FISHERIES INVESTIGATIONS IN LAKES AND STREAMS

COMPLETION REPORT

F-63

July 1, 2007 – June 30, 2012

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Study Title:	STATEWIDE RESEARCH
Job Title:	An evaluation of the relative survival of multiple families of striped bass stocked into Lake Wateree in 2008
Period Covered	July 1, 2007 – June 30, 2012

Summary

In May and June of 2008 striped bass fingerlings *Morone saxatilis* from six genetic families were stocked into Lake Wateree. We collected striped bass from December 2009 through May 2010 to assess the relative survival and growth of the stocked families. All collected fish from the 2008 year class were identified to family of origin using microsatellite DNA data, which was generated from the parents of the stocked fish. We measured standard length and weight at stocking, total length at capture, and rate of return for each stocked family to better understand the factors contributing to survival and growth of these fish. Because fish were collected by multiple sampling methods, we also evaluated the effects of mode of capture. Of the parameters tested in this study, genetic family was the only significant predictor of stocking success, as measured by rate of return. One family's return rate of 76.5% represented a 27% increase over its stock rate. Evaluation of collection technique did not indicate a bias toward family. Results of this study confirm the need to consider familial differences in stocking evaluations.

Introduction

Multiple factors in the production and stocking of hatchery reared striped bass can contribute to a batch's potential for survival and eventual recruitment to a fishery. The need exist for a better understanding of how, and which, factors contribute significantly to the ultimate success of stocked fish. Ideally study designs will allow for a homogenized gene pool across treatments. The development of microsatellite markers for striped bass provides an excellent tool in that it allows the evaluation of multiple treatment batches of fish. Elimination of genetic effects on treatment groups is not possible however when treatments are identified by their genetic mark. Further, production of individual genetic stocks introduces the potential for other effects on performance inherent to individual production ponds. Wang et al. (2006) found that dam and sire effects on juvenile growth and growth rate were significant in hybrid striped bass (*M. chrysops* female x *M. saxatilis* male). Results for measurement at two time intervals also suggested that selection for growth rate at an early life stage could affect growth rate at a later life stage. Thus, genetic effects on growth, and on other aspects of performance, are important to consider when evaluating effects such as time or location of stocking. In 2008, striped bass from 6 genetic families were stocked in Lake Wateree. Recruitment and total length at age 1 were evaluated by family, date stocked, and mean condition at stocking.

Materials and Methods

Larvae produced at Bayless Fish Hatchery were transported to Spring Stevens Hatchery for grow out in April 2008. Seven ponds were stocked with one family (1 female x 3 males) each. After growout ponds 2, 3, 5, and 6 were chosen for harvest in anticipation that these would yield the most striped bass fingerlings. Ponds were harvested on May 29. Dissolved oxygen (DO) and time required to clear each pond kettle of fish was tracked for each family. A sample of at least 300 fingerlings was retained from each pond and preserved in ethanol.

To minimize hauling/stocking effects, fish were weighed onto one truck such that each hauling compartment carried an equal number of fish, and an equal proportion of fish from each pond. Fish were tempered on the truck for up to 74 minutes prior to release.

Because harvest of Spring Stevens ponds was well below expectations, additional fingerlings were required to meet the stocking request for Lake Wateree. On June 13 striped bass fingerlings were harvested from two ponds at Dennis Wildlife Center. These fish represent 3 additional genetic families. DO readings were taken in each pond in and out of the harvest basin just prior to harvest, and in the basin at the end of harvest. Fish were handled as in the previous stocking, with fingerlings from each pond spread equally across hauling units and stocking sites.

Striped bass were collected at age 1 by winter gillnetting in conjunction with Region 2's routine monitoring on the lake. Fin clips for genetic analysis to family and otoliths were collected from all fish, and total length (tl) was recorded.

To augment gillnet collections Spring electrofishing and angling were employed. We concentrated on cove electrofishing during March. From April 2 – May 19 we made approximately weekly collecting trips to Cedar Creek Dam. Angling was performed by a small network of active Lake Wateree striped bass anglers. All fish collected by electrofishing and angling were measured and finclipped. Likely year class assignment was based on length frequencies, and those of previously aged gillnet samples. Finclips from those fish with a confirmed or likely year class assignment to the 2008 year class were transferred to Tanya Darden at Marine Resources Research Institute for analysis at 12 microsatellite markers (Fountain et al. 2009).

