Big Eyes, Big Boats, and Home Videos

Studying Sea Turtles at Sea

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Our landlubber species has done a fantastic job plodding along thousands of kilometers of coastlines around the world while counting and protecting nesting sea turtles and their progeny. However, we know very little about the life history and ecology of sea turtles in the environment where they spend the vast majority of their lives: the sea. After all, they are *sea* turtles, not *beach* turtles. To truly understand how these animals live, we need to get wet. We can't simply walk into the surf and think that we understand turtles' oceanic lifestyles.

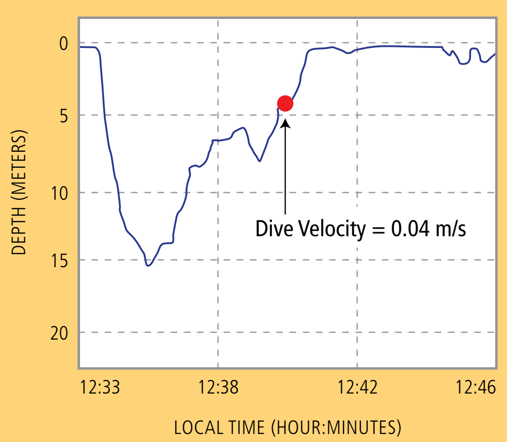
Data from satellite tags deployed onto sea turtles have revealed that they can traverse thousands of open blue kilometers, far away from any patch of land. To observe sea turtles in their element first-hand, some researchers rely on boats—big boats—as well as airplanes, turtle-borne video cameras, and other sophisticated tools. Modern technology allows scientists to follow turtles *wherever* they go, to see what they see, and thus to better understand and protect them in their watery world.

At-Sea Turtle Research in the Eastern Tropical Pacific Ocean

During the 1960s to 1980s, commercial purse-seine fishing for yellowfin tuna in the eastern tropical Pacific Ocean (ETP) caused the incidental death of more than four million dolphins. Since that time, the U.S. National Marine Fisheries Service (NMFS) has conducted survey cruises to monitor dolphin populations in an area larger than the African continent, spanning more than 20 million square kilometers (7.7 million square miles) of open Pacific Ocean. Shipboard observers use high-powered mounted binoculars, or "big eyes," to search for dolphin schools. Beginning in 1992, observers were also trained to identify and record sea turtles. In the same year, an opportunistic capture program was initiated to identify, measure, weigh, tag, and release individual turtles at sea. Today, more than 1,000 turtles have been processed and released in this manner, often hundreds of kilometers from the nearest mainland.

Spotting turtles with high-powered binoculars is one endeavor, but how do you capture a free-swimming turtle in the open ocean? When a turtle is spotted—and weather permits—NMFS observers first launch a rigid-hulled inflatable boat and then capture the animals by hand by jumping into the water and grabbing their carapaces—the "rodeo" method. Olive ridleys have a handy habit of basking at the surface for long intervals, which makes locating them quite easy. Researchers capture turtles in a wide range of different ages and sizes in this way.

Despite the challenges of traversing an endlessly blue study site for months at a time, the benefits of long-term monitoring of sea turtles at sea are unquestionable. Data gathered at sea augment beach population monitoring to provide a much more comprehensive view of turtles' life history. Olive ridleys declined during the 1960s and 1970s because of human consumption of their meat and eggs, combined with incidental mortality of those caught in fishing gear. Following redoubled protection in Mexico and Central America, nesting populations increased, some-



times dramatically. At Playa Escobilla, Mexico, for instance, olive ridley abundance increased from approximately 50,000 nests in 1988 to more than 1 million nests in 2000 (see Special Feature, pages 26–35). Encouragingly, at sea turtle counts confirmed these beach censuses: estimated ridley abundance from at-sea observations in the ETP increased from fewer than 1 million to more than 3 million turtles between 1992 and 2006.

Today, the olive ridley is by far the most common turtle in the offshore waters of the ETP. Although many sea turtle populations require urgent conservation action to prevent further declines or even extinctions, olive ridleys—as a testament to successful conservation efforts—are probably abundant enough in the ETP that scientists can begin to explore their potentially important, but largely unknown, ecological role in the marine environment. Cruising the *real* wild blue yonder in big boats is a great way to study that role.

Getting a Turtle's View of Its World

If shipboard surveys of open ocean expanses give us a broad-brush view of turtles' locations in the ocean, then focused, in-depth research in discrete marine areas can help us see the turtles' world the way they see it, literally.

