
- Nearshore Hardbottom Resources

Note: Photo credits are provided at the end of the file

SEFCRI's Maritime Industry & Coastal Construction Impacts (MICCI) Team

The MICCI focus is on activities such as vessel groundings, infrastructure installation (e.g., cables, pipelines, and outfalls), dredge and fill operations (e.g., beach renourishment) that can adversely affect coral reefs and associated habitats.

MICCI Project 4, 21, 23, 24 Phase 2: Project Objectives

- Identify issues, gaps, and overlaps that reduce permitting compliance and enforcement efficiency for coral resources.
- Work with agencies to identify methods and processes to increase the effectiveness of coral regulatory oversight and monitoring to improve compliance.
- **Develop Awareness Training Materials for agency use - the purpose of these Powerpoint units.**

Awareness Training Materials

Three Training units are available as Powerpoint files:

- **Unit 1: *Overview of Corals and Hardbottom Resources in Southeast Florida (this unit)***
- Unit 2: *Rules and Regulations Involving Corals in Southeast Florida*
- Unit 3: *Permitting and Field Approaches for Efficient Compliance and Enforcement*

In addition to the Awareness Training powerpoint materials, the associated resources are available:

- Waterproof field cards on legal rules and biology.
- The Final Report: *Optimizing Compliance and Enforcement of Coral Regulations in SE FL.*

Awareness Training: Desk and Field Applications

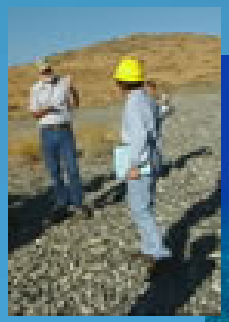
Collectively, the materials in these units address both permitting and field aspects –the more efficient the former, the less enforcement issues with the latter.

Desk and Office Components

- Coral Resource Overview (Unit 1)
- Administrative Rules (Unit 2)
- Best Permitting Practices (Unit 3)

Field Components

- Coral Resource Overview (Unit 1)
- Administrative Rules (Unit 2)
- Best Field Practices (Unit 3)
- Reef Resource Reference Cards



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Coral Biology Basics

Hard (stony) corals are the major reef architects. Corals need hard substrate for their larvae to settle and grow upon.

Individual corals are known as polyps and are colonial:

They live in tight associations with hundreds or thousands of other polyps while building a hard limestone framework.

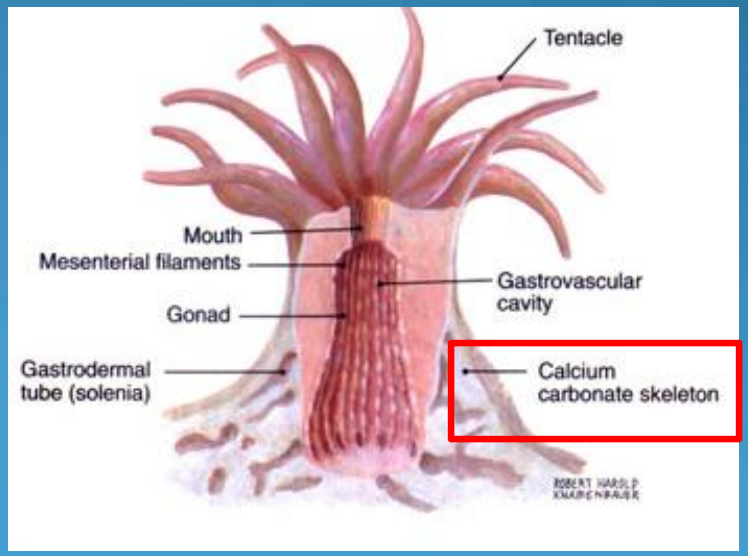
Coral diversity and complexity can be high.

Coral polyps on a great star coral (*Montastraea cavernosa*)

Coral Biology Basics (cont.)

