Dimorphic Growth Patterns on Scales of Striped Bass and *Morone* Hybrids from a Central Alabama River

Thomas D. Bryce,[1] *Alabama Cooperative Fishery Research Unit,*[3] *Auburn University, AL 36849*

William L. Shelton,[2] *Alabama Cooperative Fishery Research Unit,*[3] *Auburn University, AL 36849*

Abstract: Striped bass *(Morone saxatilis)* and *Morone* hybrids were studied in the Tallapoosa River downstream of Thurlow Dam from March through November 1980. Age and growth analysis revealed that over 80% of the striped bass scales had numerous false annuli, while none were observed on *Morone* hybrid scales. The presence of false annuli indicated interruptions in normal growth during the mid- to late-summer period. These interruptions were attributed to striped bass preferential selection of cooler water temperatures in mid-summer. The striped bass are believed to spatially separate themselves from much of their food, resulting in a reduced growth rate until water temperatures subside in the fall.

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As early as 1965, the Alabama Department of Conservation and Natural Resources initiated their statewide striped bass stocking program with the release of Atlantic striped bass fingerlings into Lake Martin on the Tallapoosa River. In 1976 they began stocking the striped bass (♀) X white bass (♂) hybrid in Lake Martin and a Coosa River impoundment, Lay Lake. Despite the sizable stocking program, creel surveys and tagging studies indicated striped bass landings have been below expectation levels relative to striped bass stocked (Jerry Moss, pers. commun.). Concurrent with Ala-

1 Present address: Fish and Wildlife Section, DEH, Fort Stewart, GA 31314.

2 Present address: Zoology Department, University of Oklahoma, Norman, OK 73019.

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barna's low striped bass harvests, mass mortalities of striped bass in late summer had been reported in Cherokee and Percy Priest Reservoirs in Tennessee and Keystone Reservoir in Oklahoma (Coutant and Schaich 1980), and the Alabama River in south central Alabama (Jerry Moss, pel's. commun.). Coutant and Schaich (1980), working on Cherokee Reservoir, suggested that temperature preference behavior exhibited by striped bass may be a limiting factor if suitable habitat is not available. They observed striped bass seeking cool temperature refuges at the cost of low dissolved oxygen levels and reduced prey abundance. This preferential behavior is suspected to be the cause of the high mortalities in reservoirs and river systems that do not possess appropriate temperature-oxygen profiles.

Out of concern for the future of the striped bass population and fishery in the Alabama River system, the Alabama Department of Conservation and Natural Resources supported a I-year preliminary study to more accurately appraise the status of the striped bass and *Marone* hybrid introductions, to better understand the biology of the species and its hybrid, and to assess the impact and value of the resultant fishery. The following discussion stems from findings obtained during this investigation.

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Methods

The Tallapoosa River is located in east central Alabama with headwaters originating *in* northwest Georgia. The river flows south by southwesterly, merging with the Coosa River north of Montgomery, Alabama, creating the Alabama River and a passage to the Gulf of Mexico. The study area was restricted to that segment of the Tallapoosa River originating below Thurlow Dam at Tallahassee, Alabama, and extending approximately 15 km southward. Three man-made reservoirs are located on the Tallapoosa River: Lake Martin, Yates Reservoir, and Thurlow Reservoir, all of which were constructed for electric power generation and flood control. The study area encompassed the Fall Line which is characterized by rocky ledges and outcrops interspersed with numerous deep pools and channels. Due to variability of regional power requirements, sporadic generation periods subjected the river to highly variable water level fluctuation and discharge rates, both daily and seasonally.

From early March through late November 1980, striped bass and *Marone* hybrids were collected using variable mesh nylon and monofilament gill nets, electrofishing boats, and rod and reel. Lateral line scales were counted as a means to differentiate between the endemic Gulf Coast striped bass race and the introduced South Atlantic stocks (Barkuloo 1970). Scales

for age and growth determination were removed from the left side of each fish collected in the area below the lateral line and beyond the posterior end of the extended pectoral fin. Four to 5 scales per fish were cleaned and mounted between glass slides and examined on a Eberbach macro-projector providing a magnification of 43X. The magnified scales were examined by at least 2 observers as a means of reducing bias and verifying patterns of scale sculpturing. Additionally, relative abundance of striped bass and hybrids was compared by calculating an average monthly catch per hour of gill netting and electrofishing effort for each species.

Results and Discussion

During 9 months of collecting effort, 50 striped bass and 19 *Marone* hybrids were captured. All 50 striped bass were identified as belonging to the South Atlantic Coast race rather than the once abundant Gulf Coast race. During scale examination an obvious difference was noted in the appearance of striped bass and hybrid scales. The hybrid scales were aged without difficulty. They were characterized by a consistent and evenly spaced distribution of circuli, and annuli were distinct and easily identifiable. Striped bass scales, however, had other marks accessory to the true annuli. Circuli were often irregularly laid down with uneven or ragged margins and the true annuli were not easily identifiable, making age determination difficult. The false annuli indicated a slowing of the growth rate for some undetermined period of time apart from the normal reduced growth rate in winter. Hybrid scales showed none of these false annuli.

