VIMS Researchers Use Sonar To Study Impact of Poundnets on Sea Turtles

By Dave Malmquist

Preliminary work with a sonar system that allows VIMS researchers to peer beneath the murky waters of Chesapeake Bay suggests that entanglement of sea turtles in poundnet "leaders" may occur less often than commonly thought.

A leader is a long, fence-like drapery of mesh used by commercial anglers to steer herring, menhaden, and other fish into a net-floored impoundment.

A program of surface observations begun in the mid 1980s by VIMS' Dr. Jack Musick and his graduate students showed that poundnet leaders with large mesh and vertical "stringers" can pose a threat to sea turtles. These leader types provide openings large enough to snare a turtle's flippers or head. Ensnared turtles can then succumb due to drowning or exhaustion.

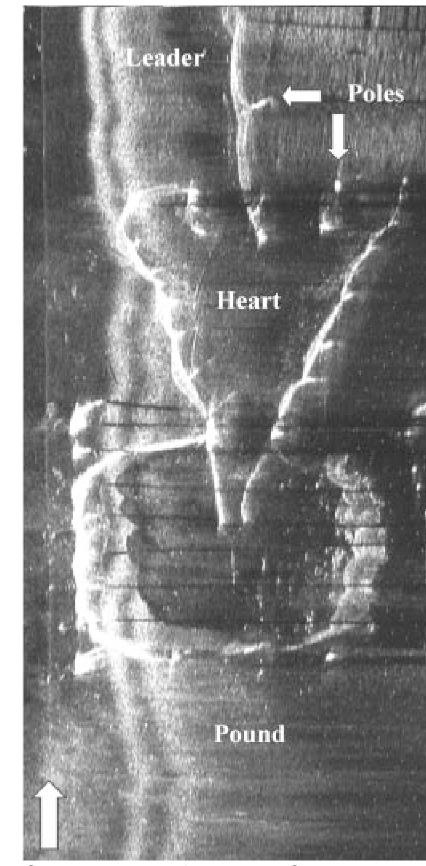
Poundnetters use large-mesh leaders to reduce clogging by jellyfish, seagrass blades, and assorted flotsam in regions where Bay currents are strong. The number of large-mesh leaders in the Bay has declined significantly since the 1980s, both through voluntary removals by concerned pound netters and an overall decline in the poundnet fishery.

Musick's team and other local sea turtle researchers have traditionally relied on observations from boats, airplanes, and the shore because the turbid waters of Chesapeake Bay obscure what might be happening in deeper water. If turtles tangle there, beneath the view of surface observers, the number of sea turtle mortalities may be underestimated.

"That's why sonar is important," says Kate Mansfield, a Ph.D. student in Musick's lab. "Some poundnet leaders reach depths of 30 feet, but we can only see a few feet into the murky water. Sonar allows us to see what's going on beneath the surface" (see sidebar on page 8).

Musick and Mansfield's sonar project is funded by the National Marine Fisheries Service (NMFS), as part of its larger effort to assess the impact of commercial fisheries on sea turtles in the Chesapeake Bay. All sea turtles in U.S. waters are classified as either threatened or endangered under the Endangered Species Act, and thus NMFS is legally bound to protect them from intentional or incidental harm due to poundnet fishing, gill netting, dredging, blasting, boating, or any other human activities.

Each year, tens to hundreds of sea turtles wash up dead on Virginia's beaches. Most of these stranded turtles are juvenile loggerheads. Because many are severely decomposed, it is often impossible to determine their cause of death through autopsy. NMFS considers poundnet entanglement the logical cause for many of the beached carcasses, citing Musick's mid-1980's observations of surface entanglement in leaders with large mesh and string-



Sonar image of western Chesapeake Bay poundnet.

ers, the possibility of additional entanglements under water, and a lack of other explanations.

Continued on page 8

To B or Not to B....
continued from page 1

long after their initial exposure to an antigen. We're really interested in why that is. There are some elements that seem very reminiscent of bone marrow."

Recent studies with mammals show that bone marrow sometimes holds long-lived plasma cells that constantly trickle antibodies targeted at previously encountered invaders. Traditional thinking holds that plasma cells are short-lived, dying off as soon as an invader is vanquished, and that memory cells in the spleen provide the long-term protection. But memory cells must be activated before they can respond. Retention of active plasma cells could thus help the immune system react more quickly to future invasions. "You save time doing it this way," says Zwollo.

If Kaattari and Zwollo's research shows that the anterior kidney is indeed the reservoir for long-lived plasma cells in trout, it would support the idea that this organ is where fish develop B cells. "That's the way it works in mammals," says Zwollo, "long-lived plasma cells reside in bone marrow, the same organ that nurtures young B cells."