All fish were identified to year class, and then to parental cross and family based on striped bass broodstock evaluations. Because fish from two families, X and Y, were grown out as fingerlings in the same pond and their individual stocking rates are not known, stocking and return numbers were combined and evaluated as one family XY.

Condition at stocking were determined for N=100 fingerlings preserved from each family. Standard length (sl, mm) was recorded for each fish. Samples were then dried for 48 hours at 60° C, and individual weights were recorded. Relative weights were calculated for each fish, and mean relative weights were determined for each of 6 families stocked.

Deviations in actual rates of return from expected rates were evaluated by family, for each of two distinct stock dates, using the G test. In an effort to better understand the factors contributing to the survival and growth of these 6 families, the relationships between total length at capture and effects including date stocked, condition at stocking, and family were evaluated. A Fixed Effects Analysis was run in PROC GLM testing the effects stock date and family(stock date). Multiple random effects models were run in PROC GLIMMIX to confirm results, and to test the random effect condition. Because fish were collected by Winter gillnetting and electrofishing in the lake, by electrofishing during the upriver Spring run, and by angling, we evaluated mode of capture as a fixed effect in PROC GLM to ensure one technique was not biased toward particular families. Logistic regression was used to evaluate the effects of condition at stocking and family on rate of return. All statistical tests were run with an alpha = 0.05.

Results

On May 29, 2008 63,972 striped bass were harvested from Heath Springs, transported to Lake Wateree and stocked at Beaver Creek and White Oak access points. DO in each pond kettle during harvest ranged from 3.6 – 6.8 mg/l. Time to clear each kettle of fish was not more than 13 minutes, with the exception of pond 2 which took 64 minutes. There was little to no mortality observed during harvest of all four ponds, and mortality at stocking appeared to be near zero.

On June 13, 2008 ponds 51 and 53 at Dennis Wildlife Center were harvested and 195,376 striped bass fingerlings were stocked at Buck Hall and Colonel Creek access points. During harvest pond 53 DO's ranged from 4.05 – 6.47. Pond 51 DO readings were low however, 0.94 outside and 2.78 in the basin at start of harvest. At the end of harvest DO in the basin was 0.50 mg/l. Time in the basin was not recorded in these two ponds, but personnel report that harvest of pond 51 was expedited because of the low DO conditions. Personnel also report there was no mortality observed at harvest or at stocking for either pond.

Striped bass (N=135) were collected by gillnet between December 15, 2009 and February 19, 2010. Striped bass ranged from 197 – 702 mm tl (Figure 1). All fish less than or equal to 605 mm tl were aged, and N=37 were assigned to the 2008 year class. These fish ranged from 412 – 501 mm tl (mean = 454.6, se = 3.6; Table 1).

N=274 fish were collected by angling and electrofishing. Cove electrofishing on Lake Wateree in March was largely unsuccessful, with 3 fish collected in 5 days of effort. March 8 and 9 N=49 striped bass were collected from one concentrated area of rocky points and shoals. Subsequent trips to this area however indicated the fish had moved on. Electofishing at Cedar Creek in April and May yielded 206 striped bass. An additional 16 striped bass were collected during the sampling period by anglers.

Based on their length frequencies (Figure 2), and those of the previously aged gillnet samples (Figure 1, Table 1), 174 fish from electrofishing and angling were assigned to the 2008 year class. Finclips from those fish and from 2008 year class gillnet collections (N=211 total) were transferred to Tanya Darden at Marine Resources Research Institute for genetic analysis at 12 microsatellite markers.

