Effects of Stocking Regime and Harvest Regulation on Florida Largemouth Bass Stocking Success

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Abstract: During a 2-year period, 250,000 Florida largemouth bass fingerlings were stocked among the endemic northern largemouth bass population of Tradinghouse Creek Reservoir (1985 = 185/ha, 1986 = 123/ha). We used electrophoresis to estimate proportions of Florida, northern, and Florida × northern intergrade largemouth bass within pre-stocking, stocking-year, and post-stocking year cohorts. Ages of largemouth bass were determined by examination of whole otoliths. The proportion of Florida phenotypes within the stocking-year cohort was not increased when the stocking rate was more than 50/ha greater. Stocked Florida phenotypes comprised 6% and 25% of the 1985 and 1986 cohorts, respectively, at age 1. Implementing a less restrictive harvest regulation accelerated introgression of the Florida genome by providing size-related, selective harvest of larger, northern largemouth bass. During the 2 year period from 1987–1989, Florida and Florida × northern phenotypes increased from 22% to 78% of largemouth bass sampled.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 45:477–483

Texas Parks and Wildlife Department began stocking Texas reservoirs with Florida largemouth bass (*Micropterus salmoides floridanus*) in 1972 to increase genetic diversity among Texas stocks of northern largemouth bass (*M. salmoides salmoides*) (Kulzer et al. 1985). Early attempts to assess the impact of Florida largemouth bass introductions, based on meristic methods described by Bailey and Hubbs (1949), did not provide consistent discrimination among subspecies and intergrade populations (Smith and Crumpton 1977, Pelzman 1980). Subsequently, Philipp et al. (1982) used starch-gel electrophoresis to redefine native ranges for

Florida, northern, and intergrade populations in the United States. Kulzer et al. (1985) used electrophoresis to assess the success of various stocking regimes for Florida largemouth bass in 19 Texas reservoirs. Existing phenotypes had not been assessed prior to the introductions, however. Moreover, broodstock contamination at Texas state hatcheries created uncertainty regarding actual phenotypes which were stocked in the study reservoirs (Harvey et al. 1980).

We conducted this study to determine the rate of genetic introgression of Florida largemouth bass into the existing northern largemouth bass population of Tradinghouse Creek Reservoir. The effects of a change in harvest regulation on the rate of introgression were also examined.

We are grateful to Phil Durocher and Roger McCabe who helped with editing and revising the manuscript. We are also grateful to Floyd Teat, Kevin Storey, and Milton Cortez for technical assistance in the field and laboratory.

Methods

Tradinghouse Creek Reservoir (804 ha) is a shallow ($\bar{X}$ depth = 5.7 m) electrical-power generation cooling-reservoir located in McLennan County, Texas. The reservoir was constructed in 1968 (Mitchell and Sellers 1989). During a 2-year period, the reservoir was stocked each spring with 250,000 Florida largemouth bass (30-mm) fingerlings (1985 = 185/ha, 1986 = 123/ha). In September 1988, a 5-fish-per-day, 356-mm minimum size limit replaced the existing harvest regulation, a 3-fish-per-day, 406-mm minimum size limit. Shoreline electrofishing was used to collect largemouth bass during October of all sampling years. Samples were collected from fixed locations between dusk and midnight with a boat-mounted, gasoline-powered generator (220v/4500w AC rectified to DC output). Methods used were described by Reynolds (1983). Sampling was continued until at least 50 fish were collected. Ages were determined from examination of whole otoliths (sagittae) as described by Taubert and Tranquilli (1982). Horizontal starch- or agarose-gel electrophoresis was used to determine largemouth bass phenotypes (Kulzer et al. 1985). Nomenclature used for protein-coding loci was that of Shaklee et al. (1990).

Results

Phenotypes prior to Florida largemouth bass stocking (1985) were predominantly those characteristic of northern largemouth bass (Table 1). Although there were no known previous introductions of Florida largemouth bass; 2 individuals, heterozygous at the *IDHP-1** locus, were identified among largemouth bass which existed prior to stocking (Table 2).

Florida largemouth bass from both stocked cohorts were recovered. Proportion-estimates of Florida phenotypes present within stocking-year cohorts at age 1 were 6% and 25% for the 1985 and 1986 cohorts, respectively (Table 1). Florida phenotypes of the 1985 cohort, present in the 1986 sample, were not recovered in subsequent years (Table 1.)

Table 1. Ages and phenotypes of largemouth bass collected by electrofishing, Tradinghouse Creek Reservoir, Texas, 1985–1987, 1989, and 1990.

