Ultrasonic Telemetry of Striped Bass X White Bass Hybrids in the Escambia River, Florida[1]

David M. Yeager, *Florida Game and Freshwater Fish Commission, Route* 1, *Box 79F, Holt, FL 32564*

Abstract: Biotelemetry studies of 13 striped bass *(Morone saxatilis)* x white bass *(M. chrysops)* hybrids in the Escambia River, Florida demonstrated positive affinity of the hybrids for saline waters. Average salinity at relocation sites ranged from 0.5 to 4.1 ppt at the surface and from 3.6 to 21.8 ppt on the bottom. Movements of hybrids in the river system appear to be strongly influenced by seasonal fluctuations in river discharge. Hybrids usually inhabited the lower, tidal delta of the river during periods of low and normal discharge and moved into the bay during times of high flow. No evidence of significant upstream emigration was observed. Two hybrids emigrated from the Escambia River estuary into adjacent river systems. Maximum movement recorded was 88 km.

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Morone hybrids were first produced in South Carolina in 1965 by crossing male white bass, with female striped bass (Stevens 1965). Since this initial development, several other states have successfully produced *Morone* hybrids. In 1972, Florida began development of a hybrid stocking program as an alternative to striped bass stocking which had met with limited success (Ware 1978). Preliminary studies demonstrated that hybrids had better survival and faster growth in early life than striped bass (Logan 1967, Ware 1974, Williams 1970). Subsequent hybrid studies dealt principally with hybrids introduced into freshwater impoundments (Crandall 1978; Germann and Harrington 1979; Williams 1971).

There is little published information on movements of hybrids in rivers or estuarine environments (Crateau et al. 1980, 1981). Information is needed to determine the affinity of this hybrid for saline water, and whether stocked fish will remain in freshwater sections of the river system or migrate into saline estuaries. Creation of, or supplementing sport fisheries is one of the

1 Contribution from Federal Aid to Fish Restoration Project F-36, Florida.

goals of hybrid introductions. To achieve this goal, it is necessary to know where and when the fish will be available to fishermen. The purpose of this study was to determine seasonal movements of hybrids by biotelemetry. An effort was also made to determine salinity and temperature preferences.

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Mefhods

The Escambia River is a temperate-zone river in northwestern Florida, characterized by slightly acidic, soft water (Bass and Hitt 1978). The river is 148 km long and drains approximately 10,878 km² of Florida and Alabama. In Alabama, the river is called the Conecuh River and the entire river system is often referred to as the Conecuh-Escambia River system. Escambia Bay is relatively shallow with depths ranging from 0.5 to 6 m and averaging 2.4 m deep at mean low water with a surface area of 9838 ha (U.S. Environmental Protection Agency 1971). During normal low water periods saltwater intrusion from the bay can occur up river as far as 13 km.

Fingerling hybrids produced from male white bass and female striped bass were stocked into the Escambia River, Florida in the spring of 1978 and each successive year through 1981. A total of 561,600 were stocked in 1978, 121,850 in 1979, 507,000 in 1980 and 510,876 in 1981. These fish were stocked throughout the river system in Florida.

Hybrids were subsequently collected from the southern, delta portion of the river with 8.9-, 10.2-, and 12.7-cm stretch-mesh sinking gill nets measuring 45.7 m in length by 1.8 m in depth. All nets were set from the bank, perpendicular to the shoreline. Most fish equipped with transmitters were weighed and measured, although lengths and weights were estimated for 4 fish for fear that additional handling would result in excessive stress. Ultrasonic telemetry equipment manufactured by Mr. Don Brumbaugh of Tucson, Arizona and Smith-Root, Inc. of Vancouver, Washington was employed to investigate seasonal movements and distribution. Both temperature sensing and standard ultrasonic transmitters in the 74 kHz range were used.

