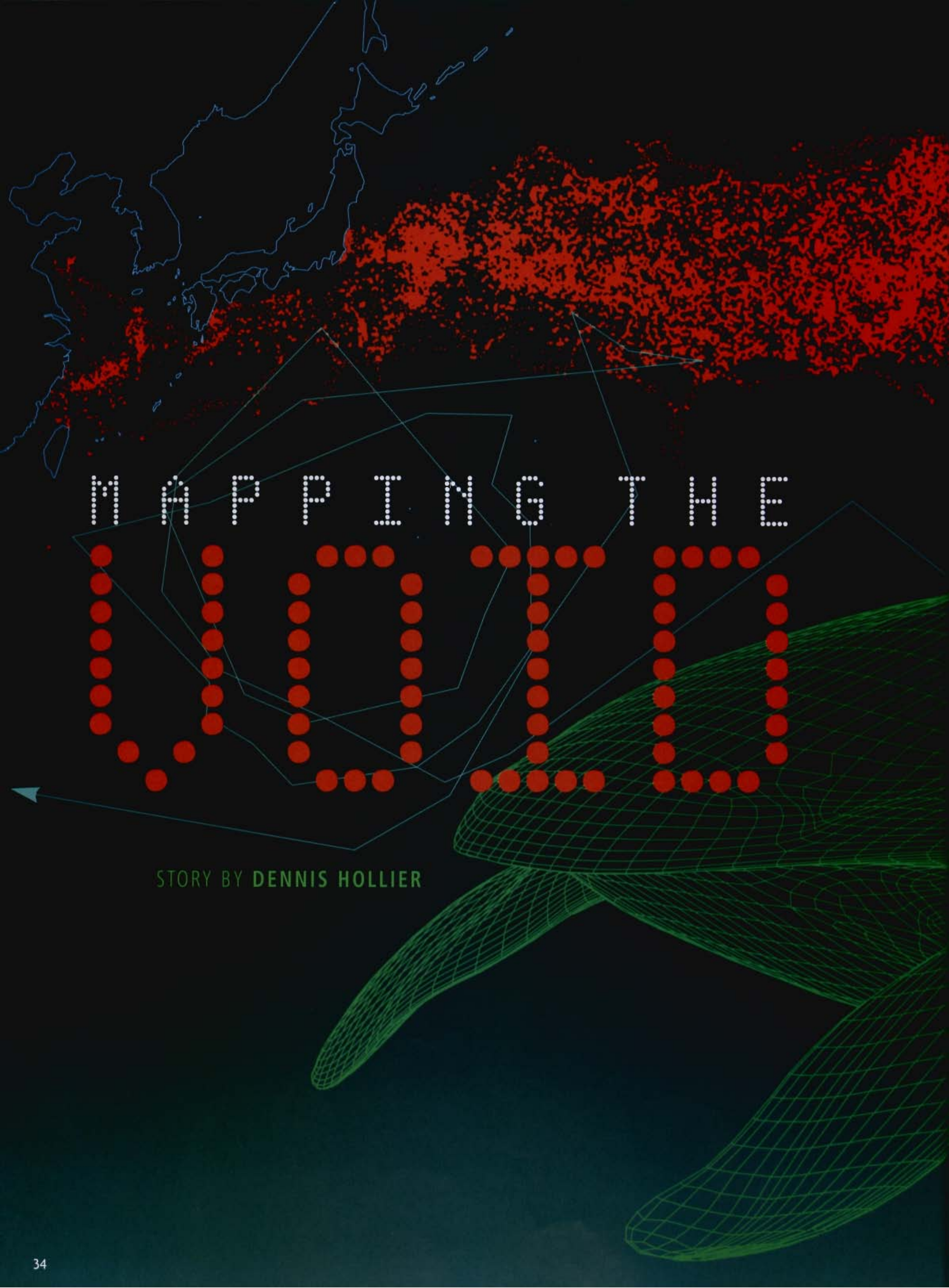