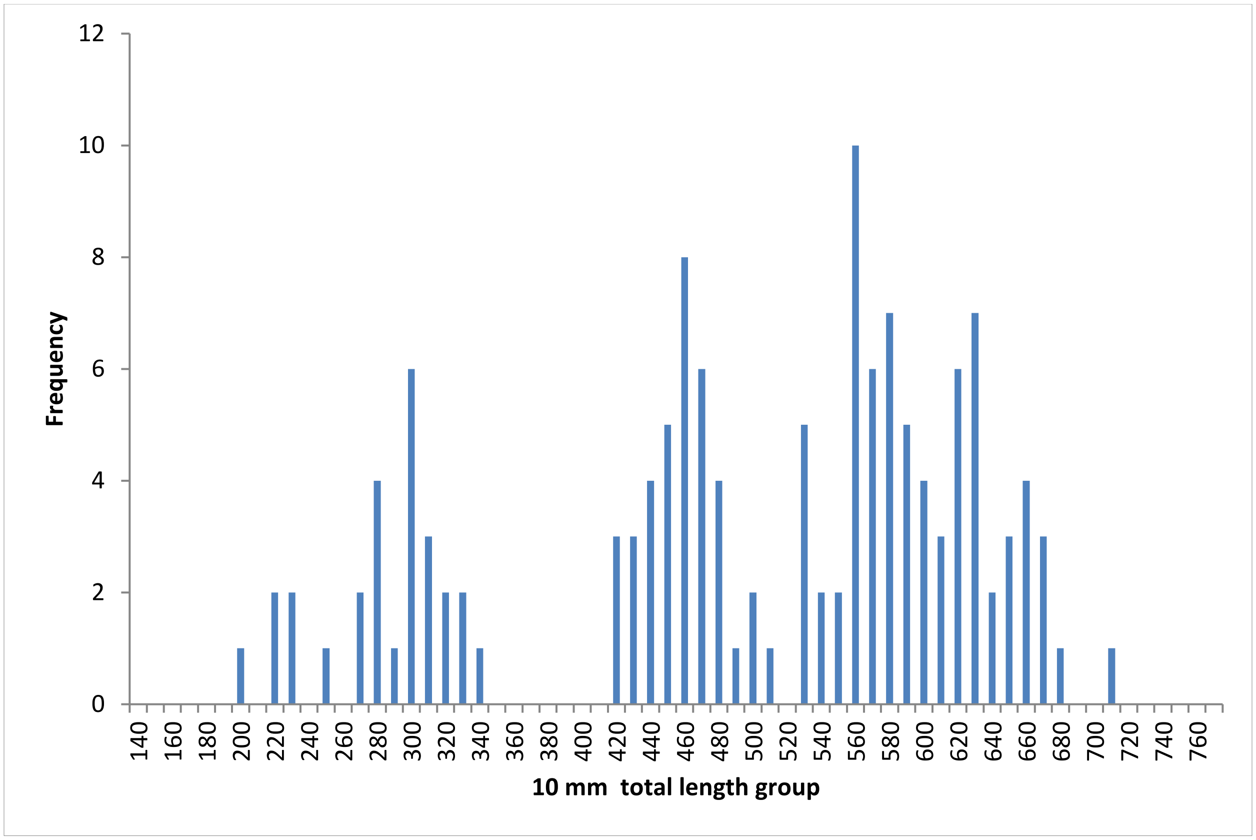

Figure 1. Length frequencies for striped bass collected by gillnetting from Lake Wateree December 2009 – February 2010.

Table 1. Mean length at estimated age for a subset of striped bass collected by gillnetting from Lake Wateree December 2009 – February 2010.

		Total length, mm		
Age	N	Mean	Range	SE
0+	27	279.7	197-333	7.1
1+	37	454.6	412-501	3.6
2+	39	562.6	522-605	3.3

