TIEE
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ISSUES – FIGURE SET

What's Killing the Coral Reefs and Seagrasses?

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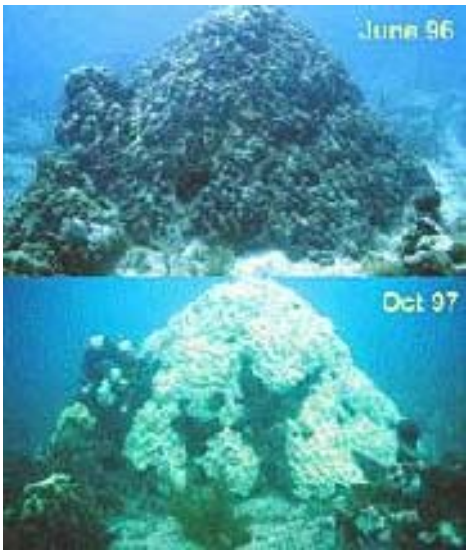

Bleaching in coastal Florida
©- Reef Relief, www.reefrelief.org)

THE ISSUE:
The loss of corals and seagrasses in waters off Florida.

ECOLOGICAL CONTENT:
decrease in coral species diversity, metabolic effects of low light on corals, nutrient loading, and loss of fish habitat

STUDENT-ACTIVE APPROACHES:
turn-to-your-neighbor, guided class discussion based on first principles, informal groupwork, and jigsaw

STUDENT ASSESSMENTS:
newspaper article, essay quiz, design an experiment, diagram quiz, minute paper

OVERVIEW OF THE ECOLOGICAL BACKGROUND

In this **Issue**, students examine published data that address the causes of coral and seagrass decline in Florida. Activities engage students in data analysis and hypothesis testing and will increase their understanding of the complexities of ecological phenomena.

Coral reefs are important ecological habitats because they provide food and shelter to many organisms, they are home to many species including endangered ones, and in many tropical areas they are reliable sources of food. However, coral reefs are in trouble in all parts of the globe. For example, the coral reefs in the Florida Keys, which are the only coral reefs in the continental United States, have been dramatically in decline since the late 1980's. Marine ecologists have recorded long term data showing increases and epidemics of coral diseases (http://ourworld.compuserve.com/homepages/mccarty_and_peters/coraldis.htm) and the loss of coral species diversity.

These problems are not restricted to coral. Seagrasses are also integral parts of marine ecosystems by helping to clarify water, stabilize the sea bottom, serve as food sources for marine life, and provide habitats and nursery areas for many types of organisms, including shrimp. Unfortunately, seagrasses are also being threatened. Seagrass beds formerly covered most of Florida Bay, but have been dramatically in decline in tandem with coral. In addition, data indicate concomitant population declines in shrimp (record low harvests of pink shrimp), spiny lobsters, 100% mortality of sponges in some places, as well as algal blooms, higher water turbidity, and many other indicators of degraded water quality.

The seagrass and coral diseases and die-offs may be related to human activity in the Florida Bay watershed where the Keys are located (see MAP).

Scientists hold different viewpoints as to the causes of water quality degradation, which is most likely to be the immediate ecological cause of coral and seagrass decline.

Some attribute the water quality decline to WATER DIVERSION to the north of the Everglades for agricultural use and accompanying increase in salinity in the Bay.

Others attribute the water quality decline to the increase in agricultural activity and suburban development from which FERTILIZER, PESTICIDES, AND HERBICIDES run-off into the Bay. Fertilizers in turn cause nitrogen and phosphorous loading (see ESA Issues in Ecology - http://www.esa.org/sbi/sbi_issues/) that can lead to eutrophication (http://www.rsmas.miami.edu/groups/jmc/fla-bay/FBayOverview1.html).

Still others suggest that water quality may in fact be affected by factors other than water diversion/salinity, or organic pollution/eutrophication; instead, in the case of Florida Bay, water degradation may have resulted from the suite of environmental impacts from the building and operation of the new FLORIDA EAST COAST RAILWAY.

