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Filling in the Missing Pages: Sheepshead and the Use of Acoustic Telemetry in Fisheries Research

Conrad Pfalzgraf holds an acoustically and externally tagged sheepshead prior to release in Grand Bay National Estuarine Research Reserve.

Imagine you're reading a book, but pages have been torn out throughout the story. You know how it begins and how it ends, but much of what happens in between is missing. For fisheries scientists, the life of a fish can look a lot like that incomplete story. We may know where a fish was born or where it was caught, and eventually, eaten by a predator or recaptured—but what happens in between?

Traditional sampling methods provide valuable snapshots of where a fish was captured at a particular moment but often tell us little about what that fish does in the days, months, or even years afterward. Once a fish is released beneath the surface, where does it go? Does it remain in the same bay for weeks or months, move between different habitats, or leave the area altogether? Does it return to the same places year after year?

Acoustic telemetry helps researchers fill in those missing pages. By allowing scientists to follow individual fish long after they swim out of sight, this technology can reveal movements that would otherwise be difficult or impossible to observe. As movement detections accumulate over time, researchers can begin piecing together when a fish arrives, how long it stays,

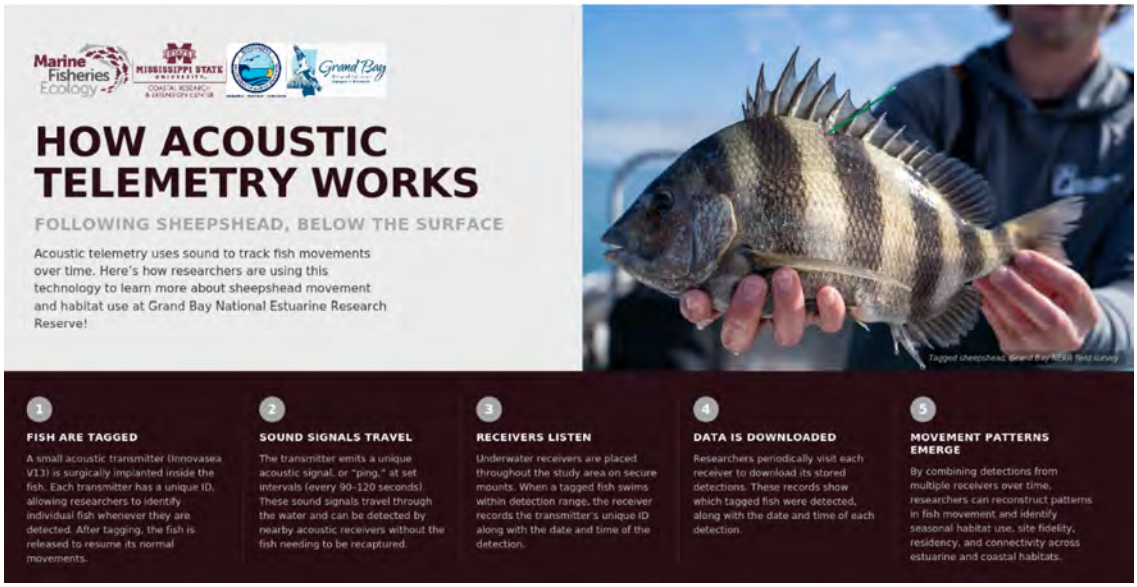
which habitats it uses, where it moves, and when it leaves. Instead of a single snapshot of where a fish was caught, acoustic telemetry provides a way to follow what happens next.

How Does Acoustic Telemetry Work?

At the center of an acoustic telemetry study are two pieces of technology: acoustic transmitters and acoustic receivers. The transmitter travels with the fish, while receivers remain stationary beneath the water, listening for tagged animals that pass nearby.

Acoustic transmitters are small electronic tags that produce uniquely coded sound signals, often referred to as “pings.” In many fish movement studies, including our work with sheepshead, these transmitters are surgically implanted inside the body cavity of the fish. After a short recovery period, the fish is released back where it was captured and continues on its way, carrying the transmitter with it.

The transmitter does not continuously broadcast or provide a live GPS location. Instead, it sends out its unique acoustic signal at programmed intervals. In our sheepshead study, transmitters send a signal approximately every 90 to 120 seconds. Sound travels efficiently through water, and when a tagged fish passes within detection range of an acoustic receiver, the receiver “hears” that signal. It then records the transmitter's unique identification number, along with the date and time it was detected.



Think of each receiver as an underwater listening station. It does not tell us exactly where a fish is every second of the day. Instead, each detection tells us that a particular fish was within range of a receiver at a particular time. As different receivers detect that same fish over days, months, or even years, those individual detections begin to form a movement history.