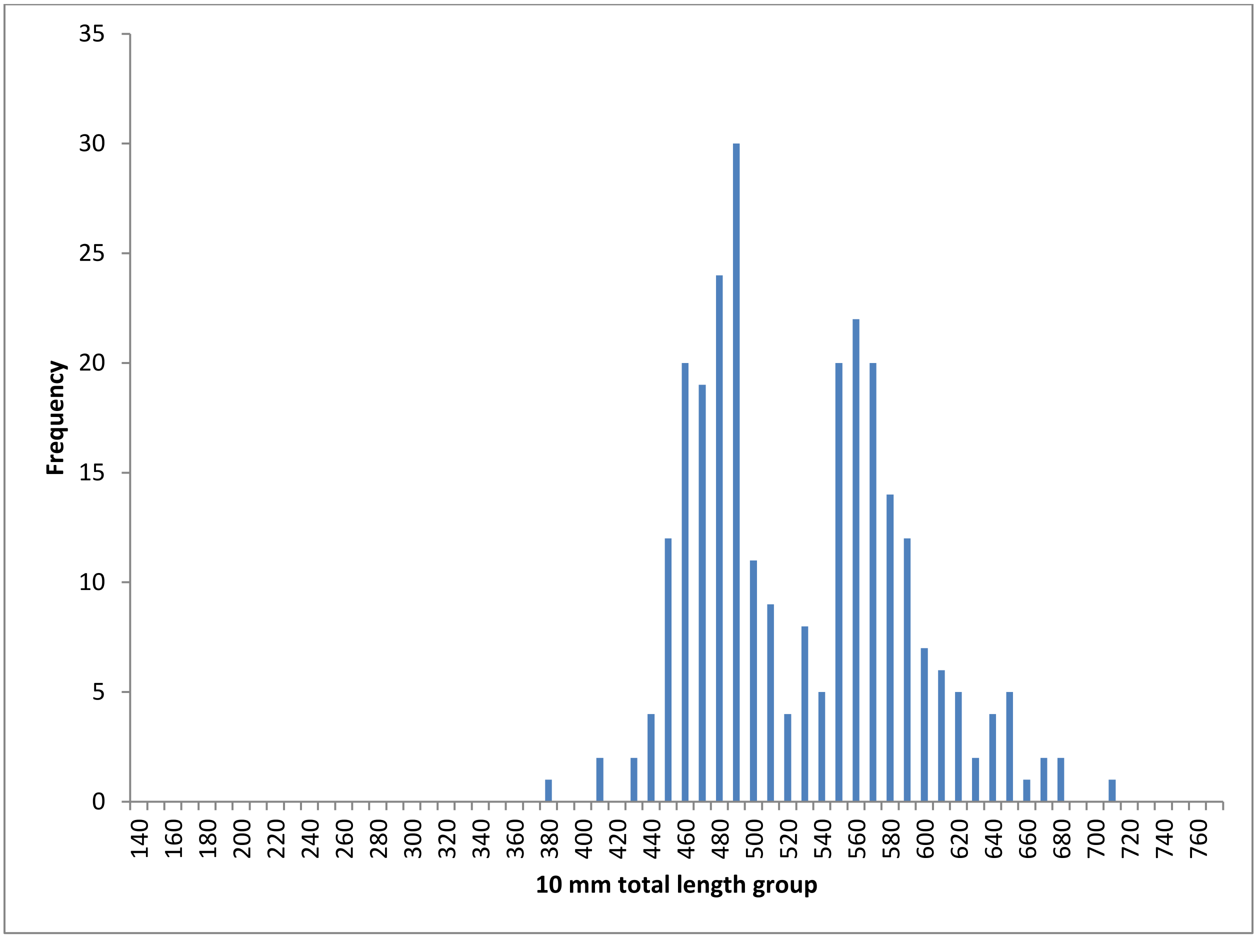

Figure 2. Length frequencies for striped bass collected by electrofishing from Lake Wateree March 8 – May 19, 2010.

Of N=210 fin clip tissue samples evaluated, all were of hatchery origin and were identified to their broodstock parents. N=168 were from the 2008 year class. All other fish were from the 2007 (N=34) and 2009 (N=2) year classes. These year classes are not being followed as part of this evaluation and are not included in any further analysis.

Condition at stocking varied among families stocked in 2008. Mean relative weights of fingerlings ranged from 87.7 – 108.9 (Table 2).

Table 2. Condition (relative weight; Wr) at stocking for 6 genetic families of striped bass fingerlings stocked in Lake Wateree in 2008.