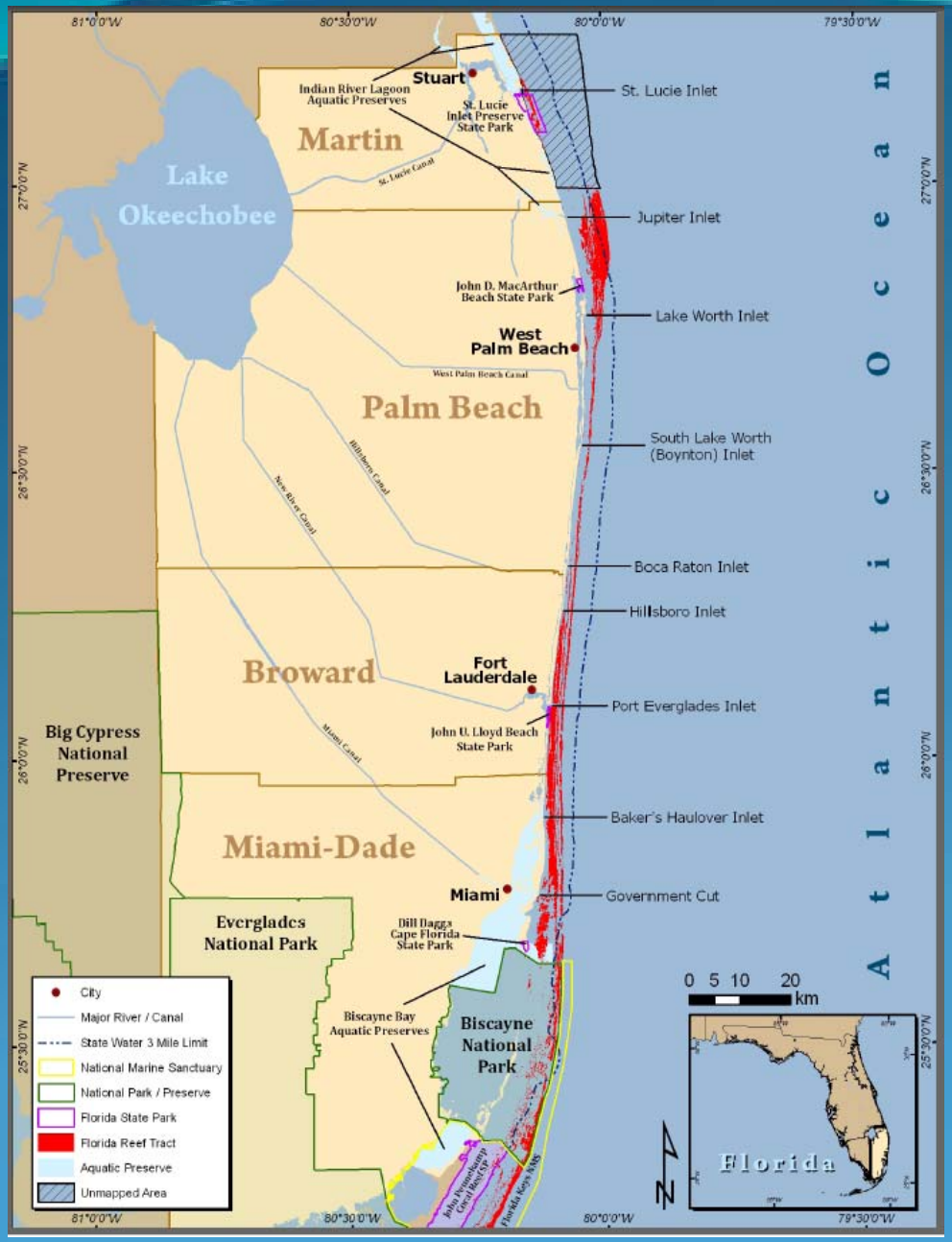
Though corals are animals, microscopic plants (called *zooxanthallae*) live within the tissues in a symbiotic relationship. The animals benefit from the energy that the plants provide through photosynthesis. The plants are protected in the coral tissues and gain nutrients from animal wastes.

Polyps, the living portion of corals, extract calcium from seawater and combine it with carbon dioxide to construct limestone (calcium carbonate) skeletons that form the reef framework.



Individual coral polyp

Mainland Southeast Florida Reefs



- Florida's reefs are the northernmost nearshore areas of the W. Atl. Ocean that support coral growth. These reefs include both coral reef and hardbottom *(sometimes called livebottom)* communities.
- Shallow water coral reef development occurs in areas with specific environmental characteristics:
  - Hard structure for larval recruitment
  - Warm and relatively clear waters

Coral Biology Basics (cont.)

- Hard coral growth rates are extremely slow in most species (4 - 6 mm/yr = 0.15 - 0.2 inches/yr). This is one reason that damage to them should be avoided. Also, damage can open up entry points for diseases.
- A few hard coral species can grow much faster:
  - The threatened staghorn coral, *Acropora cervicornis*, can grow 4 - 8 inches (100-200 mm) per year.
  - The threatened elkhorn coral, *A. palmata*, can grow 2 - 4 inches (50-100 mm) per year.