Periodically, researchers return to the receivers and download the stored detections. What may initially look like thousands of tag numbers, dates, and times can be pieced together into a movement history. Going back to our book analogy, a single detection may yield only a sentence or two, but thousands of detections can begin to fill the pages of a fish's story.

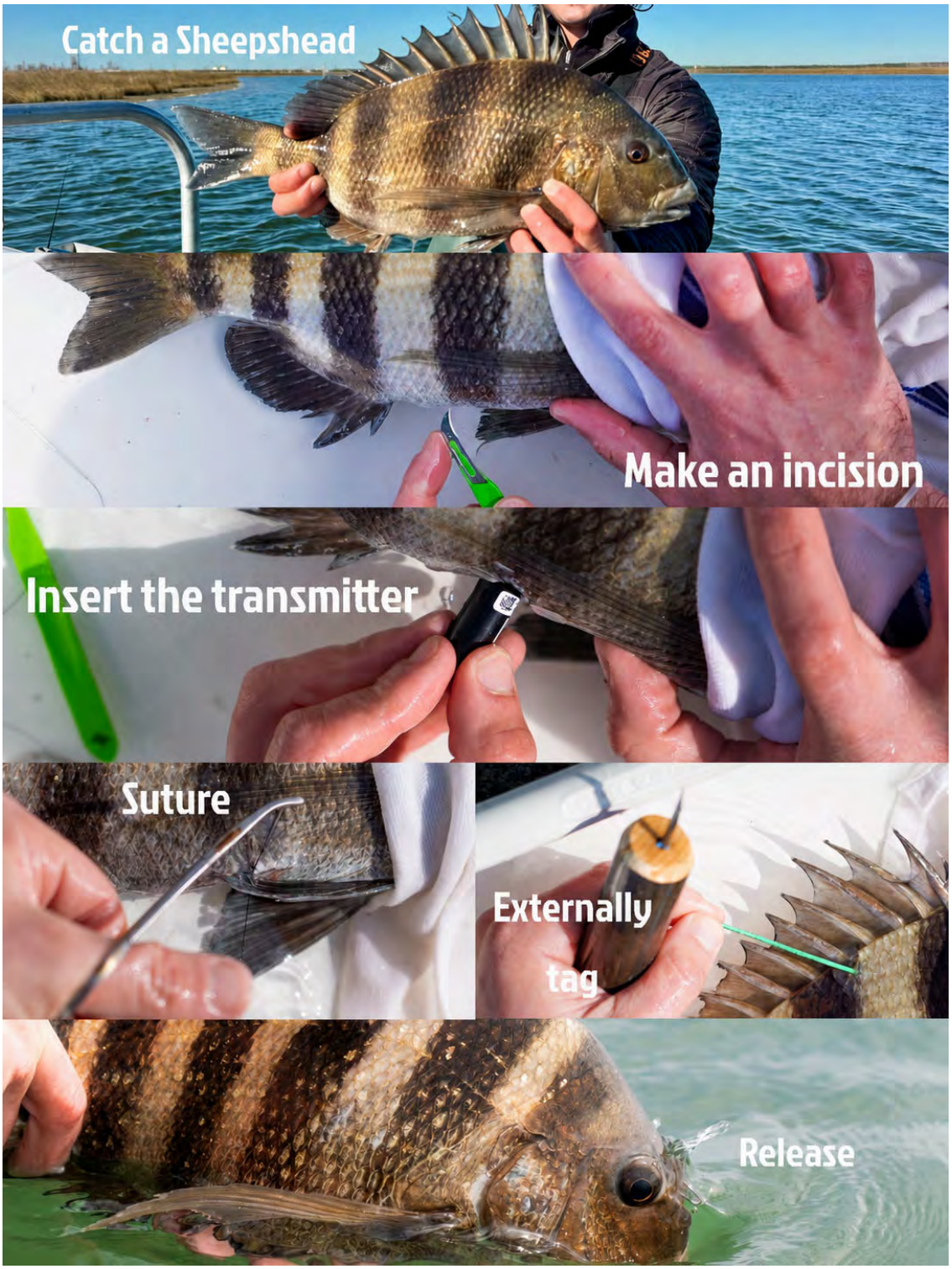
Tracking the Convicts

Along the Mississippi coast, we are using this technology to better understand the movements of sheepshead (*Archosargus probatocephalus*) in and around the Grand Bay National Estuarine Research Reserve (GNDNERR). Often nicknamed "convict fish" for the distinctive black bars running down their sides, sheepshead are a familiar species to Gulf Coast anglers. They are commonly associated with oyster reefs, bridges, pilings, and other structured habitats. Despite their recreational importance, relatively little is known about their seasonal movements and residency within Mississippi estuaries.

