

# explorations

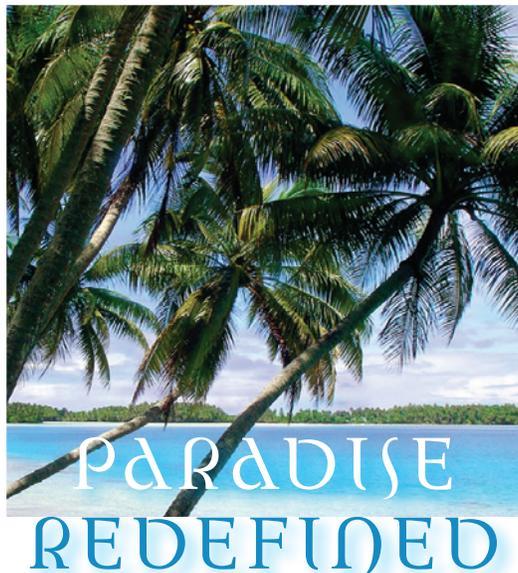
The Magazine of Ocean and Earth Sciences

JUNE 2007

## PART ONE

### EXPLORATIONS IN TROPICAL SEAS

A JOURNEY TO A CORAL REEF CHAIN HIDDEN IN THE CENTRAL PACIFIC FORCES SCIENTISTS TO REVISIT THE DEFINITION OF A PRISTINE ENVIRONMENT



By Mario C. Aguilera

*The last two days of diving have been in places where sharks came to the surface to check us out even before we jumped in the water; where countless large snappers swam around us and made fish counting almost impractical; where jacks swam towards us and then disappeared like blue lightning; and where green parrotfish with large bumps on their heads bit coral rock as though it was butter.*

—ENRIC SALA, JOURNAL ENTRY FROM THE LINE ISLANDS EXPEDITION, AUG. 20, 2005

THE ABILITY TO TRAVEL THROUGH TIME is the stuff of active imaginations, from the common daydreamer to a long list of science fiction writers.

For marine ecologists, a chance to travel back in time to study pristine ocean environments is an enticing proposition. How did earlier, unspoiled marine ecosystems differ from today's? How rich was marine fauna without impacts from fishing, pollution, and global ocean warming? How did their underlying functions differ from today's imperiled oceans?

For a group of scientists at Scripps Institution of Oceanography at UC San Diego and their colleagues, the time travel dream became reality. In the summer of 2005, the researchers traveled thousands of miles across the Pacific Ocean to study a string of coral reefs tucked away in a tropical island chain. What they saw was alarming, yet ripe with scientific potential and hope for the future.

From left, Line Islands Expedition researchers Olga Pantos, Rob Edwards, and Jim Maragos count coral along transect lines in virtually pristine conditions at Kingman Reef.

**Clockwise from right,** A gray reef shark at Kingman Reef swims over a garden of healthy acropora corals, a stark contrast to the algae-covered corals and murky waters found off Christmas Island; A giant clam; Scripps Diving Safety Officer Christian McDonald off Tabuaeran Island.



Their adventure to the Line Islands in the Central Pacific, a throwback to an age of exploration on the high seas, began with the idea of a single survey on a single island but soon became an extraordinary prism for observing varying levels of human influence on coral reefs. Their experiences and the treasure chest of new data obtained during the expedition are leading to fresh challenges of accepted theories about the ecology of coral reefs. The scientists are forging new conclusions about a coral reef's ability to withstand threats as they search for practical ways to protect and conserve marine ecosystems.

**FOUR DEGREES OF DEGRADATION**

*We are here to watch the undersea world and to learn from it.... We are here to learn how we, the people, affect this wonder and how to prevent it all from going away.*

—STUART SANDIN

*JOURNAL ENTRY FROM THE LINE ISLANDS EXPEDITION, AUG. 9, 2005*



Coral reef ecosystems around the world are suffering. Overfishing disrupts the natural balance. Pollution and rising sea temperatures can lead to coral sickness and open the door to the spread of algae that can overrun reefs.

In 2003, Enric Sala, an associate professor at Scripps' Center for Marine Biodiversity and Conservation, devised a plan to conduct a new ecological assessment of the reefs of Palmyra, an atoll in the central Pacific Ocean a thousand miles south of Hawaii. It's the sort of tropical paradise seen on travel brochures as the ultimate dream getaway destination, but in this paradise, there are no tourists.

Palmyra is administered by the U.S. Department of Fish and Wildlife and was recently purchased by the Nature Conservancy for preservation as a model marine ecosystem largely undisturbed by people. Ten residents currently live on the atoll, although during World War II it accommodated some 6,000 military personnel.

Stuart Sandin, who had recently obtained his doctoral degree at Princeton University, was hired to help lead the project for the newly formed Palmyra Atoll Research Consortium. According to Sala, the instant Sandin was hired things "exploded." Along with their colleagues—Scripps professors Nancy Knowlton and Jeremy Jackson—they began exploring ways to expand their assessment to the greater region around Palmyra. They theorized that they would find a spectrum of degradation.

