

Unit 1 Lesson 3: Corals, Forams, and Reef Health

Lesson Objectives: Students will understand the plight of coral reefs, and the diseases and factors responsible for their decline.

Vocabulary: coral bleaching, zooxanthellae, ozone, carbon dioxide, coralline, foraminifera, symbiotic

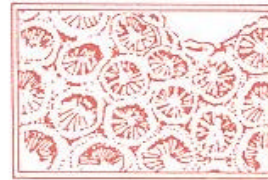
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Corals and Forams

Coral reefs are in trouble worldwide. According to a 1998 study by the World Resources Institute, 60% of the world's coral reefs are threatened. Threats to coral reefs can be classified as local, regional and global.

are subject to bleaching and may die if the environment is not favorable. Ultraviolet radiation, carbon dioxide and other factors affect them.

Forams are small organisms that live on the coral reef. They



Local Threats

Local threats include runoff of sediments and nutrients from land, **overfishing** and destructive fishing, **dredging** and careless boat operation, including grounding of large ships on coral reefs. Many "local" threats are so widespread, they are actually regional or even global in extent. For example, the World Resources Institute report concluded that there are virtually no reefs in the *entire*

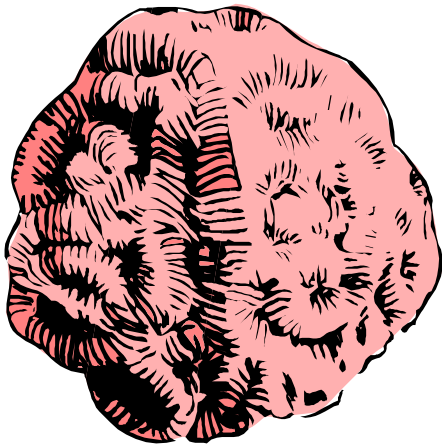
world, with the exception of some protected areas on Australia's Great Barrier Reef, that are not overfished.



Pipe Coral

Regional Threats

Regional threats include new diseases that sweep through populations of organisms living on the reefs. For example, in 1983, an unknown disease, possibly a **virus**, is believed to have come through the Panama Canal from the Pacific Ocean. This disease killed most of the spiny sea urchin



Sponge Coral.

population, first in Panama then throughout the Caribbean and to the Western Atlantic reefs of the Florida Keys and Bahamas. More than 99% of the spiny sea urchins were killed. The virus seems to still be present, because spiny sea urchins are now uncommon on Caribbean reefs.

The consequence of the die-off of the spiny sea urchin has

been unlimited growth of algae on coral reefs. The spiny sea urchin population fed on the algae populations found on the coral reefs. For example, in the early 1980's, coral covered more than 60% of the reefs in Jamaica. Now, coral covers less than 10% of the reef. Algae are taking over the reefs everywhere.

Another disease swept through the coral reefs of the Caribbean and western Atlantic in the 1980's – **white-band disease**. This disease, which looks like a white band of death as it attacks a coral colony, wiped out most of the branching coral (*Acropora palmata* and *Acropora cervicornis*) throughout the Caribbean. White Band disease is one of the reasons why Jamaican reefs lost most of their coral.

Another coral disease is **Black Band disease**, which mostly attacks head-forming corals like star coral and brain coral. This disease was first reported in the 1970's and now is extremely common, especially in areas where corals are weakened by other stresses such as **coral**

bleaching or excess nutrients

A variety of other coral diseases have more recently been discovered. Scientists don't know much about them,

from sewage or fertilizers. but they have been given descriptive names like **White Pox, White Plague, and Rapid Wasting disease.**

Global Threats

There are truly global problems that contribute to the prevalence of coral diseases. The two global problems are **global warming** and **stratospheric ozone depletion**. Global warming is the natural consequence of increasing concentrations of

carbon dioxide in the atmosphere caused by burning fossil fuels like coal, oil and natural gas. These fuels are carbon compounds that, when burned, combine with oxygen from the atmosphere to form carbon dioxide.

Global Warming

Carbon dioxide is a "greenhouse" gas in the atmosphere, and therefore may contribute to global warming. Carbon dioxide in the atmosphere acts like a blanket that holds in heat and energy. This process is called global warming. Sources of carbon dioxide in the Earth's atmosphere include decomposition of organic matter, burning of fossil fuels and by-products of human and animal respiration. The amount of carbon dioxide needs to be "just right". If too much heat is trapped, the ocean waters can become warmer than normal. If

levels of greenhouse gases drop, another ice age may be the result.

During years known as **El Nino years**, tropical oceans around many coral reefs become warmer than usual. The years 1983, 1987, 1991, and 1997 were warmer than normal. Many coral reefs suffered bleaching. **Coral bleaching** is when the corals expel their symbiotic algae, known as **zooxanthellae**, in an attempt to save themselves.

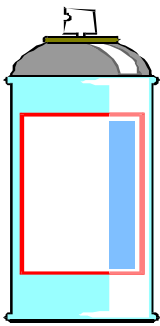
Zooxanthellae are **symbiotic dinoflagellates** that live within

the corals and give them their **carbohydrate** and **protein** food supply. Usually corals die

after expelling their zooxanthellae.

Ozone Depletion

The second global problem is **stratospheric ozone** depletion. It is caused by certain chemicals called **chlorofluorocarbons**, which were used in aerosols (e.g., in spray cans) for several decades, and in air conditioning and refrigeration systems (e.g.,



freon). High in the Earth's atmosphere is a layer called the **stratosphere**, where a special form of oxygen called **ozone** is found. Molecules

of ozone selectively absorb the part of sunlight that is especially biologically damaging –**ultraviolet radiation (UV)**. UV radiation can cause mutations, skin cancer and 'sunburn' in many organisms, including corals. If there were no ozone in the stratosphere, life on Earth would be much reduced or changed.