The pair's B-cell research builds on Kaattari's previous advances in developing the rainbow trout as an alternative to mice as experimental animals. Researchers have historically relied on mammalian models—the proverbial "lab rat"—to explore biomedical questions. "In our lab," says Kaattari, "we're refining trout as another model of biomedical research, particularly in immunology."

Several traits favor fish, trout in particular, as biomedical models. For one, researchers can manipulate fish reproduction to quickly produce large numbers of identical offspring. Whereas it took hundreds of generations to produce genetically identical mice, collaborators at Washington State University created strains of identical trout in only two generations. Use of genetically identical animals ensures a consistent, statistically meaningful response to immunological challenges. Young trout are also small enough that thousands can be reared in a normal-sized laboratory, yet they grow large enough (10-15 pounds) for easy manipulation and use in long-term experiments. With mice, juveniles and adults vary little in size. Finally, trout care is relatively easy, particularly now that high-tech biofilters and chillers ensure that fish in aquaria have the cold, clean water they need.

But the trout's big advantage is that it provides researchers with a model animal that is agriculturally important. Trout, and their near relatives the salmon, "are about the most important species in aquaculture," says Kaattari. "They are cultured around the world. In Virginia alone, there are at least 12 trout hatcheries."

Use of a trout model to increase basic understanding of the fish immune system thus promises significant economic return, particularly since farmed fish are crowded and therefore more prone to disease than their wild kin. Coupled with its basic scientific merits, the potential economic value of Kaattari's research makes it attractive to a wide range of funding agencies. To date, five different agencies have funded his trout work, including the National Oceanic and Atmospheric Administration, the US Fish and Wildlife Service, the US Department of Agriculture, the National Institutes of Health, and the Department of Energy.

In addition to trout, Kaattari is studying the immune response within another commercially important fish species—the striped bass.

In Chesapeake Bay, around 70% of these popular game fish are now infected with mycobacteriosis, a chronic disease whose characteristic lesions first showed up in Bay stripers in 1994. The prevalence of this disease in the Bay's striper population has raised numerous questions concerning its origin and transmission.

To help answer these questions, Kaattari and fellow VIMS researchers are developing a suite of genetic tests to determine if a striper is infected with or has developed immunity to mycobacteriosis. The tests will require only a small sample of blood, which could be taken by VIMS' Juvenile Trawl Survey team during their monthly catch-and-release sampling of Chesapeake Bay fish and invertebrates. The Trawl Survey and other population and tagging studies provide a comprehensive view of the Bay's striper population. Correlating the blood-test results with abundance and distribution data from these surveys will "allow us to look at the dynamics of disease and its impact within a wild population, and that's virtually never been done before," says Kaattari.

For further information on fish immunity research at VIMS (including video clips from Steve Kaattari's laboratory), visit the VIMS web site at http://www.vims.edu/env/research/immune.html

Calendar of Events

—August 2002—

02 Public Tour
09 Public Tour
14-16 Wetland Plants ID Course
16 Public Tour
23 Public Tour
26-27 Fall Semester Orientation
28 Fall Semester Classes Begin
30 Public Tour

For more information call 804/684-7101 or 804/684-7011.

—September 2002—

02 Labor Day – Closed
06 Public Tour
13 Public Tour
Pat Donahue Concert
17-20 Wetlands Delineation Workshop
19 VA Native Plant Society
20 Public Tour
27 Public Tour
27-28 VIMS Council

—October 2002—

01 TOGA Board Meeting
04 Public Tour
04-05 Mid Atlantic Marine Education Association (MAMEA) Conference
10 Garden Clubs of Virginia Presidents Meeting
11 Public Tour
14 Chef Symposium
18 Public Tour
25 Homecoming Weekend, Tour @ 2pm
25 Public Tour
26 Donor Day

Visit our website at www.vims.edu

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continued from page 4

To date, Mansfield's research does not support this view. She has so far seen no evidence that poundnet leaders are trapping live turtles at depth, regardless of leader type. "We've seen a few turtles in the nets," says Mansfield, "but these are severely decomposed and may have floated in with the tide after death."

To help explain these results, Mansfield notes that the 1980s study took place when there were more than 300 pound nets in the Bay, over half of which were large mesh. "Now," she says, "there are far fewer nets being fished, and less than 20 are considered large mesh." The Chesapeake's main stem currently holds from 50-75 active leaders. Of these, 10-15 feature large mesh, vertical "stringers," or both.

