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## Caring for our coastal corals

Monitoring systems designed to sustain marine ecosystems and improve conservation efforts

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Information and communications technology has proved it benefits to ecological conservation by monitoring the environmental impacts in a fast and accurate way.



Coral reefs are crucial to tourism, fisheries, shoreline protection and serve as environmental indicators.

And Racha Island in Phuket, one of the most fertile coral reefs in Thailand, has become the first site in Southeast Asia where the sensor network system has been implemented in the ecological monitoring of coral reefs.

Thanks to the National Electronics and Computer Technology Centre (Nectec), the Centre of Excellence Ecoinformatics (COE) of Walailak University and Ban Raya Resort & Spa, as well as scientists and engineers from the US and Australia, the collaborative network makes it possible to provide real-time data about the marine ecosystem.

The environmental observation station here aims to provide publicly accessible scientific data for researching environmental changes to coral reefs. This project is part of the Coral Reef Environmental Observation Network (Creon), a group of international institutions made up of scientists and engineers whose goal is to develop tools for coral reef study.

Coral reefs are the most complex, species-rich and productive marine ecosystems. The benefits of coral reefs are crucial to tourism, fisheries, shoreline protection and the discovery of new medicines, as well as serve as environmental indicators, making them a priority for conservation and a major concern for sustainable development, according to Krisanadej Jaroensutasinee, the project leader and director of COE.

Elevated ocean temperatures due to global warming, reduction or increase in salinity, intense solar radiation, low winds, exposure to air during low tides or low sea levels, as well as sedimentation and chemical pollutants can cause major stress to coral, which can lead to coral reef bleaching events. Barometric pressure may be correlated with bleaching due to its regional influence on winds and ocean currents. Bleaching responses vary with exposure, time, species and location. These factors can act in concert to cause mass bleaching events.



The research team installs a CTD sensor, where data is measured every five minutes.

The research team deployed HOBO Pendant Temperature and Light Data loggers to measure the water temperature and light intensity within a 10-minute sampling frequency. However, the sensors are not linked to a network and therefore they require a scuba-diver to collect the data every three months.

A conductivity (salinity), temperature and depth sensor, known as a CTD sensor, is deployed on the fringing reef in about 10m water depth with a five-minute sampling frequency.

The deployment uses inductive coupling technology to send data back to the station located onshore. Four EcoCams capable of real-time video capture are used, one underwater at the reef and three on land. The cameras display real-time feeds of the reef and surrounding environment.

All the instruments are connected to a weather station onshore, measuring air temperature, rainfall, winds, barometric pressure, the UV index and solar radiation.

Krisanadej explained that the weather station, CTD, and EcoCams stream observations are received at a data centre located at Walailak University, which is then mirrored to the University of California San Diego (UCSD) and Nakhon Si Thammarat Rajahat University.



Coral recovered from a bleaching event that occurred last year.

The system includes cyberinfrastructure for real-time streaming data acquisition, scalable event stream processing, and data publication services. Scientists at Walailak University, UCSD and the Australian Institute of Marine Science (Aims), as well as other remote locations, access the data and video streams via a suite of client applications for visualisation, modelling and analysis.

"The data is also open to the public as they can get access by the Realtime Data Viewer program, which is open source," he said.

The data is also linked to Ban Raya Resort's IT centre, which means its guests and people around the world can also view the weather information ([www.weatherlink.com](http://www.weatherlink.com)) in real time.

The resort, located on Khon Khae Bay, the south-east side of Racha Yai Island, has supported the research project by providing the venue for the research station.

"This helps us to learn the right way of conservation," said Piyawat Sangiamkul, the resort owner, adding that although it is not a national park, the coral reefs here are fertile.

He also noted that Phuket is growing because of marine ecotourism. All five bays of Racha Island are recognised for their aesthetic marine biology. The coral bleaching event didn't just occur last year, but about four to five years ago. The bleaching was not only caused by El Nino, but the coral reefs were found to have a greasy coating.





Green turtles can often be seen at Khon Khae Bay and La Bay.

A major problem is fisheries, as they damage the coral reefs and all marine ecology, said Krisanadej. Once the soft coral reefs die, they are hard to revitalise because of their sensitivity to the changes. The hard ones are essential in terms of structuring, creating ecological structures for aquatic ecosystems and housing for diverse sea creatures. Hard coral reefs are very important because they can expand the ecological structures.

"We hope to restore the natural resource as much as possible based on our knowledge. For example, once coral bleaching begins there will be seaweed, which means parrotfish eating that seaweed will throng \_ it's a natural way to save coral reefs. The problem is that the number of parrotfish has greatly declined due to the fisheries. The solution is for the fisheries to release the parrotfish."

The CTD, tide and salinity all correlate with the quantity of rain. Initially, the researchers found that the salinity and temperature did not directly impact coral bleaching, but later discovered that there were other contributing factors, such as light. So, building shade to control the amount of light entering has become one solution, together with introducing some species of seaweed to feed the coral.

Another goal of this project is to develop a system that can be deployed simply and at a reasonable cost to dramatically increase the number of units and understand the biological processes that sustain or threaten coral reef systems. The long-term research project will lead to a greater knowledge-base system to enhance scientific discovery and allow ecological forecasts and management.



Tourists can appreciate an abundance of marine life and fertile coral reefs just by snorkelling. Coral reefs provide essential shelter for aquatic animals, including lionfish and feather stars.

Nectec, which is responsible for the database system, recently conducted tide research and storm surge simulation through its large scale simulation research lab (LSR). Sornthep Vannarat, the chief of the lab, said that the automatic monitoring system helps reduce the impact of the coastal system problem. The key components of the system include the sensor, the sensor controlling system, the network and the data recording system. Nectec's Thai Microelectronics Centre (TMEC) has developed the sensor technology and thus, in the future, such in-house developed sensors can be brought to serve the project in measuring temperature, pressure, pH and conductivity.

It does not only serve as way for collecting coastal data, but also builds an accurate simulation and helps researchers acknowledge the procedure and correlation of the factors that have impact on the coast. These factors comprise a great number with complex correlation. Also, the computer simulation will be able to forecast the consequences of a natural hazard based on previous incidents \_ such as flooding due to heavy storms \_ and the data from the simulation will benefit to further define the measures of reducing losses and dealing with coastal problems.

The coral sensor network project at Racha Island is one of the successful collaborative projects that Nectec will showcase during its 25th anniversary on September 28 and 29.





Coral reefs and seaweed are crucial nutritional sources for fish.



The coral reefs at a five-metre depth.



One of the hard coral sculptures created after the 2004 tsunami, known among scuba-divers as the 'Underwater City'.



The ecoinformatics research team from Walailak University.



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