Elkhorn coral

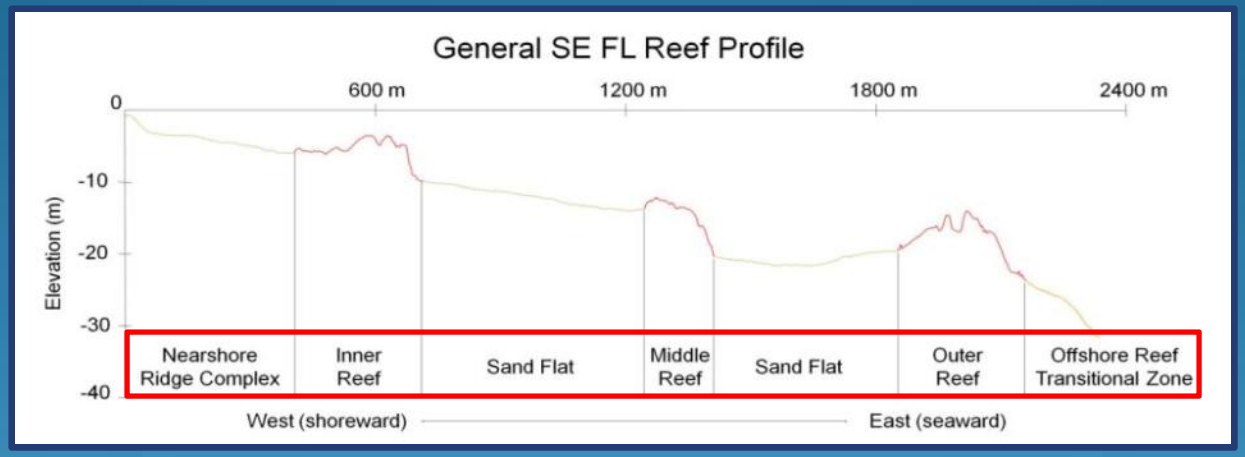
Octocorals = Gorgonians or Soft Corals

Octocorals, including sea fans and sea whips, do not have polyps and zooxanthallae like hard corals and do not have a major role in forming reef structural frameworks.

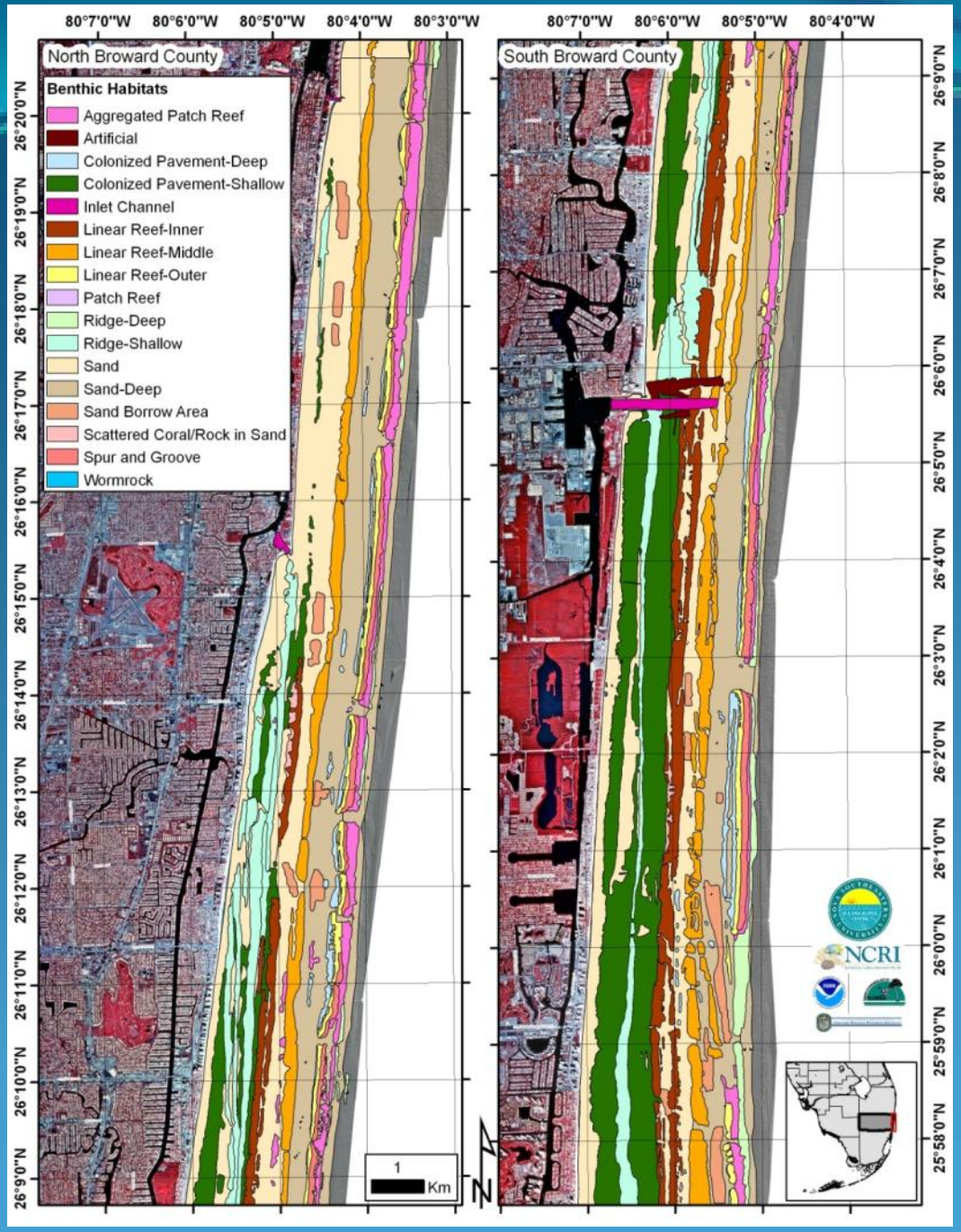
- Usually very abundant and have substantial habitat value to many fishes and invertebrates.
- Octocorals are more common than hard corals in the SE FL region.

Reefs Across the Southeast FL Shelf

The northern extension of the Florida Reef Tract is a series of hardbottom habitats and discontinuous reef lines that parallel shore.



