

Day Time vs. Crepuscular Movements of Newly Tagged Striped Bass, *Morone saxatilis*, Using Ultrasonic Telemetry

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ABSTRACT

This study is to observe and compare the daytime and crepuscular movements and habitat use of striped bass, *Morone saxatilis*, in the Great Bay/Mullica River Estuary. The fish used in this project were newly tagged this summer offering the opportunity to observe the affect of the tag implantation surgery on fish behavior. Fish were tracked using acoustic telemetry to locate the tagged fish and environmental data was taken at that location in order to determine what factors influence striped bass activity. I found that while their activity is atypical immediately following and up to a week after surgery, data collected subsequently is accurate and indicates that striped bass are more active during the crepuscular period than during the day.

INTRODUCTION

Striped bass, *Morone saxatilis*, are anadromous fish that are important predators in estuarine environments like that of the Mullica River/Great Bay area. They choose habitat based on environmental factors such as water temperature, dissolved oxygen, salinity, tidal flow, and sunlight. Not only are they important contributors to the estuarine ecosystem, but also are an economically important species in New Jersey.

Most studies on striped bass, including much of the research being conducted currently focuses on activities of the fish during the daylight hours. However, there is observational evidence (especially by fishermen) that striped bass increase their activity during the crepuscular period (1800-2200), or the time surrounding sunrise or sunset, and during slack tides. Scientifically, it has been shown that striped bass (Tupper and Able, 2000) use the tidal flow to minimize their energy output both during the day and night. Additionally, striped bass respond to diurnal temperature changes (Bjorgo et al., 2000). The fish are also sensitive to light. Strong UV radiation may damage their sensitive eyes; therefore they avoid shallow water during the day (Fuentes, 2004, unpublished data).

There is also a question of how the tagging procedure affects fish behavior. In order to implant an ultrasonic tag, it is necessary to sedate the fish and perform surgery. This invasive procedure and the affects of the anesthesia may have an effect on the fish's activity and habitat use immediately after and in the weeks following the surgery. Evaluating the magnitude of change in the fish is crucial to determining the accuracy of habitat use data collected immediately after tagging.

METHODS

Presently there is an extensive tracking program at the Rutgers University Marine Field Station utilizing ultrasonic telemetry to track a number of tagged striped bass. Additional striped bass were tagged during this project (Table 1). Using this system, there are two main ways to track a fish: passive telemetry and active telemetry. Passive telemetry consists of a stationary array of hydrophones set up to monitor acoustically tagged fish's movements in and out of the estuary and rivers (see Figure 1A). These will detect a fish's presence within a certain radius and offer a general idea of where and when the fish moves and what areas it prefers. Unfortunately, they cannot report any specifics about the fish's movement or the environmental conditions that may have influenced that movement.

In order to gather specific data about a particular fish's activities, I used two methods of active telemetry. In tracking, I used a mobile directional hydrophone to obtain a more exact location of a fish in the bay or river (see Figure 1B). After initially locating the fish, I tracked it for a period of hours monitoring and taking note of changes in position as well as recording environmental data (weather conditions, tidal flow, pH, and surface and bottom temperature, salinity, and dissolved oxygen) approximately every fifteen minutes using a portable YSI, depth finder, and pH meter. In fixed location active telemetry, I used the mobile hydrophone and followed a series of fixed locations to locate all the fish present in the estuary that day and recorded environmental data at each fish's location. I gathered data in this fashion for three newly tagged fish. Each of these fish was caught on hook and line in a different part of the estuary using and had a LOTEK acoustic transmitter implanted in its abdominal cavity (see Figure 1C). I then tracked two of these fish immediately after surgery and all three intermittently during the days and nights following their surgeries.

Mobile Tracking Equipment:

LOTEK LPH hydrophone supported by an SRX_400 receiver/data processor.

LOTEK CAFT16_3 coded acoustic transmitters broadcasting at 76.8 kHz every 5s.



Figure 1A: Map of the locations of the stationary hydrophones in the Great Bay/Mullica River estuary

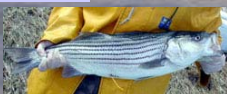


Figure 1C: A striped bass after surgery, prior to release. Incision where tag was inserted is visible on the abdomen.



Figure 1B: Mobile tracking. White pipe held in water at right has the hydrophone at the bottom in the water. Direction is indicated by the horizontal pipe at top.

RESULTS

Fish behavior during the crepuscular period varied greatly compared to their movement during the day. The most dynamic example of this is C-Lover (102). It appears that this fish was not particularly active (Figure 2B, day). He tended to stay near the bank, but still in relatively deep water (approximately 12.0 meters, Table 2). However, when the sun became less intense around 6:00pm, this fish moved so rapidly that it was difficult to gather data without losing the fish (Figure 2B, night). He did not stay in the same place for extended amounts of time as he did during the day, and he favored shallower water (approximately 5.6 meters, Table 2). This large increase in activity at night is also evident on the stationary hydrophone array (See Figure 3A). Almost every day C-Lover can be picked up for extended periods of time on hydrophone 1, indicating that he is remaining fairly stationary as I observed during tracking, but each night with few exceptions, his signal disappears (Figure 3B). This means that he moves out of the 1 kilometer listening radius of the hydrophone. Generally he was not seen on the array again until the next morning. Fourier analysis of the hydrophone data revealed that C-Lover has a ten hour cycle of presence and absence. This may be slightly skewed because day length is not equal to night length.

