A CORAL REEF WILDERNESS REVEALED

PHOENIX

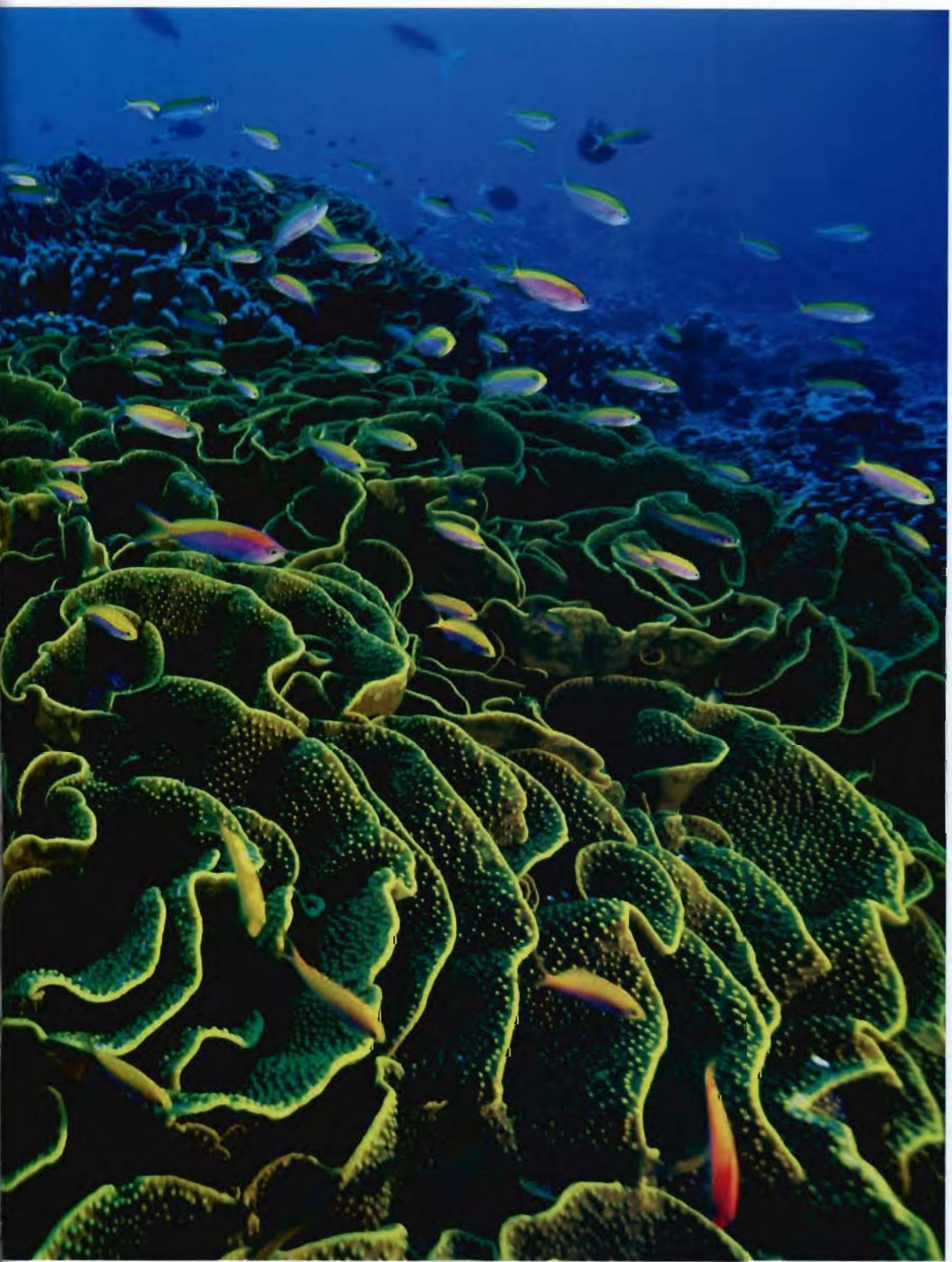
OVERHARVESTED ELSEWHERE IN THE PACIFIC, COCONUT CRABS AS FAT AS FOOTBALLS THRIVE ON THIS UNSPOILED ARCHIPELAGO.

