Angler Use and Stocking Evaluation of a Coastal River Fishery in Southwest Alabama

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Abstract: Hybrid striped bass *Morone saxatilis* x *M. chrysops*, channel catfish *Ictalurus punctatus*, and blue catfish *I. furcatus* were tagged and stocked to assess the potential for recreational fishery enhancement in a coastal Alabama river. Creel and mail surveys were completed to evaluate the existing fishery and success of fish stocking. After adjusting for angler tag reporting, tag loss, and mortality, catch rates were 2%, 11%, and 17% for blue catfish, channel catfish, and hybrid striped bass, respectively. No directed angler effort was recorded for any stocked species and catch rates did not increase over time. Estuarine species, such as speckled seatrout *(Cynoscion nebulosus)*, white trout *(Cynoscion arenarius)*, and red drum *(Sciaenops ocellatus)*, comprised over 67% of targeted effort and 58% of the catch. Bluegill *(Lepomis macrochirus)*, redear sunfish *(Lepomis microlophus)*, largemouth bass *(Micropterus salmoides)*, and crappies (*Pomoxis* spp.) were the most targeted freshwater species. Angler surveys suggest that resident freshwater and estuarine fish were important and supplemental stocking of fish did not create the desired effect on this fishery.

Key words: coastal, river, creel, hybrid striped bass, channel catfish.

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Hybrid striped bass have been stocked throughout the southeast to establish popular sport fisheries. Most studies of hybrid striped bass focused on small lake or reservoir fisheries (e.g., Moss and Lawson 1982, Morello 1984). However, few studies have focused on fishery assessments in coastal rivers. Tucker (1989) stocked striped bass and hybrid striped bass to enhance the sport fishery in the river delta of Mobile Bay. Hybrid striped bass were also introduced into coastal Florida rivers with existing fisheries near large metropolitan areas (Young 1984, Yeager 1985).

In Alabama, coastal rivers are of high interest to anglers because of the abundance of important recreational fish species (Tucker 1979, Lucas 1983). Baldwin County, one of only two coastal Alabama counties, has a rapidly growing population that increased 43% from 1990 to 2000 (2001 population 145,799; U.S. Census Bureau 2002). Expansion of human populations will increase the demand for productive fisheries in coastal rivers. To meet this demand, the Alabama Division of Wildlife and Freshwater Fisheries (ADWFF) has stocked hybrid striped bass in Fish River and three other coastal rivers since 1996. To date, assessment of stocking hybrid striped bass in these rivers has not been addressed.

The objectives of this study were to document angler effort, catch, and species

preference within Fish River and assess the stocking of hybrid striped bass. Stocking of channel catfish and blue catfish, popular with anglers in local rivers and Alabama community fishing programs, was also assessed.

Methods

Fish River is a tidal (mean fluctuation 0.3–0.5 m) river that is located in Southwest Baldwin County, Alabama. The Fish River watershed is 409 km^2 and mean annual discharge is approximately 6.8 $m^3 \cdot s^{-1}$. Fish River and Magnolia River encompass the major drainages of Weeks Bay, a large estuary draining into Bon Secour and Mobile bays. The study area has 14.4 km of navigable water. Two access ramps are available for anglers. One is located at the mouth of Fish River near U. S. Highway 98 and the other is 8.4 km upstream. Most of the study area is bordered by individual residences. The lower portion is protected from development by the Weeks Bay National Estuarine Research Reserve (WBNERR).