Although an international treaty slowed the use of ozone-destroying chemicals nearly a

decade ago, the chemicals already introduced into the atmosphere *continue* to cause ozone depletion. Besides the Earth being extra warm during the 1980's and 1990's, more biologically damaging UV radiation has been reaching the Earth. UV radiation by itself can cause coral bleaching in some cases, but corals actually produce their own sunscreens to protect themselves from UV damage. Unfortunately, when the ocean temperature goes up, the coral is stressed and unable to produce its sunscreens at the normal rate, making the corals even more vulnerable to "sunburn".

Together, high temperatures and high UV can be especially damaging. High UV levels also damage the immune systems of organisms, which may be why there are so many incidences of new or previously unknown diseases.

New diseases have also been found in a variety of other reef plants and animals, besides corals. Sea fans are

susceptible to a fungus that comes from land, probably either from river runoff or atmospheric dust. New or previously unknown diseases

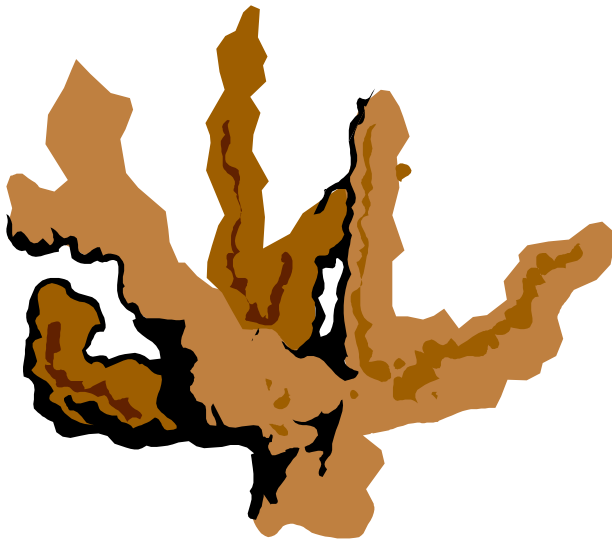
have also decimated coralline algae, seagrasses, sea urchins and sponges in some reef areas.

Other Reef Plants and Animals in Peril

Another group of organisms that are susceptible to both bleaching and new diseases are reef-dwelling **foraminifera**, single-celled animals that form a calcium carbonate outer skeleton. The most common foram on reefs worldwide, *Amphistegina* spp., have been stressed worldwide throughout the 1990's. Seasonal, depth and latitudinal patterns of

bleaching suggest that biologically damaging UV radiation may be the cause, since these forams don't seem to be bothered by slightly elevated temperatures.

The forams become progressively weakened and unable to fend off attack by diseases, predators, and parasites, and there is an increase in incidents of birth defects in the population. Bleaching in forams results when their symbiotic algae stop working (**photosynthesizing**). This prompts the forams to digest their symbionts. Without them, the forams ultimately starve.



Elkhorn Coral



Activity 3-1: Environment in Danger

Background: To make this a successful classroom exercise, the teacher should assign the exercise a week ahead of time so the students have something to report. The classroom part allows students to identify where their news report is from using a world map. Use pushpins to do so.

Purpose: To make students aware that problems occur in natural populations and environmental factors are sometimes the source of the problems. To show students there is a need for more research on many environmental issues.

Exercise: Watch the news or nature programs on TV, listen to the news on the radio, look in the newspaper, or look in magazines at home or in the library for one story on disease, unusual affliction, or unexplained decline in plant or animal populations other than humans. Examples could include, such things as beak deformities in chickadees in Alaska, the unexplained decline of bison in Wood Buffalo National Park in Canada, bleaching or disease in coral reefs of Florida, or deformed frogs in Minnesota. Give the source of the story (which news or TV program, newspaper or magazine, date, the kind of plant or animal, and where in the world the report is from).

Ask students to summarize the known scientific explanation for each event. Then ask what are the unknown aspects of the event that may require additional research.

Variation: Instead of having the students present their materials individually, have them gather together in groups that are “geographically” near each finding. Have the students in each group discuss if there was a ‘local’ event that might have resulted in the findings that they have found in the media. Have one spokesperson for the group working together.

Student Information Sheet 3: Corals, Forams, and Reef Health.

Corals and foraminifera survive together in reef communities. This is a symbiotic relationship. A symbiotic relationship is one in which both organisms benefit from living together.

Coral reefs are in trouble. There are local, regional and global threats that influence the overall health of reef populations. Local threats include sediment and nutrient runoff, dredging, and careless boat operation. Regional threats include diseases to organisms that live on reefs, and diseases to corals themselves. A few coral diseases are white-band disease, coral bleaching and White Pox. Globally, there are two outstanding threats to coral reefs: global warming and ozone depletion.

Global warming causes water temperature to rise, and corals expel their symbiotic algae, called zooxanthellae.

Zooxanthellae are dinoflagellates that live within the corals and give them their rich colors. They also produce complex carbohydrates and proteins that feed the growing corals. Usually corals die after expelling their zooxanthellae.

Ozone depletion is a result of chemicals called **chlorofluorocarbons** being released into the atmosphere and destroying the protective ozone layer of the atmosphere. This allows more ultraviolet (UV) sunrays into the earth's atmosphere, and ultimately sunburns the coral reefs and organisms. Combined with increased temperatures, coral reefs can become very stressed.

Things you can do to help

1. Don't use aerosols that contain chlorofluorocarbons (CFC's).
2. Don't pollute.
3. Volunteer in coral reef monitoring programs. If you do not live near the coast, get involved in local programs to save the river or bay. Remember, all watersheds affect the oceans and eventually the coral reefs.