ISLANDS

By GREGORY S. STONE Photographs by PAUL NICKLEN

FAIRY BASSLET FISH DART AMONG BLOSSOMS OF LETTUCE CORAL. HEALTHY REEFS ARE ESSENTIAL TO THE SURVIVAL OF THE

SUN STREAMED DOWN, BRIGHTENING



FRAGILE ATOLLS. WITHOUT LIVING REEFS, WARNS BIOLOGIST DAVID OBURA, "THESE ISLANDS WOULD QUICKLY ERODE AND DISAPPEAR."

YELLOW, GREEN, AND PURPLE CORALS.

THE ANEMONE RECOGNIZES THE FISH AS FRIENDLY AND WON'T STING IT. IN RETURN, THE FISH GROOMS THE ANEMONE AND CHASES OFF PREDATORS.

AN ENTIRE CORAL ECOSYSTEM HAS SURVIVED.

A RAUCOUS CLOUD OF TERNS hovered over Kanton island, calling out in high-pitched screeches. Beyond the low sandy atoll, the South Pacific stretched forever beneath tropical clouds topped by immense crowns of gold, red, and white. It was 6:30 a.m., and biologists David Obura, Sangeeta Mangubhai, Mary Jane Adams, dive master Cat Holloway, and I adjusted our scuba gear as we sat on the pontoon of the gently rocking skiff.

"This is definitely the spot," David said. "Let's hope they're here."

I bit onto my regulator, grabbed my underwater camera, and fell backward into the island's narrow lagoon entrance. The others followed, and we descended 70 feet to the bottom. Streaming through the water, the morning sun brightened the yellow, green, and purple corals around us. A manta ray and a green turtle nosed nearby as if curious.

Then, like the start of a breeze, the water began to move. Nearly imperceptible at first, the strengthening current gradually diverted our bubbles at a slight angle as they ascended. The flow increased steadily and a roar replaced the peaceful silence as water began to gush out the lagoon's entrance into the ocean on the full moon ebb tide.

Cued by this outgoing current, a school of perhaps 5,000 Pacific longnose parrotfish gathered around us and started to circle. Our bubbles were flowing sideways now as we clung to bottom rocks, and our hair and dive gear flapped and fluttered in the torrential tide. If we had let go of the rocks, we would have been swept out into the ocean.

The foot-long parrotfish tightened their school and swam faster. This was what we had come here to see: the periodic spawning of the parrotfish on the outgoing tide. Within the group, a few fish swam faster and shook, stimulating the entire school to spiral and bolt upward, releasing ecstatic bursts of eggs and sperm along the way like biological fireworks. The egg and sperm clouds they left behind were so dense they dulled the penetration of sunlight through the water.

Again and again the fish repeated this act, spiraling toward the surface every ten to fifteen seconds. For almost an hour the school exploded in a rite of reproduction, relying on the fast ebb tide to carry the fertilized eggs far out to sea, where they would be safer from predators. As I watched from the seafloor, a large shadow passed over me. A half-ton manta ray, hovering magically and somehow unmoved by the current, was feeding serenely on the parrotfish eggs and sperm.

TOO SOON, our nearly empty air tanks forced us to return to the surface and our waiting skiff.

"Incredible—I've never seen anything like it!" said David, a specialist in coral reefs who has spent more than a thousand hours underwater studying ocean life. I also was deeply moved. As vice president for global marine programs at the New England Aquarium, I've made it my goal to find Earth's last pockets of primal ocean, those underwater havens that have remained unspoiled as long as the ocean can remember. Here in this lagoon we had discovered such a place.

We'd motor-sailed five days out from the Fiji Islands to reach the Phoenix archipelago: eight small islands, including Kanton, strung like jewels on an irregular necklace. The islands cover 25,000 square miles of the Pacific, about one-fifth the area of Australia's Great Barrier Reef, and are part of the Micronesian country of Kiribati (pronounced KEE-ree-bas).

