Evaluation of Phase I and Phase II Hybrid Striped Bass in the Escambia River, Florida[1]

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Abstract: Relative survival rates for phase II (150- to 250-mm total length) striped bass hybrids *(Morone saxatilis* x *M. chrysops)* were 23, 200 and 137 times greater than phase 1 (30- to 45-mm total length) fish for the 1983, 1984 and 1985 year classes, respectively. Mean condition factors of phase I fish collected in the ficld were significantly higher than phase II fish for all 3 year classes. Mean total lengths of phase I fish were significantly greater than phase II fish for the 1983 year class and for the 1984 fish collected in the spring of 1986. However, 1985 phase II fish collected during the summer of 1986 were significantly larger than 1985 phase I fish. Phase II fish made up 35% and 48% of the estimated striped bass hybrid harvest during the 1984-85 and 1985-86 creel periods, respectively. Stocking of tagged phase II fish was a useful technique in evaluating fingerling survival.

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Striped bass hybrids were first produced in South Carolina by crossing female striped bass *(Marone saxatilis)* with male white bass *(Marone chrysops)* (Stevens 1965). As a result of this development, many states created successful *Marone* hybrid fisheries through stocking programs (Bayless 1972, Ware 1974, Crandall 1978, Borkowski and Snyder 1982, Young 1984, Yeager 1985). The *Marone* hybrid stocking program in Florida began in 1972 as an alternative to the striped bass stocking program which had met with limited success.

From 1978 through 1982, the Escambia River was annually stocked with fingerling striped bass hybrids in an effort to supplement the existing sport fishery. A significant hybrid fishery developed from June 1981 through May 1982 (Yeager 1985). However, this fishery declined dramatically the following year. In an effort to revitalize this fishery, phase II hybrids (150- to 250-mm total length) were stocked in conjunction with phase I fingerlings (30- to 45-mm total length) from 1983 through 1985. The purpose of this study was to evaluate survival and growth

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rates of the phase I and phase II fish and the contribution each made to the hybrid fishery.

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Methods

The Escambia River in northwestern Florida is a temperate-zone river, characterized by slightly acidic, soft water (D. G. Bass and V. G. Hitt, Unpub!. rep., Fla. Game and Fish Comm., 1978). It drains approximately 10,878 km^2 of Alabama and Florida. The Alabama portion of the river is called the Conecuh River. As a result the basin is often referred to as the Conecuh-Escambia river system. The Conecuh-Escambia is approximately 148 km long and is Florida's fourth largest river based on average discharge. The Florida portion of the river is approximately 87 km long. Minimum and maximum flow rates from 1934 through 1980 were 16 and 2,610 m^3/sec, respectively with an average of 181 m^3/sec (U.S. Geo!. Surv. 1980). During low-water periods, saltwater intrusion from Escambia Bay can extend 13 km up river.

During 1983, 84 and 85 phase I striped bass hybrids were stocked in the spring, and phase II fish were stocked in the fall. Except for 925 phase II fish stocked approximately 80 km upriver in 1984, all fish were stocked in the lower tidal portion of the Escambia River and marsh.

All phase II fish were tagged with internal anchor tags manufactured by Floy Tag and Manufacturing, Inc., Seattle, Washington.[2] Tags were composed of a 50-mm piece of vinyl tubing, secured to a laminated plastic oval disk measuring 4.7 mm by 14.3 mm. After being anesthetized, fish were tagged by making a small incision through the body wall on the left side posterior to the end of the pectoral fin. The disk portion of the tag was then pushed through the incision into the body cavity with the vinyl tubing portion remaining outside the fish. Each tag was numbered for identification and a toll free telephone number printed on the vinyl tubing enabled anglers to inform project personnel of creeled fish. No monetary reward was offered for the return of tags by anglers.

