New tags may help diagnose turtle losses

Up to 8 feet long and weighing in at 1,200 pounds or more, the leatherback is the world's largest turtle—and one of the most unusual. Because leatherbacks are endangered globally, conservationists are anxious to help protect these behemoths of the high seas.

And a tiny, biodegradable screw may help.

Earlier this month, Molly Lutcavage of the New England Aquarium in Boston affixed a small radio transmitter to the back of a female leatherback, just minutes after the turtle had laid a clutch of eggs on a beach in Culebra, Puerto Rico. Lutcavage anchored the pocket-pager-size device to the animal's shell, or carapace, with screws normally reserved for orthopedic surgery patients. She's hoping the transmitter—the smallest satellite tracking device ever used on a sea turtle—will remain in place for the better part of a year, sending signals whenever the leatherback surfaces.

Wildlife biologists have long known the sites where adult females come ashore to lay eggs. However, "we have almost no data on leatherbacks in nonnesting areas," observes Samuel Sadove of Long Island University in Southampton, N.Y., and director of leatherback research in Culebra. "A whole portion of the leatherbacks' life cycle—probably the most significant portion—is spent feeding [at sea] or traveling to and from feeding areas," he says. The paths that the far-ranging, virtually warm-blooded animals take and the company they keep remain "huge unknowns."

Meanwhile, the species is dying out. "To say that leatherbacks are disappearing at a staggering rate, especially within the last 7 to 10 years, is an understatement," Sadove maintains.

If scientists could map the turtles' high-seas trek with long-lasting transmitters, they might learn where the animals are most vulnerable, helping regulators design programs to protect them effectively. Until now, the leatherbacks' unique shell has thwarted most long-term tagging efforts.

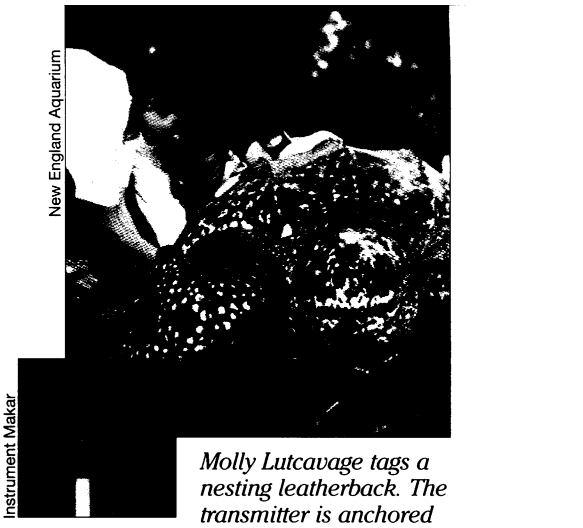
While biologists can glue transmitters to the bony shells of other turtles, the oily, flexible skin that covers the thin, loosely fused, bony plates in a leatherback's carapace resists adhesives. Indeed, Lutcavage spent a semester with chemical engineering students at the Massachusetts Institute of Technology, having them test every glue they could find. The bottom line: "Nothing worked."

Though some biologists have used bolts to attach transmitters to leatherback shells, the metal causes irritation. Eventually, the shell breaks around the bolt—dropping the transmitter and disfiguring the animal.

The idea of trying biodegradable screws came from Anders G.J. Rhodin, an orthopedic surgeon in Lunenburg, Mass., who has made turtle biology his avocation. The leatherback supplies blood to the bone in its shell "in a way that's characteristic of mammals, but totally different from all other turtles," he says. So Rhodin suggested that Lutcavage take a mammalian approach, piercing the bone with roughly half-inch-long screws made of a synthetic polymer that slowly dissolves. She used screws provided by Instrument Makar of Okemos, Mich.

Threaded through each screw is a nylon suture that ties on the $4,000 transmitter. "As the screws dissolve," Rhodin explains, "they are replaced by bone" that continues to anchor the sutures until they weaken and release the transmitter. Once unburdened, a turtle will swim away with an intact shell, he predicts.

If this approach works, Lutcavage says, her goal will be to tag juveniles and males that are accidentally hauled in by fishing fleets at sea. Indeed, while other sea turtles that encounter fishing gear frequently drown when they get hooked or held underwater, leatherbacks more often survive encounters with fishermen because, as jellyfish feeders, they ignore the hook-ridden bait. —*J. Raloff*



Molly Lutcavage tags a nesting leatherback. The transmitter is anchored with biodegradable screws (inset), threaded with a suture, and inserted with a special screwdriver (silver).

Playing ball with new carbon molecules

The aesthetically pleasing shape of buckminsterfullerene—60 carbon atoms arranged in the pattern of a soccer ball—captured the imaginations of scientists everywhere when the molecule was first discovered in 1985. Now, two studies have isolated for the first time several members of the fullerene family, one smaller and the others larger than their famous cousin.

In the June 25 NATURE, researchers from the University of California, Berkeley describe their discovery of carbon-36 (C_{36}), the first fullerene smaller than the buckyball. In the June 18 NATURE, scientists from TDA Research in Wheat Ridge, Colo., report success in extracting larger fullerenes, notably C_{74} and C_{80}, from an indeterminate mix of carbon molecules. Previously, scientists had known that bigger fullerenes existed but didn't have a practical way to separate them.

Both studies may help researchers explore the properties of fullerenes in solid form. The larger fullerenes and C_{36} readily fuse into polymer films. The strong bonds that form between molecules appear to give these solid films electronic and mechanical properties that differ from those of buckyball films.

The most common method of making fullerenes is by sparking two carbon rods together to produce a soot that contains a melange of fullerenes and other carbon compounds (SN: 10/13/90, p. 238). Unlike C_{60} and C_{70}, neither C_{36} nor the larger fullerenes are soluble in toluene, an organic solvent, so they cannot be extracted easily from the soot.

The Berkeley researchers, physicist Alex Zettl and his colleagues Charles R. Piskoti and Jeffery Yarger, used two novel methods to isolate C_{36}. One technique produced a hard, black film and the other a fine powder. Using electron diffraction to examine the powder, they found evidence that the C_{36} molecules bond strongly with each other.

The C_{36} films seem to be more robust than films of C_{60}, surviving at high temperatures, says John H. Weaver of the University of Minnesota in Minneapolis.

Moreover, by adding sodium or potassium atoms to solid C_{36}, the researchers could lower the electrical resistance of the material, suggesting that, like C_{60}, it could become superconducting with some modification.

At TDA Research, John M. Alford and Michael D. Diener found a way to make the ordinarily insoluble fullerenes such as C_{80} dissolve in an organic liquid. After removing the bulk of the C_{60} and C_{70}, "we add electrons to the fullerenes electrochemically, which breaks the bonds" holding them together, says Alford. The resulting negatively charged molecules dissolve in benzonitrile, allowing the researchers to extract them.

"It's a very convincing demonstration of how to prepare things that we had thought were insoluble," says Weaver.

The electronic structure of the larger fullerenes allows them to polymerize more easily, says Alford. Although this makes them harder to work with than buckyballs, it also gives them some interesting and unusual properties. The same could be said for C_{36}. The two groups are already exploring what those properties might be. —*C. Wu*