- The reefs and hardbottom areas in this region support a rich and diverse biological community.
- Nearshore reef habitats in SE FL include hardbottom substrate, patch reefs, and worm reefs (*Phragmatopoma* spp.), sometimes with locally abundant macroalgae, octocoral, hard (stony) coral, sponge, and zoanthid assemblages.
- Approximately 26 different species of hard coral have been documented in Broward County alone!



Benthic Habitat Maps exist for reef resources in Miami-Dade, Broward, and Palm Beach counties. Martin County habitat maps are in development.

All benthic maps are available for download at: http://www.dep.state.fl.us/coastal/programs/coral/reports/

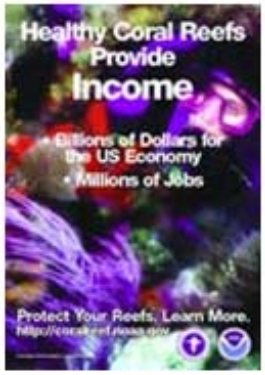
Values of Southeast FL Reefs

- Habitat complexity and diverse reef species create an environment that is highly productive. Many of FL's recreationally & economically important marine organisms spend significant parts of their lives around coral reefs or associated hardbottom resources.
- It is estimated that natural reefs in Martin, Palm Beach, Broward, and Miami-Dade counties generate $3.45 million in sales and income, and support 36,000 jobs in the region annually (Johns 2001).
- Recreational reef user surveys found that visitors and residents in Broward County were willing to pay $84 million annually to maintain the current condition of natural reefs.

Values of Coral Reefs: US and Territories

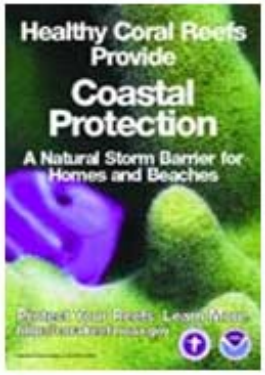
Information from NOAA Coral Reef Conservation Program

Healthy Coral Reefs Provide:



Income: Billions of Dollars for U.S. Economy, Millions of Jobs

Healthy coral reefs support commercial and subsistence fisheries as well as jobs and businesses through tourism and recreation. Local economies also receive billions of dollars from visitors to reefs through diving tours, recreational fishing trips, hotels, restaurants, and other businesses based near reef ecosystems.



Coastal Protection: A Natural Storm Barrier for Homes and Beaches

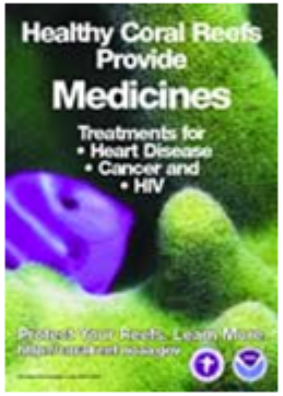
The coral reef structure buffers shorelines against waves, storms and floods, helping to prevent loss of life, property damage and erosion. When reefs are damaged or destroyed, the absence of this natural barrier can increase the damage to coastal communities from normal wave action and violent storms.

Habitat: Home for 1 Million Species

Coral reefs support more species per unit area than any other marine environment, and are living museums that reflect thousands of years of history. Today, many human activities threaten these important habitats.

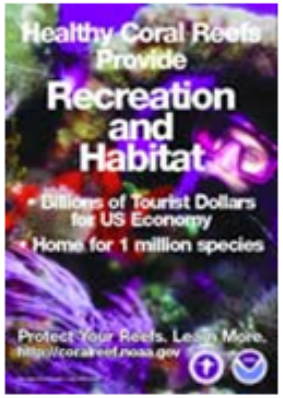
Values of Coral Reefs: US and Territories

http://coralreef.noaa.gov/aboutcorals/values/psaposters/



Medicines: Treatments for Heart Disease, Cancer and HIV

Coral reefs are considered by some scientists to be the medicine cabinets of the 21st century. Coral reef plants and animals are important sources of new medicines being developed to treat cancer, arthritis, heart disease, viruses, and other diseases.



Recreation: Billions of Tourist Dollars for U.S. Economy

Every year, millions of scuba divers, snorkelers and fishermen visit US coral reefs. An even larger number of tourists visit the beaches that are protected by US coral reefs. Despite their great economic and recreational value, coral reefs are threatened by pollution, disease and habitat destruction.

(The posters and cards represented on this and the prior slide are no longer available from NOAA)

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Threats to Southeast Florida Coral Reefs

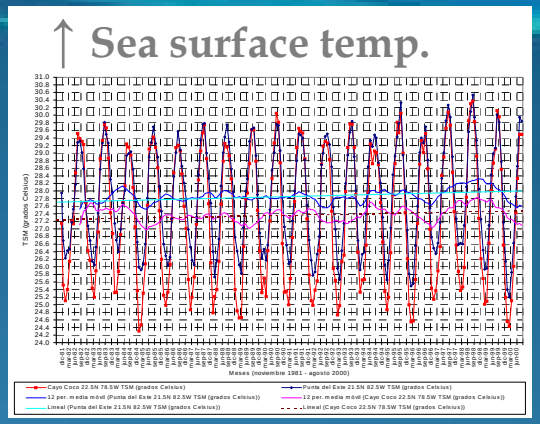
- Coral cover on many Caribbean reefs has declined up to 80% over past decades. SE FL reefs show diseases, bleaching, and other evidence of degradation.
- The stressors that drive these changes originate from both local and global sources. Global changes in climate affect corals in multiple manners and can contribute to bleaching and diseases.
- The remainder of this section focuses on local and regional scale stressors - but the local stressors can also be amplified by global stressors in complex manners.

