Contribution of Largemouth Bass Reared in Nursery Ponds to Year Classes in Two Texas Reservoirs

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Abstract: Genetically-marked Florida largemouth bass (*Micropterus salmoides floridanus*) fingerlings with rare or unique genotypes were stocked into nursery ponds at Lake Conroe (8,484 ha) and Lake Gladewater (323 ha). Following grow-out, advanced-size individuals were stocked into respective reservoirs. We measured the contribution of stocked individuals to corresponding year classes in receiving reservoirs. Largemouth bass survival in nursery ponds at the end of the grow-out period was 15.6% at Lake Conroe and 20.9% at Lake Gladewater. A total of 2.8 fish/ha (mean total length = 138 mm) were stocked in Lake Conroe and 8.8 fish/ha (mean total length = 121 mm) were stocked in Lake Gladewater. Following reservoir stockings, largemouth bass populations were sampled with electrofishing gear in fall and spring and electrophoretic analysis was conducted to evaluate the contribution of stocked fish to corresponding year classes. Largemouth bass from nursery ponds comprised 0.0%, 5.0%, and 0.0% of the 1991 cohort at Lake Conroe in October 1991, April 1992, and November 1992 electrofishing samples, respectively. Largemouth bass from Lake Gladewater nursery ponds comprised 4.5%, 6.7% and 0.0% of the 1992 cohort in December 1992, March 1993, and March 1994 electrofishing samples, respectively. Returns from nursery pond stockings were low with minimal contribution to year classes in study reservoirs.

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Nursery ponds have been utilized as a management tool to grow fish to intermediate size to reduce natural mortality and increase stocking success. As with direct fry/fingerling stockings, fishes reared in nursery ponds are used to achieve 1 or more of the following objectives: rebuild depleted stocks, increase recruitment, introduce a non-native sport fish, and genetically manipulate a target population.

Nursery pond programs have been popular among angling groups and generate good public relations; however, success of any stocking program should ultimately be measured by its contribution to the fishery. Although numerous studies have documented the use of nursery ponds as an effective management approach for a variety of fishes, literature evaluating the contribution of largemouth bass reared in nursery ponds to the recreational resource is limited. Kreiger and Puttman (1983) reported hatchery-reared largemouth bass stocked 3 consecutive years, at rates of 25–133 bass/habitat-ha, comprised 12%, 59%, and 59% of the individuals sampled in the corresponding year classes 1 year following annual stockings in Chatfield Reservoir, Colorado. Although contribution of stocked fish to respective year classes approached 60%, long-term benefits to the fishery were not reported. Marzolf (1954) found it was not economically feasible to use rearing ponds to produce largemouth bass to 0.45 kg for supplemental stocking in large Missouri reservoirs because availability of sufficient suitable waters for production purposes was limited.

Resource agencies occasionally have to justify largemouth bass nursery pond programs sponsored and endorsed by fishing organizations and controlling authorities. While largemouth bass nursery pond programs generate good public relations for cooperators, benefits to the resource and the anglers are not clear. Depending on the management objective, alternative approaches may be more efficient, more effective, and less costly.

Texas Parks and Wildlife Department (TPWD) biologists have experienced satisfactory results using direct-stocking methods with hatchery-reared Florida largemouth bass fingerlings to genetically manipulate largemouth bass populations to maximize fishing quality in public reservoirs. Forshage and Fries (1995) reported Florida largemouth bass alleles were present in ≥20% of the largemouth bass sampled in 97 of 126 Texas reservoirs evaluated. They suggest Florida largemouth bass introgression appeared to be related to reservoir age and size, stocking frequency, and latitude. Kulzer et al. (1985) also found introgression of Florida largemouth bass may be influenced by stocking frequency and suggested repetitive annual stockings of small fingerlings or fry may be more effective in establishing this genotype in Texas reservoirs.

