Impacts of Increasing Hybrid Striped Bass Stocking Rate and Frequency

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Abstract: The impact of changing the hybrid striped bass (white bass *Morone chrysops* ♂ × striped bass *M. saxatilis* ♀; WBxSB) stocking strategy on 2 Texas reservoirs was evaluated. Stocking of WBxSB in lakes Arlington and Graham was increased from 20 fingerlings (25–76 mm TL)/ha and 112 fry (6 mm TL)/ha biennially, respectively, to approximately 50 fingerlings/ha annually. Annual fall or winter gill net surveys were conducted to monitor densities of WBxSB and gizzard (*Dorosoma cepedianum*) and threadfin (*D. petenense*) shad. Spring creel surveys were conducted to evaluate angler utilization of WBxSB. Scales from WBxSB collected in 1987 were aged to determine year class strength at each lake. Gill net catch rates of WBxSB increased significantly after fingerling stocking rate and frequency were increased. Catch rates of gizzard and threadfin shad did not change significantly. Total fishing effort and directed pressure and angler harvest rate for WBxSB also increased significantly after the stocking rate and frequency were increased.

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Hybrid striped bass (white bass *Morone chrysops* ♂ × striped bass *M. saxatilis* ♀; WBxSB) have been stocked at various rates and frequencies throughout the United States (Ware 1975, Moczygemba and Morris 1977, Axon and Whitehurst 1985). Success of these introductions has been variable (Crandall 1978, Axon and Whitehurst 1985, Austin and Hurley 1987, Kinman 1987). Regardless of stocking strategy, Axon and Whitehurst (1985) noted WBxSB fisheries developed in 179 of 283 (67%) reservoirs surveyed.

Stocking of WBxSB began in lakes Arlington and Graham, Texas, in 1978 and 1979, respectively (Table 1). Stocking rate and frequency were the same as those

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Table 1. Stocking history of white bass ♂ x striped bass ♀ hybrids in Lake Arlington and Lake Graham, Texas.

		N/ha	
Lake	Year	Fingerlings (25–76 mm TL)	Fry (6 mm TL)
Arlington	1978	13.0	
	1980	24.4	
	1982	22.8	
	1984	50.6	
	1985	48.9	
	1986	47.8	
	1987	49.3	
Graham	1979		97.0
	1981		97.0
	1983		144.0
	1985	58.8	
	1986	58.1	
	1987	58.1	

used at most reservoirs throughout Texas. This stocking strategy failed to provide catch rates which generated significant angler interest in WBxSB at these reservoirs. Creel surveys during 1983 revealed few anglers sought WBxSB (<7%) and catch rates were low (<0.01/hour) (Bamberg 1984, Moczygemba et al. 1984). Low angler interest and WBxSB harvest were likely due to low WBxSB densities.

In 1984 the statewide WBxSB stocking strategy was changed. Numbers of WBxSB stocked were increased to approximately 50 fingerlings/ha and stocking frequency was changed from biennial to annual. The new stocking strategy was intended to increase WBxSB populations to a density that generated angler interest without decreasing prey fish populations. The objectives of this study were to evaluate the effects of this change in stocking strategy on densities of WBxSB and on angler participation and success at Lake Arlington and Lake Graham, Texas. The effect of the increased stocking on shad (*Dorosoma* spp), the primary prey of WBxSB, was also evaluated.

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Methods

Study Sites

Lake Arlington, a 921-ha impoundment on Village Creek (tributary of West Fork Trinity River) in Tarrant County, Texas, was constructed in 1957. An oil/gas-fired power plant on the reservoir operates during peak-power demand. At conservation pool (169.4 m above mean-sea-level), the reservoir has a maximum depth of 15.5 m and mean depth of 6.1 m.

Lake Graham, a 1,031-ha impoundment on Salt Creek (tributary of Brazos River) in Young County, Texas, was built in 1958. An oil/gas-fired power plant at the reservoir operates continuously. The maximum depth is 14 m and the mean depth is 6.4 m at conservation pool (328 m above mean-sea-level).

There were no bag or length limits on WBxSB for either reservoir during the study.

Study Procedures

Gill nets were used to determine changes in population densities of WBxSB, gizzard shad (*D. cepedianum*), and threadfin shad (*D. petenense*). Experimental monofilament gill nets 61 m long and 2 m deep were used. Mesh size increased by 13-mm increments from 13 mm to 102 mm at 8-m intervals. Nets were set in the afternoon and retrieved the following morning. Total fishing hours were recorded for each net. Catch was sorted and counted by species in order to determine catch per unit effort (fish per hour) for each species. Gill nets were set at 5 stations on Lake Arlington in 1983 and 1985 through 1987. At Lake Graham, 5 stations were sampled in 1985 and 1987, and 10 stations in 1984 and 1986. Each station was sampled once during late fall or early winter (October through January).