Photos: Carysfort Reef, N. FL Keys, 1975-85-95, J. Greenberg.

Regional & Global Stressors

Bleaching & Diseases

Urchin Mortality



↑CO_2

African Dust

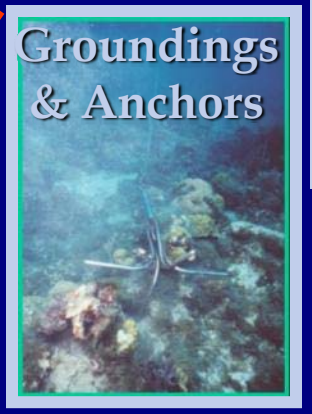
Coral Reef Resources

Local Stressors

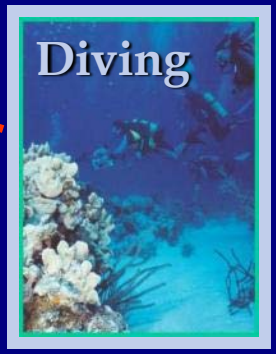
Nutrient Loading

Overfishing

Sedimentation



Groundings & Anchors



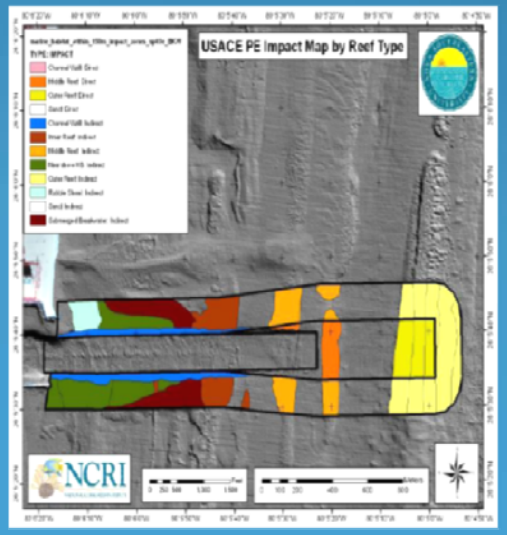
Diving

Adapted from: P. Alcolado, Cuban Inst. of Oceanology

Threats to SE Florida Coral Reefs (cont.)

- Beach renourishment (dredge and fill) projects can impact corals, hardbottom, and other benthic communities in acute and chronic manners by:
  - Mechanical impacts during dredge operations;
  - Anchoring and cable drags;
  - Sediment deposition during and after construction;
  - Reducing the amount of light available for photosynthesis via elevated turbidity over short- or long-term periods.

- Large coastal infrastructure projects, such as installation of pipes, cables, and wastewater outfalls, can damage corals through mechanical or water quality impacts.
- Port expansion projects can combine several of the stressors from above.



Proposed Port Everglades channel expansion eastward across the shelf.

Threats to SE Florida Coral Reefs (cont.)

- Ships and other vessels that run aground or drop anchor on reefs can dislodge and crush corals.
- Abandoned, improperly discarded, or lost fishing gear like line, nets, and traps cause physical damage to reef systems.

- Overfishing has depleted many fishery resources. 77% of 35 fish stocks studied in Biscayne National Park, Florida indicated they were overfished according to federal designations (Ault et al., 2001).
- Physical contact from fins, hands, or equipment of boaters, divers, snorkelers, and fishermen can damage delicate corals.

Terrestrial Inputs can Damage Corals

- Runoff from residential, industrial, and agricultural areas containing fertilizers, silt, chemicals, debris, and other contaminants are carried through storm drains to Florida's waterways.
- Inputs miles from the coast can damage corals as liquids and solids eventually make their way to the ocean through numerous inland canals and waterways, and groundwater transport.
- Sewage and nutrient discharges from waste treatment facilities, boats, and developed land contribute to coral diseases and can trigger algal blooms that smother reefs, and may also contain bacteria and viruses which threaten both the marine environment and humans.

Reef Injuries Can Result from Permitted Activities

Permitted Activities include:

- Beach nourishment (large dredge and fill projects).
- Pipeline construction, communication cable installation.
- Port maintenance or expansion.
- Scientific research on corals.

These require authorization from local, state, and federal regulatory entities.

Fiber optic cable directly impacting a great star coral (*Montastraea cavernosa*) colony.

Pillar Coral Impacted by a Cable Drag

Hillsboro Inlet Dredging, 2002

Image taken from a video on the Vŏnē Research web site:

http://voneresearch.org/?pageID=vid_handler.php&source_vid=http://www.youtube.com/v/rGsR04oYhQg

Sedimentation from Construction Activities Can Impact Corals

Dredged Sediments can have Direct & Indirect Impacts from Days to at least Months

Research by Telesnicki and Goldberg (1995a, 1995b) on common Florida corals has relevance to coastal construction permitting and compliance:

- Significant stress responses (mucous production, increased respiration) were found at nephelometric turbidity units (NTUs) of 14-16 and 28-30 for two common SE Florida corals, elliptical star coral and maze coral.
- "These results suggest that adherence to turbidity-related water quality standards as presently defined in FL, may result in short term stress and long term decline in at least some coral species."
- The measurement of NTUs in the field is problematic.