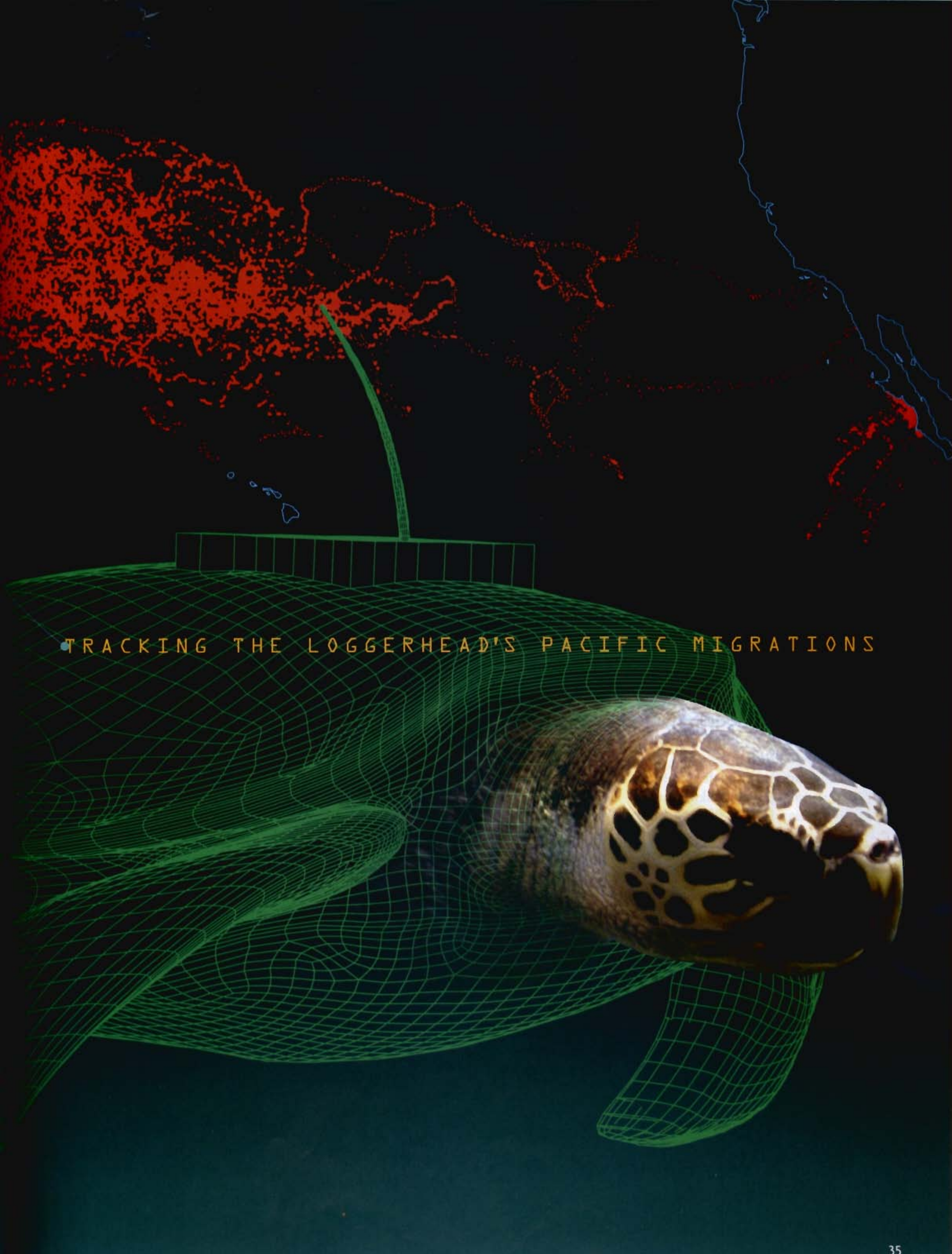


