

new frontiers in
**BAHAMIAN
BIODIVERSITY**



by **BARBARA J. BRUNNICK, JOSEPH FREY, AND STEFAN E. HARZEN**

Considered among the most complex and diverse environments on Earth, coral reefs play a key role in the health of our planet's oceans. Caring for them, however, is dependent on our knowing far more about these extraordinary benthic environments and the associated ecosystems they host, and the establishment of baseline data against which future assessments of ocean health can be measured. With these goals in mind, we launched an expedition in August 2008 to produce a highly accurate map of a coral reef that would not only set a new standard in the field of marine science but would also serve as an invaluable tool for the monitoring, management, and preservation of such environments worldwide.

As a proving ground for our pioneering mapping project, we selected a magnificent coral reef adjacent to Peterson Cay National Park, some 800 meters off the southern shore of Grand Bahama Island. The northernmost landmass of the 700-island Bahamian archipelago, Grand Bahama offers a unique carbonate bank system, with shallow banks and deep-water basins providing a variety of marine benthic and open-water habitats. We selected the site for two reasons: first, mapping the reef complex would provide direct and immediate benefits to those responsible for its management, and secondly, the reef complex is large enough to be significant, yet small enough to be charted in the time we had available.

A DOLPHIN PASSES OVER SEAGRASS. PHOTOGRAPHS BY STEFAN E. HARZEN



A PORCUPINE FISH ON A CORAL REEF LEDGE

Our expedition—undertaken in concert with the International Coral Reef Initiative (ICRI), which designated 2008 as the International Year of the Reef—was awarded Explorers Club Flag N° 100. First flown in 1939, it is slightly tattered, its woolen fibers worn thin, and its colors are fading from its many expeditions to the West Indies, Galapagos Islands, and off of the Australian coast, as the club's records would show. For nearly eight decades it has endured scorching sun and stiff winds, silently witnessing scientific research carried out by Explorers Club members. Now it was flying high on the communication antenna of our 13-meter research vessel *Bahama Breeze*.

In preparation for the field expedition, a set of ortho- and geo-rectified aerial raster images of the study area were analyzed to create a first draft of the map by applying ArcGIS at various scales. Discernable habitat types were outlined to create numbered polygons in the vector layer of the map. Each polygon was then assigned a particular code to organize similar habitats by appearance. The first draft of the map was then uploaded to ArcPad and transferred to a Trimble Unit, a highly accurate GPS tool (accuracy $\leq 1\text{m}$), which we then took to the field. For a week and a half, we would be diving in the 82°F, gin-clear water to collect spatial information about the reef's rich marine life and, once back in the lab, to integrate the data into the map.

The August heat in the Bahamas is intense

and we couldn't load the *Bahama Breeze* quick enough on our first day to get out onto the cooling waters surrounding Peterson Cay. But it soon became apparent that Tropical Storm Fay would temporarily force us off the water. Adjusting our plans to work around the storm and keeping an eye on NOAA's satellite imagery, we spotted a new storm cell making its way across the Atlantic Ocean that would eventually develop into Hurricane Gustav. The erratic weather forced us to temporarily shut down our field operations for four days. During that time some of us worked on the video and photo material we had begun to gather and tested new equipment, while others worked on refining the map.

Once the weather settled down, our team moved into high gear like a well-oiled machine and resumed data collection in the field. The team left each morning and, once at the study site, split into two teams—one that ground-truthed the area from a smaller vessel or kayak, the other scuba diving and collecting video and still images of the underwater habitats. The process of ground-truthing principally consists of identifying the type of habitat by viewing the seafloor from the surface through a conk glass and recording the exact position in longitude/latitude as the boat drifts over the seafloor. We would take as many readings as necessary to ensure that we covered the entire study area (up to 1,000 per 10,000 meter linear distance). Upon

CORAL REEF BENTHIC COMMUNITIES PETERSON CAY, GRAND BAHAMA



200
METERS

MAP BY BARBARA J. BRUNNICK.



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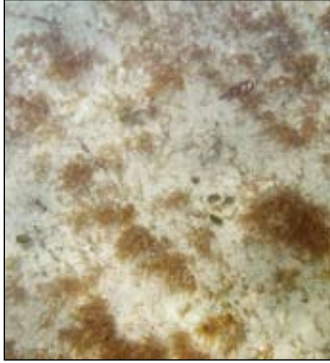
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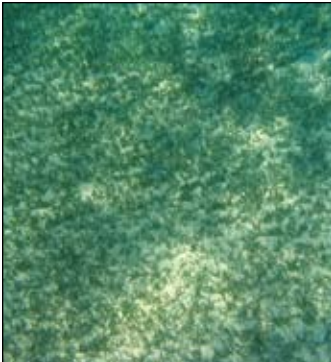
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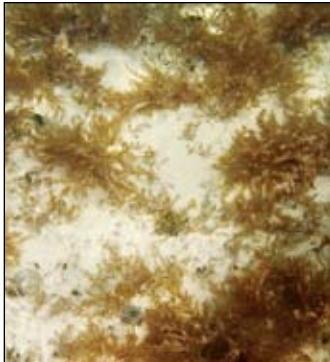
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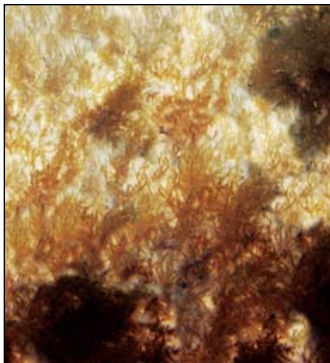
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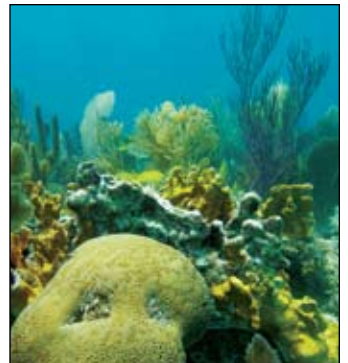
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HARDBOTTOM REEFAL: > 60%



