Growth of Hybrids of Striped Bass × White Bass Fed Redbelly Tilapia or Trout Pellets

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Abstract: The growth in weight of hybrids of striped bass (*Morone saxatilis* × white bass *M. chrysops*) fed trout pellets was compared to that of hybrids fed redbelly tilapia (*Tilapia zilli*, the latter of which were starved to reduce lipid content or were well-fed to ensure greater lipid levels. Production did not differ significantly between fish that ate starved tilapia and those that ate trout pellets. Growth was significantly greater, however, in hybrids that ate fed tilapia than in those that ate starved tilapia. The nutritional value of the pelletized ration was inferior to that of well-fed tilapia, indicating the need for improvements in diet formulation.

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Hybrid striped bass has been a popular sport fish throughout the southeast for many years (Stevens 1984). Recently, several states have legalized farm production of hybrid striped bass in response to the growing interest of aquaculturists (Kerby et al. 1983, Smith and Jenkins 1984, Smith et al. 1985). For more than 10 years striped bass and hybrids have been reared at the Southeastern Fish Cultural Laboratory, Marion, Alabama, in monoculture and in polyculture with common carp (*Cyprinus carpio*), fathead minnows (*Pimephales promelas*), redbelly tilapia, and blue tilapia (*Tilapia aurea*). During this period, the healthiest-appearing striped bass and hybrids have been produced in ponds in which prey fishes provided a supplement to the prepared rations. However, fish maintained in tanks as potential brood fish

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and fed a combination of pelletized rations and prey fishes (also maintained in tanks and fed prepared diets) were typically not as colorful and robust as striped bass reared in ponds with prey species. The objectives of this study were 1) to determine if the fat content of prey organism red tilapia influenced growth rate of hybrids of striped bass × white bass and 2) to determine if the growth rate of hybrids fed a prepared ration was equal to that of fish fed red tilapia.

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Methods

Hybrids used in these experiments (Table 1) were either 7-month-old fish of the 1986 year class from the Marion (Alabama) State Fish Hatchery or 21-month-old fish of the 1985 year class from Welaka (Florida) National Fish Hatchery. Both groups were raised in ponds at the Southeastern Fish Cultural Laboratory, Marion, Alabama. Hybrids were moved from ponds and acclimated to tank conditions at least 2 weeks before the experiments were started. Hybrids were fed trout grower pellets (40% protein, 10% fat), to satiation twice a day during both the acclimation and experimental periods. They were not fed for 24 hours before handling to allow evacuation of the gut in order to reduce the oxygen deficit associated with metabolic acidosis during stress (Nikinmaa et al. 1984). Experiments were conducted indoors in 2-m diameter, 1,500-liter plastic tanks fitted with a center standpipe; each tank received aerated well water. Temperature was 20°–21° C and dissolved oxygen was at least 8.0 mg/liter throughout the tests.

Two groups of tilapia from ponds with natural spawns were used as forage for hybrid striped bass: 1 group was harvested 8 weeks before initiation of experiments,

Table 1. Design of experiments evaluating growth of striped bass × white bass hybrids on diets of fed tilapia, starved tilapia, and trout "grower" pellets (pellets).

Experiment	Treatment	*N* tanks	Feeding rate (%)	*N* hybrids/ tank	Hybrid age (mo)	Days in study
1-1[a]	Fed tilapia	3	10	25	21	30
	Pellets	2	3	25	21	30
1-2[a]	Fed tilapia	2	10	10	21	20
	Pellets	2	2	10	21	20
2-1[a]	Starved tilapia	2	10	15	21	30
	Pellets	2	3	15	21	30
3-1[b]	Fed tilapia	3	10	7	7	20
	Starved tilapia	3	10	7	7	20

[a]1,500 liter tanks.
[b]400 liter tanks.

and the second group was harvested 2 weeks before initiation of experiments. Each group was placed into a separate 1,500-liter tank located in the laboratory. The tilapia tanks received aerated well water from the same source as the hybrid striped bass tanks. Tilapia of the first group were starved for 2 months before they were used in experiments. Those in the second group were fed trout grower pellets (40% protein, 10% fat) to satiation twice per day. Fat content of both groups of tilapia was determined by the method of Bligh and Dyer (1959).

