



Man, Sea and Sky – Keeping the Coral Reefs Alive in a Complex World

Bar-Ilan researchers have shown that coral survival depends on everything from industrial fish farming, to algae growth, to the phases of the moon. Their work may help policy makers determine the best way to preserve this beautiful – and endangered – ecosystem.

Translated and adapted from the Hebrew article by Avi Blizovsky,
published in *Hidushim*, Vol. 2

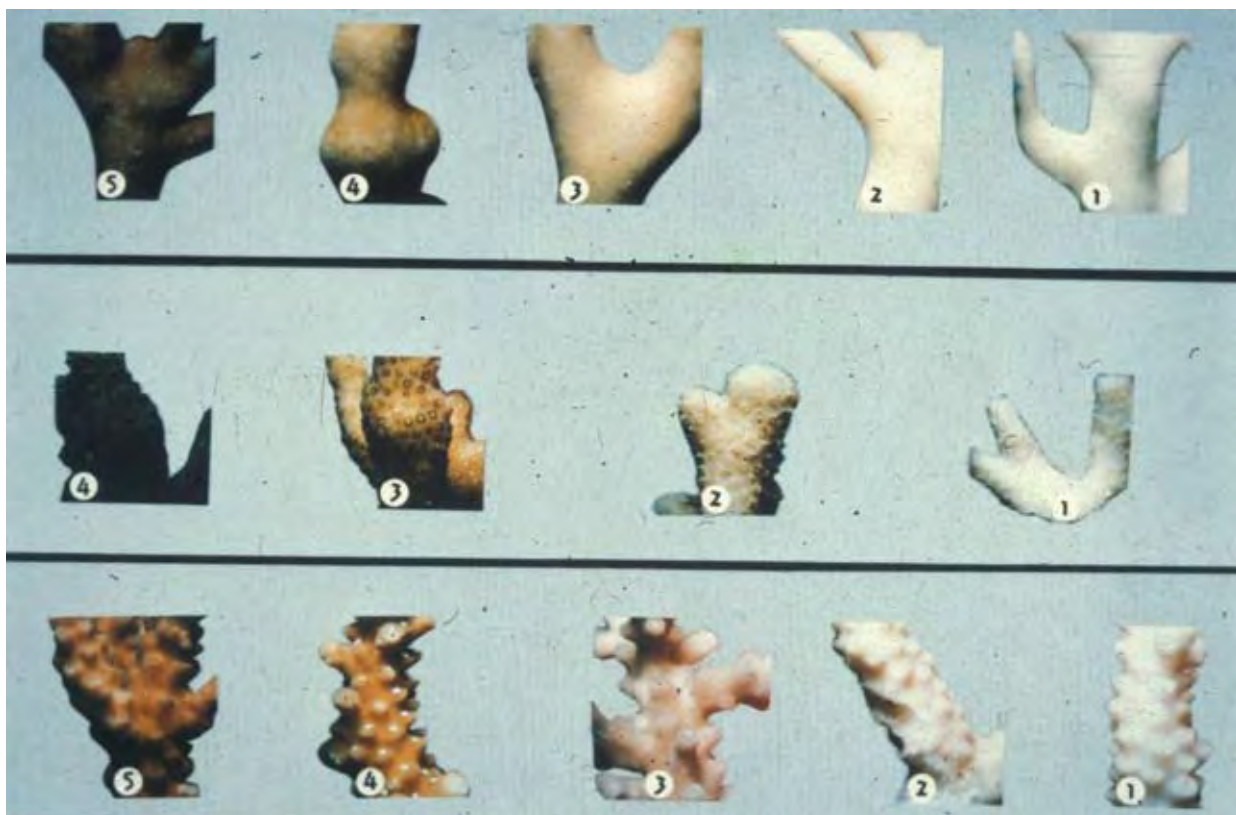
Our beautiful coral reefs are in danger. Scientists estimate that unless a significant change occurs, two thirds of the Earth's coral reefs will be destroyed in the coming few decades, due to a combination of global warming and pollution.