Supplemental stocking of largemouth bass has been a frequently used management technique when the objective is to increase year-class strength; however, available literature indicates results may be highly variable. Boxrucker (1986) stocked largemouth bass at a rate of 450 fingerlings/ha to enhance year-class strength in 2 Oklahoma impoundments. Stocked fish comprised >70% of that year class for 2 growing seasons in both reservoirs following the stockings. However, high natural mortality of stocked fish at age 1+ occurred and angler catch and harvest rates did not increase. Lawson and Davies (1977) evaluated supplemental stocking of fingerling and intermediate-size largemouth bass to reduce black crappie (*Pomoxis nigromaculatus*) density and increase recruitment of harvestable-size largemouth bass in Lee County Lake, Alabama. They reported fingerling stockings appeared to increase year-class strength; however, intermediate-size largemouth bass were vulnerable to angling and apparently experienced high angling and natural mortality. Returns of marked intermediate-size individuals were rarely observed in angler creels 3 months following stocking. Terre et al. (1993) used genetically-marked largemouth bass at different stocking rates (30–200 fingerlings/ha) to evaluate year class and genetic contributions to largemouth bass populations in 3 Texas reservoirs. They found contribution of stocked bass to year classes did not appear to be directly related to stocking rate. They suggested year-class strength and recruitment characteristics of the population at the time of the stocking and other density-dependent variables may influence success of supplemental stocking programs.

Low recruitment of largemouth bass has been identified as a management problem at Lakes Conroe and Gladewater, Texas. The catch rate of largemouth bass ≥203 mm in fall electrofishing was 44.5 fish/hour at Lake Conroe (Webb and Henson 1994) and 12.0 fish/hour at Lake Gladewater (Ryan and Janssen 1993). The mean catch rate of stock-size largemouth bass is approximately 76 fish/hour in fall electrofishing samples in Northeast Texas public reservoirs (>202 ha).

Recruitment of largemouth bass at both reservoirs may be limited by availability of submerged aquatic vegetation (Durocher et al. 1984). Aquatic vegetation density at Lake Conroe declined to <1% of the reservoir surface area following the introduction of grass carp (*Ctenopharyngodon idella*) during the early 1980s (Webb and Henson 1994). Submerged aquatic macrophytes comprise <1% of the surface area at Lake Gladewater (Ryan 1995).

Lake associations have been utilizing nursery ponds at both reservoirs to produce advanced-size largemouth bass for stocking. Objectives of these nursery pond programs have been to supplement recruitment and increase the percentage of Florida largemouth bass alleles present in reservoir populations. However, benefits of these programs to the fisheries have not been measured. Our objective was to measure the contribution of genetically-marked Florida largemouth bass produced in nursery pond programs to a year class in those reservoirs.

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Methods

Lake Conroe is a 8,484-ha reservoir located in Southeast Texas in Walker and Montgomery counties, approximately 20 km north of Houston. Lake Gladewater is a 323-ha reservoir located in Gladewater in Northeast Texas in Gregg and Upshur counties. Both reservoirs were constructed to serve as municipal water supplies.

Five earthen ponds averaging 0.40 ha at Lake Conroe and 2 earthen ponds averaging 0.23 ha at Lake Gladewater were used in this study. Ponds at Lake Conroe were fertilized to maintain a visible plankton bloom prior to stocking. Fertilization was not conducted at Lake Gladewater because a high concentration of terrestrial vegetation was inundated in ponds just prior to stocking. Fathead minnows (*Pimephales promelas*) were periodically stocked in ponds at both reservoirs throughout the grow-out period.

Florida largemouth bass with rare or unique genotypes were utilized in this study. Lake Conroe nursery ponds were stocked in May 1991 with Florida largemouth bass (74,979 fingerings/ha) fixed for certain allele combinations at the sAAT-B* and sSOD* loci. Samples taken prior to stocking the marked fish indicated relatively low frequencies for the genetic marks (sAAT-B* = 0.138, sSOD*60 = 0.167) and individuals with the marked gene combinations were absent. Consequently, any increase in the frequencies of the genetic marks could be attributed to stocking success. Alternatively, Lake Gladewater nursery ponds were stocked in May 1992 with Florida largemouth bass (33,829 fingerlings/ha) fixed for a unique allele at the sIDHP* locus. This allele, sIDHP*109, differs from the typical Florida largemouth bass sIDHP* allele (sIDHP*122). Any fish possessing the sIDHP*109 allele was assumed to be a stocked fish.