# MAPPING THE VOID

STORY BY **DENNIS HOLLIER**

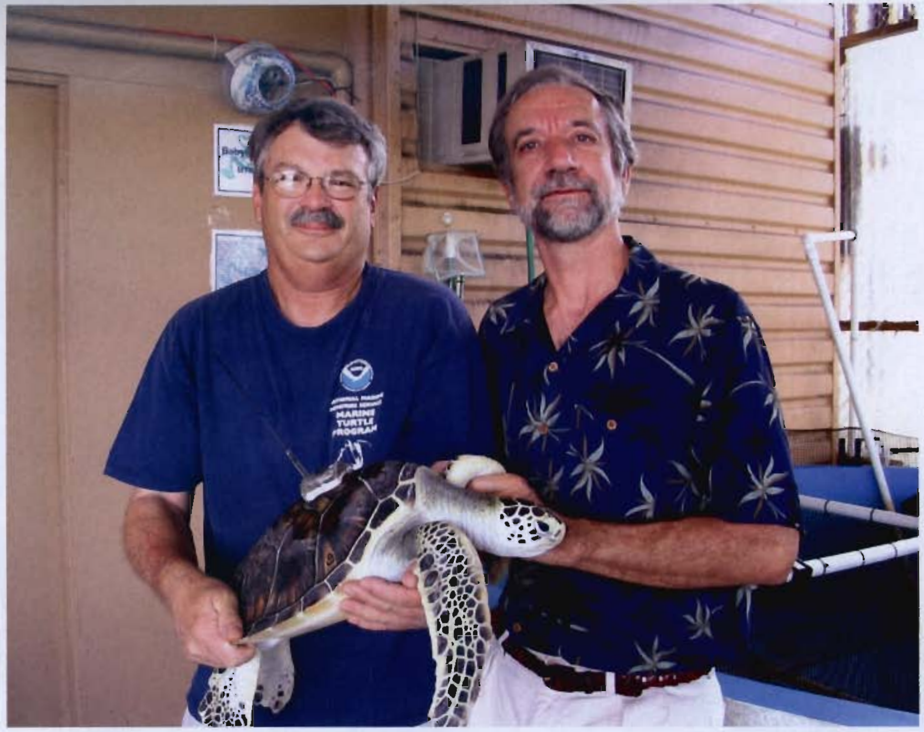
# TRACKING THE LOGGERHEAD'S PACIFIC MIGRATIONS



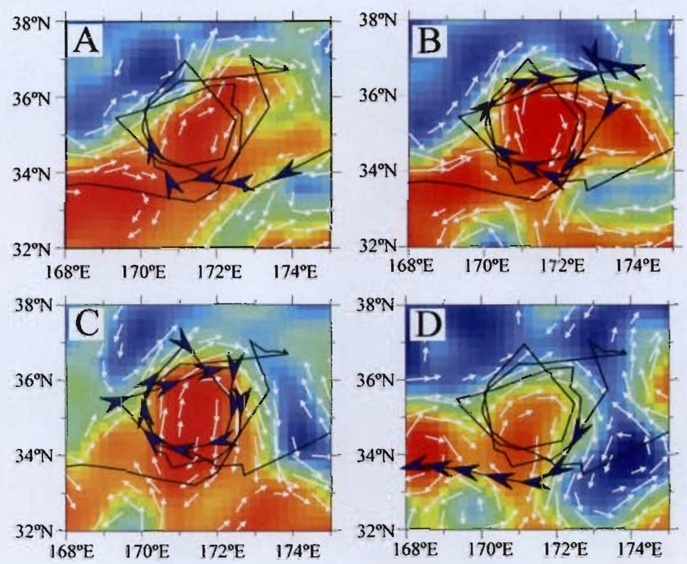
Far out in the North Pacific, a loggerhead turtle paddles lazily with the current, glutting itself on jellyfish and pelagic snails. The water is tinged green with the plankton and other nutrients that are the basis of life in the ocean. A vast, warm-water eddy concentrates all this bounty into a narrow band along its edge. Eddies like this one are common in this part of the Pacific. Sometimes reaching 200 miles across, they spin like tumbleweeds off the great Kuroshio Current, which passes just to the north. This loggerhead has patiently foraged the edges of this eddy for several months. Four, five, six times, it has spiraled around the broad perimeter, just as loggerheads probably have for millions of years. It has the same sad eyes as all those that came before; the same tufts of red algae grow on its carapace; the same species of pelagic crabs hitchhike in the leathery creases around its tail. But there is one small difference between this turtle and its ancestors: a small, white ARGOS satellite transponder fixed to its shell.

Fifteen hundred miles away, in the Mānoa office of the National Oceanic and Atmospheric Administration, the signal from that transponder pings Jeffrey Polovina's computer. Polovina, an oceanographer and Director of the Ecosystems and Oceanography division of NOAA's Pacific Islands Fisheries Science Center, has been following Turtle 124 for almost three years. Two or three times a day, the loggerhead's position is updated on the computer, revealing a breathtaking migration that has crisscrossed 12,000 miles of the Pacific. Together with turtle experts like NOAA's George Balazs, Polovina has been charting the movement of more than 200 Pacific turtles this way. Some were hatched in a Japanese aquarium and released with satellite tags. Others were by-catch on commercial fishing boats, and NOAA fishery observers aboard the vessels tagged and released them. Using this data, researchers are finally shedding some light on the mysterious and complicated journey of the loggerhead.