Most of the 93,000 people of Kiribati don't live on the Phoenix Islands. All but a few live 600 miles to the west on the Gilbert Islands or 1,000 miles to the east on the Line Islands. Kanton is the only permanently inhabited island in the Phoenix archipelago. But what they lack in human population, the islands make up for in animal life, much of it revolving around magnificent coral reefs that keep marine biologists like me awake at night thinking of undiscovered species they shelter.

PRESERVING PRIMAL OCEAN

A skiff slicing across Kanton's lagoon (above) carries scientists on a biological survey of the Phoenix Islands. The archipelago's isolation and lack of fresh water have kept it mostly uninhabited and helped preserve some of the world's last pristine coral ecosystems. Part of the nation of Kiribati, the eight atolls lie scattered over an area about the size of West Virginia. With scant land resources and only 93,000 citizens, the country relies on revenue from commercial fishing licenses. Still, to protect the Phoenix Islands' marine environment, officials are banning foreign purse-seine tuna boats within a 60-nautical-mile exclusion zone. Kiribati leaders are also working with the New England Aquarium on a proposal to the Global Conservation Fund to restrict reef fishing and to create an endowment that would reimburse lost fishing revenue.

SHARK POPULATIONS DON'T BOUNCE BACK QUICKLY. LOCAL SPECIES GIVE BIRTH TO ONLY A FEW LIVE YOUNG EACH YEAR.

I had first visited the Phoenix Islands two years before on a scouting trip arranged by Cat Holloway and Rob Barrel of Naia Cruises in Fiji. Encouraged by what I had seen, I chartered their 120-foot sloop-rigged motor sailer *Naia* to return in June 2002 with an 11-person scientific expedition to survey the biodiversity of the world's last unexplored oceanic coral archipelago. Underwater we would assess the health of various species of hard coral upon which, and within which, live fish and invertebrates such as sea cucumbers, giant clams, nudibranchs, and sea stars. On land we would study the islands' tropical vegetation and abundant birds.

Our first destination was Nikumaroro, a densely vegetated island with a shallow lagoon known for its abundance of sharks. Our plan was to count sharks in the upper reef and to seek new species of other fish in the deep reef zone. Rob found an anchorage for *Naia* off the island's western point.

Carrying my scuba gear and cameras, I made my way down *Naia*'s side deck to the dive skiffs tied off her stern. Jerry Allen, an ichthyologist with Conservation International, and Steve Bailey, another scientist from the New England Aquarium, joined my wife, Austen Yoshinaga, who is also a researcher at the aquarium, and me in the skiff. Our excitement was tinged with concern as we sped toward the island and *Naia* disappeared from view around the point. The shadowy outlines of sharks darted beneath us in the clear water. When we got within 200 yards of Nikumaroro's south side we slowed the skiff to an idle. We could see the narrow lagoon entrance and palm trees jutting up through the island's dense undergrowth.

"OK, let's go," I shouted as we rolled backward into the water as a group for safety.

Divers are most vulnerable to sharks at the surface and in mid-water, so I wanted to get to the seafloor quickly. Austen and I tucked in among the coral heads at 60 feet, then watched Jerry and Steve continue over the edge of the reef into deeper water, where they would search for well-hidden reef fish.

Baby blacktip reef sharks circle the toes of a dive guide in Nikumaroro's lagoon (left), their home until adulthood, when they'll move to outer reefs. Near Kanton, a gray reef shark (above) lies snared in a local fisherman's net. Such subsistence fishing poses little threat to shark populations, unlike foreign commercial fishing vessels, one of which took thousands of sharks in 2001.

The water around Austen and me was filled with gray, whitetip, and blacktip reef sharks. They appeared to be hunting for food amid a school of some 2,000 striped convict surgeonfish that were grazing on algae along the bottom and several hundred bigeye trevally that passed above us. Sharks generally don't attack divers without provocation, but their shape and manner can nonetheless have an unnerving effect on you.