To evaluate angler utilization rates, hybrid striped bass, channel catfish, and blue catfish were tagged and stocked in Fish River. Prior to stocking, fish were maintained in earthen ponds, fed commercial pelleted food, and tagged at the ADWFF Marion Fish Hatchery, Marion, Alabama. Fish were tagged using Floy brand (model FM-95W) polyethylene internal anchor tags with 5-×19-mm disks, 51-mm sheathed streamers, and attached in the upper abdomen of each fish. The streamer and disk of each tag were individually numbered. Each tag also had a printed mailing address and phone number for anglers to report captured fish. During tagging, a random sample of fish was measured for total length (nearest mm). Tagged fish were monitored for tag loss and mortality for 24–48 h prior to stocking. Delayed mortality (60 d) was assessed for channel catfish by counting fish remaining in earthen hatchery ponds. Hybrid striped bass and channel catfish were stocked in Fish River during January and December 1999 and January 2000. Blue catfish were stocked only in 2000.

Informational signs about tagged fish and stocking activities were posted and maintained at access ramps and fish camps on Fish River. Tag returns were recorded when anglers reported catching tagged fish. These anglers received a thank you letter with information about the project. No monetary reward was offered for fish tag returns.

Angler creel interviews were performed for parties that completed trips at access sites only. Creel surveys were done on 40 dates during October 1999 through September 2001. The creel design followed modified ADWFF access survey guidelines intended to maximize angler interviews, not determine total catch and effort (ADWFF 1999). Consequently, creel clerks interviewed for three to eight hours, and sample dates were randomized by site and weekend days during expected peak use. Angler use of access areas was monitored by frequently counting vehicles with trailers during the sample. Creels were performed at least once a month to reduce seasonal bias in catch data. Creels were rescheduled if needed to avoid sampling during poor weather conditions when fishing effort was low. All anglers in a party were interviewed individually when possible. The interview included questions about areas

fished, trip duration within each area, species targeted, catch, harvest and specific comments about trips within Fish River. Non-reporting rates for captures of tagged fish were determined by direct questioning of anglers ($N = 159$) during creels. When only one individual of a party could be interviewed, the data were expanded for all party members. Because the ADWFF only manages freshwater fish species, anglers targeting estuarine species were only asked basic questions about their fishing trip (i.e., effort, catch, and harvest) and fish were not counted or measured. Therefore, catch data from anglers seeking estuarine species are based on recall. Interviews with estuarine anglers were terminated when other anglers returned to access areas. This occurred during less than 5% of interviews.

Because some anglers fished in Fish River and other bodies of water during the same trip, separation of effort and fish caught within a given body of water was often not possible. Therefore, anglers and their associated catch data were grouped by areas they fished during each trip. Six separate or combined bodies of water were defined as bays combined (Mobile, Bon Secour, and Weeks Bay), bays and Fish River combined, Fish and Magnolia rivers combined, Magnolia River, and Fish River. The Fish River was split into lower and upper areas based on the access site where anglers were interviewed.

Surveys ($N = 204$) were mailed during March, July, and November 2001 to anglers who returned fish tags or agreed to follow-up surveys during creel interviews. Surveys consisted of 17 questions that asked anglers about their fishing experiences, species preferences, trip expenditures, hometown, and specific comments about Fish River. Surveys were accompanied by a stamped, return envelope. No monetary reward was offered for returns of mail surveys.

In all analyses, bream refer to bluegill and redear sunfish combined. Crappies are the combination of black crappie *(Pomoxis nigromaculatus)* and white crappie *(P. annularis)*. Chi-square analysis was used to test for differences in catch and harvest of fish species groups among areas fished. Differences in mean length at stocking were determined using *t*-tests. Differences in variance were tested using the variance ratio test. Unequal variances were determined for mean lengths of hybrid bass and Welch's approximate *t'* was used (Zar 1999). All analyses were tested at $P = 0.05$.

Results

Stocked blue catfish ranged from 210–345 mm TL. Channel catfish were 215–391 mm TL, and hybrid striped bass were 142–243 mm TL at stocking (Table 1). Mean total lengths were significantly different between stocking periods for channel catfish (*t*-test, df = 423, $P = 0.001$) and hybrid striped bass (*t*-test, df = 407, $P < 0.001$).