Family	Pond	Mean Wr	N	SD
A	HS 2	99.5	100	7.0
B	HS 3	108.9	98	9.6
C	HS 5	100.5	100	8.4
D	HS 6	106.4	96	10.5
XY	DC 53	87.7	98	6.9
Z	DC 51	100.8	100	10.2

Fish were recaptured from each of the 6 genetic families stocked. Catch rates varied from stocking rates. Family A comprised 14.2% of total fingerlings stocked in 2008, but accounted for 54.2% of returns at age 1+. Conversely, families XY and Z combined provided 75.9% of stocked fingerlings, but accounted for just 29.2% of total recaptures at age 1+. When statistically evaluated by date, catch rates were similar to stocking rates for two families stocked on June 13. Four families stocked May 29 returned in proportions different to those expected. Three May 29 families returned at rates lower than those at which they were stocked, while one family's return rate of 76.5% represents a 27% increase over its stock rate (Table 3.).

Table 3. Stock and return data for striped bass fingerlings stocked in Lake Wateree in 2008. Data is presented by stock date and genetic family. G test statistics and P-values are presented by stock date, and evaluate the difference in actual and expected (based on stocking proportions) rates of return.

Stock Date	Pond	Family	N Stocked	N Returned	Stock Proportion	Return Proportion	G	P-value
5/29/2008	HS 2	A	38,517	91	60.21	76.47	17.369	0.0006
	HS3	B	17,108	23	26.74	19.33		
	HS5	C	1,015	1	1.59	0.84		
	HS6	D	7,332	4	11.46	3.36		
6/13/2008	DC53	XY	71,312	21	36.50	42.86	0.591	0.442
	DC51	Z	124,064	28	63.50	57.14		

Total length at recapture was significantly correlated to date stocked. Fish from 4 families stocked May 29 were larger on average (mean tl = 476.55; se 1.80) than those from 2 families stocked June 13 (mean tl = 453.31; se = 3.64). Size at recapture was not correlated to condition at stocking, or to genetic family however. Evaluation of collection technique indicated no bias toward family. Logistic regression on rate of return showed no correlation with condition at stocking. Family was significantly correlated with rate of return, as indicated by the earlier G-test. One family (A) returned at a higher rate than 4 others (B,D, XY, and Z). Rate of return for family C was not significantly different from any other family tested due to sample size, as only one fish was collected from family C.

Discussion

Genetic marks have become an important tool in the evaluation of stocking strategies for striped bass. They enable us to evaluate returns based on a wide range of factors. These may include but are not limited to timing of stocking, stocking location or zone, stocking method, and source of fingerlings. An important factor to consider in the use of genetic marks is that they preclude the homogenization of genetic families across treatment groups prior to stocking. This introduces the possibility of a family effect inherent to those treatments we wish to evaluate. These may be related to heritable genetic traits or to effects introduced by production the logistics of production.

Of the parameters tested in this study, genetic family was the only significant predictor of success as measured by rate of return. For four families stocked May 29, rates of return at age 1 differed considerably from expected rates. From the point of fingerling harvest to stocking these families were all treated equally, including being spread equally among the hauling compartments on the transport truck used for stocking. The increase in return rate of family A over stocking rate is significant and underscores the importance of design in these types of experiments.

A number of factors contribute to the survival of any fish at stocking, and to its eventual contribution to a target fishery. The development of genetic markers that can be used to identify individual fish to family, and even to individual cross, provide a valuable tool in evaluating those factors. However, because the tool precludes the homogenization across genetic families of stocked fish, study designs that employ genetic marks must take into account the potential for selection or performance differences inherent to different families, as well as more typical study variables such as stock date, size at stocking, and condition.

Recommendations

Based on this evaluation, ensure that any study design that incorporates genetic marks considers family as a recruitment variable in data analysis.

Literature Cited

Fountain, J., T. Darden, W. Jenkins, and M. Denson. 2009. Three multiplexed microsatellite panels for striped bass, *Morone saxatilis*. Southeastern Naturalist 8(4): 671-676.

Wang Xiaoxue, Kirstin E. Ross, Eric Saillant, Delbert M. Gatlin III, John R. Gold. 2006. Quantitative genetics and heritability of growth-related traits in hybrid striped bass (*Morone chrysops x Morone saxatilis*). Aquaculture 261: 535-545

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