We moved down the reef. Austen was carrying a blunt, two-foot plastic "shark stick" to hold off curious or aggressive animals. "False security is better than no security," she had told me back on the boat. I planned to use my underwater video housing, the size of a car battery, if I needed a shark deterrent.

Turning back toward Austen, I saw silhouettes of sharks behind, above, in fact all around her. As I looked ahead, a six-foot gray reef shark shot at me like a torpedo. I hadn't been paying enough attention and didn't spot it earlier—and apparently it was surprised by me too. I stiffened, kicked back, and thrust my camera housing toward it. It veered and darted away like the snap of a whip, passing in a blur only eight inches away from me.

We completed our shark count without further incident. "I've never seen so many sharks!" Austen said as she pulled herself back into the skiff, clearly glad to be out of the water. We were gratified to find the shark population so healthy, having counted over a hundred of them on the reef. Ten minutes later, Jerry Allen broke the surface. Treading water next to us, he spit out his regulator, peeled off his mask, and yelled, "We got a new species!"

The unprepossessing prize was a deepwater damselfish species, pure white and one-fourth the size of a business card. Steve, who had surfaced with Jerry, had collected the specimen in the plastic bag that now rested on the skiff's pontoon. We congratulated Jerry and Steve on their discovery.

As we motored back to *Naia*, bouncing off waves, Steve told us he had seen several thousand surgeonfish and over 500 humphead parrotfish—numbers you don't see in most

places anymore. We also found the coral in a wonderful state: 92 species of live coral covered as much as three-fourths of the seafloor at Nikumaroro, and where there was no coral we found healthy coverings of *Halimeda* and Corallinaceae algae, all of which indicated a healthy hard coral reef community.

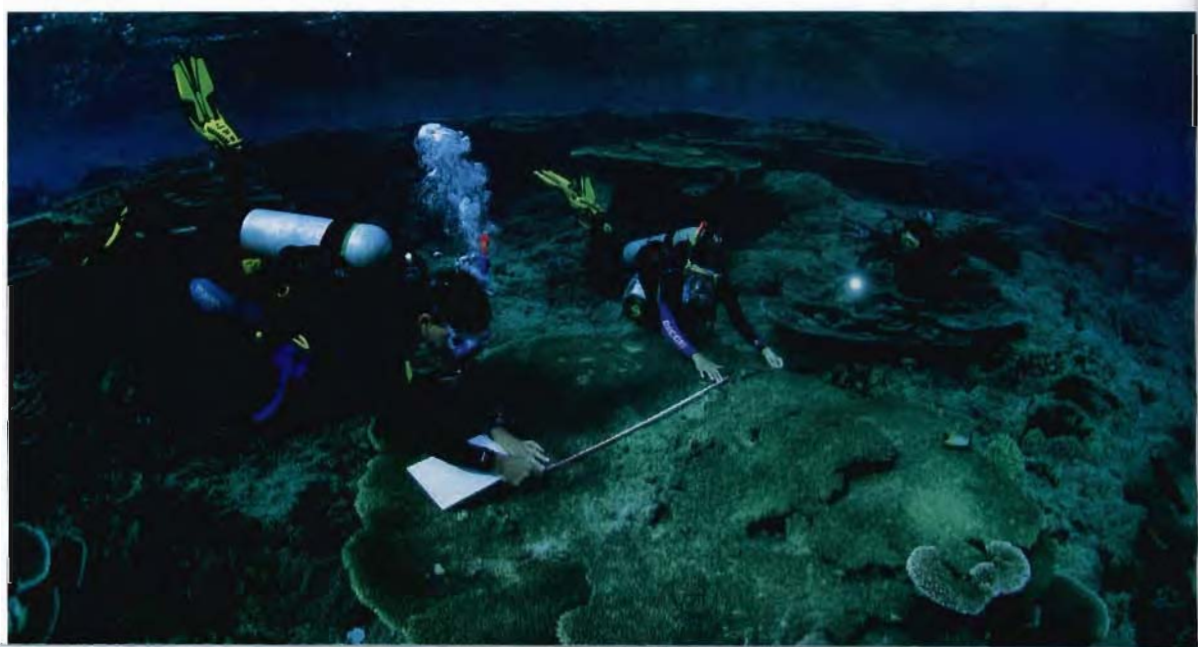
THREE DAYS LATER we stopped at tiny Rawaki (formerly known as Phoenix Island), which is little more than a pile of coral rock in the heaving ocean. But to a wildlife researcher like Austen it was a paradise, with hundreds of thousands of birds laying their eggs there. It was her job to count this swarming mass of birdlife, including the threatened Phoenix petrel, named after this island, where it was known to breed in the past.