return to base, the field data were loaded into the mapping software to begin the process of verifying the contours of the preliminary map prepared prior to the expedition. Each polygon eventually received its final attribution and color-coding.

After a couple of days it became clear that Peterson Cay reef is in excellent shape. We saw healthy large corals, sponges, and multiple species of fish. We also noted myriad little baby reefs, coral heads, and Elkhorn corals in the surrounding area. We also encountered porcupine fish, sea turtles, and dolphins. Yet there were also signs of trouble.

On the east side of the reef we found red algae and lionfish (*Pterois volitans* and *Pterois miles*), an invasive species. If the red algae are left unchecked they will eventually smother the reef, so it is a management issue. We are not sure what is causing the red algae to grow on Peterson Cay reef but at the moment it is fortunately only located in a couple of small spots. Lionfish, a native of the sub-tropical and tropical Indo-Pacific region, is both gorgeous and dangerous. Dumped into the Atlantic Ocean by private aquarium owners, they have no natural enemies and can deplete four-fifths of a reef in just a few weeks, according to

Mark Hixon of Oregon State University. At present, these two organisms appear to be the only threats to an otherwise healthy and diverse coral reef.

The reef map of Peterson Cay integrates aerial and satellite imagery with Global Positioning Systems (GPS), remote sensing and Geographic Information Systems (GIS), and on-site field surveys. Although these technologies have been used in the past by civil engineers and land surveyors, only recently have they been appropriated for use in conservation biology to create what we now call biodiversity atlases. The spatial information is then combined with the marine habitat classification framework defined by the Ecological Society of America (ESA) and the National Oceanography and Atmospheric Administration (NOAA) Office of Habitat Conservation.

The result is a high-resolution geo-rectified map that discerns different habitat types from bare ocean floor to algae, seagrass, and coral reef; highlights density variations in each; and pinpoints the location of individual species of interest such as the endangered Elkhorn coral. Furthermore, the map also allows us to determine



A SCHOOL OF GROUNDS ON EXPLORERS REEF, NAMED IN HONOR OF OUR EXPEDITION.

with impressive precision the spatial expansion of each marine habitat across the study site.

By documenting the actual environmental conditions, we are able understand the relationship between different habitat types and the larger reef ecosystem, as well as monitor expansions or declines of certain habitats. Conducting similar studies on adjacent reefs will eventually lead to a larger scale map and a deeper understanding of both local and regional reef ecosystems and their processes.

Although this new mapping technology doesn't necessarily represent the natural state of any ecosystem, it can at least provide a baseline against which we can compare future observations. And that's what the map of Peterson Cay's coral reef will do. By combining traditional observational recordings with precise spatial information, it will provide new insight into the fascinating world just below the water's surface. Completed in late October 2008, the map of Peterson Cay has been presented to the Bahamian government, which is responsible for the marine resources in the archipelago, and to the Bahamas National Trust, which manages Peterson Cay National Park. ▲ ▽

ACKNOWLEDGMENTS

An international expedition from its inception, our team members hailed from Germany, Britain, Canada, the Bahamas, and the United States, and included Explorers Club members Harvey Oyer, FN'07; Jonathan Frey, SM'06, and the authors. Non-club members included Larry Wood, a conservation biologist with the Palm Beach Zoo, and award-winning cinematographer and underwater production specialist Paul Mockler, who has worked on countless feature films, including *Titanica*.

BIOGRAPHY

Fellows of The Explorers Club since 2001, Barbara Brunnick, Ph.D., and Dr. Stefan Harzen have pioneered the production of highly accurate maps of critical habitats for conservation purposes. Barbara is well known for her ongoing groundbreaking research on Atlantic spotted dolphins in the Bahamas, while her husband Stefan's expertise ranges from marine mammals, coral reefs, and wetlands to natural resource management and sustainable business practices. For more information on their work, go to www.taras.org. Lt (N) Joseph Frey, FI'02, is an accomplished science writer who has been published in major publications in Canada, Britain, and the United States. He is also chairman of the Canadian Chapter of The Explorers Club www.explorersclub.ca.