Of all marine turtle species, leatherbacks are probably the most difficult to study at sea, largely because they are almost always on the move—usually at great distances from shore—and, with a few exceptions, because they tend not to aggregate in known feeding areas. One such exception is the California Current ecosystem along the western U.S. coast, which is a corridor of ocean productivity that hosts many large marine food webs, including important areas where Pacific leatherbacks forage for their favorite food: jellyfish. During the past decade, genetic analyses and satellite telemetry studies have revealed that leatherbacks feeding in the California Current belong to the population that nests primarily in Indonesia.

It's a long way between feeding areas in cold, foggy California waters and tropical Indonesian nesting beaches (see *SWOT Report, Vol. 3,* page 17, showing the nearly 13,000-mile migration route of one Pacific leatherback). So leatherbacks have to be quite proficient at finding and acquiring enough energy to fuel their trip. Scientists have long wondered how these enormous creatures are able to meet the huge energy demands of such a journey while consuming such low-energy

THIS PAGE: Researchers record behavioral and morphometric data on a juvenile olive ridley that was captured by hand while at sea. © LINDSEY E. PEAVEY / NOAA NMFS SWFSC PRD PERMIT # 774-1714 BELOW, FAR LEFT: This graph of a leatherback's dive profile shows the leatherback's vertical movements through the water during a single dive. The red dot on the graph marks the point at which the still frames at right were recorded. SECOND FROM LEFT THROUGH FAR RIGHT: This sequence of 5 still images was taken from video footage of a leatherback eating a sea nettle jellyfish. Videos from sea turtle-borne cameras are used by researchers to study sea turtles' behaviors. © SCOTT BENSON, JIM HARVEY, BILL WATSON PREVIOUS SPREAD: A leatherback glides through rich, soupy waters off Nova Scotia, Canada, while eating a jellyfish. The clean, dark spot on its carapace was cleared by researchers to attach a video camera that allowed the leatherback to record its own "home video." © BRIANSKERRY.COM

prey. By some estimates, leatherbacks need to consume approximately 20–30 percent of their body weight in jellyfish per day—roughly 50 gallons—just to meet their nutritional needs.

Over the past few years, using spotter planes and a boat specially designed to haul leatherbacks out of the water for study, researchers in California's Monterey Bay have captured and later released dozens of turtles equipped with satellite transmitters. Data from these animals, as well as from others tagged in Indonesia while nesting, have revealed that leatherbacks typically move from coastal U.S. waters into the eastern tropical Pacific Ocean for several months; then they return to temperate California waters in pursuit of jellyfish. These findings show that leatherbacks need two or more consecutive years at the California Current jellyfish buffet before being able to migrate back across the Pacific to reproduce.

To get a better view of the leatherback-jellyfish relationship, scientists left the slippery decks of their boat and took to the air. Fine-scale aerial surveys have documented highly dynamic spatial patterns of co-occurrence between leatherbacks and jellyfish species in the California Current. They also have demonstrated that jellyfish abundance fluctuates on seasonal, annual, and even decadal scales, which means that leatherbacks must carefully cue in on ocean conditions in order to position themselves in the right locations to coincide with high jellyfish availability.

For all their advantages, boats, planes, and transmitters permit observation of leatherback feeding behavior only at the water's surface. For a deeper perspective on leatherbacks' activities while out of sight, researchers deployed suction cup-mounted time-depth recorders and video cameras on turtles to obtain detailed dive profiles and data on prey selection and consumption rates. These turtle "home videos" showed leatherbacks ascending from shallow dives to consume jellyfish aggregated close to the surface, and they further revealed that leatherbacks targeted the largest jellyfish species with the highest carbon content (*Chrysaora fuscescens*). In fact, leatherbacks appear to be picky eaters: they munched on only the most carbon-rich portions of the jellyfish, consuming parts of multiple jellies on each dive (see video sequence on pages 10–11).

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So, by observing leatherbacks in their own dining room, we have learned—not surprisingly—that they eat what's good for them and that they eat a lot of it. Preliminary calculations based on the videos suggest that a single turtle might gulp down several hundred *tons* of jellyfish each year, underscoring the importance of the leatherbacks' role within the California Current ecosystem and showing how leatherbacks might consume enough jellyfish to support their long journey west to breed.

Whether by boat, plane, satellite, or camcorder, scientists are beginning to glimpse the previously unknown world of sea turtles, one big ocean or one jellyfish buffet at a time. ■

A research team heads back to the "mother ship" after a day on the water studying free-swimming sea turtles. © NOAA NMFS SWFSC PRD PERMIT # 774-1714