Less than a mile in length and barely 11 feet in height, the island was so small that Rob could find no anchorage for *Naia* and was forced to drift offshore while we did our work. The only way for us to reach the island was to swim from the skiff through surf breaking on coral ledges.

As the skiff nosed between the narrow, propeller-breaking limestone fissures, Austen leaped into the surf, shoes first, fully clothed for protection from the sharp coral. Clutching the gear bag, she started kicking. I followed her lead, and suddenly we were both over our heads, struggling to avoid being gashed on the coral ledges or getting sucked

To make a biological map of the islands, scientists logged roughly a thousand dives, identifying more than 900 species of coral, fish, and invertebrates, and discovering four new fish species in the process. To survey life below scuba depth, the team lowered a video camera (right) outfitted with bait and timed flashes. In Kanton's lagoon (below), they found delicate table corals flourishing in the absence of anchors and other man-made disturbances.

HE SPIT OUT HIS REGULATOR, PEELED OFF HIS



MASK, AND YELLED, "WE GOT A NEW SPECIES!"

beneath them, and trying to avoid sharks.

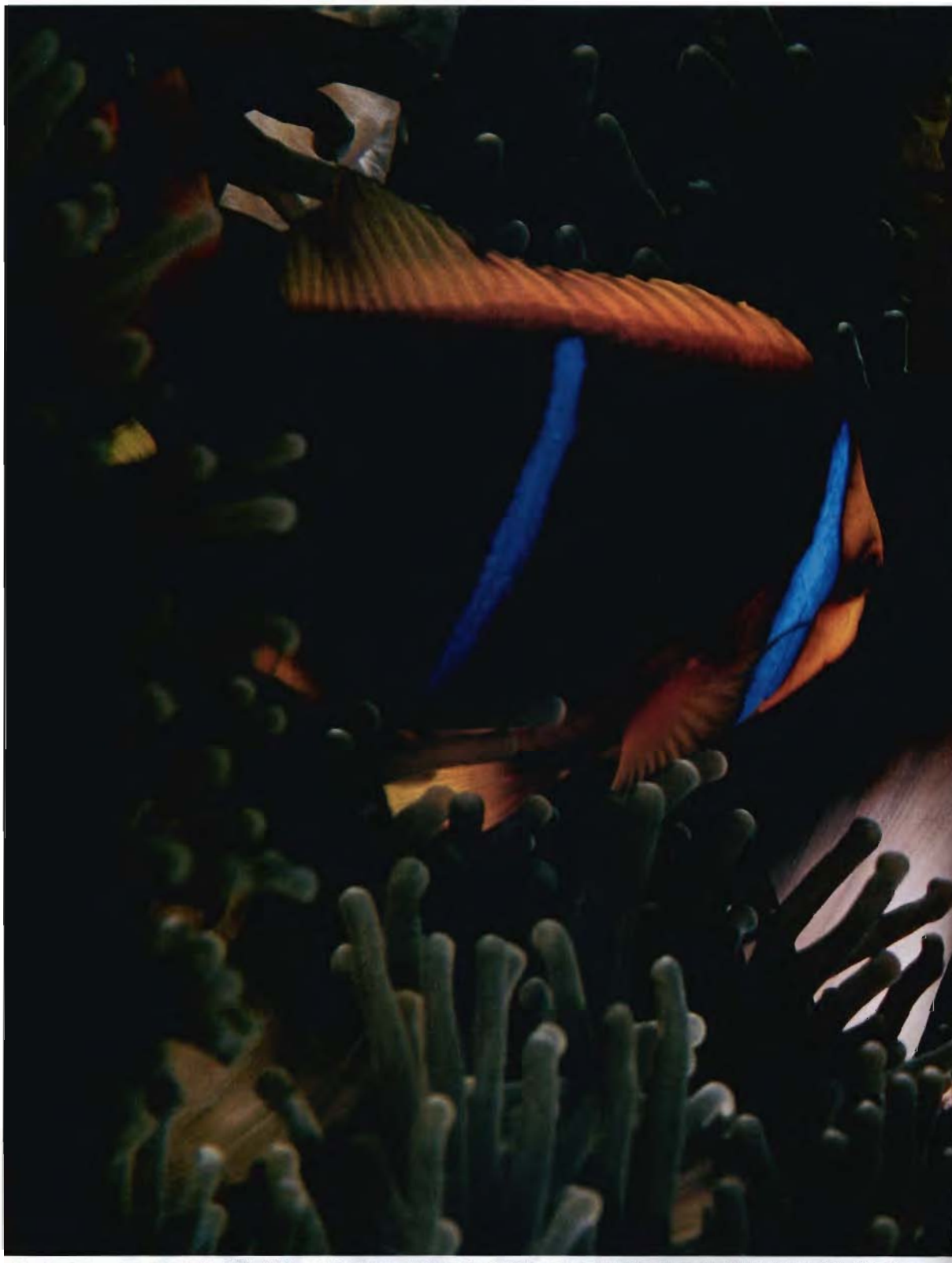
Each wave hurled us toward the rocks and then dragged us seaward, two steps forward and one step back, until we scrambled ashore, crawling on hands and knees, with only a few bruises and scrapes, and feeling lucky.