This worldwide problem affects Israel as well. According to a recent study conducted by Bar-Ilan University Prof. Zvy Dubinsky – an expert in marine biology and marine biotechnology – together with his former PhD student, Dr. David Zakai, the coral reefs in the Gulf of Eilat (Aqaba) are in serious trouble. Their examination of the reef and its environs – an area of importance to both the Israeli and Jordanian tourist industries – has revealed interconnected factors that influence coral survival, including everything from

industrial fish farming, to algae growth, to the phases of the moon.

Zakai – who serves as the marine biologist for the Gulf of Eilat (Aqaba) with the Israel Nature & Parks Authority – has long been interested in the factors that influence the survival of coral reefs. Most recently, the BIU Life Sciences graduate has been searching for ways to protect the coral reef ecosystem by managing human activity in the area.

Together with Prof. Dubinsky, Zakai has been actively engaged in drawing attention to the damage caused by underwater fish cages, in which commercial companies culture sea basses and sea breams for the market. “This fish breeding technique, in which



The harmful effects of pollution on three coral species. Courtesy of Prof. Zvy Dubinsky

>>

>>

about 3,000 tons of fish are held in confined cages, releases a high level of fish excretions and food remnants into the water – a level of pollution similar to that created by an urban population of 50,000 people,” Zakai explains. “This ‘fertilization’ of the Gulf drastically changes the environmental balance, resulting in a rapid reproduction of seaweeds and phytoplankton. The rapidly growing seaweeds easily outcompete the corals, smothering them by monopolizing the available substrate and blocking the light on which the corals depend for energy, through their symbiotic algae, harbored within the coral animal’s cells. In addition, the proliferation of phytoplankton makes the water murky, and accelerates the decline of the corals in the gulf.”

Algae – the Coral Reef’s Best Friend (and Enemy)

But what is the connection between coral reefs and algae? According to the scientists, coral and algae are linked together – as in marriage – for better or worse. This is due to the mutually supporting symbiosis between millions of microscopic algae living within the cells of their host, the coral, which is actually an animal. Through their photosynthetic activity in the transparent tropical waters, these algae provide energy to the coral, while absorbing from it essential nutrients such as nitrogen and phosphorus compounds stemming from the coral’s metabolic waste products. Thus, when these tiny symbionts are lost, in so called “bleaching” episodes, entire reefs die. Bleaching events have been increasing in severity and frequency, triggered by global warming.

Contrary to those algae on which the corals and the entire ecosystem depend, the relation between corals and seaweeds is that of a struggle for settling substrate.

In clean seawaters corals fare better than seaweeds, that can not thrive in the nutrient-poor “blue deserts”. Thus the corals monopolize all coastal areas in the tropics.

As the burgeoning human population encroaches on all coastal zones, surrounding waters become nutrient-enriched “fertilized”, due to sewage dumping, agricultural wastewater, deforestation and the resulting runoff, coastal development and mariculture. When that



Photograph: Prof. Zvy Dubinsky

Seastar on coral in the Red Sea

occurs, the seaweeds rapidly overgrow corals, and replace them, destroying the entire reef ecosystem.

“Corals may look like plants or rocks, but they are actually multi-cellular animals that begin their lives as free-floating larvae,” Prof. Dubinsky explains. “If bigger creatures in the area don’t eat the larvae, they settle down on a rocky platform where they develop into polyps. Polyps secrete a limestone skeleton that attaches them to the rock and eventually, a colony of these polyps forms the basis of the ravishingly colorful coral reefs we know. However, if algae cover the surface of the platform, sunlight is blocked and water circulation is disrupted. As a result, the transformation never takes place and coral never has a chance to grow.”

An interesting factor affecting coral reef development was revealed in the research that formed the basis of



shutterstock/ASAP

>>

>>



A cave dwelling Red sea coral, *Balanophyllia*, tentacles extended

Zakai's MA and PhD theses, which shows that the rate with which larvae are transformed into polyps is affected by the phases of the moon. "Scientists had always thought that fertilization – the first stage in the production of new coral polyps – occurs randomly throughout the year," Zakai says. "But our studies showed that the production of coral gametes – the cells involved in sexual reproduction – accelerates considerably during the first twelve days of each month, after the full moon. This was confirmed in further studies, both in the natural environment and in the lab."

Coral-Algae Symbiosis in the Mature Reef

Coral reefs are a source of food and shelter for thousands of species of fish and mollusks. But algae – the same organism that can sometimes prevent coral formation – are also found here, playing an important, and for the coral, life-sustaining role.