-Telesnicki, G. and W. Goldberg. 1995a. Effects of turbidity on the photosynthesis and respiration of 2 South Florida reef coral species. *Bull. Mar. Sci.* 57(2):527-539.
-Telesnicki, G. and W. Goldberg. 1995b. Comparison of turbidity measurement by nephelometry and transmissometry and its relevance to water quality standards. *Bull. Mar. Sci.* 57(2):540-547.

Dredged Sediments can have Direct & Indirect Impacts over Days to at least Months (cont.)

Resolving sediment compatibility issues early can reduce compliance needs and better protect coral resources (Wanless & Maier, 2007):

- Criteria for evaluating **quartz sands** are used for SE FL sediments which are actually high in **carbonates** (less durable than quartz).
- This allows fill that can: a) break down into sediments with mud-like characteristics, and b) more easily suspend in the water column.
- Therefore, sediment compatibility analyses should not only use sieving, but wet settling and durability analysis.
- Follow FAC 62B-41.007: "…shall be similar in color and grain size distribution (sand grain frequency, mean and median grain size, and sorting (coefficient) to the material in the existing coastal system…"

Wanless, H.R., and Maier, K.L., An evaluation of beach renourishment sands adjacent to reefal settings, Southeast Florida, *Southeastern Geology* 45:25–42, 2007.

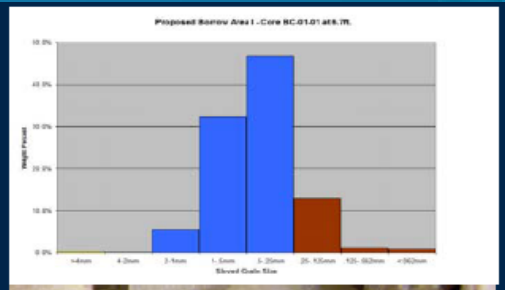
EXAMPLE OF A SUITABLE CARBONATE BEACH NOURISHMENT SAND

- Sand is **between 1mm - 0.25mm**

- Carbonate particles are **rounded & polished** skeletal fragments (already worn).
  - Will not be prone to rapid abrasion and release of silt- and clay-sized particles.

- Carbonate skeletal particles are **solid**, not full
- of open pore space.
  - Will behave as indicated by sieved size.
  - Will not be prone to rapid abrasion and breakdown on beach.

- Carbonate particles are fairly **equant shaped**, not thin rods & flat plates.
  - Will move as indicated by sieved size.
  - Will not be prone to rapid abrasion and breakdown on beach.



2-1 mm

1-0.5 mm

0.5-0.25 mm

Image from MICCI Project 3: ***Identification and evaluation of existing innovative and emerging technologies for coastal construction in SE FL.*** http://www.dep.state.fl.us/coastal/programs/coral/reports/MICCI/7-Donald_McNeill.pdf

Reef Injuries Also Result from Unpermitted Activities

Unpermitted Activities and Incidents include:

- Acts of nature (e.g. hurricanes, tropical storms, etc.).
- Vessel groundings and salvage efforts.
- Commercial and recreational anchoring on coral reefs.
- Propeller wash, towing cable drags.

These actions are not governed by regulations for permitted activities.

Vessel Groundings

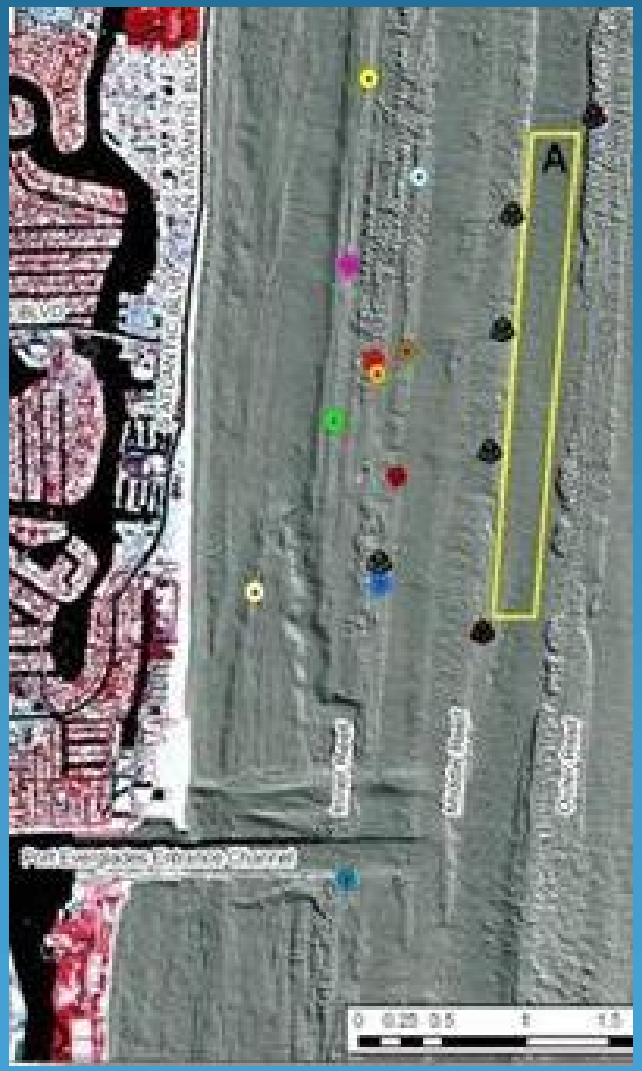
Vessels that run aground or drop anchor on reefs can dislodge, overturn, and crush corals.