"Just your ordinary day of bird-watching!" Austen sputtered, peeling dripping strands of hair from her face and tidying plastered-on clothing.

The birds were all around us—large and small, light and dark, squawking and screeching—and the air reeked of musty guano. To make the most of our time, Austen and I split up, walking in opposite directions around the island, counting birds and sea turtle nests as we went. With no land predators here except crabs, the terns, frigatebirds, and boobies nested right on the ground, their eggs everywhere. I stepped gingerly through the cacophony of birds, careful not to crush any eggs or disturb downy nestlings or roosting adults.

One red-footed booby watched me with incredulous eyes above a blue beak, its head jutting back and forth as it sat on a hefty egg. White terns hovered inches from my face, impossibly delicate and endearing. Dark wheels of large frigatebirds lazed up and away into the distance.

Eight hours later Austen and I met on the far side of the island, having completed our survey. We were concerned that neither of us



PROTECTED BY A SEA ANEMONE'S TENTACLES, AN ORANGE-FIN ANEMONEFISH INSPECTS THE BRIGHT CLUSTER OF EGGS HIS MATE HAS JUST LAID.

OUR MOST VALUABLE DISCOVERY WAS THAT

THE AIR IS ALIVE WITH THE FRENZY OF LESSER FRIGATEBIRDS—AND PUNGENT WITH THE SMELL OF THEIR GUANO. RAWAKI ISLAND, A TREELESS

I STEPPED GINGERLY THROUGH THE BIRDS,

NUBBIN OF LAND, HOSTS SOME 300,000 SEABIRDS. NINETEENTH-CENTURY SPECULATORS MINED THEIR DROPPINGS FOR FERTILIZER.

CAREFUL NOT TO CRUSH ANY EGGS.

BARELY ANY PEOPLE LIVE ON THE PHOENIX ARCHIPELAGO. KANTON IS THE ONLY PERMANENTLY INHABITED ISLAND.

had found any Phoenix petrels. But we did identify 13 other bird species nesting or roosting here, some of which fly a hundred miles or more offshore each day to feed. The diversity of species was low, typical of remote islands, but the number of individual birds was high. We counted 150,000 spectacled and sooty terns and more than 50,000 lesser frigatebirds. We also found five nesting sites of green sea turtles, further bolstering the island's ecological importance.