Trout Pellets Versus Fed Tilapia

Experiment 1 was designed to compare the growth of 21-month-old hybrids on a diet of trout pellets (TP) with those fed tilapia (FT) 6–8 cm long. The experiment, composed of 2 trials, was conducted in plastic 1,500-liter tanks with a flow rate of 26 liters/minute. In the first trial, 5 tanks each were stocked with 25 hybrids (125 fish total). Fish in 3 tanks were fed live tilapia at about 10% of the hybrid body weight per day in 1 feeding at 0800 hours and fish in 2 tanks of hybrids were fed TP at 3% of the hybrid body weight per day divided into 2 equal feedings, 1 at 0800 hours and 1 at 1500 hours. The weight of tilapia (10%) or pellets (3%) fed to fish in each tank remained constant throughout the trial, but the number of tilapia varied slightly each day. Selection of the feeding rate of 10% body rate per day was based on the work of Cox and Coutant (1981) who reported juvenile striped bass consumed 9.8% of their body weight per day when fed fathead minnows at 20° C. The rationale for feeding the pellet diet at the rate of 3% body weight per day was based on our expectations and experience that this amount of food would be readily consumed when offered in 2 feedings. After 30 days the experiment was terminated and the group weights per tank of tilapia that were not consumed by the hybrids were recorded. In the second trial, 4 tanks were each stocked with 10 hybrids. Fish in 2 tanks were fed TP at 2% (a reduction from trial 1 because larger fish were used and food consumption as a percentage of body weight declines as weight increases) of initial body weight per day divided into 2 feedings. Fish in the other 2 tanks were fed tilapia at about 10% initial body weight per day in 1 feeding at 0800 hours. After 20 days the experiment was terminated and the group weights per tank of tilapia that were not eaten were recorded.

Trout Pellets Versus Starved Tilapia

Experiment 2 was designed to compare the growth of 21-month-old hybrids on a diet of TP or starved tilapia (ST). The experiment was conducted in 4 1,500-liter plastic tanks receiving aerated water at the rate of 26 liters/minute. Hybrids were stocked at 15 per tank. Fish in 2 tanks were fed ST at 10% of the initial body weight per day in 1 feeding at 0800 hours, and fish in 2 other tanks were fed TP at 3% of body weight per day divided into 2 equal feedings, 1 at 0800 hours and 1 at 1500 hours. The weight of tilapia or pellets fed to each tank of fish was recorded daily. After 30 days the experiment was terminated and the group weights per tank of tilapia not consumed by the hybrids were recorded.

Fed Tilapia Versus Starved Tilapia

Experiment 3 was designed to compare the growth of 7-month-old hybrids offered FT to those offered ST. Seven hybrids were stocked into each of 6 400-liter plastic tanks receiving 9 liters/minute aerated well water. Fish in 3 tanks were offered FT and those in 3 other tanks ST. The daily weight of tilapia (8–10 cm) offered once a day at 0800 hours was 10% of the hybrids' initial body weight. After 20 days the experiment was terminated and the group weights of tilapia recovered from each tank were determined.

Total weights of hybrids and tilapia in each tank were determined at the beginning and end of each experiment. Total fish weights were divided by the number of fish per tank and then averaged over the number of tanks per treatment. One-way single classification analysis of variance was used to compare treatments within each treatment. Differences at $P \leq 0.05$ were considered significant.

Results

In trial 1 of experiment 1, production was significantly higher in hybrids fed FT than in those fed TP (Table 1). In trial 2, however, the difference in production between the group of hybrids on the 2 diets was not significant because of the high variability in the group fed TP. Food conversion ratios on a dry weight basis were similar, at 3.9 in trial 1 and 4.1 in trial 2 for hybrids fed TP. Food conversion differed for hybrids fed tilapia in trial 1, 9.1 on a wet weight, and 2.5 on a dry weight basis compared to trial 2, 4.3 on wet weight, and 1.2 on a dry weight basis. Hybrids offered FT daily consumed 10.1% of their initial body weight in trial 1 and 3.8 in trial 2.