Tagging procedures were similar to those used by Schaich and Coutant (1980) and Waddle et al. (1980) on striped bass in Tennessee. Ultrasonic transmitters were modified for external attachment. Approximately 300 mm of plastic coated 20-pound test steel wire was fastened to each transmitter by Slipping 3 14-mm diameter rubber "O" rings over the wire and transmitter. The "O" rings were coated with epoxy to secure them and the wire to the transmitter, forming a harness. Fish to be tagged were removed from gill nets and placed in a floating cage to make certain they were upright and swimming prior to tagging. They welre then anesthetized by placing them in a trough con-

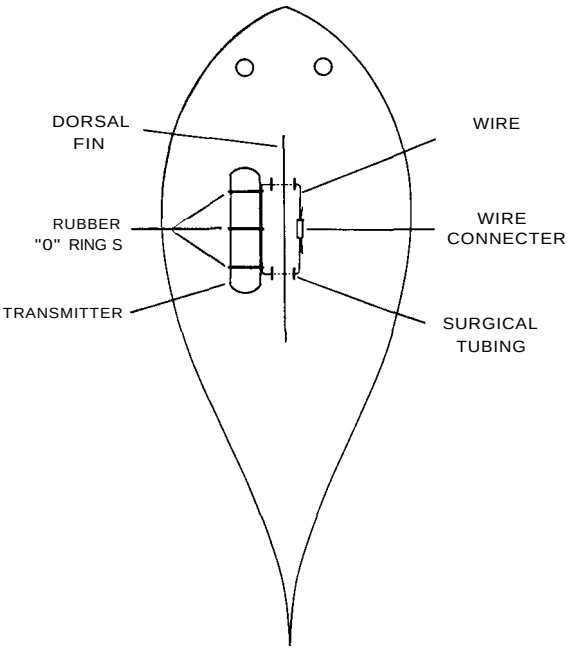

Figure 1. Dorsal view of externally attached transmitter.

taining 80 mg/l of MS222 (tricaine methanesulfonate) dissolved in water. Upon anesthesia (approximately 3 to 5 minutes) an I8-gauge, 5-cm long hypodermic needle was inserted through the fish approximately I to 1.5 cm below the front dorsal fin. One end of the wire attached to the transmitter was inserted through the fish via the needle bore, and the needle drawn back through the fish exposing the wire. This procedure was repeated in the same manner approximately 4 cm posterior to the first wire. Both ends of the harness wire were then inserted through a non-insulated 16- I8-gauge solderless wire connector and drawn tight, insuring that the transmitter fit snugly against the fish. The wire connector was then closed with electrical crimping pliers (Fig. I). During the tagging procedure, the harness wires were inserted through 6-mm pieces of I2.7-mm diameter surgical tubing cut in half lengthwise. These shields were placed on both sides of the fish to prevent the wire from eroding the flesh. Immediately after tagging, fish were placed back into the holding cage until revival and then released. All tagged fish were released at or near their capture site. The entire tagging procedure, less the time required for anesthesia, took <3 minutes to complete.

Later in the study, the tagging procedure was further modified by placing plastic strips around the transmitter between the "0" rings to keep them

from sliding together. Both wires were also inserted through a 3.8- by 0.6-cm plastic strip after insertion through the fish for further support.

Attempts were made to locate fish at least twice a week. Surface and bottom salinity and tempe:rature measurements were made at each relocation site. Hybrids equipped with temperature sensing transmitters provided data on water temperature preference. During the fall and spring months when the surface and bottom water temperatures were significantly different, the approximate depth of the fish and salinity at that depth were determined by constructing temperature and salinity profiles of the water column with a Yellow Springs Instrument Company SCT meter. Water discharge data for the Escambia River was obtained from the U.S. Geological Survey, Tallahassee, Florida.

Results

Movements of 13 hybrids equipped with ultrasonic transmitters were monitored from November 1980 through January 1982 (Table 1). Tagged fish ranged from 374 to 495 mm total length and from 817 to 1,589 g in weight. The first 10 fish were captured, tagged, and released at Site A at the confluence of East River and Escambia River or just inside East River, fish numbers 11 and 12 at Site B at the confluence of Gonzalez Lake and Escambia River, and the last (number 13) at Site C at the confluence of Thompson's Bayou and Escambia River (Fig. 2). All tagging locations were within the tidal portion of the river. Movements of fish Number 10 were fol-

Table 1. Summary of Biotelemetry Data for 13 Hybrids Tagged With Ultrasonic Transmitters

