UA geoscientist uses coral as 'skeleton key' to past climates

4 Feb 2000

Melanie Lenart
for UA News Services

"Ability to coax climate signals out of coral reefs" -- it's a skill one rarely sees advertised in the Want Ads. Yet it is a talent that landed University of Arizona geoscientist Julia Cole and some colleagues a spot in the prestigious pages of Jan. 28 issue of Science.

Cole and three colleagues from Kenya and California used the annual growth rings in a coral reef in Kenya to construct a 194-year proxy record of sea surface temperatures for the region. Their work indicates that the western IndianOcean warms and cools on a decadal cycle linked to El Nino (generally dubbed ENSO by scientists).

"This record tells us a story that has broad climate implications," Cole explained. "ENSO has a very long reach. El Nino brings more rain to East Africa just as it does to Arizona, but it also warms the oceans there."

"Our study indicates that in addition to being responsible for some of the year-to-year changes in East African climate, ENSO may also set the pace for slower decadal changes," she added.

Coral of the Porites genus grow in colonies 12 feet tall. This photo, taken in January 1995 in the western Pacific Ocean, shows coral typical of specimens Cole studies off the coast of Kenya. (Photo courtesy of Julia Cole.)

ENSO, an abbreviation for the El Nino/Southern Oscillation, refers to oceanic and atmospheric fluctuations that originate in the tropical Pacific and affect climate in a variety of locations around the globe via "teleconnections."

Just as a home television set can tell you about events on the other side of the continent, the coral in East Africa appears to be picking up signals related to the distant changes in atmospheric pressure over the Pacific Ocean that herald the arrival of El Nino or its counterpart, La Nina.

In this analogy, these long-lived corals are acting as a VCR as well by recording the climate signals for posterity.

This is particularly important because reliable instrumental records of sea temperature go back only a few decades, making it difficult for scientists to untangle the long-term influence of El Nino on sea temperatures.

What's more, an observed global warming since about 1976 -- which many blame on human input of greenhouse gases to the atmosphere -- might be obscuring the natural cycle of oceanic temperature fluctuations.

"El Nino - and its impacts - might be sensitive to greenhouse warming. So with long coral records we can start to ask whether recent variations are like past variations or whether we're seeing a change in El Nino," she noted.


Porites coral near Kenya. (Photo courtesy of Julia Cole.)

In fact, the coral record from Malindi, Kenya, used by Cole and her colleagues does indicate the regional ocean warmed by more than 2 degrees Fahrenheit overall since 1801, and the years since 1980 are the warmest on record.

Land-based instrumental records indicate Earth's surface temperature since the mid-1970s has warmed in a jump that seems to go beyond natural variability. If the warming trend continues, it is expected to permeate the more stable ocean in the years to come. If it does, the coral can be counted on to respond in its characteristic fashion - by incorporating relatively less heavy oxygen into its skeleton.

Researchers can pinpoint the ratio of heavy to light oxygen in the coral skeletons to the precision of better than one in 10,000 and then compare the observed variations to modern temperature fluctuations. That done, they can use the relation between the two to gauge the temperature of the surrounding water at the time the coral was building its skeleton.

When the coral's annual growth rings stand out as much as they do in the Malindi core, it can serve as a calendar as well as a thermometer.

"This is the most tree-ring-like coral I've ever seen," Cole said, noting that it was possible to see the annual growth rings even with the unaided eye. Usually scientists must X-ray their specimens to observe the denser layers of growth that mark the end of another year by the coral's internal clock.

Cole and her colleagues found this particular living thermometer about 20 feet underwater near the Malindi Marine Park in Kenya. They drilled a small core through the 12-foot tall colony of coral *(Porites lutea)*, which lies on the northern end of Kenya's fringing reef.

"We cored up and down the Kenya coast, from the Tanzanian border to Malindi," Cole said. "We had the advantage of having local ecologists on the project with us and they helped us find the best sites," Cole said.

The research team is in the process of examining some of the other coral cores to construct a more regional -- and more seasonal -- picture of sea temperature fluctuations, with ongoing support from the National Science Foundation (NSF) and the National Oceanic and Atmospheric Administration Paleoclimatic program.

Cole, who joined the UA geosciences department in the fall from the University of Colorado, is confident that paleoclimatic evidence from corals will continue to provide new details on how ENSO and its effects have changed over time.

Apparently the National Science Foundation agrees. Cole received word that NSF will continue funding the project for another five years.