In experiment 2, there was no significant difference in average daily weight gain between hybrids fed ST and hybrids fed TP (Table 2). Food conversion ratios for hybrids on these 2 diets were similar to those of fish in other experiments fed ST and TP. Hybrids raised on a diet of ST consumed 3.1% of their initial body weight per day. In experiment 3, hybrids raised on a diet of FT had significantly higher daily weight gain than hybrids on a diet of ST. For hybrids fed FT the food conversion ratio was approximately 29% lower than for those on a diet of ST. Hybrids consumed 6.8% of their initial body weight per day in FT and 7.2% in ST. Total body fat content of FT ($3.0 \pm 0.38\%$, mean $\pm$ SE) was significantly higher than that of ST ($2.35 \pm 0.60\%$). The average weight gain of 7-month-old hybrids fed tilapia was 4.1 g/day and for 21-month-old hybrids fed tilapia, 5 g/day. Hybrids fed pellets grew between 2.6 and 5.1 g/day.

Discussion

Redbelly tilapia appeared to be an adequate diet for hybrids of striped bass $\times$ white bass of the sizes we tested. Our results demonstrated significant growth differences in 1 trial between fish fed tilapia and those fed TP. Production was higher

Table 2. Initial and final average weight (g) of fish per tank, average daily gain (g/day), and food conversion on a wet weight basis (wet) and dry weight basis (dry) of striped bass × white bass hybrids on diets of fed tilapia, starved tilapia, and trout "grower" pellets (pellets).

Experiment & trial	Treatment	Initial weight		Final weight		Average daily gain		Food conversion	
		Mean	SD	Mean	SD	Mean	SD	Wet	Dry
1-1	Fed tilapia	475	6	633	13	5.2[a]	0.2	9.1	2.5
	Pellets	487	25	602	0	3.8[b]	0.8		3.9
1-2	Fed tilapia	563	37	664	36	5.0[a]	0.1	4.3	1.2
	Pellets	554	25	607	55	2.6[a]	1.5		4.1
2-1	Starved tilapia	632	66	768	77	4.6[a]	0.4	4.3	1.1
	Pellets	672	16	801	4	4.3[a]	0.7		4.2
3-1	Fed tilapia	252	25	334	24	4.1[a]	0.3	4.2	1.2
	Starved tilapia	253	28	319	24	3.4[b]	0.3	5.4	1.5

[a,b]Means with the same letter within a trial are not significantly different ($P < 0.05$).

in tanks in which fish were fed tilapia than in tanks in which fish were fed TP. There were no differences in survival; all hybrids in all tests survived. Differences in growth between hybrids fed ST and FT suggested that nutrients such as lipids, vitamins, and amino acids in the prey organisms varied with their diet and subsequently influenced growth in predators. Presumably the quality (stamina and disease resistance) of predators feeding on these organisms would also vary with the nutritional content of the prey.

Hybrids used in experiments 1 and 2 were 21-month-old maturing fish. At the end of the experiments, most males were flowing milt, and gonad development was observed in females. We could not distinguish between sexually immature fish (and did not wish to kill them to examine gonads); therefore, there could have been different sex ratios in different tanks during the experiments. Differing growth rates between maturing males and females (which are often considerable) may have influenced the results in experiments.

Daily gains of hybrids fed pellets in this study were comparable to those reported by others for striped bass and hybrids. Smith et al. (1985), working with 600- to 835-g hybrids in recirculated brackish water, reported an average growth rate of 2.35 g/day when fish were fed pellets. Williams and Sandifer (1981) found that the average growth of the F_1 hybrids was 3.3 g/day and Wawronowicz and Lewis (1979) reported growth rates of 2.03 g/day for 459-g striped bass fed a pelletized diet.

It is apparent that hybrid striped bass exhibit an excellent growth potential under culture conditions. Our work suggests that redbelly tilapia reared in ponds would provide adequate nutrition for rapid growth of hybrids of striped bass × white bass. When reared in polyculture, hybrids have the potential to limit the population size of redbelly tilapia stocked to control aquatic vegetation in warmwater ponds.

In most areas of the United States, tilapia would not survive the winter in ponds thus eliminating the need to separate them from hybrids harvested late in the year.

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