Fish No.	Total Length (mm)	Weight (g)	Date Tagged	Date Terminated	Reason Terminated	Days Active
1	483[a]	1,300[a]	*11/12180*	*12105/80*	Shed	24
2	406[a]	900[a]	11/12/80	05/04/81	Shed	168
3	495	1,453	*11112180*	*02121/81*	Recaptured	64
4	430	888	11119/80	*12118/80*	Tag Failed	28
5	472	1,135	11119/80	*02105/81*	Lost	48
6	429	1,271	*01129/81*	*03/17/81*	Tag Failed	48
7	471	1,407	03/19/81	*03124181*	Lost	6
8	375	863	*08/20/81*		Lost	
9	374	817	*09/02181*	*09122/81*	Recaptured	21
10	420	1,180	09/02181	03/15/82	Lost	195
11	443	1,271[a]	*10/08/81*	*10/09/81*	Lost	1
12	420	1,089[a]	10/08/81	12121181	Recaptured	15
13	480	1,589	11/19/81	*01125/82*	Lost	76

• Estimated lengths and weights.

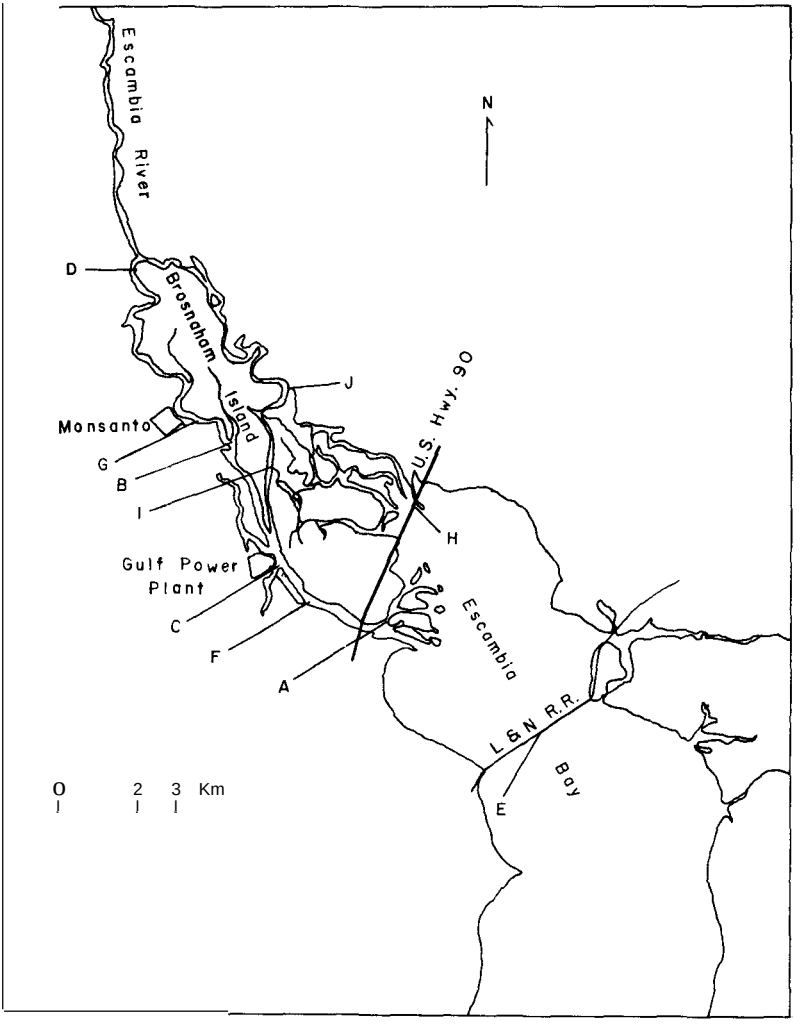

Figure 2. Hybrid tagging sites and relocation sites of fish Numbers 10, 12 and 13 in the Escambia River delta.

lowed for 195 days; however, fish 8 was never relocated and fish 7 and 11 were relocated only once.