Initial 24- to 48-h tag loss was <1% for hybrid striped bass stocked during December 1999 and <1% for channel catfish stocked during January 1999. No initial tag loss was recorded for hybrids or blue catfish during January 1999 and 2000, respectively.

Initial 24- to 48-h tagging mortality was <1% for hybrid striped bass during

Table 1. Stocking rates, mean length at stocking, and adjusted tag return rates of fish species stocked in Fish River. Mean lengths at stocking were analyzed using *t*-tests and significant differences are denoted by asterisks at ($P < 0.001$).

Species	Stocking periods: month	Stocking periods: year	*N* stocked	Mean length mm (*N* sampled)			Returns: *N*	Returns: %	Returns: adjusted %
Blue catfish	Jan	2000	2500	261	(100)		9	<1	2.2
Channel catfish	Jan	1999	2908	293	(324)	*	41	1.4	9.4
	Jan	2000	2500	278	(101)		45	1.8	10.8
Hybrid striped bass	Jan	1999	1337	160	(443)		7	0.5	3.1
	Dec	1999	2135	188	(300)	*	59	2.8	16.6
Totals			11,380				161		

January and December 1999, respectively. Initial 24- to 48-h tagging mortality was <1%–7% for channel catfish stocked during 1999. No tagging mortality was observed for blue catfish or channel catfish stocked during January 2000.

Post-tagging mortality of channel catfish (60 d; $N = 107$) tagged during 1999 and held in hatchery ponds was 10%. There was 21% tag loss for channel catfish held to 60 d. These parameters were not determined for hybrid striped bass or blue catfish.

Initial tag return rates were <1% for blue catfish, 1% to 2% for channel catfish, and <1% to 3% for hybrid striped bass, respectively. Catch rates were adjusted for tag loss, tagging mortality, 60-d tag retention and mortality (channel catfish only), and tag reporting by anglers. Adjustments for tag reporting by anglers were determined during creel interviews for an overall report rate of 17%. Adjusted tag return rates were estimated as 2% for blue catfish, 9% to 11% for channel catfish, and 3% to 17% for hybrid striped bass (Table 1).

A total of 313 anglers within 156 angler parties were interviewed. These anglers fished 1444 h in saltwater bays and freshwater rivers. Only 1278 angler hours (88%) were targeted for specific fish species. Speckled seatrout *(Cynoscion nebulosus)* was the most common fish caught and harvested with the greatest amount of targeted effort (62%). Largemouth bass ranked second in amount of targeted effort, but lowest for harvest rate at 0.03 fish per hour. Mean total length of harvested largemouth bass was 290 mm. Bream were the third most targeted group and had the highest catch (1.31 fish/h) and harvest rates among all species or groups targeted. Mean total length of harvested bluegill was 175 mm, and harvested redear sunfish averaged 191 mm TL. Other fish targeted included crappies, red drum *(Sciaenops ocellatus)*, white trout *(Cynoscion arenarius)*, and southern flounder *(Paralichthys lethostigma)* (Table 2).

Among the six areas of water fished by anglers, targeted effort varied for freshwater and estuarine fishes (Table 3). Fish River was the most heavily utilized body of water with 1044 h (72%) of total effort. Anglers exclusively fishing this river comprised 844 h (66%) of total targeted effort.

Excluding anglers not targeting fish species, total catch for estuarine fish was significantly greater (68%) than that of freshwater species (χ^2 test, df = 5, $P = 0.001$).

Table 2. Targeted effort, catch, and harvest by species or groups across all areas in the Fish River watershed during October 1999 through September 2001. Column data represent sums and average rates of instantaneous counts during this period.