To investigate these movements, Mississippi State University master's student Conrad Pfalzgraf and his research team deployed a network of 25 acoustic receivers throughout GNDNERR. Rather than placing receivers uniformly throughout the reserve, they were strategically positioned across open-bay, marsh-transition, bayou/channel, and structured habitats. Receivers were also placed along important movement corridors and across the entrance to the estuary, allowing researchers to listen for tagged fish as they move among habitats or enter and leave GNDNERR.

Alena Anderson and Conrad Pfalzgraf download detection data from an acoustic receiver in Grand Bay National Estuarine Research Reserve as part of routine receiver maintenance and data collection.

Between October 2025 and February 2026, our team surgically implanted acoustic transmitters into 39 sheepshead captured within and around the reserve. Each fish also received an external identification tag before being released, allowing anglers who recapture a tagged fish to report the encounter back to our research team. Together, acoustic detections and angler-reported recaptures provide different pieces of information about where these fish go after release.



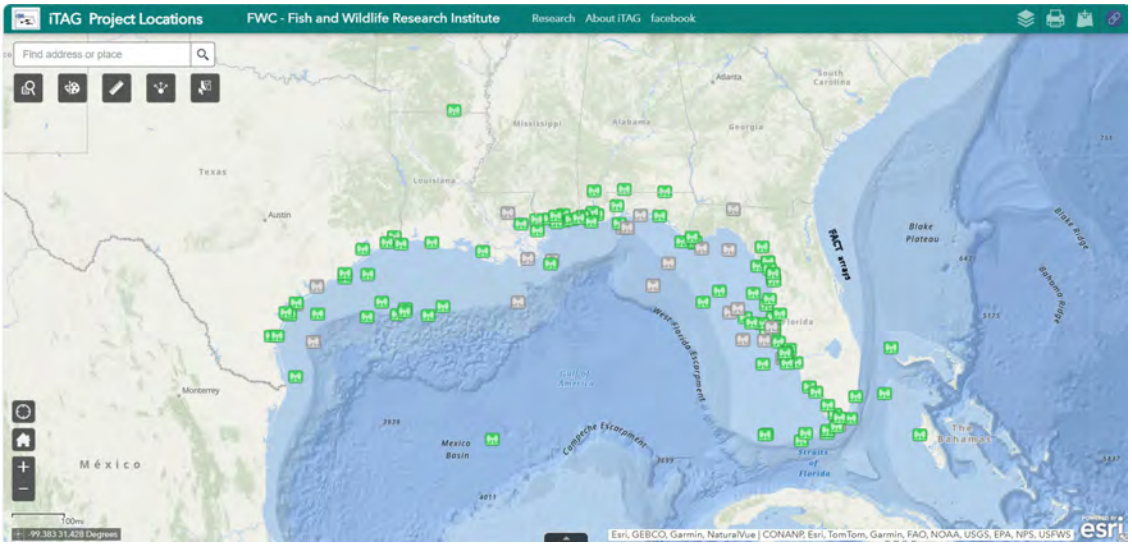
Sheepshead acoustic tagging process, from capture through release.

For sheepshead, those broader questions about what happens once released becomes the focus of our research. When do they enter and leave GNDNERR? How long do individual fish remain within the reserve? Do they repeatedly return to the same locations? How do they move among different habitats? And are there particular seasons or locations where fish become especially concentrated?

These questions are important because understanding where fish go is about more than satisfying scientific curiosity. Movement influences when and where fish interact with different habitats, environmental conditions, and anglers. Identifying periods of when fish remain in the same areas, repeatedly return to particular locations, or form aggregations, can also help researchers understand when and where they may be particularly vulnerable to fishing pressure. Ultimately, answering these questions can provide managers with better information to support sustainable fisheries for generations to come.

A Growing Tool for Fisheries Science

One of the greatest strengths of acoustic telemetry is that the story does not end when a fish leaves the study area. Acoustic telemetry has become increasingly collaborative, as researchers establish networks that allow them to share detections among projects. If a tagged fish swims beyond one receiver array, it may later pass another receiver maintained by an entirely different research team. Instead of disappearing from the story, that fish can potentially be detected again miles away.



Map of acoustic telemetry projects participating in the Integrated Tracking of Aquatic Animals in the Gulf of America (iTAG) network. The network connects receiver arrays and researchers across the northern Gulf and surrounding region, allowing detections of tagged animals to be shared among participating

projects and extending researchers' ability to track movements beyond individual study areas. Map courtesy of iTAG/FWC Fish and Wildlife Research Institute.

These collaborations are particularly valuable for highly mobile species that move among estuaries, coastal waters, and offshore habitats. By connecting researchers, receivers, and tagged animals across larger areas, telemetry networks allow scientists to investigate movements and connectivity that would be nearly impossible for a single study to document alone. These networks also foster collaboration and data sharing among universities, researchers, resource managers, and other stakeholders.