Polovina has the dignified, gray-haired eminence and measured cadences of a scientist, but his bright eyes and elfin features belie a youthful enthusiasm for his work. For him, tagging turtles is less about the turtles themselves than the opportunity to study the ocean through their eyes: The ocean is not, it seems, a vast, featureless desert that they drift aimlessly across. It's a diverse and intricately structured habitat that they exploit meticulously.



Shawn K. K. Murakawa, NOAA Fisheries




Jeffrey Polovina, NOAA Fisheries

**Team turtle: NOAA's Jeff Polovina (right), turtle expert George Balazs (left) and a satellite-ready sea turtle. Once it's released, Polovina will track the turtle, which may range over thousands of miles of Pacific ocean during its lifetime. Maps based on data from more than 200 turtles reveal ocean patterns and fluctuations, like those of this warm-water eddy (right) in the central North Pacific over a four-month period.**

Polovina describes the journey of the loggerhead as "one of the world's great migrations." All of the loggerheads in the North Pacific were born on beaches in the southern islands of Japan. Genetic studies have shown that these same turtles are often observed along the coasts of California and Mexico as adults. Although there is no practical way to tell the age of wild turtles, juvenile loggerheads can spend as much as thirty years at sea. In fact, even at the leisurely pace of turtles, some of Polovina's loggerheads travel more than 3,000 miles a year.

No one really knew, though, what happened to the turtles in between. Experts—even scientists like Archie Carr, perhaps the pre-eminent authority on sea turtles—believed that the juvenile loggerheads were passive migrants on the great ocean currents like the Kuroshio. Maybe the most dramatic discovery that Polovina and his colleagues have made has been the clear demonstration that loggerheads are not mere passengers on a transoceanic cruise; they are some of nature's most accomplished navigators. They do not swim in a straight line from west to east; their erratic paths crisscross thousands of miles of ocean in a way that looks, at first, to be random. But it's not.

Previous spread: Wire-frame rendering by Christopher Earle; photo by © Jurie Maree | Dreamstime.com; digital composite imaging by Samuel Lee