Species	Effort (hours)	Catch		Harvest	
		N	(*N*/h)	*N*	(*N*/h)
Speckled trout	787	420	0.53	169	0.21
Bream	155	203	1.31	103	0.67
Largemouth bass	231	81	0.35	6	0.03
Crappies	28	25	0.91	8	0.29
Red drum	47	14	0.30	5	0.11
White trout	21	6	0.29	4	0.19
Southern flounder	9	0	NA	0	NA
Totals	1278	749		295	

Table 3. Targeted effort and number of anglers targeting freshwater or estuarine species in the Fish River watershed during October 1999 through September 2001. Total catch and harvest data excludes anglers not targeting species but includes all fish caught. Column data reflect total sample size *(N)* and rates per hour (*N*/h). Areas of water sampled are organized by increasing distance from bays.

Areas of water fished	Anglers	Effort (h)		Catch *N* (*N*/h)		Harvest *N* (*N*/h)	
	N	freshwater	estuarine	freshwater	estuarine	freshwater	estuarine
Bays	28	0	102	0 (0.00)	150 (1.47)	0 (0.00)	70 (0.68)
Bays and Fish rivers	39	8	172	9 (1.12)	137 (0.80)	0 (0.00)	84 (0.49)
Fish and Magnolia rivers	14	4	64	9 (2.25)	63 (0.98)	0 (0.00)	10 (0.16)
Magnolia River	17	24	59	49 (2.00)	18 (0.31)	20 (0.82)	10 (0.17)
Fish River, lower	108	109	392	86 (0.79)	470 (1.20)	43 (0.40)	215 (0.32)
Fish River, upper	69	268	75	279 (1.05)	68 (0.90)	116 (0.43)	24 (0.32)
Total *N* (Mean *N*/h)	275	413	864	432 (1.05)	906 (1.05)	179 (0.43)	413 (0.48)

Total harvest of estuarine fish species was also significantly greater (70%) than that of freshwater species (χ^2 test, df = 4, $P = 0.001$). Mean catch rates were identical for both targeted freshwater and estuarine species at 1.05 fish per hour. Mean harvest per hour was lower for freshwater (0.43 fish/h) than for estuarine species (0.48 fish/h) of fish (Table 3).

Hybrid striped bass, channel catfish, and blue catfish were never targeted in the creel, and total catch always made up <1%. Mail surveys ($N = 89$ responses) asked anglers to rank the three species of fish they targeted, caught, and harvested most often. Compared to creel estimates, responses to mail surveys overestimated effort, catch, and harvest for stocked hybrid striped bass and blue catfish which was <4% (Table 4). Among the three species stocked, the mail survey ranked channel catfish with the highest percentage of effort (5%), catch (6%), and harvest (9%). Except for speckled seatrout and largemouth bass, the mail survey overestimated effort for six species of fish targeted in the creel. However, the mail survey underestimated catch

Table 4. Creel survey results are compared to mail survey results. Creel data reflect actual percentage of total effort, catch, and harvest by fish species for all anglers combined, including non-target fish. Mail survey data reflect percentages of summed responses by anglers for the "three most-preferred" species. Species are organized by decreasing catch in the creel survey.

	Creel survey % total			Mail survey % total responses		
Species	effort	catch	harvest	effort	catch	harvest
Speckled seatrout	62	33	30	26	28	26
White trout	2	18	25	10	9	10
Bluegill	11	18	19	11	13	10
Atlantic croaker	—	7	4	—	4	1
Largemouth bass	18	7	2	9	8	3
Red drum	4	4	4	22	19	18
Southern kingfish	—	4	6	—	—	—
Redear sunfish	1	3	5	4	3	2
Black and white crappies	2	2	1	4	3	4
Hardhead catfish	—	1	—	—	—	—
Sheepshead	—	1	1	2	1	<1
Southern flounder	<1	<1	<1	2	1	6
Hybrid striped bass	—	<1	<1	3	3	2
Striped bass	—	—	—	2	<1	6
Skipjack herring	—	<1	—	—	—	—
Atlantic stingray	—	<1	—	—	—	—
Warmouth sunfish	—	<1	1	—	—	—
Spotted sunfish	—	<1	<1	—	—	—
Black drum	—	<1	—	—	—	—
Spotted gar	—	<1	—	—	—	—
Mangrove snapper	—	<1	<1	—	—	—
Blue catfish	—	<1	—	—	<1	—
Channel catfish	—	<1	—	5	6	9
Chain pickeral	—	<1	—	—	—	—
Longear sunfish	—	<1	<1	—	—	—
Pinfish	—	<1	—	—	<1	—
Striped mullet	—	—	—	<1	<1	<1
Red snapper	—	—	—	<1	—	—
Total number or responses	1277	1429	621	252	224	219

