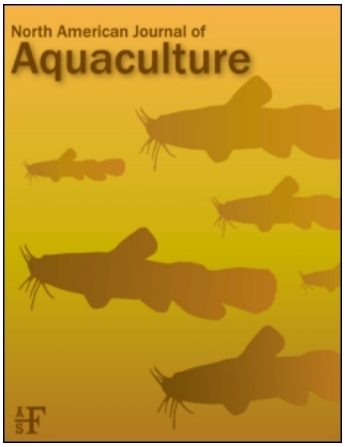

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Comparative Production Characteristics of Sunshine Bass and Sunshine Bass × Striped Bass in Recirculating-Water Systems

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Abstract.—The production characteristics of juvenile sunshine bass (female white bass *Morone chrysops* × male striped bass *M. saxatilis*)and juvenile backcrosses (female sunshine bass × male striped bass) were compared in a 56-d growth trial in recirculating-water systems. Survival, growth, and feed conversion ratios were similar ($P < 0.05$). Condition factors of the sunshine bass were significantly higher. The results of this study indicate that juvenile sunshine bass and the sunshine bass × striped bass backcross perform similarly in culture situations and that the backcross may offer an alternative to sunshine bass and palmetto bass (male white bass × female striped bass) in the hybrid striped bass industry.

Hybrid striped bass are grown commercially in the United States, with production of market-size fish in 1996 estimated to have been 6.6–7.6 million kg (Kahl 1997). Most (82.6%) of producers surveyed grew the reciprocal hybrid striped bass (female white bass *Morone chrysops* × male striped bass *M. saxatilis*; Kahl 1997), also called the sunshine bass. Initially, hybrid striped bass were cultured to fill a shortfall in a market traditionally supplied with wild-caught striped bass. Hybrid striped bass were cultured instead of striped bass because they were hardier, grew faster under culture conditions, and exhibited a higher dressout percentage than striped bass (Harrell 1997).

During the production of hybrid striped bass, adequate numbers of female broodfish often are not available. A possible way to address this shortage may be to backcross female hybrid striped bass with male striped bass. Both the hybrid and the striped bass mature within the time frame of a food fish production cycle (about 2 years); thus, large numbers of female hybrids are available. Initial indications (T. I. J. Smith, unpublished data) are that hybrids can be spawned and that they produce more and larger eggs than white bass. The fry hatching from the larger eggs are capable of initially consuming nauplii of brine shrimp *Artemia* sp. and do not require live rotifers for food as do the reciprocal hybrid fry (simplifying early production). This study compared production characteristics of sunshine bass juveniles and juvenile backcrosses of female sunshine bass × male striped bass in recirculating-water systems.

Sunshine bass were obtained from Southland Fisheries Corporation (Hopkins, South Carolina), and backcrosses were obtained from the South Carolina Department of Natural Resources (Marine Resources Research Institute, Charleston). The white bass and striped bass for the crosses were obtained from the Santee-Cooper River system in South Carolina. Eight females and eight to twelve males were used to produce the backcrosses. Fish were transported to Clemson University by truck-mounted tank and were maintained in 1,300-L recirculating-water systems until used for experiments. Fish were fed a commercial trout feed (crude protein ≥ 38%, crude fat ≥ 8%, crude fiber ≤ 4%; Zeigler Brothers, Inc., Gardners, Pennsylvania) during the holding and experimental periods.

Experiments were conducted in 375-L fiberglass recirculating-water systems (Living Streams, Frigid Units Inc., Toledo, Ohio). The fish-holding tank of each recirculating-water system was rectangular and was divided by screens into a series of three chambers of approximately the same size. Each recirculating-water system was equipped with a thermostatically controlled heater and refrigeration system. The photoperiod was set at 12 h light and 12 h dark. All tanks were constantly aerated.

Thirty sunshine bass were stocked into each of five recirculating-water systems, and thirty backcrosses were stocked into each of three recirculating-water systems. The backcrosses were significantly longer at stocking than the sunshine bass

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TABLE 1.—Production characteristics of sunshine bass and sunshine bass × striped bass (backcross) reared for 56 d in recirculating-water systems. Values are means ± SD of tank means, or regression statistics. Comparisons were made with analysis of variance unless otherwise indicated. Intercepts and correlation coefficients were not compared. Values along a row without a letter in common are significantly different ($P \leq 0.05$).

Production characteristics	Sunshine bass	Backcross
Total length at stocking (mm)	101.2 ± 0.84 z	156.0 ± 1.00 y
Weight on day 0 of study (g)	22.9 ± 0.38 z	51.2 ± 1.46 y
Initial spatial densities (g/L)	7.1 ± 0.12 z	7.9 ± 0.23 y
Final total length (mm)[a]	149.6 ± 2.30 z	197.3 ± 1.53 z
Final weight (g)[a]	48.6 ± 3.50 z	88.6 ± 1.46 z
Final spatial densities (g/L)	10.0 ± 0.75 z	9.1 ± 0.10 z
Condition factor[b]	1.432 ± 0.0582 z	1.1207 ± 0.0404 y
Percent survival	99.8 ± 0.45 z	99.0 ± 1.00 z
Feed conversion ratio[c]	3.3 ± 0.59 z	3.8 ± 0.37 z
Slope of growth line (weight)	0.467 z	0.690 z
y-intercept of growth line (weight)	21.44	50.58
r^2 of growth line (weight)	0.986	0.996

[a] Not significantly different when initial lengths or weights are considered (analysis of covariance).
[b] Weight/length^3.
[c] Weight of feed fed/by weight gained.

due to earlier spawning (Table 1). To reduce differences in spatial densities (g biomass/L of water in the chamber), the sunshine bass were stocked into one chamber of each of the recirculating-water systems, and the backcrosses were stocked into two adjacent chambers with the partitioning screen removed in each of their recirculating-water systems (Table 1).