KANTON ISLAND, the largest of the Phoenix group, was our farthest stop. The sun rose early and hot on our first morning there; we were only three degrees south of the Equator now, and the air was thick and hard to breathe. Alistair Hutt, an officer with the New Zealand Department of Conservation, and I took a skiff ashore to talk to the locals.

There to meet us, smiling and leaning on his red motorcycle, was Eketi Tokorake, the police officer, customs chief, and all-around guy in charge of the 35 people who live on the island. Eketi told us about a group of bottlenose dolphins that live around Kanton—the kind of insular population Alistair had been looking for. Working with the University of Auckland, Alistair hoped to become the first researcher to determine the local dolphins' genetic composition, unraveling the evolutionary history of some of the least studied dolphin groups in the South Pacific. While I stayed with Eketi, Alistair headed out in the skiff and obtained several tissue samples from the dolphins using a tiny biopsy dart.

On his days off, Eketi told me, his time was normally filled by "fishing, resting, and making toddy"—the local drink of fermented coconut sap, collected by climbing up coconut trees and harvesting nectar from flower bud stalks. The year before, however, Eketi had witnessed something unusual.

"A boat came here," he said, a commercial fishing boat hunting for sharks. The boat had stayed for two months, catching from 30 to 100 sharks a day, he estimated. After visiting several other islands, the boat apparently

The Kiribati government recruited Titiku (left) and about 150 others to settle on Orona in 2001, but coconut farming and fishing are not proving commercially viable in such a remote location. The island offers few amenities but holds a bounty of natural treasures like shimmering giant clams (above), hand-size gems prized by both seafood and aquarium dealers.

broke down, returning to Samoa for repairs.

Our dives at Kanton soon proved Eketi's report disturbingly accurate. We found far fewer sharks this year than we had seen two years earlier. Most of the other reef animals—like the spawning parrotfish we saw in the lagoon—were still there, but the absence of the sharks made the reefs seem quieter and less complete. Without the sharks, moreover, the population of bohar, a kind of snapper, had grown significantly larger.

Shark populations don't bounce back quickly. Unlike most fish, which produce thousands of eggs, the local shark species give birth to only a few live young each year. So even if the coral and other fish populations remain untouched and intact, it will take many years for Kanton to regain its sharks.

HAVING COMPLETED our survey of life in and around the islands, we pulled anchor and headed back toward Fiji. In about 1,000 dives at 60 sites, we had discovered six new species of coral and fish, identified 130 species of coral, 518 species of fish, and more than 250 species of invertebrates, collected 28 tissue samples from dolphins, 70 from fish, and 1,400 from invertebrates, surveyed birds, turtle nests, and vegetation, and explored the sea as deep as 3,000 feet with nets and cameras.

But our most valuable discovery was that the Phoenix Islands, as an entire coral ecosystem, have survived largely intact, making them one of the last havens of ocean wilderness. The world's seas are the key to global survival: They moderate climate, provide food, and generate a significant amount of the oxygen we consume. Sadly, damaged reefs now dominate tropical waters. What we learned in the Phoenix Islands, therefore, may be invaluable to help us understand and even diagnose degraded coral reef systems elsewhere. And that makes it more important than ever to save such primal ocean hideaways.

WEBSITE EXCLUSIVE Read photographer Paul Nicklen's field notes to find out why island bunnies hang out with boobies and brown noddies at **nationalgeographic.com/magazine/0402**.

"IT'S RARE TO SEE SO MANY ANEMONEFISH IN ONE PLACE," SAYS BIOLOGIST JERRY ALLEN OF THIS GROUP ON A MANRA REEF. "THE PHOENIX

WE MUST SAVE SUCH PLACES BECAUSE THE

ISLANDS ARE LIKE A TIME CAPSULE. THEY ALLOW US TO SEE WHAT OTHER REEF SYSTEMS MIGHT HAVE LOOKED LIKE BEFORE MAN INTERVENED.*

OCEANS ARE KEY TO GLOBAL SURVIVAL.