LOOK GRAND

Wailea Breezes

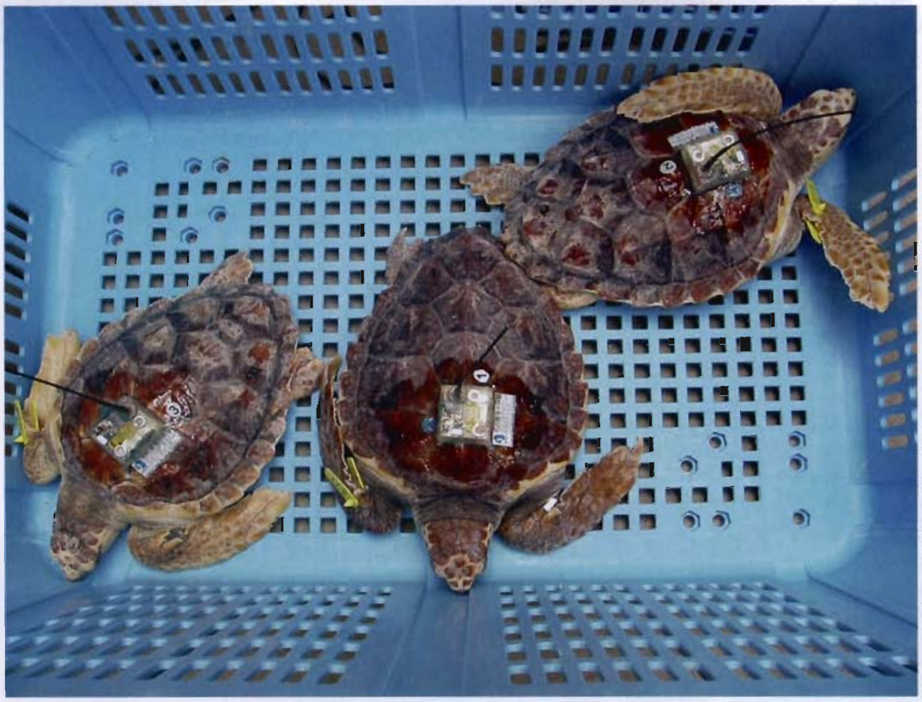
Cruise

Na Hoku

Grand Wailea Resort
HOTEL & SPA
The Waldorf-Astoria Collection

Shop out of the ordinary

3850 Wailea Alanui Dr., Wailea, Maui, HI 96753
tollfree: 800.888.6100 tel: 808.875.1234



George Balazs, NOAA Fisheries

The ocean, as it turns out, is far from homogenous. Satellite imagery has revealed it to be an intricate assemblage of vast and changing features. "There are eddies, meanders, fronts, upwellings, down-wellings, convergences and divergences," Polovina says. For turtles and other marine animals, these features are critical habitat. "To find them and to see how the animals are using them is a real advantage." To do that, he relies on several different satellites. Some measure the ocean's temperature, mapping thermoclines—boundaries between cold and warm water. Others exploit tiny variations in sea surface heights to chart currents, which, on a map, look like a paisley of eddies and meanders. Other satellites detect the color of the ocean's surface, revealing, for example, the dramatic Chlorophyll Front, an oceanwide boundary between the cold, green, plankton-rich water of the Arctic and the warm but much more nutrient-poor blue water of the subtropics.

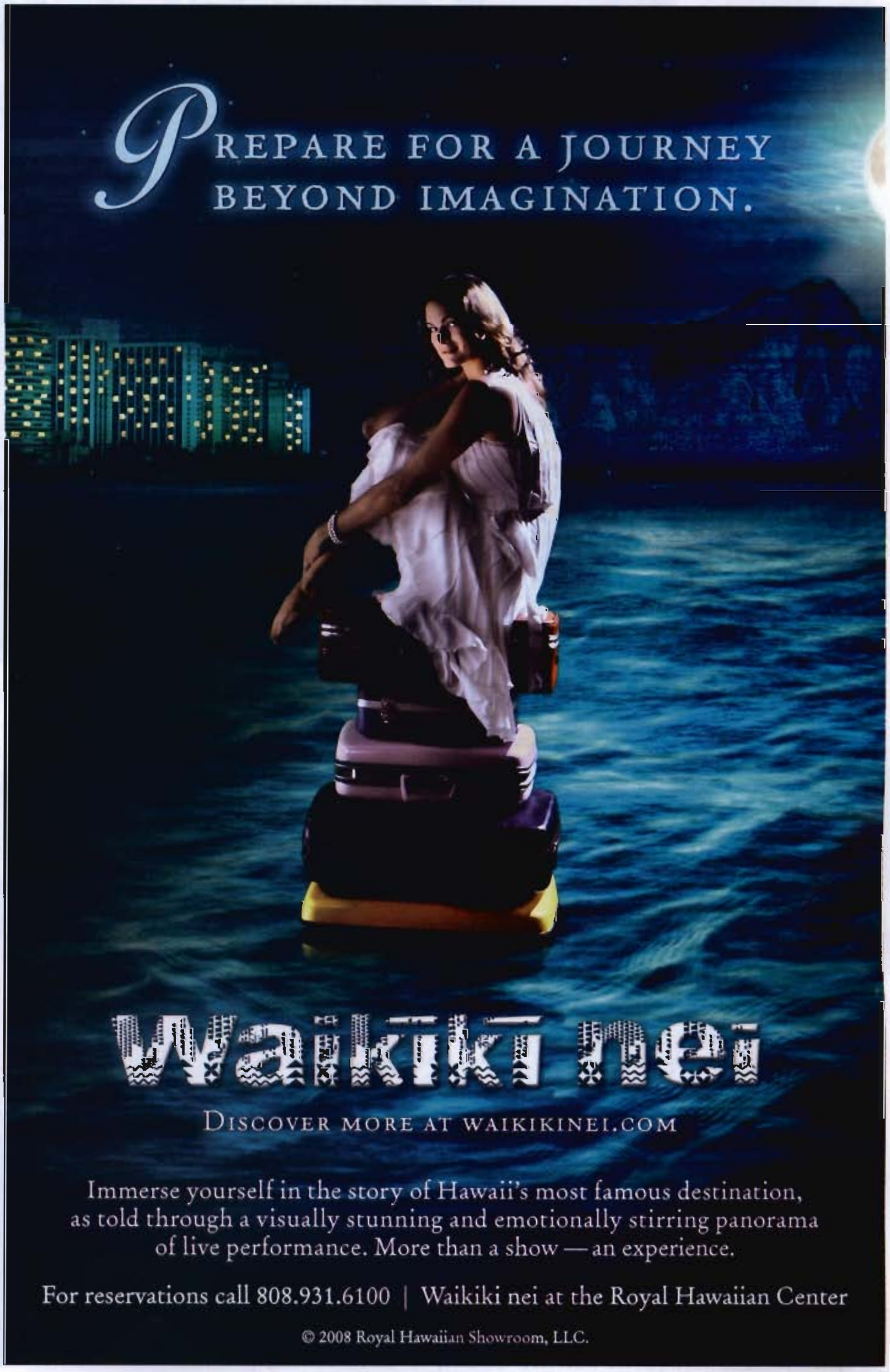
Combined with the satellite maps of the ocean's features, the turtles' route begins to unscramble. It's clear that the turtles are traveling among the ocean's varied features, seeking the most productive habitat. Like Turtle 124, they spend months feeding at the edges of warm-water eddies. They nuzzle into the crooks of meanders and into places where converging currents crowd their food sources together. In the winter, they're especially fond of the waters along the Chlorophyll Front, which continue to bring food to the surface even when the great eddies of the Kuroshio Current have petered out.