Eleven days after stocking, the fish from each recirculating-water system were weighed (to the nearest 0.1 g) as a group in water and returned to the system (day 0 of study). This process was repeated on days 14, 28, 45 and 56. After weighing on day 28, the number of fish in each recirculating-water system was reduced to 20 because projections of growth over the next 4 weeks indicated that the capacity of the biofilters would probably be exceeded if the initial number of fish were maintained. On day 56, fish were weighed as a group and then individually measured (to the nearest millimeter). Fish were lightly anesthetized with tricaine methanesulfonate before each weighing. During the study, fish were offered up to 5% of their body weight per day in two feedings. Feeding activity was observed and an attempt was made not to offer more than the fish would consume.

TABLE 2.—Water quality measurements (mean ± SD) in the recirculating-water systems during a 56-d comparison of production characteristics of sunshine bass and sunshine bass × striped bass (backcross). The number of observations is given in parentheses. Values along a row without a letter in common are significantly different ($P \leq 0.05$).

Measurement	Sunshine bass	Backcross
Temperature (°C)	23.0 ± 0.04 z (56)	23.0 ± 0.00 z (56)
Salinity (g/L)	3.1 ± 0.05 z (56)	3.0 ± 0.00 z (56)
Total ammonia-N (mg/L)	0.41 ± 0.067 z (45)	0.50 ± 0.035 z (45)
Nitrite-N (mg/L)	0.15 ± 0.117 z (45)	0.26 ± 0.048 z (45)
Dissolved oxygen (mg/L)	7.7 ± 0.08 z (56)	6.5 ± 0.10 z (56)
pH	7.1 ± 0.04 z (50)	7.1 ± 0.01 z (50)

Synthetic sea salt was dissolved in dechlorinated tap water to attain the desired salinity (3 g/L). Salinities and temperatures (measured to the nearest 0.1 units) were monitored daily (model 30/10FT temperature–salinity meter, Yellow Springs Instrument Company, Yellow Springs, Ohio) and adjusted as needed. The pH was monitored (Accumet model 915 pH meter, Fisher Scientific, Pittsburg, Pennsylvania) at least five times per week and adjusted upward with sodium bicarbonate whenever it decreased to below 7. Ammonia and nitrite were monitored at least five times per week (APHA et al. 1989). Dissolved oxygen was monitored daily (model 58 dissolved-oxygen meter, Yellow Springs Instrument Company). Water quality is summarized in Table 2.

Final weights and lengths were compared by analysis of covariance (ANCOVA), with initial weight and total length at stocking as the covariates. Other comparisons were made with analysis of variance (ANOVA). Least-squares regression was applied to initial, intermediate, and final weights. Mean values for fish in each recirculating-water system were entered into each analysis. The Fulton condition factor (K, a weight to length^3 ratio) was calculated with the formula of Bagenal and Tesch (1978), as described in Busacker et al. (1990). Feed conversion ratios were calculated as

weight gain divided by weight of feed offered. Statistical significance was established at $P \leq 0.05$.

Both sunshine bass and backcrosses increased in weight in a linear manner during the study (Table 1). The slopes of the regression lines were similar, and ANCOVA indicated that, after considering initial weights and total lengths, final weights and total lengths were similar. Survival and feed conversion ratios were similar. The feed conversion ratios are higher than those reported elsewhere (reviewed in Kelly and Kohler 1996). However, they are within the range reported by Wolters and DeMay 1996).

Condition factors were significantly higher in the sunshine bass. Differences in condition factor are probably a reflection of the naturally different shapes of the two hybrids. The backcross has a shallower body more characteristic of a striped bass; the sunshine bass has a deeper body. The similarity of the shape of the backcross to the striped bass may provide the basis for improved consumer acceptance of the backcross when marketed as a striped bass substitute.

Dissolved oxygen concentrations were significantly lower and ammonia and nitrite concentrations were numerically higher (Table 2) in the backcross systems. This was probably a consequence of the larger size of the backcrosses and because more feed was offered to them each day compared with the sunshine bass. However, all water quality characteristics measured were well within guidelines for good growth of striped bass and its hybrids (Tomasso 1997).

The results of this study indicated that juvenile backcrossed sunshine bass perform similarly to juvenile sunshine bass, at least during the 56-d trial in recirculating-water systems. Our results are consistent with that of a pond trial (J.H. Kerby, U.S. Geological Survey, personal communication) and a tank trial (T. I. J. Smith and L. Heyward, unpublished data) that indicated that backcrosses also perform similarly to sunshine bass when reared to larger sizes. Given the need for an expanded supply of juvenile hybrid striped bass, definitive comparative studies appear to be in order.

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