Movements

Tagged hybrids tended to follow the shoreline when actively moving. Inactive fish were usually associated with structures or points of land where river currents were strongest. Hybrids were most frequently relocated in the lower river from the southern tip of Brosnaham Island to the river mouth. Fish 1, 4, 5, and 9 were never relocated more than 1.6 km from where they were released (Fig. 2, Site A). The transmitter on fish 4 failed after 28 days and fish 1 shed its tag after 24 days. Fish 9 was recaptured under the U.S. Highway 90 bridge 21 days after its release. After heavy rains and subsequent flooding of the river in early February 1980, fish 2, 3, and 5 could not be relocated in the river. Two weeks later, fish 3 was recaptured in Perdido Bay on the Florida-Alabama boundary, approximately 88 km from its last recorded location. Fish 2 was relocated once in northern Escambia Bay approximately 180 m offshore on February 19, and was not relocated again until late April when the fish was found under the U.S. Highway 90 bridge in the lower river. The movements of this fish were followed for several more days before the tag was shed. During this time, the fish remained under the Highway 90 bridge during the day and moved into East River at night. It is assumed that fish 5 also moved out of the Escambia River system in February and was lost. Fish 6 was the only tagged hybrid that was found in the river during the high water period. However, there were several occasions when this fish could not be located after extensive searches of the lower river and upper bay indicating it may have been moving between the bay and the river.

Fish 10, which was tracked for the longest period of time, also exhibited the most movement. Movements of this fish were recorded in the river from the northern tip of Brosnaham Island, approximately 14 km north of the river mouth, to the L & N Railroad trestle in northern Escambia Bay, approximately 5 km south of the river mouth (Fig. 2, Sites 0 and E). This fish, which was tagged in early August 1981, was always relocated in the river between the southern end of Brosnaham Island and the river mouth during that month. In October, fish 10 was found most often between the Monsanto Chemical Plant and the southern end of Brosnaham Island. It was also during this time that the fish was found at its furthest point up river at the north end of Brosnaham Island. This fish was always located between the Monsanto Chemical Plant and the mouth of the river during November and December. From October through December, this fish was relocated 12 times in heated water of a thermal discharge from the Monsanto Chemical Plant (Site G) and a power plant (Site F). Fish 12 and 13 were also found in these warm

water areas at times. After the river began to rise in early January 1982, fish 10 moved out of the river and was relocated in northern Escambia Bay associated with the L & N Railroad trestle. From mid-January, this fish was periodically relocated at the trestle until mid-March, when the signal was lost.

Fish 12 and 13 occupied much the same area as fish 10 with 2 exceptions. Fish 13 was found once under the U.S. Highway 90 bridge at the mouth of Simpson River (Site H) and fish 12 left the main river channel and was relocated several times at the confluence of White and Little Rivers (Site 1) and White and Big Simpson Rivers (Site J). On January 12, 1982, this fish was followed out of the river and into the bay and the signal lost. One week later, this same fish was recaptured in the Blackwater River approximately 45 km from its last recorded location.

During the period in which this paper was written, fish 10, which was assumed lost, was relocated in the southern, tidal portion of the Escambia River delta on May 21, 1982. Fish 13, which was also assumed lost, was recaptured in northern Escambia Bay, northeast of the river mouth on May 2, 1982.

Salinity and Temperature Preference

Hybrids were located in water with at least some salt concentration 97% of the 184 times that salinity readings were made. Average salinity readings taken at each relocation site ranged from 0.5 to 4.1 ppt on the surface and from 3.6 to 21.8 ppt on the bottom (Table 2). Fish 3, 7, and 13, equipped with temperature sensing transmitters, were pinpointed at depths ranging from I to 7 m. where salinity concentrations ranged from 4.2 to 33.0 ppt (Table 3). Except for the low reading of 4.2 ppt when fish 3 was located in heated water just below the thermal discharge canal of the Gulf Power Plant, these 3 fish were always found near the bottom of the river where salinity concentrations were highest. Average surface and bottom temperature readings ranged from 12.0 to 27.7 C and from 13.7 to 29.4 C, respectively. Fish tagged with temperature sensing transmitters were located at water temperatures ranging from 9.5 to 25.0 C.