One example is an ongoing Gulf-wide cobia and tripletail telemetry project led by Dylan Kiene, a postdoctoral researcher with Mississippi State University's Marine Fisheries Ecology Program. The project brings together researchers and partners across all five Gulf states to better understand cobia and tripletail movements, habitat use, survival, and connectivity throughout the Gulf. By working across state and institutional boundaries, projects like this can track highly mobile fish across a much larger portion of their range than any one research team or receiver array could accomplish alone.

Gulf-wide collaborative acoustic telemetry project tracking cobia and tripletail across the Gulf. Led by Dr. Dylan Kiene, the project brings together researchers and institutions from across the region to tag and track these highly mobile species. Shared receiver networks allow tagged fish to be detected well

beyond where they were originally released, demonstrating the value of regional collaboration in acoustic telemetry research.

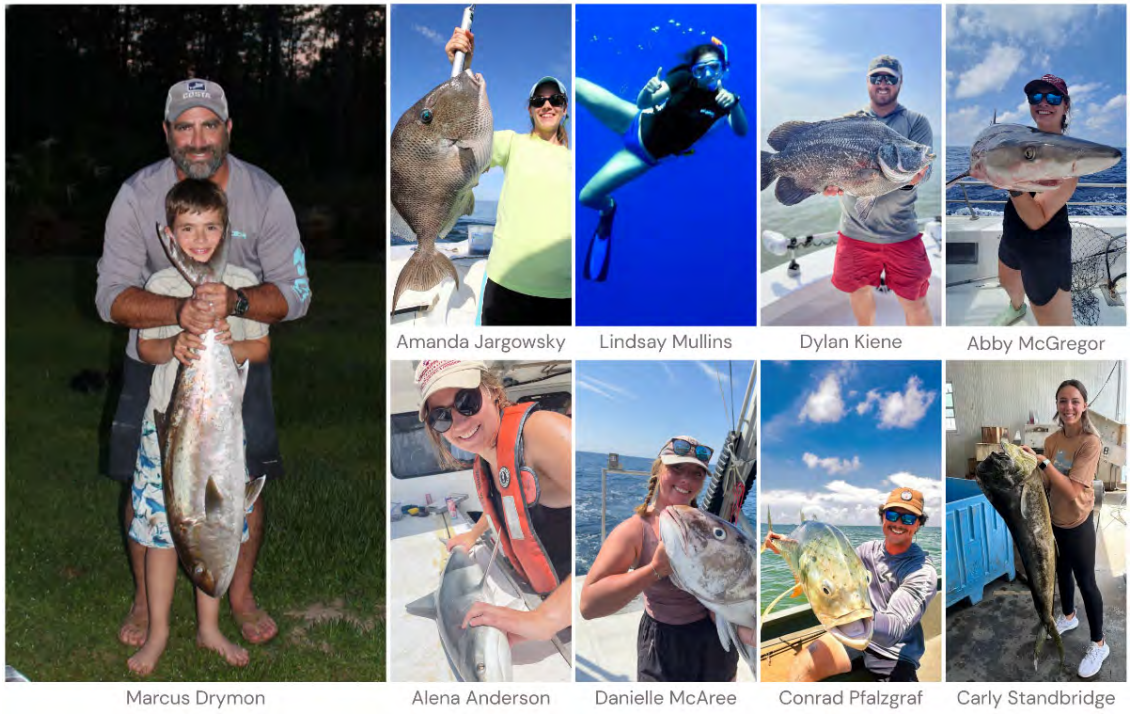
As more researchers adopt acoustic telemetry and contribute to these collaborative networks, the value of each receiver and tagged fish continues to grow. The technology itself is also continuing to advance. Longer-lasting batteries, smaller transmitters, improved receiver range, and increasingly connected networks allow researchers to study more species and follow individuals over longer periods. Depending on the transmitter, battery life can range from several years to as as long as a decade, allowing some fish to continue providing information throughout a substantial portion of their lives without needing to be recaptured or handled again.

For our sheepshead project, this means a fish leaving GNDNERR does not necessarily disappear. If a tagged sheepshead passes a compatible receiver elsewhere or is recaptured by an angler, that information can add another piece to its movement history and potentially reveal connections between GNDNERR and other coastal habitats.

Every detection adds another page to the story. A handful of detections might tell us that a fish visited a particular habitat. Months of detections may reveal that it remained there for an entire season. Detections across multiple receivers can show movement among habitats, while detections outside the reserve may reveal where a fish went after leaving GNDNERR.

Acoustic telemetry will never allow us to see every moment of a fish's life. There will always be a few missing pages. But with every ping recorded, researchers can fill in a little more of the story and better understand the fishes that are important to the Gulf Coast.

Learn more about this project on our website.



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