Finally, increasing water temperature - as a result of rising carbon dioxide - appears to be another contributor to coral decline in the Florida Bay (http://www.publicaffairs.noaa.gov/iyorwk35.html). As water temperature rises, corals expel their zooxanthellae and become "bleached". Coral bleaching events are on the rise globally.

Researchers therefore are not sure about the main cause of coral reef and seagrass decline or if it is due to some combination of these and perhaps other factors.

FIGURE SETS

These are published figures from peer-reviewed research journals and monographs that engage students in data analysis and critical thinking organized by teaching approach, Bloom's Taxonomy cognitive skills, and class size. The student-active approaches listed here are suggestions and examples; modify them as appropriate for your teaching.

Figure Set and Ecological Question	Student-Active Approach	Cognitive Skills	Class Size/Time
(1) Evidence for Decrease in Coral Diversity in the Florida Keys (EPA 2000)	turn to your neighbor	knowledge comprehension interpretation	any/short
(2) Evidence for Nitrogen Limitation in the Ocean (Vince & Valiela 1973)	guided class discussion	comprehension application	any/short
(3) How Shading Affects Photosynthetic/ Respiratory Balance in Corals (Rogers 1979)	turn to your neighbor	knowledge comprehension	any to intermediate
(4) Loss of Seagrasses in Florida Bay and Nutrient Loading from Watersheds (Hall et al. 1999, Tomaska et al. 1996, Wright et al. 1995)	informal groupwork	application evaluation	small to medium/long
(5) Eutrophication and Anoxia (Nixon 1999, Nixon & Valiela 1999, LaPointe & Matzie 1966, LaPointe & Clark 1992)	jigsaw	knowledge comprehension interpretation application synthesis evaluation	medium/long
(6) Effects of Habitat Loss on Fish (Thayer et al. 1996)	informal groupwork	knowledge comprehension interpretation application synthesis	any/long

RESOURCES

- http://www.coral.noaa.gov/coral_disease/literature.shtml NOAA Coral Health and Monitoring Program
- http://coralreef.gov/usgs.cfm USGS Coral Reef Task Force
- http://www.news-press.com/special_sections/reefsindanger/ Press Release "Reef in Danger"
- http://www.evergladesplan.org/docs/fs_fl_bay_feas_study.pdf. Feasibility Study PDF
- http://www.nova.edu/ocean/eglades/sum00/flabay.html - Good overview and links
- Harvell, C. D., et al. 2002. Climate warming and disease risks for terrestrial and marine biota. *Science* 296: 2158-2162.
- Harvell, C. D., et al.. Emerging marine diseases - climate links and anthropogenic factors. *Science* 285: 1505-1510

Here are a number of other web sites that provide information on the issue of coral reef and seagrass decline:

- National Marine Sanctuaries - Florida Keys (http://www.sanctuaries.nos.noaa.gov/oms/omsflorida/omsflorida.html)
- ReefKeeper International Homepage (http://www.reefkeeper.org/)
- NOAA State of the Coast Report (http://state_of_coast.noaa.gov/)
- NOAA State of the Coast - Harmful Algal Blooms (http://state-of-coast.noaa.gov/bulletins/html/hab_14/hab.html)

Coral Reefs:

- International Society for Reef Studies (http://www.uncwil.edu/isrs/)
- Coral Reef Protection: US EPA (http://www.epa.gov/OWOW/oceans/coral/)
- NOAA's Coral Health and Monitoring Program (CHAMP) (http://coral.aoml.noaa.gov/)
- Environmental and Scientific Affairs U.S. Department of State (http://www.state.gov/www/global/global_issues/coral_reefs/)

Seagrass:

- Florida Seagrass Ecosystems (http://www.fiu.edu/seagrass/)
- Florida Keys Seagrass Data (http://serc.fiu.edu/seagrass/report/DataHome.htm)

Photo Gallery:

- Florida Keys - includes organisms and habitats (http://www.sanctuaries.nos.noaa.gov/pgallery/pgflorida/pgflorida.html)