Discussion

The tagging procedure employed in this study did not appear to adversely affect normal activity of the fish. Fish 3 and 12 demonstrated significant movements, as they were eventually recaptured 45 and 88 km from their original tagging locations. All 3 recaptured fish were caught with other unmarked hybrids. Unmarked hybrids were also taken by angling at locations where tagged fish were present. Of the 3 fish recaptured, 2 were caught by anglers, indicating active feeding. Fish 12, which was recaptured and re-

Table 2. Temperature and Salinity Ranges and (Means) Taken at Hybrid Relocation Sites

Fish No.	Time Period	Times Relocated	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Temp. (C)	Bottom Temp. (C)	Times Recorded
1	11/12/80-12/05/80	14	1.5-5.2 (2.8)	3.8-25.0 (17.8)	13.0-19.0 (15.6)	16.0-21.0 (18.0)	9
2	11/12/80-05/04/81	35	0-11.5 (3.5)	0-36.0 (16.6)	6.9-27.0 (15.0)	10.9-26.0 (15.9)	25
3	11/12/80-02/21/81	22	0.2-7.0 (2.7)	1.1-33.0 (21.8)	6.9-16.5 (12.0)	9.8-18.0 (13.8)	18
4	11/19/80-12/18/80	9	0.5-7.0 (3.4)	4.4-24.0 (15.5)	12.8-17.5 (14.8)	15.0-18.0 (16.0)	8
5	11/19/80-02/05/81	21	1.1-10.5 (4.1)	4.4-28.0 (17.3)	6.9-16.5 (12.3)	10.0-18.0 (13.7)	20
6	01/29/81-03/17/81	7	0-2.6 (0.5)	0-9.4 (3.6)	10.0-18.0 (14.7)	12.4-18.0 (14.9)	6
7	03/19/81-03/24/81	1	1.5-3.8 (2.7)	23.0-25.0 (24)	15.9-17.0 (16.5)	17.0-18.0 (17.5)	2
9	09/02/81-09/22/81	11	1.9-4.6 (3.3)	14.0-22.1 (17.0)	25.0-29.5 (27.7)	28.5-30.0 (29.4)	6
10	09/02/81-03/15/82	85	0-9.8 (3.4)	0-21.0 (14.4)	8.8-29.0 (18.9)	10.0-29.6 (19.8)	47
11	10/08/81-10/09/81	1	2.5 -	19.1 -	26.0 -	27.0	
12	10/08/81-12/21/81	41	0-19.5 (4.0)	4.7-19.5 (14.1)	10.5-26.0 (18.4)	12.0-27.0 (19.9)	29
13	11/19/81-01/25/82	17	1.0-8.5 (3.6)	5.3-18.2 (13.0)	8.8-24.8 (15.3)	10.0-24.8 (15.7)	13

Table 3. Temperature and Salinity Readings Taken at Depths Occupied by 3 Hybrids Tagged With Temperature Sensing Transmitters

Date	Depth of Fish (m)	Temperature at Depth of Fish (C)	Salinity at Depth of Fish (ppt)	Salinity Range (ppt)
12/18/80	4.0	15.5	22.2	3.0-22.2
12119/80	3.5	15.5	23.5	4.2-23.5
12129/80	4.0	12.0	20.5	1.2-20.5
12131180	1.0	14.8	4.2	3.0-26.0
01105/81	4.0	11.4	25.0	1.4-25.0
01113/81	6.0	10.8	26.0	1.1-26.0
01121181	7.0	10.0	33.0	3.0-33.0
03/24/81	3.0	16.8	25.0	1.5-25.0
11124/81	2.5	16.8	13.0	3.8-18.2
11125/81	4.5	17.5	13.5	2.1-13.5

turned to project personnel after 75 days at large, exhibited a condition factor (Ksl) of 2.75 and had food organisms in its stomach. This condition factor is comparable to those of other fish of the same size class collected during the same period of time.

Movements

Movements of hybrids in the Escambia River system appear to be strongly influenced by seasonal river discharge fluctuations (Fig. 3). Hybrids were most often found in the lower, tidal portions of the river during periods of low and normal water levels. During times of rising water, hybrids moved out of the river into Escambia Bay and sometimes into adjacent river systems as indicated by recaptured hybrids from the Blackwater River and Perdido Bay. (The presence of other, untagged hybrids in these 2 river systems has subsequently been verified. Twelve were collected from the Blackwater River and 1 from the Perdido River.) There has been no indication that hybrids make a spawning run up the Escambia River, however, there have been confirmed reports of fishermen catching hybrids in the upper river in Alabama (M. Newman, pers. commun.). Crateau et al. (1980) reported substantial movements by 13 of 422 marked hybrids in the Apalachicola River, Florida, 9 of which moved upstream a distance of 6.4 to 171.2 km and 4 of which moved downstream 11.2 to 163.2 km.