Angler participation in the fishery and catch rates of WBxSB were estimated using fixed-access stratified creel surveys. Surveys were conducted on Lake Arlington on 9 randomly selected days (5 weekend days and 4 weekdays) each year from February through April 1983 and 1985–1987, and likewise on Lake Graham from February through April 1983, and from March through May 1986–1987. Creel clerks contacted anglers upon completion of their fishing trip. Information obtained from each party included number of anglers, hours fished, species sought, and number and weight of each species harvested. Angler counts were taken at each reservoir during randomly selected times. Total fishing effort (angler-hours/day) was estimated as the product of angler counts and hours fished from angler interviews. Harvest was estimated as the product of harvest rate from angler interviews and total fishing effort (Lambou 1961, Malvestuto 1983). Directed pressure towards WBxSB (percent angler-hours seeking WBxSB), WBxSB catch rates (fish/angler-hour), and WBxSB harvest (number/ha and kg/ha) were determined from creel data.

Scales were removed from a representative sample of WBxSB collected in 1987 to determine year class strength at each reservoir. All WBxSB were individually weighed (g) and measured (mm TL). Scale impressions were made on acetate slides with a heated hydraulic press. After enlarging with a microprojector, scale images

were aged. Age and length at capture were used with length frequency graphs to determine year class strength at each reservoir.

A 1-way analysis of variance (ANOVA) was used to test annual trends for medians of 6 variables (non-parametric analysis): WBxSB gill net catch rates (fish/gill net-hour), gizzard shad gill net catch rates, threadfin shad gill net catch rates, total fishing effort (angler-hours/day), directed pressure towards WBxSB (percent of angler-hours seeking WBxSB), and WBxSB harvest rates (fish/angler-hour). Values of each variable were ranked within each reservoir and analyses were performed on the rank values using years as the main effect. This was asymptotically equivalent to using the Friedman 2-way analysis for block designs with reservoirs forming the blocks (Conover 1980). Annual trends were also tested using the 1-way ANOVA model with orthogonal polynomial contrasts of pre-treatment versus post-treatment. Analyses were performed using the Statistical Analysis System (SAS) General Linear Models procedure (SAS 1985). The null hypothesis of no significant difference was rejected at $P < 0.05$.

Results and Discussion

Fish Population Surveys

Gill net catch of WBxSB in the study reservoirs increased significantly ($P = 0.0065$) after the change in stocking rates (Table 2). Populations of WBxSB in both reservoirs were dominated by 2 year classes in December 1987 (Fig. 1). In Lake Arlington it was the 1985 and 1986 year classes, and in Lake Graham it was the 1986 and 1987 year classes. These year classes were also the most abundant in the 1987 creel at Lake Arlington, where the 1985 year class made up 44% of the WBxSB harvest, and the 1986 year class contributed 34%.

Table 2. Gill net catch rates of white bass ♂ x striped bass ♀ hybrids (WBxSB), gizzard shad, and threadfin shad relative to years before and after change of WBxSB stocking strategy (year 0) at Lake Arlington and Lake Graham, Texas.

Lake	Years before and after stocking change	Median N per gill net hour		
		WBxSB	Gizzard shad	Threadfin shad
Arlington	−1	0.00	0.81	0.86
	0			
	1	0.51	0.47	0.28
	2	0.20	0.40	0.00
	3	0.18	0.61	0.13
Graham	−2	0.00		
	−1			
	0	0.00	0.00	0.00
	1	0.00	0.00	0.12
	2	0.05	0.07	0.02