Phenotypes[a]	Age 0	Age 1	Age 2	Age 3	Age 4	Total
			1985 N = 50			
Nor	11	32	5	0	0	48
Fla	0	0	0	0	0	0
F_1	0	0	0	0	0	0
F_x	0	1	1	0	0	2
			1986 N = 50			
Nor	1	29	18	0	0	48
Fla	0	2	0	0	0	2
F_1	0	0	0	0	0	0
F_x	0	0	0	0	0	0
			1987 N = 88			
Nor	6	32	24	8	3	73
Fla	0	11	0	0	0	11
F_1	3	1	0	0	0	4
F_x	0	0	0	0	0	0
			1989 N = 50			
Nor	4	6	1	0	0	11
Fla	1	1	0	0	0	2
F_1	6	8	1	2	0	17
F_x	5	12	3	0	0	20
			1990 N = 50			
Nor	5	7	0	0	1	13
Fla	4	1	2	2	0	9
F_1	5	2	3	0	1	11
F_x	8	7	2	0	0	17

[a] Nor = northern largemouth bass; Fla = Florida largemouth bass; F_1 = F_1 intergrade; and F_x = non F_1 intergrade.

Table 2. Largemouth bass allele frequencies at 3 loci, Tradinghouse Creek Reservoir, Texas, 1985–1987, 1989, and 1990.

		Frequency				
Locus	Allele	1985 (N = 50)	1986 (N = 50)	1987 (N = 130)	1989 (N = 50)	1990 (N = 50)
*IDHP-1**	**100*	0.98	0.96	0.83	0.66	0.56
	**136*	0.02	0.04	0.17	0.34	0.44
*sAAT-2**	**100*	0.94	0.94	0.82	0.58	0.48
	**118*	0.06	0.02	0.01	0.01	0.00
	**125*	0.00	0.02	0.14	0.24	0.29
	**153*	0.00	0.02	0.03	0.17	0.23
*SOD-1**	**100*	1.00	0.96	0.91	1.00	0.96
	* *56*	0.00	0.04	0.09	0.00	0.04

The presence of F_1 intergrade phenotypes was observed during 1987, 2 years after the initial stocking (Table 1). Age 0 and age 1 individuals were collected and F_1-types were present among the cohorts of each subsequent year (Fig. 1).

Northern phenotypes remained predominant among the population until after fall 1987, before a less restrictive harvest regulation was implemented (Fig. 2). By 1989, 1 year after the regulation was changed, the proportion comprised by Florida and Florida × northern intergrades had increased to 78% of largemouth bass sampled.

Discussion

Presence of Florida alleles within the preexisting population indicated previous studies (without prior knowledge of existing phenotypes) could have overestimated intergradation of recent Florida largemouth bass introductions. The source of Florida largemouth bass alleles among the preexisting population in Tradinghouse Creek Reservoir was not determined; there was no known previous introduction of Florida largemouth bass. Philipp et al. (1982) reported 4 of 6 Texas reservoirs sampled

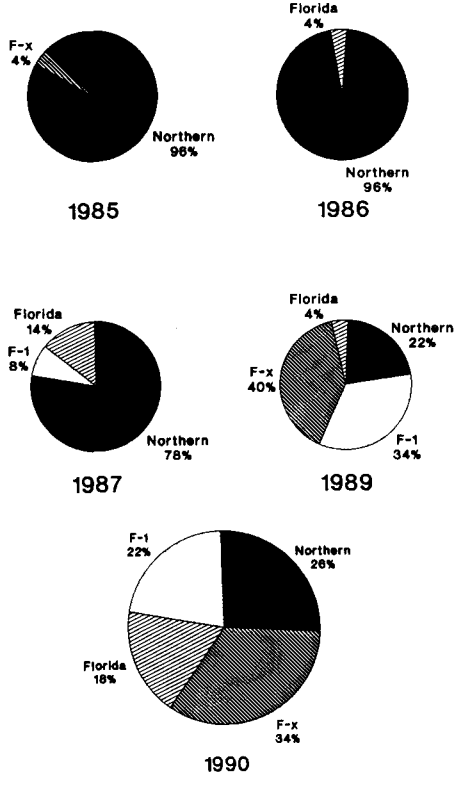

Figure 1. Largemouth bass phenotypes (F_1 = F_1 intergrade and F_x = non-F_1 intergrade), Tradinghouse Creek Reservoir, Texas.