Fish were sampled monthly in the lower 15 km of the Escambia River and marsh from May 1983 through December 1986 with gill nets. Additional samples were also collected by electrofishing. Length and weight data were recorded for all fish collected. Hybrids recorded in a creel survey of the lower 20 km of the Escambia River and marsh were also used in this evaluation. The creel survey, designed by D. W. Hayne, North Carolina State University, was an access type survey using nonuniform probability methodology (Pfeiffer 1967, Ware et a!. 1972, Malvestuto et a!. 1978). Unmarked fish were assigned ages by otolith analysis and otolith

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length-at-age data from a previous study (Yeager et al. 1983). Assignment of ages to *Morone* hybrids through the use of otoliths was verified by Snyder et al. (1983). Relative survival estimates of phase I and phase II fish were calculated for each year class using the following formula:

$$\text{Relative Survival} = \frac{\text{No. of Phase I Collected/No. of Phase I Stocked}}{\text{No. of Phase II Collected/No. of Phase II Stocked}}$$

After each year class of phase II fish were stocked, all fish collected for a period of I year were used in calculating the relative survival rate for that particular year class.

The Kruskal-Wallis rank test was used to determine if there were significant differences in mean total length and K(sl) between phase I and phase II fish within year classes, and the Spearman rank correlation was used to determine if any correlation existed between K(sl) and standard length (Wilkinson 1987). The Kolmogorov-Smirnov test was used to determine if samples were normally distributed (Wilkinson 1987).

Results and Discussion

Overall return rates of phase II striped bass hybrids collected in the field from May 1983 through December 1986 were much greater than for phase I fish. Return rates for the 1983, 1984, and 1985 year classes of phase II fish were 23, 72, and 131 times greater than return rates for phase I fish, respectively (Table 1). These return rates include young-of-the-year phase I fish collected prior to stocking of phase II fish. Return rates for phase II fish may be somewhat conservative since some tag loss on fish collected in the field was observed. Tag loss was not considered significant, however. Less than 5% of all phase II fish collected showed evidence of tag loss.

Relative survival rates were also much higher for phase II fish. Based on 1 year of sampling after each phase II stocking, survival rates of the 1983, 1984 and 1985 phase II year classes were 23, 200, and 137 times greater than survival rates

Table 1. Overall return rates for phase I and II striped bass hybrids collected from the Escambia River from May 1983 through December 1986.

	Year class	Number stocked	Number collected	Percent collected
Phase I	1983	320,000	265	0.08
Phase II	1983	3,997	72	1.80
Total	1983	323,997	337	0.10
Phase I	1984	525,000	137	0.03
Phase II	1984	3,333	72	2.16
Total	1984	528,333	211	0.04
Phase I	1985	329,000	139	0.04
Phase II	1985	2,240	117	5.22
Total	1985	331,240	256	0.08

Table 2. Relative survival rates of phase I and II striped bass hybrids stocked in the Escambia River, Florida.

Year stocked	Number stocked: Phase I	Number stocked: Phase II	Year sampled	Number returned: Phase I	Number returned: Phase II	Relative survival
1983	320,000	3,997	12/83 to 11/84	244	70	0.0435
1984	525,000	3,333	2/85 to 1/86	53	67	0.0050
1985	329,000	2,240	1/86 to 12/86	126	117	0.0073
Total	1,174,000	9,570		423	254	0.0134

Table 3. Results of Kruskal-Wallis rank test for mean total lengths of phase I and phase II striped bass hybrids collected by season.

Year class	Stocking phase	Season collected	Sample size	Mean total length (mm)
83	I	Summer 1984	135	316
	II		33	284*
83	I	Fall 1984	85	374
	II		25	352*
84	I	Summer 1985	11	320
	II		9	284
84	I	Spring 1986	17	307
	II		35	276*
85	I	Summer 1986	83	292
	II		73	309*
85	I	Fall 1986	34	362
	II		26	363

*Length of phase II fish significantly different ($P < 0.05$) from length of phase I fish collected during the same period.

of phase 1 fish (Table 2). The lower survival rate of 1983 phase II fish was probably related to tagging procedures. These fish experienced higher than usual initial mortality (20.6%), which was attributed to shock induced by handling. As a result, it is likely that delayed mortality was substantially greater for the 1983 phase II fish. Handling problems were not encountered while tagging the 1984 and 1985 phase II fish.

Mean condition factors of phase 1 fish (2.45 to 2.55) were significantly higher than for phase II fish (2.36 to 2.39) for all year classes. Through the use of the Spearman rank correlation (Wilkinson 1987) it was determined that there was no correlation between condition and standard length; therefore, fish were not separated into size groups when comparing mean condition factors.

