# The Use of Ultrasonic Telemetry for Assessing Diel Differences in Habitat Use by Juvenile and Adult Summer flounder, *Paralichthys dentatus*, in the Great Bay-Little Egg Harbor Estuary

**Katherine Seebald[*], Dana Rowles[†], John Quinlan[‡], Thomas Grothues[†], and Kenneth Able[†]**

[*]Georgetown University, Institute of Marine and Coastal Sciences, 71 Dudley Road, New Brunswick, NJ 08901

[†]Rutgers University Marine Field Station, Institute of Marine and Coastal Sciences, 132 c/o 800 Great Bay Blvd. Tuckerton, NJ 08087

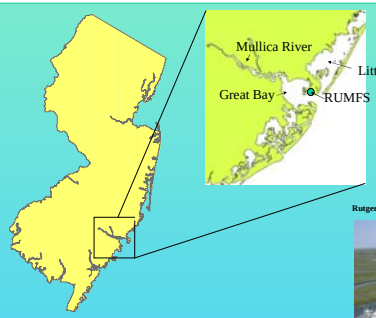
[‡]Rutgers University, Institute of Marine and Coastal Sciences, 71 Dudley Road, New Brunswick, NJ 08901

Rutgers University/National Marine Fisheries Service

Summer Flounder Dynamics Research Program

## ABSTRACT:

We used ultrasonic telemetry to track tagged juvenile and adult (>210 mm) summer flounder, *Paralichthys dentatus*, in New Jersey's Great Bay/Mullica River system in the daytime (0600-2000) and nighttime hours (2000-0600). Since most prior studies of estuary-inhabiting summer flounder have been conducted during the day, this project's purpose was create a more complete assessment of the summer flounder's estuarine habitat use. By comparing water conditions like salinity, temperature and dissolved oxygen levels for the daytime and nighttime points, we were able to find that more summer flounder go to hotter, less saline and less oxygen-rich areas during the daytime, whereas more travel to cooler, more saline and more oxygen-rich areas at nighttime. This assessment helps us to more clearly identify the estuarine environment(s) that qualify as the juvenile and adult summer flounder's "essential fish habitat", or "those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity" (Able 1999). Through this enhanced understanding of the role of the estuary in the summer flounder's development, better resource and fishery management decisions can be made to protect important summer flounder habitat and ensure the species' continued prosperity in the Middle Atlantic bight and other regions off the east coast of the United States.





Rutgers University Marine Field Station (RUMFS)

## INTRODUCTION:

In 1996 Congress amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to require the identification and conservation of designated "essential fish habitat" (EFH), or "those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity" (Able 1999). Since summer flounder larvae migrate to coastal estuaries to complete springtime morphological changes (Keefe and Able 1993) and summertime maturation to juveniles and adults, (Able and Kaiser 1994), coastal estuaries arguably possess critical yet unexplored insights into summer flounder habitat use and EFH. For instance, prior studies have recorded diel differences in activity for summer flounder larvae, juveniles and adults (Weinstein et al. 1980, Keefe and Able 1994, Szedlmayer and Able 1993, Rountree and Able 1997). Since there has been no previous scientific study solely focused on night vs. day flounder activity, this research addresses that question vis-à-vis the tracking of acoustically tagged summer flounder in the Great Bay/Mullica River estuarine system. Since the Great Bay and Mullica River are both located within the Jacques Cousteau National Estuarine Research Reserve (JCNEER), one of the cleanest reserves along the U.S. east coast, the summer flounder's natural behavior can be recorded in this study without substantial, calculated consideration of human impact on the estuarine environment.

SEE PRINTOUT FOR REFERENCES

**Mobile Tracking Equipment:**

LOTEK LPH hydrophone (Figure 2A) supported by an SRX_400 receiver/data processor (Figure 2B).

LOTEK CAFT16_1 (16 x 84 mm, 155 dB) & CAFT 11_3, (11 mm x 54mm, 150 dB) coded acoustic transmitters broadcasting at 76.8 kH every 5s (Figure 2C).


Figure 2A: LOTEK LPH hydrophone


Figure 2B: SRX_400 Receiver


Figure 2C: LOTEK acoustic transmitter

## METHODS:

***Tagging***: The fish is captured by hook and line, anesthetized and tagged with an ultrasonic transmitter using Bridger and Booth's method. According to this method, the transmitter is attached to the flounder's dorsal musculature and secured by means of stainless steel wiring, a stainless steel crimp, and water-resistant glue (Bridger and Booth 2002). After a period of recovery from the surgery, the fish is released into the water at the precise coordinates where it was originally found. See Figure 3A for image of tagged fish.

***Tracking***: When we search for a fish, we insert a portable directional hydrophone with a 1 kilometer search field into the water and listen via. the SRX receiver for the distinct clicking sound of a fish tag. The intensity of the sound, quantified by th receiver, tells us how close we are to the fish. We follow the direction of the more intense sound, lowering the listening range of the hydrophone until we acquire a sound intensity, or *power*, of 130 on the fish on a range, or *gain*, of 15. When the fish is found within these conditions, its tag number (reported by the receiver), time and date are recorded and a YSI meter measures the salinity, temperature and dissolved oxygen levels in the water. The pH is also recorded.