Salinity and Temperature Preference

There is strong evidence that hybrids prefer brackish water. Hybrids were almost always found in waters containing at least some salt. When the depth of the fish could be determined, it was usually near the river bottom where salinity was highest. Several hybrids moved into the brackish water of

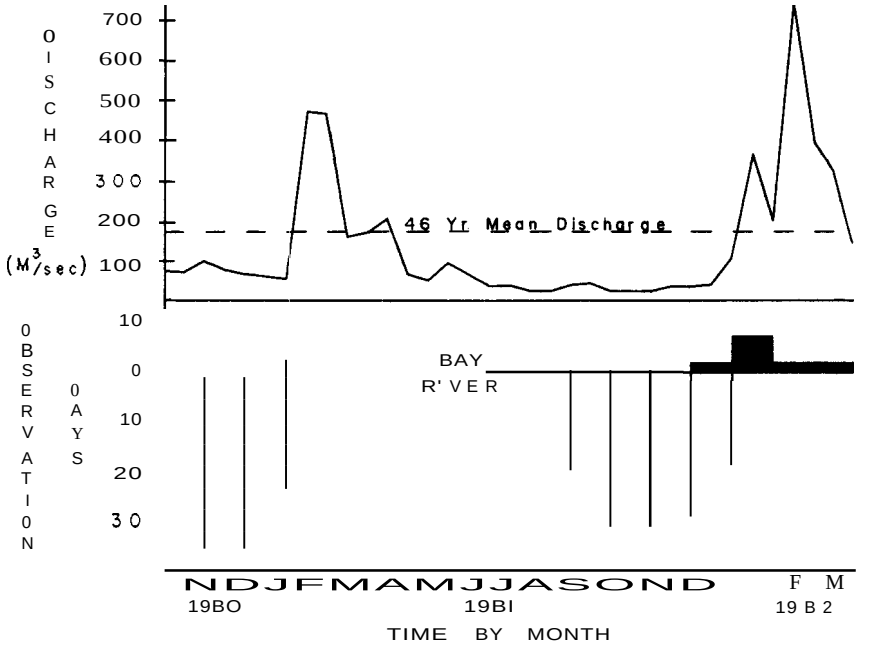

Figure 3. Relationship between hybrid location and river discharge.

the bay when water levels in the river rose and salinity decreased due to heavy rains. The fish which traveled from the Escambia River to Perdido Bay passed through either the saltwaters of the Gulf of Mexico or the Intracoastal Waterway. Kerby et al. (I97r) reported hybrids were caught in the Rappahannock River, Virginia where salinities varied from fresh water to 17 ppt.

In addition to 13 original hybrids (white bass male X striped bass female) tagged with ultrasonic transmitters, 2 adult reciprocal hybrids (white bass female X striped bass male) were collected from a lake in northeastern Florida and tagged, and released in freshwater approximately 20 km north of the Escambia River mouth. Two weeks later, both reciprocal hybrids had moved downstream into the lower river where salinities ranged from 1 to 18 ppt. This migration also seems to verify a preference for brackish water.

Enough temperature data was not gathered to ascertain temperature preference of the hybrids. Water temperatures where hybrids were relocated during the winter months varied greatly, ranging from 9.5 to 25.0 C. Salinity rather than temperature may be the principal factor determining habitat selection by the hybrid in an estuarine environment.

Hybrids of size classes other than those tagged in this study may have

different salinity or temperature preferences. U.S. Fish and Wildlife Service personnel have rarely collected hybrids in excess of 2 kg in the estuary of the Apalachicola River, Florida indicating that larger hybrids may not inhabit brackish water areas (C. M. Wooley, pers. commun.). Coutant (1981) reported striped bass appear to have a changing thermal niche with age. Hybrids may also exhibit this characteristic to some extent. Further work is needed to determine water quality preference of all hybrid size classes in river and estuarine environments.

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