Ponds were drained July through August 1991 at Lake Conroe and November 1992 at Lake Gladewater. The number and mean total length of largemouth bass recovered in ponds at Lake Conroe were estimated from a 10% subsample. The total weight of bass recovered from ponds at Lake Gladewater was recorded and subsamples taken to estimate the number and mean total length (mm) of largemouth bass. Largemouth bass were placed into tanks containing oxygenated water, transported by truck or boat, and stocked at 4 locations in each reservoir.

Spring and fall electrofishing was conducted 3 times within a 1.5-year period following reservoir stockings to determine percent contribution of stocked fish to corresponding year classes in both reservoirs. A boat-mounted Smith-Root Model GPP 5.0 Electrofishing Unit was used to collect largemouth bass at both reservoirs. Electrofishing was conducted at 12 stations (1991) and 8 stations (1992) at Lake Conroe and 6 stations (1992–1994) at Lake Gladewater. Stocking sites were included in electrofishing stations at Lake Conroe in fall 1991 and Lake Gladewater all years because age-0 largemouth bass are reported to stay near their stocking site (Copeland and Noble 1994). Sampling was conducted at night; effort was 15 minutes/station.

Otoliths (sagittae) and liver tissue were removed from individual largemouth bass collected in electrofishing surveys. Otoliths were viewed with a microscope to determine year class. Liver tissue from individual largemouth bass from year classes corresponding to that of stocked bass was placed in numbered vials, frozen, and later subjected to protein analysis. The phenotype of individual specimens was determined by electrophoretic analysis according to methods modified from Philipp et al. (1983). Percent contribution of stocked bass to the corresponding year class was calculated by dividing the number of genetically-marked bass by the total number of largemouth bass in the corresponding cohort represented in a sample.

Results

Survival of largemouth bass in nursery ponds was 15.6% at Lake Conroe and 20.9% at Lake Gladewater (Table 1). Mean length of bass recovered was 138 mm and 121 mm in nursery ponds at the respective reservoirs. Because of high mortality

Table 1. Summary of parameters relative to nursery ponds used at Lakes Conroe and Gladewater, Texas.

Parameter	Lake Conroe	Lake Gladewater
	Nursery Ponds	
N	5	2
Avg. size (ha)	0.4	0.2
Fertilized	Yes	No
	Nursery pond stocking	
N stocked	151,457	13,667
Stocking rate (*N*/ha)	74,979	33,829
Mean total length (mm)	19.1	26.3
	Reservoir stocking	
Size (ha)	8,484	323
N stocked	23,680	2,853
N/ha	2.8	8.8
Mean total length (mm)	138	121

of largemouth bass in nursery ponds, stocking rates in reservoirs were only 2.8 and 8.8 bass/ha in lakes Conroe and Gladewater, respectively.

Contribution of nursery pond-reared bass to corresponding year classes was highest for the year following stocking in spring electrofishing collections at both reservoirs (Table 2). Largemouth bass from nursery ponds comprised 0.0%, 5.0%, and 0.0% of the 1991 cohort at Lake Conroe in October 1991, April 1992, and November 1992 electrofishing samples, respectively. Largemouth bass from Lake Gladewater nursery ponds comprised 4.5%, 6.7%, and 0.0% of the 1992 cohort in December 1992, March 1993, and March 1994 electrofishing samples, respectively.

Table 2. Percentage of genetically-marked largemouth bass represented in electrofishing samples of the 1991 cohort at Lake Conroe and the 1992 cohort at Lake Gladewater, Texas. Sampling was conducted at 12 stations (1991) and 8 stations (1992) at Lake Conroe and 6 stations (1992–1994) at Lake Gladewater.