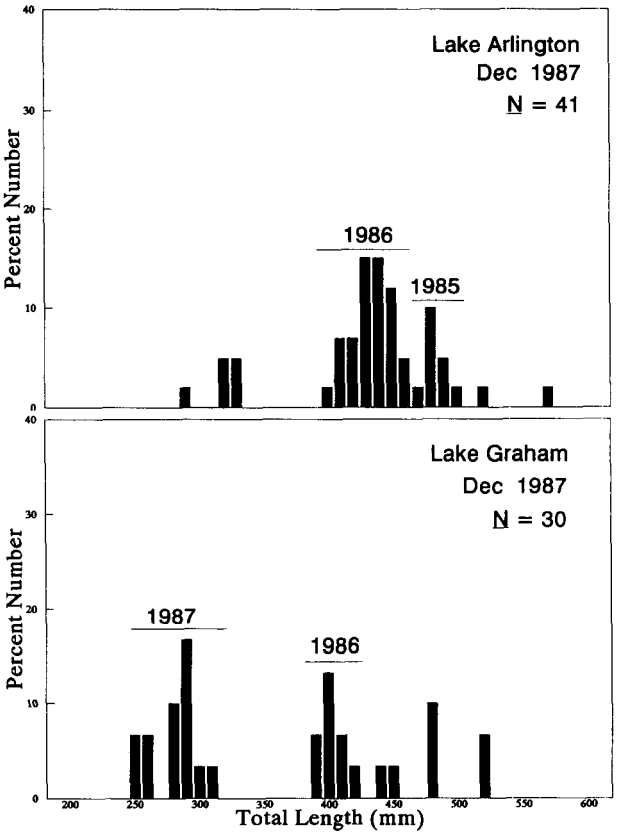

Figure 1. Length frequency distribution of white bass ♂ x striped bass ♀ hybrids from gill netting samples at Lake Arlington and Lake Graham, Texas, 1987. Dominant year classes are marked according to size ranges.

No significant changes in gizzard ($P = 0.3075$) or threadfin ($P = 0.0620$) shad gill net catch rates were detected at the study reservoirs (Table 2). Similarly Kinman (1987) reported no significant changes in densities of shad at Herrington Lake, Kentucky, after stocking WBxSB.

Creel Surveys

Total fishing pressure ($P = 0.0026$), directed pressure towards WBxSB ($P = 0.0001$), and angler harvest rate for WBxSB ($P = 0.0105$) increased significantly after the stocking strategy was changed (Table 3). Total fishing effort at each reservoir was highest 2 years after increased stocking. Median percent angler-hours seeking WBxSB at Lake Arlington and Lake Graham was higher each year after stocking. However, Lake Graham anglers responded more rapidly than those at Lake Arlington. By the end of the study, directed pressure towards WBxSB at both reservoirs was much higher than found in other studies. For example, Austin and Hurley (1987) concluded 2%–4% angler time seeking WBxSB was low and indicated a less than acceptable WBxSB fishery. Yeager (1985) considered 13% angler time

Table 3. Total fishing pressure, percent angler-hours seeking white bass ♂ × striped bass ♀ hybrids (WBxSB), and angler harvest for WBxSB relative to years before and after change of WBxSB stocking strategy (year 0) at Lake Arlington (A) and Lake Graham (G), Texas.

	Median angler hours per day		Median % angler-hours seeking WBxSB		Median WBxSB per angler hour	
Year[a]	A	G	A	G	A	G
−2		95		5.0		0.00
−1	370		0.0		0.00	
0						
+1	851	271	1.8	10.0	0.00	0.13
+2	1,074	653	5.2	27.9	0.05	0.05
+3	837		24.8		0.03	

[a]Years before and after stocking change.

seeking WBxSB to be excellent for the Escambia River, Florida. Median angler harvest rate of WBxSB was Ø WBxSB/angler-hour in both reservoirs before increased stocking (Table 3). In Lake Arlington median angler harvest rate peaked at 0.05 WBxSB/angler-hour 2 years after increased stocking. In Lake Graham WBxSB harvest rate increased to 0.13 WBxSB/angler-hour 1 year after increased stocking and then declined. The dramatic increase of total fishing pressure and directed fishing pressure for WBxSB may have caused the drop in angler harvest rate.

In the spring of 1983 and prior to the increased stocking of WBxSB, angler harvest of WBxSB was 0.4 kg/ha at Lake Arlington and 0.0 kg/ha at Lake Graham. After increased stocking spring angler harvest of WBxSB varied from 1.3 to 2.1 kg/ha at Lake Arlington and 0.7 to 6.4 kg/ha at Lake Graham. The spring harvest rates of WBxSB at both reservoirs were much greater than the mean annual WBxSB harvest rate of 0.7 kg/ha as reported by Axon and Whitehurst (1985) for freshwater impoundments in the United States.

Management Implications

Biennial stocking of WBxSB at 13 to 24 fingerlings/ha or 97 to 144 fry/ha did not create a measurable WBxSB fishery at Lakes Arlington or Graham. After stocking 48 to 58 fingerlings/ha/year, the density of WBxSB was increased and a WBxSB fishery was developed. Not only did total fishing pressure increase, but percent angler-hours fishing for WBxSB increased, which indicated an increase in total angler-hours fishing for WBxSB. The greatest impact to the creel occurred from 1 to 2 years after the increased stocking, but WBxSB entered the creel within a year after stocking. A significant decrease of the forage base was not detected after the density of WBxSB was increased. We recommend the stocking of WBxSB be continued at approximately 50 fingerlings/ha/year at Lakes Arlington and Graham.

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