Knowing where loggerheads are likely to be found isn't a purely academic issue. The International Union for Conservation of Nature and Natural Resources lists them as "endangered," meaning they face a high risk of extinction in the near future. In the United States, they're listed as "threatened" and are protected under the Endangered Species Act. Swordfish and tuna longliners sometimes accidentally hook turtles, but NOAA has set strict limits on by-catch. Once the Pacific Island fleet catches eighteen loggerheads or seventeen leatherbacks, the whole fishery is shut down for the season. The fishermen clearly have a real incentive to avoid snagging turtles. In 2006, the first year of the regulations, the eighteenth loggerhead was caught in March, sending the entire fleet back to port after only two months. Now, though, Polovina's maps are available on the Internet; the longliners can simply avoid areas where there are likely to be loggerheads. The fishery hasn't shut down since 2006.

One of the more remarkable things about Polovina is that he's not a turtle biologist. "I'm an ecological nomad," he says. Scientists typically become specialized over the course of their careers, but Polovina's career has been characterized by highly productive dabbling. After an undergraduate degree in biology and graduate work in statistics, Polovina has bounced in five-year increments among different specialties. He did work in aquaculture and population dynamics. He studied the efficacy of artificial reefs in Japan and managed commercial fisheries here in Hawai'i. Among his peers, though, Polovina is probably most closely associated with something called Ecopath modeling. "I'm famous for that," he says. Employing simple statistical methods, Ecopath allows ecologists to predict the effect small changes will have in a large ecosystem—in essence, Ecopath is the precursor to modern ecosystem management.

It was probably his statistical bent that led Polovina to oceanography and the high tech world of satellite telemetry. The power of statistics to make predictions—their principal value to scientists—depends upon having sufficiently large and stable data sets. Some of the satellites Polovina uses have scanned the surface of the ocean continuously for decades. With these "very large and very unusual data sets," he can study ocean features spread thousands of miles across the globe—often without leaving his desk. For example, he used a decade of satellite data to prove that the ocean's desert zones—the vast, almost lifeless blue areas at the centers of the ocean's equatorial gyres—are growing at a faster pace than would be predicted by current models of global warming. The unexpected growth could just be part of the cycle of El Niño and La Niña events, or it might forebode the continued decline in the world's fisheries. "We may need another decade of data to know for sure," Polovina says.

In the absence of this kind of data, the ocean can seem mute and undifferentiated to us. Though satellites can reveal some of its features, they don't always tell us what those features mean to the animals and plants that live among them. Tracking the turtles allows Polovina to see the ocean through their eyes and to begin to understand the ocean as habitat. In addition to turtles, Polovina has tagged tuna and *opah* (moonfish) and even whale sharks. In effect, in addition to the satellites, Polovina has hundreds of little remote submersibles constantly scanning the features of the ocean. Polovina's eyes narrow conspiratorially when he thinks of all these turtles gathering data for him. "Each satellite gives you a different way to find these features and to measure different aspects of them," he says. "Then you put the animals out there. These turtles are 100 million years old; they're sensing the ocean in a different way. In a way, we're using these animals to tell us what part of the ocean is important." **HH**

# Hana Hou!

THE MAGAZINE OF HAWAIIAN AIRLINES

volume 11 number 4
August / September 2008

## On One Breath
*Diving free off the Big Island*

## Reunion Island
*A family heads home to Samoa*

## Rolling Sculptures
*Hawai'i's master bike designers*

Your Complimentary Copy

0 74470 66948 7 08

At the Newsstand: $3.99