Reservoir	Date	Cohort in sample (*N*)	Catch per unit effort[a]	Stocked fish in sample *N*	Stocked fish in sample %
Conroe	Oct/91	142	47.3	0	0.0
	Apr/92	40	20.0	2	5.0
	Nov/92	48	24.0	0	0.0
Gladewater	Dec/92	67	44.7	3	4.5
	Mar/93	45	30.0	3	6.7
	Mar/94	36	24.0	0	0.0

[a]Electrofishing effort was 15 minutes/station; catch per unit effort = *N*/hour.

Discussion

The contribution of largemouth bass reared in nursery ponds to corresponding year classes was low in both reservoirs. Even with high stocking rates in nursery ponds, production was inadequate to provide substantial numbers of bass for stocking at either reservoir. Marzolf (1954) also reported an inverse relationship between stocking rates in ponds and survival to grow-out.

Low reservoir stocking rates alone probably influenced our results. However, density-dependent factors in largemouth bass populations at study reservoirs may have also been a contributing factor. Terre et al. (1993) reported supplemental stocking success may be inversely influenced by density and recruitment characteristics of the receiving population. Year-class strength appeared to be higher at both reservoirs during the years stockings were conducted (Table 2).

Availability of preferred habitat in receiving reservoirs may have limited survival of stocked largemouth bass. Aquatic vegetation densities were low at both reservoirs. Durocher et al. (1984) found a significant positive relationship between percent submerged vegetation and both standing crop and recruitment of largemouth bass to harvestable size.

Arguably, modified pond-rearing techniques may have contributed to higher production and better growth of largemouth bass during the grow-out period. However, maximum production potential in ponds is limited and pond space was inadequate at both reservoirs to produce substantial numbers of bass.

Time of year nursery ponds were drained and availability of prey in receiving reservoirs may have contributed to high stocking and natural mortalities of stocked bass. When nursery ponds were drained during summer months at Lake Conroe, water temperatures could have contributed to higher stress-related mortalities. When largemouth bass from Lake Gladewater nursery ponds were stocked in November, suitable-size prey may not have been available.

One or combinations of the aforementioned factors could have negatively influenced supplemental stocking success at lakes Conroe and Gladewater. Our results and available literature suggest stocking of largemouth bass to supplement recruitment may not be an effective management strategy under certain circumstances (Loska 1982, Terre et al. 1993). Although several authors reported supplemental stockings increased year class strength, high mortality rates of age-0 and age-1 largemouth bass appeared to undermine long-term benefits to the fishery (Lawson and Davies 1977, Boxrucker 1986). No largemouth bass from nursery ponds were recovered from lakes Conroe or Gladewater 1.5 years following stockings.

Supplemental stocking has been an effective management tool to genetically manipulate largemouth bass populations in reservoirs located in southern latitudes (Kulzer et al. 1985, Gilliland and Whitaker 1989, Terre et al. 1993, Forshage and Fries 1995). Direct stockings of fry or fingerling Florida largemouth bass have been the most frequently used and most effective stocking strategy employed to genetically alter largemouth bass populations in public waters.

The stocking objectives of the Lake Conroe Restocking Association and Gladewater Lake Advisory Board were to supplement year class strength and increase Florida largemouth bass introgression. Our data indicate largemouth bass from these supplemental stocking programs provided minimal contribution to year classes at either reservoir. Because of the length of this study we concede that there may have been limited recruitment of stocked bass which may ultimately provide some residual genetic benefits. However, based on the literature, direct stocking with Florida largemouth bass fry or fingerling appears to produce more effective results when genetic manipulation is the management objective. This strategy may be more efficient and economical assuming state hatchery resources can meet stocking demands.

The cooperative efforts of TPWD and the Lake Conroe Restocking Association and Gladewater Lake Advisory Board were noteworthy. Money, labor, and other resources from these groups were combined with the goal of improving the largemouth bass fisheries at these reservoirs, illustrating the value of cooperative management programs. However, any applied management effort should be evaluated to determine its benefit. Fisheries managers have a responsibility to constituent groups to insure applied management programs are effective. Although good public relations were generated from these nursery pond programs, benefits to the fisheries were negligible; therefore, termination of these programs has been recommended. TPWD is currently working with the Lake Conroe Restocking Association and Gladewater Lake Advisory Board to implement management alternatives to which they can better utilize their resources.

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