Mansfield's grant allows her to monitor sea turtle interactions with active leaders in Virginia's Chesapeake Bay waters from May to June, when sea turtle strandings in Chesapeake Bay traditionally peak. This is when turtles begin to migrate into warming Bay waters to start feeding on a summertime bounty of blue crabs, horseshoe crabs, and fish.

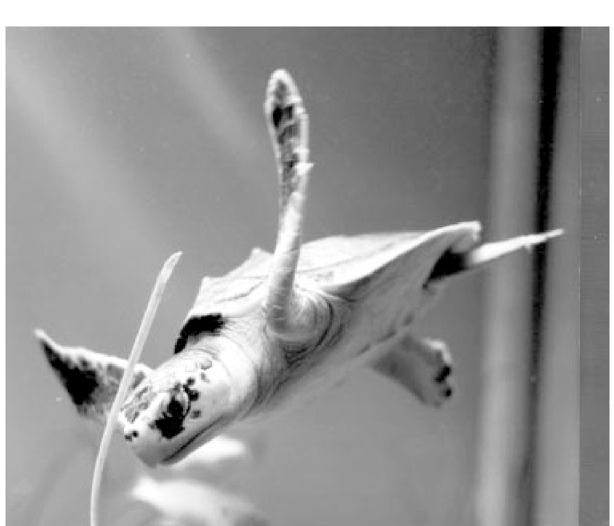
If the weather allows, Mansfield visits and scans each active leader every week or so. To corroborate and extend her findings, Mansfield would like to monitor the nets more frequently, and throughout the sea turtle residency season, which continues in the Bay until autumn cooling. Surface entanglements and strandings are much less common after the migratory peak ends in late June.

"There's some evidence," says Mansfield, "that turtles are more likely to become entangled when they first migrate into the Bay because their energy reserves are low and they're unable to avoid or escape the leaders in areas where currents are strong and the leader mesh size large. Some of the loggerheads have migrated to the Chesapeake from as far away as the Florida Keys and the Gulf of Mexico."

The decline in entanglements during the remaining warm-weather months may occur because turtles have had a chance to regain strength by feeding in Bay waters and to establish regular feeding grounds.

By helping to determine if pound nets are a hidden source of turtle mortality or instead pose a diminishing threat due to their decreasing numbers, Mansfield's work can help the National Marine Fisheries Service (NMFS) refine its regulations concerning human interactions with Chesapeake Bay sea turtles. A recent NMFS ruling banned leaders with large mesh and stringers from the Virginia poundnet fishery from early May to the end of June.

For additional information on the VIMS Sea Turtle Stranding Program, visit http://www.fisheries.vims.edu/turtletracking/stsp.html


Juvenile Kemps Ridley turtle.

Passing sailors may have thought them a nautical apparition, two pirates sending a pair of shrouded shipmates to Davy Jones' locker.

But the "pirates" are really VIMS researchers Kate Mansfield and Bob Gammisch, their "shipmates" the frozen bodies of a loggerhead and Kemp's ridley sea turtle. The burial shroud is a length of fishing net, and the pirate ship is the VIMS R/V *Coot.*

Mansfield and Gammisch are using the preserved turtle specimens as models, snapping sonar images of their net-bound carcasses to help better envision how a living or newly dead turtle would look on sonar if tangled in a poundnet "leader." Certain types of leader nets have been implicated in sea turtle mortality and strandings in Chesapeake Bay (see accompanying article).

By scanning submerged carcasses of a loggerhead and Kemp's ridley (on loan from Dr. Jack Musick's specimen collection), Mansfield and Gammisch are able to develop a "search image" of each species' characteristic shape, size, and capacity for reflecting sound waves. Most entangled turtles are juvenile loggerheads.

Some of the resulting images are so detailed and crisp, says Mansfield, that using them to calculate the dimensions of a scanned carapace gives values within inches of physical measurements of the actual shells.

Scanning of the frozen carcasses is a necessary first step in developing techniques for quick and accurate sonic identification of leader-entangled turtles. Even with the latest in high-tech gear, recognizing a turtle in a sonar image still requires a practiced eye. The reflected sound waves that create the sonar image also echo back from the leader netting, fish, suspended sediments, and assorted flotsam.

Mansfield and Gammisch have also developed a catalog that contains a sonar image of each active leader when turtle-free. These provide a baseline to help identify any entangled turtles on subsequent surveys of the same net.

If a sonar image shows a shape that resembles their search images, Mansfield lowers a video camera to confirm that it is indeed an entangled sea turtle, and not a clump of flotsam or seaweed. Use of video obviates the need to send a diver into the water, a risky enterprise given that many poundnet leaders are located in areas with strong currents.