Similar behavior can be observed for Big Mike (110). During the day, this fish remained in approximately the same position (Figure 2C, day) in about 7.6 meters (Table 2) of water. Again, when the sun began to set the fish showed a large increase in movement both into shallower water (4.6 meters, Table 2) and out into the middle of the river (Figure 2C, night). While Big Mike did not cover as much distance as C-Lover, he did move much more rapidly during the crepuscular period than during the day, also supporting my theory. Unfortunately, this fish prefers habitat that is out of range of any of the stationary hydrophones, so no presence and absence data is available.



Figure 2A: Map of day (left) and night (right) movements of Phenix (122) recorded during tracking in Great Bay. Yellow points represent movements immediately after surgery.



Figure 2B: Map of day (left) and night (right) movements of C-Lover (102) recorded during tracking in Great Bay. Tracking was not possible immediately after surgery.



Figure 2C: Map of day (left) and night (right) movements of Big Mike (110) recorded during tracking in the Mullica River. Yellow points represent movements immediately after surgery.

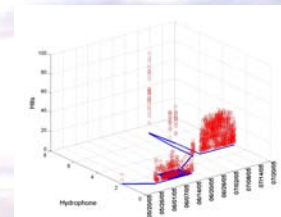


Figure 3A: Graph of movement for two fish consecutively tagged with code 122 (Phenix on 6/29/05) in the stationary array. The peak at 7:02/05 represents movement of the second fish up the river after surgery.

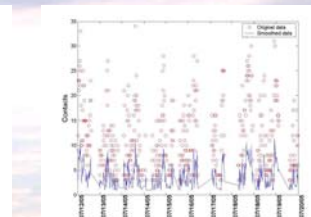


Figure 3B: Graph of C-Lover's movement on the stationary array. Peaks represent presence on hydrophone 1.

Table 1: Summary of tracked striped bass characteristics

Fish Code	Fish Name	Date Tagged	Location Caught	Fork Length (cm)	Weight (kg)	Number of times fish found after tagging	Total hours tracked
122	Phenix	6/29/2005	RUMFS Boat Basin	64.14	2.27	8	15.73
110	Big Mike	6/30/2005	Mullica River (Blood Point)	59.69	---	6	9.35
102	C-Lover	7/1/2005	Goose Bar (behind Holgate)	82.55	7.27	6	14.37

Table 2: Environmental data recorded during tracking

	Phenix (122)		Big Mike (110)		C-Lover (102)	
	Day	Night	Day	Night	Day	Night
Average Depth (m)	12.5	---	7.6	4.6	12.0	5.6
Average Surface Temperature (°C)	21.7	23.5	27.3	24.9	25.8	22.8
Average Bottom Temperature (°C)	21.3	23.7	27.1	24.7	25.3	22.8
Average Surface Salinity (ppt)	28.5	26.9	17.1	22.6	28.6	29.5
Average Bottom Salinity (ppt)	26.2	27.8	17.7	23.7	28.7	29.5
Average Surface Dissolved Oxygen (mg/L)	6.62	5.70	5.15	5.89	5.89	6.49
Average Bottom Dissolved Oxygen (mg/L)	6.92	6.09	5.23	6.08	5.93	6.77
Average pH	7.46	7.40	7.19	---	7.39	7.72

DISCUSSION AND CONCLUSION

While passive telemetry cannot offer details of where a fish moves at night, it does corroborate the behavior I observed while tracking and therefore supports my hypothesis that striped bass are more active during the crepuscular period. Despite the fact that C-Lover is a bay fish and prefers a more saline, colder environment than Big Mike, a river fish, the two demonstrate similar crepuscular behavior, indicating that there may be little difference between bay fish and river fish activity during this time. This also means that the increase in activity is most likely due to the decrease in the intensity of light rather than the other environmental factors such as salinity, temperature, and dissolved oxygen.

Phenix (122) is the least dynamic of the fish I tracked. It appears that during the day and night he stays in approximately the same position fairly close to the bank and near a steep drop-off (Figure 2A). It is possible that the fish stays on the deep side of the drop-off during the day to avoid the most intense sunlight, then goes to into shallower water near sunset. This type of movement vertically in the water column, but in the same area can not be detected with the mobile hydrophone.

All three of these fish were tagged within the past month. It appears that while their behavior immediately after tagging was atypical for striped bass, within a week of the surgery the fish were behaving in the expected manner based on movement and habitat use data collected for fish that had been tagged for over a month. It was not possible to track C-Lover immediately after tagging because of bad weather conditions, however I was able to track Phenix and Big Mike. Both of these fish stayed near the area where they were released during the hours following surgery (Figures 2A and 2C, yellow points). When I relocated them at later dates, they were near their release areas, but seemed to have selectively chosen a different location. This indicates that their behavior and habitat use after surgery is different from that of a healthy fish. Additionally, Phenix, a bay fish, was observed on hydrophone 7 up the Mullica River a few days after his surgery (Figure 3B). This is clearly atypical behavior as the fish was caught in the bay and located there eight separate times subsequent to its run up river (Table 1). This further supports that striped bass habitat use is very different during the days after tag implantation.

Acknowledgements

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