Grounding and anchoring incidents can also happen during permitted activities.

Historical Broward County Commercial Vessel Groundings

Yellow polygon = old commercial anchorage boundary.

The anchorage was reconfigured in 2008. As of January 2011, there have been no major groundings.



Known Grounding Events

- Firat (1994)
- Sealand Atlantic (1994)
- Hind (1998)
- Pacific Mako (1998)
- Alam Senang (2003)
- Cosette (2004)
- Eastwind (2004)
- Federales Pescadores (2004)
- Orphan Site (2005)
- Clipper Lasco (2006)
- Spar Orion (2006)

Known Anchor Events

- Puritan (2004)
- Afra (2006)
- Azov Wind (2006)
- Caribe Legend (2006)
- Miranda Rose (2006)
- Paladin (2006)

Figure: B. Walker

Coral Damage can Occur from Non-anthropogenic Sources

Examples include:

← Disease (e.g. black band disease)

Predation → (e.g. parrotfish bites)

← Bleaching

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Powerpoint Resources for SE FL Coral Identification

(Book and Web Resources at the End of this File)

- C. Boykin, FDEP CRCP, ***Identification of Corals on SE FL Reefs***
  - 113 slides; with quizzes.
  - Integrates multiple sources including below.
  - Not as detailed as below, but an excellent start.
  - Avail. on the same DVD as these awareness training files.

- V. Kosmynin, FDEP BBCS, ***Field ID of Scleractinian Corals***
  - 5 hours; >280 slides; exams; highly comprehensive.
  - Contact:

Vladimir. Kosmynin@dep.state.fl.us

SE Florida Corals - Basic Identification

Kingdom: Animalia **(Corals are animals)**

Phylum: Cnidaria

(also contains jellyfish and sea anemones)

Class: Anthozoa

Orders:

Scleractinia (**Stony or hard corals**)

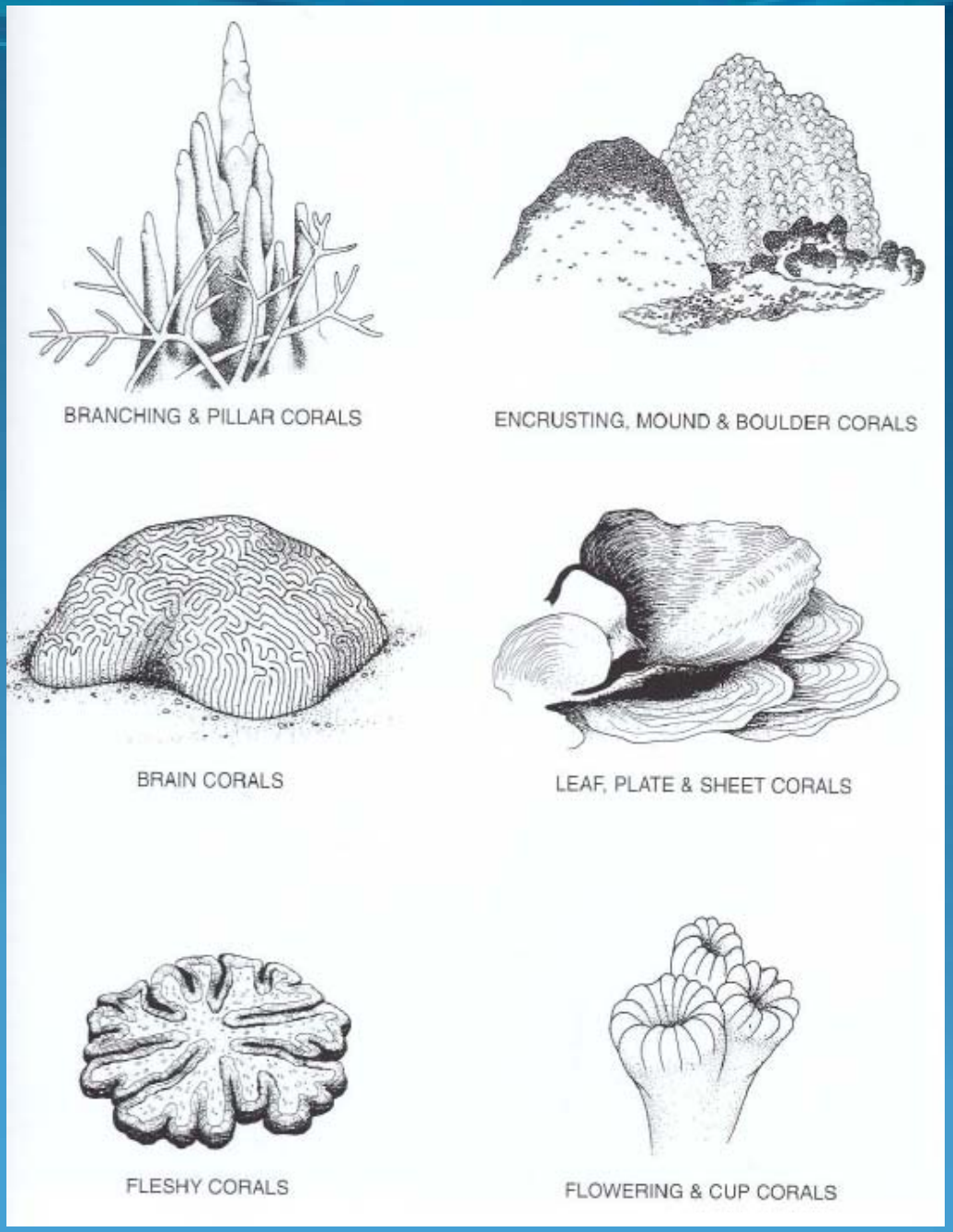
Alcyonacea (**Octocorals – sea fans, sea whips, gorgonians**)