Mean total lengths of phase 1 fish were also significantly higher than for phase II fish of the 1983 year class and for 1984 fish collected in the spring of 1986 (Table 3). However, 1985 phase II fish collected during the summer of 1986 were significantly longer than 1985 phase 1 fish. There was no difference between mean total lengths of 1985 phase 1 and II fish collected during the fall of 1986 or for 1984 fish collected in the summer of 1985. Phase II fish stocked in 1983 were substantially smaller than those stocked in 1984 and 85. The smaller mean total lengths of the

1983 phase II fish are likely due to the size of stocked phase II fish. Average total lengths of phase II fish at stocking were 149, 225, and 230 mm for the 1983, 1984, and 1985 year classes, respectively. Phase I fish normally ranged from 200 to 250 mm at the time phase II fish were stocked. Therefore, at least for the 1983 year class, one would expect the mean total length for phase II fish collected in the field to be smaller than phase 1 fish.

No cost estimates were available for fish stocked in 1983 and 1984. Costs directly associated with production of the 1985 phase 1 and phase II fish were estimated at $0.0085 and $0.3975 each, respectively (C. C. Starling, unpubl. rep., Fla. Game and Fish Comm., 1986). However, phase II fish experienced heavy mortality due to bird predation while in hatchery ponds, resulting in higher than normal production costs. Direct costs for production of phase II striped bass ($0.1299) were approximately 5 times those incurred for phase I fish ($0.0273) for 2 years at Natchitoches National Fish Hatchery, Louisiana, and Mammoth Springs National Fish Hatchery, Arkansas (D. Culbertson, pers. commun., u.S. Fish and Wildl. Serv., Atlanta, Ga.).

Creel surveys conducted on the Escambia River from 1983 to 1986 indicated that 60% to 80% of the hybrid striped bass harvested were I year of age or older (Yeager et al. 1984, 1985, 1986). Therefore, the success of the hybrid fishery is dependent upon the survival of the year class stocked the previous year. The relative survival rate of the 1983 phase I fish was approximately 9 times greater than that of the 1984 phase 1 fish. This greater survival rate of the 1983 phase 1 fish was reflected in the creel survey harvest estimates. During the 1984-85 creel period (spring and summer 1984 and spring 1985) the 1983 phase 1 and phase II fish made up 61% and 24% of an estimated 4,214 hybrids harvested, respectively. Harvest estimates declined almost 70% the following year to 1,323 fish, with 1984 phase 1 fish comprising only 38% of the harvest and the 1984 phase II fish comprising 34%. The decline in the number of 1984 phase 1 fish in the 1985- 86 creel period and subsequent decline in total harvest most likely indicates poor survival of the 1984 fingerlings.

The exact causes affecting fingerling survival in the Escambia River are not known; however, food availability after stocking may be a critical factor. Results from a 4-year evaluation of hybrid striped bass in 5 Alabama lakes where small (741 to 832 fish/kg) and large (178 to 257 fish/kg) fingerlings were stocked indicated there was no difference in recapture rates between small and large fingerlings. However, recapture rates for large fingerlings from lakes classified as infertile were over 4 times as great as those for small fingerlings (J. Turner, pers. commun., Ala. Dep. Conserv., Marion).

Even though the costs of production of phase II fish are higher, their survival rate can be much greater as demonstrated by this study. Therefore, fewer phase II fish would need to be produced for stocking. Fishery managers must decide if the increased return rate from phase II stockings justifies the increased cost of production. *Marone* fisheries may also be enhanced or even created in bodies of water where phase I stockings have been less successful. The probability of a year class failure may also be greatly reduced by supplemental stockings of phase II fish. Creel surveys conducted during this study indicated that phase II fish comprised 35% and 48% of the total hybrid bass harvest during 2 creel periods on the Escambia River.

Annual harvest rates of hybrid striped bass in the Escambia River have fluctuated dramatically since they were first stocked in 1978. Previous studies have related these fluctuations to periods of high and low river discharge (Yeager 1982, 1985). Results from this study indicate that fingerling survival is also directly related to the success of the hybrid fishery. The stocking of tagged phase II fish was a useful technique in evaluating fingerling survival in this study.

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