On one end of the spectrum they pinpointed Kiritimati (also known



**Clockwise from below.** Researchers offload equipment in preparation for a new day of diving; Stuart Sandin (left) and Enric Sala on board *White Holly*, steaming between *Tabuaeran Island* and *Palmyra Atoll*; *White Holly* anchored inside *Tabuaeran Lagoon*. **Far right,** *Olga Pantos* captures water samples for microbial studies.



as Christmas Island). Part of the country of Kiribati, it is the largest of the Line Islands and believed to be the largest atoll in the world. With 5,100 residents and vigorous fishing activities, Kiritimati was targeted as a model for studying how human activities alter coral reefs.

On the other end of the spectrum is Kingman Reef, a mostly submerged reef annexed by the United States in 1922. Uninhabited, Kingman offered the researchers a chance to document one of the few virtually undisturbed places on Earth.

Completing the choice of locations was the selection of Tabuaeran,

or Fanning Island. With 2,500 residents, its population size is midway between that of heavily populated Kiritimati and unspoiled Kingman.

The four destinations thus became a “perfect gradient” where degrees of human disturbance could be analyzed.

In the months leading to the expedition, the team spent countless hours hammering out logistics, from securing passage aboard *White Holly*, a former U.S. Navy yard freighter ship built during World War II, to raising money by impressing the importance of their research on donors willing to fund a thousand-mile diving expedition, an exploratory scientific venture rarely

undertaken these days.

Then came the task of recruiting a “dream team” of scientists to join the cruise. Such a group would provide expertise from the predators at the top of the food chain down to microbes.

“Our perspective was to bring in some of the best people that work across the Pacific Ocean to document everything from sharks to viruses—the entire ecosystem,” said Sandin.





## A REDISCOVERY OF CORAL REEFS

*The sky was packed with stars, and the sea was warm and inviting. When the crescent moon dived in the black velvet sea, we jumped into the darkness.*

—ENRICH SALA

JOURNAL ENTRY FROM THE LINE ISLANDS EXPEDITION, AUG. 8, 2005

For five weeks in late August and early September 2005, life aboard *White Holly* was a non-stop research “circus,” as the researchers called it in journal entries.

While the coral experts measured coral growth with digital cameras and waterproof pencil and paper, fish experts nearby meticulously counted species across 25-meter transects. The microbiologists collected seawater and conducted water chemistry analyses in a former storage room aboard *White Holly* converted to a high-tech laboratory.

This went on from 7 a.m. to midnight, every day. The scientists dived, logged data, discussed research strategies, prepared for the next day’s explorations, and finally slept before doing it all over again. Dinner conversations covered the marine life witnessed on that day’s dives — from algae growth to the behavior of curious sharks—and tantalizing new species being discovered.

“We didn’t have the most comfortable berthing, we certainly were not eating copious amounts of wonderful food,” said Sandin. “Our resources were adequate but not over the top. But the one thing that was phenomenal during that cruise that I’m always going to appreciate is the good spirit and enthusiasm of everyone on our research team. That’s what brought it through.”

“Satisfying our curiosity is what makes us scientists,” said Sala, who recently left Scripps but continues to be involved with Line Islands research. “Why are we scientists? It’s because we have this innate curiosity like children. We were all like children on that boat—discovering the world.”

The team’s goal was to develop a multifaceted biological picture of coral reefs and do so with such methodical detail that systematic changes to the ecosystems could be tracked along the slope of human disturbance. The interdisciplinary nature of the team paid dividends immediately. Algal specialists compared notes with the bacterial specialists, who checked information with coral specialists.

Nuances of each researcher’s specialty initially led to communication problems. Yet it didn’t take long for things to change. Easels and drawing paper were used to draw pictures and diagrams emphasizing why a researcher believed one island’s system looked different from another’s. By the end of the first week, Sandin saw a common language being developed.

In the end, the researchers logged more than 1,000 hours of diving over 800 dives. They surveyed more than 100 sites and recorded data on nearly 1,000 different species. Never before had researchers painted such a comprehensive portrait of coral reef ecosystems.

After the journey concluded, the researchers began piecing the data together, looking for clues about the big picture and the mechanisms behind it.

Out of the volumes of data collected, a single coherent story emerged.

*In five weeks we have lived the equivalent of several lives. We went back in time, to that place where humans were only a dream. We rejuvenated ourselves. Besides the science, we collected memories and learned about possibilities for the future of our oceans.*

—ENRICH SALA

JOURNAL ENTRY FROM THE LINE ISLANDS EXPEDITION, SEPT. 5, 2005

**NEXT MONTH:** In part two of “Paradise Redefined”, find out what the researchers are discovering from their journey to the Line Islands. Their analysis and results are helping to reshape scientific views about the processes underlying marine food webs. New ideas are emerging about how coral reefs can withstand and rebound from harmful influences, leading to important conclusions about marine conservation and ways to preserve marine resources for the future.

*To learn more about the Line Islands Expedition and read the full daily entries, see:*



<http://scripps.ucsd.edu/lineislands>.



FOR MORE INFORMATION PLEASE CONTACT SCRIPPS COMMUNICATIONS OFFICE  
Scripps Institution of Oceanography  
UC San Diego  
9500 Gilman Drive, 0210  
La Jolla, California 92093-0210 USA  
Phone: 858-534-3624  
e-mail: [scrippsnews@ucsd.edu](mailto:scrippsnews@ucsd.edu)  
web: [scripps.ucsd.edu](http://scripps.ucsd.edu)

Photo credits: Jennifer E. Smith, Jim Maragos, U.S. Fish & Wildlife Service, Kevin Lafferty, US Geological Survey