Families: i.e. – Acropor*idae*, Millepor*idae*, etc.

As of 2010, there are approximately 28 identified coral species in the SE FL region.

Over 30 species of the most common hard corals fall into 6 growth forms

1. **Branching & Pillar corals** (6 spp)
2. **Encrusting, Mound & Boulder Corals** (11 spp)
3. **Brain Corals** (5 spp)
4. **Leaf, Plate & Sheet Corals** (2 spp)
5. **Fleshy Corals** (3–6 spp)
6. **Flowering & Cup Corals** (2 spp)



Meandrina meandrites / maze coral

Page #/abund. in Humann bk on corals

Reef Coral / Humann: pg #129
Common to occasional South FL

Miami-Dade	confirmed	common
Broward	confirmed	2%
Palm Beach	confirmed	very common
Martin	confirmed	?

Latin Name / common name

- Size = ½′ – 2 1/2′ (typically ht. in Humann bk, citation at end of file)
- Polyps = ¾″ – 1¼″ (diameter in Humann bk.)

County presence

THIS IS THE TEMPLATE FOR THE FOLLOWING SLIDES (FROM THE BOYKIN AND KOSMYNIN FILES)

County abundance (if known)

Abundant – At least several sightings can be expected on nearly every dive.
Common – Sightings are frequent, but not necessarily on every dive.
Occasional – Sightings are not unusual, but not on a regular basis.
Uncommon – Sightings are unusual.
Rare – Sightings are exceptional.

Special thanks to:

- Miami-Dade County Department of Environmental Resources Management
- Broward County Department of Environmental Protection and Growth Management
- Palm Beach County Department of Environmental Resources Management
- St. Lucie Inlet State Park Aquatic Preserve (Martin County)
- Smithsonian Marine Station at Fort Pierce (Martin County info)

Threatened Corals – Federal & State Endangered Species Act (ESA)

Elkhorn coral
Acropora palmata

Pillar coral
Dendrogyra cylindrus

Staghorn coral
Acropora cervicornis

Acropora ESA Critical Habitat Definition:

- **Natural consolidated hard substrate or dead coral skeleton that is free from fleshy and turf macroalgae cover and sediment cover** to maximize the potential for successful recruitment and population growth.
- Pillar coral: Currently "endangered" under Florida State Endangered Species Act (FAC 62A-27).

Acropora palmata / elkhorn coral

Reef Coral / Humann: pg #93
Once abundant in FL, but now only occasional

Miami-Dade	confirmed	?
Broward	confirmed	?
Palm Beach	not confirmed	na
Martin	not confirmed	na

- Size = 3 – 12′ (branch diam. 2 - 10″)
- Very easy to identify
- Thicker / flattened branches
- **Listed as Federally threatened species in 2006 under Endangered Species Act**

Acropora cervicornis / staghorn coral

Reef Coral / Humann: pg #91
Occasional to uncommon South FL

Miami-Dade	confirmed	rare to occ
Broward	confirmed	<1%
Palm Beach	confirmed	?
Martin	not confirmed	na

- Size = 1 – 8′ (branch diameter ¾ - 1 1/4″)
- Very easy to identify
- Thin / round branches
- **Listed as Federally threatened species in 2006 under Endangered Species Act**

Dendrogyra cylindrus / pillar coral

Reef Coral / Humann: pg # 97
Occasional to rare South FL

Miami-Dade	not confirmed	na
Broward	confirmed	?
Palm Beach	confirmed	very rare (2)
Martin	not confirmed	na

- Size = 4 – 10′
- Colonies form numerous, heavy, cylindrical spires that grow upward from an encrusting base mass
- **Listed by FWC as endangered (FAC 62A-27)**
- One of the only stony corals that has extended polyps during the day
- Very uncommon, but unmistakable