and harvest for speckled seatrout, white trout, bluegill, and redear sunfish. Both surveys ranked speckled trout and bluegill number one and three with respect to percentage of effort, catch, and harvest.

When non-targeted fish were included in analyses, white trout comprised a large portion of catch and harvest among anglers. This species of fish was generally an incidental catch during the fall and early winter months for most anglers. This pattern was also true for Atlantic croaker *(Micropogonius undulatus)*, southern kingfish *(Menticirrhus americanus)*, hardhead catfish *(Arius felis)*, and sheepshead *(Archosargus probatocephalus)*. Conversely, red drum are a highly prized fish among local anglers, but were overestimated in the mail survey compared to creel estimates.

Discussion

Anglers were readily expected to exploit the hybrid striped bass, blue catfish, and channel catfish stocked during the winter months of 1999 and 2000. This is particularly true for catfishes and Morones which are the third and fourth most popular groups of sport fish among Alabama anglers (U. S. Department of the Interior 2002). However, species stocked during this study were never targeted and made up <1% of the total catch combined. These results are surprising since angler awareness about the fish stocking project was 30% in 2000 and 36% during 2001.

The moderate return rate of stocked channel catfish and blue catfish was probably not related to stocking of small fish. Despite an assemblage of predators in the Fish River watershed, stocked channel catfish and blue catfish were large enough to avoid predation with average lengths >260 mm TL. Storck and Newman (1988) suggested that channel catfish should be stocked at sizes greater than 200 mm to reduce mortality by potential predators. However, predation may have been a factor for hybrid bass which, on average, were much smaller than those stocked by Yeager (1994). In the Escambia River, stockings of 215–252 mm hybrid striped bass were highly successful and comprised a substantial portion of the total effort and catch (Yeager 1994). Small size at stocking may have limited the success of hybrid striped bass.

Hybrid striped bass are highly mobile, and emigration of fish from study sites may have reduced the population of fish available to anglers. In this study, five hybrid bass were captured and reported from outside the Fish River watershed. Yeager (1982) found that two of 13 hybrid bass fitted with ultrasonic tags moved to other bodies of water outside the Escambia River delta. He suggested that hybrid bass actually prefer water with measurable salinities and may emigrate to find suitable brackish waters. Unlike hybrid striped bass, this emigration pattern was not observed in channel catfish and blue catfish in Fish River. Channel catfish and blue catfish prefer less brackish waters with salinities of 1.4 and 3.7 ppt, respectively (Perry 1966). At the mouth of Fish River, salinity ranged from 0.1 to 25.2 ppt (S. Phipps, WBNERR, unpubl. data). Most reports of tagged catfish came from the upper reaches of Fish River. Hale et al. (1986) found that over 51% of tagged and recaptured catfish moved upstream from an estuarine area of a coastal river, while 26% moved downstream. It is probable that higher salinities of the lower Fish River watershed prevented most of the migration of catfish from the study area.

Return rates of tagged fish stocked during this study were similar to those of previous studies. Tucker (1989) obtained a 7% overall return rate for tagged hybrid bass in the Mobile Delta. In Florida, Yeager (1994) achieved tag return rates from 7% to 11% for palmetto and sunshine bass hybrids. In Fish River, return rates of hybrid striped bass were not different from these studies. Return rates of channel catfish from this study were similar to results of Hale et al. (1986), where tagged catfish were returned at a rate of 11% from the St. Johns River. Modest return rates for tagged fish stocked in Fish River were confounded by several factors, including possible long-term tag loss, mortality, and low angler reporting rates.