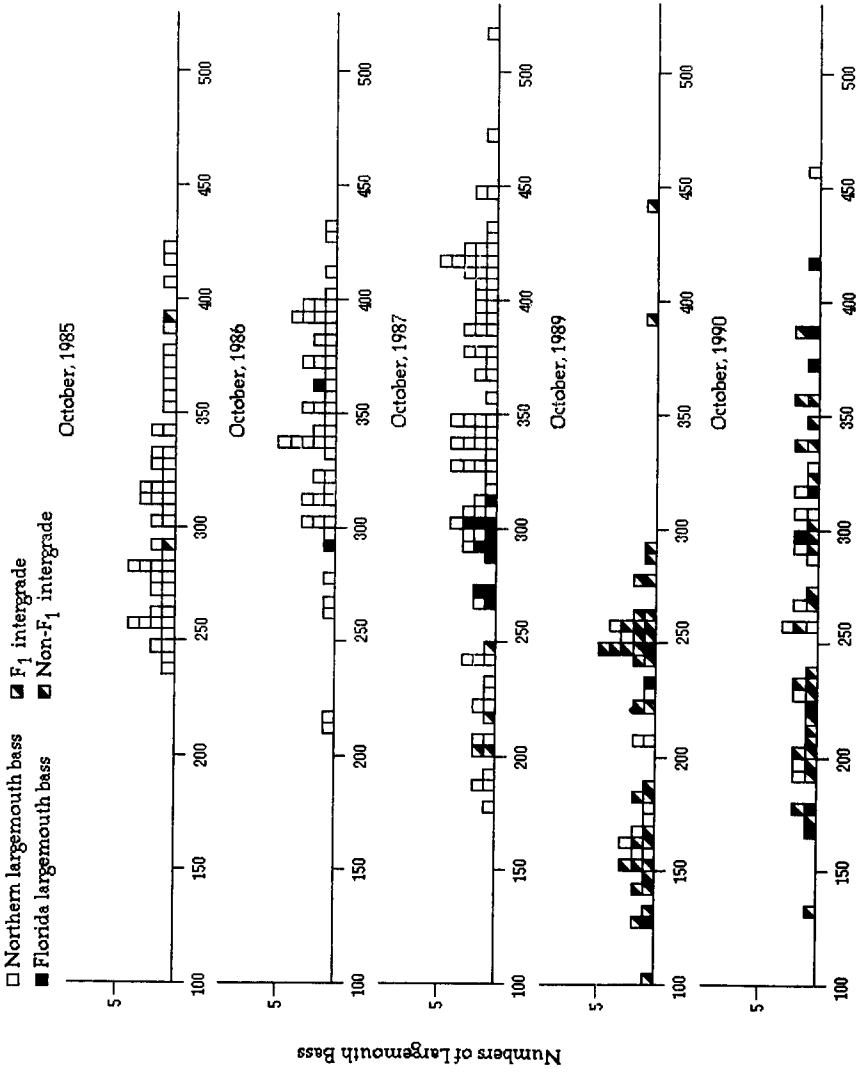

Figure 2. Largemouth bass length frequency, Tradinghouse Creek Reservoir, Texas.

contained intergrade largemouth bass populations; the authors concluded presence of Florida alleles in these populations were most probably the result of deliberate introductions of the Florida subspecies. Whitmore and Hellier (1988) observed alteration of the genetic integrity of native largemouth bass in Squaw Creek Reservoir, Texas, by natural hybridization of northern largemouth bass with introduced smallmouth bass and Florida largemouth bass. Because Florida alleles in the preexisting population of Tradinghouse Creek Reservoir were present at only 1 of the 3 loci examined (only 2 heterozygotes were observed at this locus), presence of these alleles may not represent an introgression of alleles from an external source; such alleles may have been the result of a naturally-occurring event within the preexisting population.

Introgression of the Florida genome was accelerated when a less restrictive harvest regulation was implemented and older northern largemouth bass were removed. Northern phenotypes still comprised a greater proportion of the population in 1987; moreover, largemouth bass >315 mm were exclusively northern. Florida phenotypes comprised 44% of largemouth bass from 200-300 mm, but none were >320 mm. As an initial result, the less restrictive regulation provided greater protection for existing Florida phenotypes and provided for selective harvest of northern phenotypes. By 1989, Florida and Florida × northern intergrades had become the predominant phenotypes among the population.

Within the range of our data, the proportion of age 1 Florida phenotypes was not increased by a stocking-rate increase of greater than 50/ha. The 1985 stocking, despite the greater stocking rate, was less successful than the 1986 stocking. Although Florida phenotypes from the 1985 cohort were not recovered after 1986, F_1 progeny recovered in 1987 (at age 1) were a probable result of northern phenotypes mating with Florida phenotypes from the 1985 stocking. Because F_1 phenotypes from this cohort were recovered in 1987 and subsequent sampling years to age 4, the 1985 stocking thus contributed to the overall effectiveness of the regime. Our results support the conclusion of Kulzer et al. (1985) that repetitive stocking is more important in establishing Florida largemouth bass than the total number stocked. Kulzer et al. (1985) reported their data was consistent with observations of others who concluded Florida largemouth bass were more difficult to establish in older reservoirs (with existing northern largemouth bass populations). However, our results indicate a 2-year stocking regime such as the one used here can be sufficient to establish Florida phenotypes in older reservoirs such as Tradinghouse Creek.

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