None of the 50 striped bass scale samples examined possessed false annuli during the first year of growth; however, 42 (82.4%) possessed at least 1 false annulus at some later period in scale development (Table 1). False

Table 1. False Scale Annuli by Year of Growth for Striped Bass (STB) Collected on the Tallapoosa River Below Thurlow Dam, Alabama

Year of Growth	Total No. of STB	STB Without False Annuli		STB With False Annuli	
		No.	Percent	No.	Percent
1st	50	50	100.0	0	0.0
2nd	42	21	50.0	21	50.0
3rd	39	0	0.0	39	100.0
4th	34	9	26.5	25	73.5
5th	19	1	5.3	18	94.7
6th[a]	7	3	42.8	4	57.2

• All 7 scale samples may have possessed false annuli; but due to annuli crowding on the scale margin, false annuli could not be verified on 3 samples.

annuli were difficult to detect among age-6 fish due to closer spacing of annuli on the scale margin; consequently, false annuli could only be clearly identified in 57% of these older fish although more were probable.

These irregularities in sculpturing of the scale are theorized to be related to high water temperature. Coutant and Schaich (198o) noted that during the summer the striped bass in Cherokee Reservoir, Tennessee, avoided temperatures of 25 to 27 C and higher. On occasion the fish would make short excursions into warmer water but always returned to thermal refuges containing temperatures ranging from 17 to 23 C with a selection averaging 20.5 C. Coutant (1978) observed that striped bass followed the 20 to 22 C isotherm as they moved downward in the water column and into refuges in late summer. He felt this behavior effectively separated the striped bass from their shad *(Dorsoma* spI'.) food source. At no time did he observe striped bass returning to the surface to feed, thus concluding that temperature preference was a stronger influence than feeding.

Coutant and CarrolJl (198o) noted ontogenetic changes in temperature preference in which the mean temperature selected by adult striped bass in Cherokee Reservoir was approximately 20.5 C, while 2-year-old fish sought an average temperature of 22 C and juvenile striped bass preferred a mean of 25 C. The resultant situation was that young striped bass with a higher temperature tolerance were able to thrive, while older individuals that required cooler temperatures found these waters either unoxygenated or totally unavailable in late summer. This condition resulted in high mortality among adult striped bass (Coutant and Schaich 198o). This ontogenetic change of temperature preference by striped bass may help to explain the absence of false annuli on the scales during the specie's first year of gorwth as well as their absence among 50% of the bass during their second year of growth. As striped bass age and temperature preferendum lowers, they may spatially separate themselves from their prey in search of cool thermal refuges. This lower temperature preference results in a reduced gowth rate in summer and the formation of false annuli, which became a common scale characteristic found on nearly all age-3+ striped bass scales from the Tallapoosa River.

The Tallapoosa River at Tallassee is cooler than other rivers in the area because of a deep water draw from the summer stratified Lakes Martin, Yates, and Thurlow. Maximum temperature of the discharge below Thurlow Dam during this study was 24.4 C in mid-July, while below Jordan Dam on the Coosa River, the maximum temperature attained was 31 C during the same period. The reported minimum striped bass avoidance temperature of 25 C, noted by Coutant and Schaich (1980), was never exceeded immediately below Thurlow Dam, but was exceeded below Jordan Dam as early as the third week in June and remained above that temperature until the last week in October. Thus the Tallapoosa River appears to be a more favorable

environment with regard to temperature because of thermal refuges in the immediate tailwater area beneath Thurlow Dam.

From electrofishing below Thurlow Dam, the authors observed an abundance of gizzard shad *(Dorosoma cepedianum)* and threadfin shad *(Dorosoma petenense)* in the spring followed by a substantial decline in their abundance as the summer progressed. Miller (1960) observed these species migrating back down river following spawning and noted their ability to tolerate temperatures as high as 35 C. Coutant and Schaich (1980) also indicated the genus had a higher temperature preference and lethal limit than striped bass.

The average monthly catch per unit of collecting effort revealed a steady increase in striped bass relative abundance from April through June, peaking in late June (Table 2). Striped bass continued to show up in the collections through the last week in August. *Morone* hybrids, however, peaked a month earlier in mid-May and were not collected beyond the first week in July (Table 2). This would infer striped bass are remaining in the Thurlow Dam tailwater area longer than the hybrids before emigration downstream.

Therefore, considering the above observations, false annuli on Tallapoosa River striped bass scales may be explained by the specie's attraction to these thermal refuges below Thurlow Dam, which by mid- to late-summer lack adequate available prey for continuation of normal growth. As temperatures subside in the fall and the river system becomes more isothermic, striped bass movement may increase resulting in a greater prey and striped bass distributional overlap, a higher incidence of feeding, and a resumption of growth. However, in the case of hybrids, the attraction to the thermal refuges may not be as strong, thereby resulting in an earlier emigration from the tailwater area and a possible prolonged distributional overlap with prey down river for a continuation of normal growth throughout the summer.

Additional work is needed to determine temperature preference differences between the striped bass and its hybrid. Meanwhile, should other

Table 2. Average Monthly Catch Per Hour of Gill Netting and Electrofishing Effort by Species on the Tallapoosa River Below Thurlow Dam, Alabama

Month	Number of Fish Per Hour of Effort	
	Striped Bass	*Marone* Hybrid
April	0.14	0.02
May	0.31	0.14
June	0.37	0.05
July	0.08	0.05
August	0.03	0.00
September	0.00	0.00
October	0.00	0.00
November	0.00	0.00

striped bass populations in southeastern reservoirs be exhibiting similar temperature preference behavior, this unique dimorphic growth pattern on the scales may serve to assist the manager in identifying stressed populations.

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