Initial 24- to 48-h tag loss and mortality were low for all hybrid striped bass

stocked in Fish River. Long-term tag retention and mortality estimates were not derived for this species. Henderson-Arzapalo et al. (1999) obtained an 11% post-tagging mortality of juvenile striped bass during the initial 14 d of an anchor tag evaluation study. These researchers obtained greater than 55% survival to 180 days using tag designs similar to those used during the current study. Van Den Avyle and Wallin (2001) estimated the retention of t-bar anchor tags as 0.94 at 4 months, 0.64 at 16 months, and 0.33 at 28 months. They suggested that low retention of tags was not suitable for long-term studies of striped bass that are <250 mm. Hybrid striped bass stocked in the current study were small and similar in size to fish stocked by Van Den Avyle and Wallin (2001). Unaccounted tag loss and mortality may have occurred for substantial numbers of hybrid striped bass stocked in Fish River.

Long-term tag loss and mortality data are lacking for all species in this study. The inability to account for these factors reduced the efficacy of the fish tagging program. Only channel catfish were studied for tag loss and mortality up to 60 d. Combined mortality and tag loss rates for channel catfish held in hatchery ponds were high (29%). Moreover, 20% of channel catfish with tags attached after 60 d were in the process of expelling them. The most common observations were inflamed eruptions on the ventral abdominal area where internal disks were forced out of the body through the skin (N. Nichols, ADWFF, pers. commun.). Hale et al. (1983) obtained a tag retention rate of 97% for white catfish *(Ictalurus catus)* and channel catfish tagged with Floy brand (model FD-68B) anchor tags. These authors also yielded a survival rate of 86% for white catfish and channel catfish stocked and held in hatchery ponds for 184 d. Buckmeier and Irwin (2000) tagged channel catfish using the same tag model as in Hale et al. (1983). Tag retention in their study decreased from 100% at 97 d to 71% at 270 d. Both authors tagged fish near the posterior portion of the dorsal fin. Buckmeier and Irwin (2000) further suggested that, because tags were inserted through the dorsal ray pterygiophores, tissue at this location may retain tags better than at other locations. Channel and blue catfish in the current study were tagged slightly above and anterior to the pelvic fin. This tag location may have hastened tag expulsion by catfish. Anglers reporting tagged fish were questioned about the condition and tag firmness at the insertion point within the fish. Many reported what appeared to be infected wounds at the tag insertion point.

Because angler catches during the current study were small and protracted over time, high tag losses or mortalities of these magnitudes are unacceptable for long-term evaluations of stock utilization. Moreover, a large portion of adjusted tag return rates are based on reporting rates derived during angler interviews. Since correction for long-term mortality and tag retention was not possible, angler catch rates of stocked fish are conservative assuming all adjustments are accurate.

This investigation successfully described the importance of freshwater and estuarine species within the Fish River watershed. Similar data have not been published for any other coastal systems in Alabama. Bream, crappies, speckled seatrout, and largemouth bass are important to anglers within Fish River, possessing the highest catch rates for all fish compared. However, largemouth bass had the lowest harvest rate among all targeted species. This is expected, in part, due to a no-consumption

mercury advisory for all largemouth bass within Fish River since early 2000 (Alabama Department Public Health 2003). Water quality problems, specifically mercury pollution, were the most common comments found during both creel (12.5% comments) and mail surveys (25% comments).

This project failed to establish a substantial fishery for stocked fish species which were never targeted and comprised a small portion of harvested fish. It is important to maximize efficacy of stocking programs by utilizing locally accepted species and sizes of fish. Before supplemental stockings of fish are undertaken in bodies of water where a particular species does not exist, biologists may consider small-scale studies to examine the potential contribution to existing fisheries.

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