"There is a symbiosis between algae and coral," Prof. Dubinsky explains. "Algae live inside the transparent tissue of the coral where they absorb sunlight and use it to perform photosynthesis. Simultaneously most of the

algae's organic waste seeps into the coral, supplying up to 95% of the coral's metabolic needs." The coral returns the favor by giving off algae-sustaining nitrogen, phosphorous and carbon dioxide – compounds that allow the algae to survive and thrive underwater.

Maintaining a Maritime Balance

"In my Master's research I explored the damage caused to the coral reefs by divers who, unintentionally, broke coral branches and sometimes even destroyed entire coral colonies," Zakai recalls, adding that he later shifted his research focus to factors affecting coral reproduction. "In studying *Stylophora pistillata*, one of the most common corals in the Gulf of Aqaba, I saw how low tides in the early 1970's left the shallow part of the reefs exposed, outside the water – something that destroyed most of the corals that were close to the surface. The reef was also damaged due to oil leaks from tankers, as well as by raw sewage flowing from both Aqaba and Eilat into the Gulf."

To make matters worse, industrial fish tanks were added to the mix. "The nutrients excreted by these cultured fish caused an increase in the algae population which blocked out sunlight and stunted coral growth," he says, adding that some 40 species of wild fish have also been infected with pathogens carried by fish from the tanks. "Some of these wild fish fed on algae. When their population shrank, the algae population increased, causing even further damage."

Fish Cages or Climate Change?

While local pollution and changes in the animal population certainly affect the coral reefs in the Gulf of Aqaba, Prof. Dubinsky points out that climate factors are also involved. "In 1991, the Mount Pinatubo volcano erupted in the Philippines triggering a global temperature decline, and an unusually cold winter" he says. "As a result, the waters in the Gulf of Aqaba mixed all the way to the bottom, and the upper layers

became filled with an overabundance of nutrients. This caused a population explosion of seaweeds which blocked out the sun, and destroyed a quarter of the corals in the Gulf – particularly the young ones.”

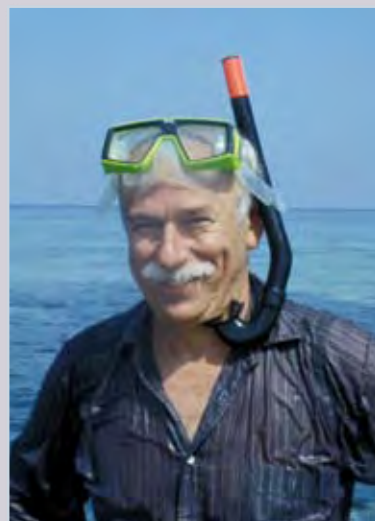
Data like this renders the murky picture of what's happening in the Gulf even cloudier, allowing representatives of the fishing industry to argue that their cultured fish cages are not the cause of the coral reef's decline. While Zakai admits that the fish tanks are not solely to blame, he insists that the policy of placing large populations of cultured fish in the Gulf must be reexamined. “If human activity causes a risk to the environment, it must be avoided,” he says.

Currently, the National Land Administration for Israel coastline has ruled after long deliberation the cessation of fish cages altogether, and the transfer of this industry to artificial ponds has already begun. Hopefully, this move will restore health – and balance – to this most beautiful of ecosystems. ❖



Photograph: Prof. Zvy Dubinsky

Parrot fish scraping tissue from corals, Red sea



Professor Zvy Dubinsky, a marine biologist in Bar-Ilan University's Mina and Everard Goodman Faculty of Life Sciences, has been lecturing at his alma mater for over 40 years. The Spanish-born Dubinsky has participated in research expeditions to Antarctica, Hawaii, Eritrea, and Seychelles Islands and has conducted research both in Japan and in the United States. A research associate of the Rockefeller University in New York, he has published 200 scientific articles and produced scientific films for Israel's Educational Television channel. Prof. Dubinsky's artistic photography has been exhibited widely, and has appeared in several publications and on the cover of ten international scientific journals.

David Zakai, a graduate of the Mina and Everard Goodman Faculty of Life Sciences, serves as the Israel's Nature & Parks Authority marine biologist in the Gulf of Aqaba.