We track the fish in the system using two different procedures. Twice per week we conduct a *spot track* in which researchers spend the entire day (or night) searching for one point on each fish found in the system (see Figure 3B). For safety reasons, the nighttime spot tracks are limited to the area immediately surrounding the field station. Another two days a week (one during the day, the other at night) are spent *mobile tracking*, or tracking an arbitrarily chosen fish every 15 minutes for a period of around six hours. Again, the nighttime mobile tracks are limited for safety reasons to the area immediately surrounding the field station.


Figure 3A: Tagged Summer Flounder

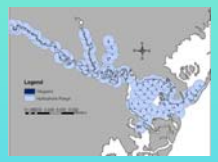


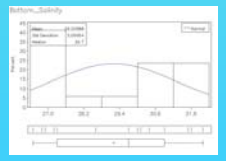
Figure 3B: Spot Tracking points on the Great Bay/Mullica River system. The black dots indicate each point we check for fish with the hydrophone. The blue circles indicate the range of the hydrophone at each of these points.

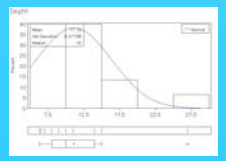
Figure 3C: Location of all spot and mobile tracking points included in this analysis

## RESULTS:

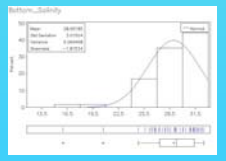
### SPOT TRACKING:

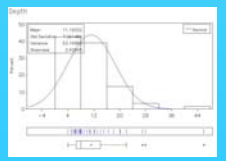
**DAY:**





**NIGHT:**

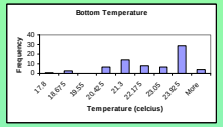


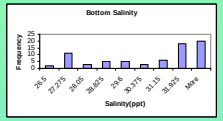


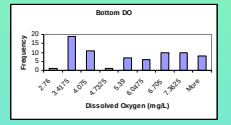
The graphs to the left indicate the comparative bottom salinities and depths of the spot tracking and tagging data. According to the Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises and Anderson-Darling tests for normality, these two factors were the only two out of five (the others including bottom temperature, bottom dissolved oxygen and pH) that were deemed significant for analysis. The bottom salinity and depth histograms show the fish in approximately the same ranges during the day and nighttime, with more fish preferring higher saline waters at nighttime than during the day.

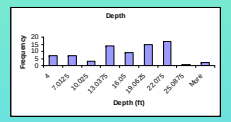
### MOBILE TRACKING:

**DAY:**



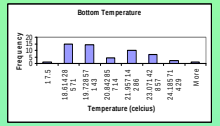



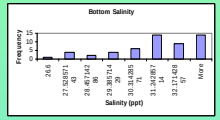



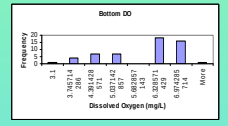



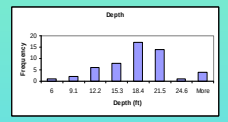

**NOTE: Daytime pH histogram not shown because it was deemed statistically insignificant by the Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises and Anderson-Darling tests for normality.**

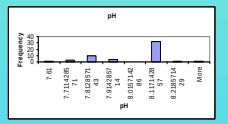
**NIGHT:**




The above mobile tracking data demonstrates that during the daytime, more fish are found in water with higher temperatures, lower salinities, much lower dissolved oxygen levels, and slightly shallower waters than at nighttime. At nighttime, these same fish are more likely to be found in cooler, more saline, more oxygen-filled waters with a clear preference for deeper waters with a pH approximating 8.2.

## DISCUSSION AND CONCLUSIONS:

The spot tracking data yielded fewer and less clear conclusions than the mobile tracking data. The spot tracking data does illustrate that bottom salinity and depth have statistical significance; however, the mobile tracking data shows significance for all water conditions except for the daytime pH levels of the water. In addition, the spot tracking histograms show less of a clear pattern in fish habitat preferences than the mobile tracking histograms. For these reasons, the spot tracking data is important in that it shows the general areas in the Great Bay in which summer flounder are found. However, in order to definitiely draw conclusions on summer flounder habitat use, the mobile tracking data yields the statistical and empirical weight for such analysis.

Based on those considerations, I believe one explanation for the mobile tracking data trends is the summer flounder feeding habits. As visual predators, summer flounder may be tracking their food during the daytime, potentially taking them into areas where the water does not hold the ideal temperature, salinity, and dissolved oxygen levels for the species. However, once they stop feeding around nighttime, they tend to find areas that contain the species' more ideal water conditions. This does not mean, however, that the summer flounder stop moving at nighttime; to the contrary, the mobile tracking data does indicate that the flounder move at night. However, that movement might not be so much based on finding food but seeking out ideal water conditions for growth and sustainability.

## ACKNOWLEDGEMENTS:

The National Science Foundation and Rutgers University in the Ocean Sciences provided us with the material and intellectual support for this project. Thanks to Ken Able and Thomas Grothues for their advice for the project, and Dana Rowles for her day-to-day help in the field.