Development of a Trophy Largemouth Bass Fishery in Louisiana

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Abstract: The management objective at Caney Creek Reservoir, a Louisiana lake impounded in 1986, was to produce trophy-size largemouth bass (*Micropterus salmoides*). Management actions included introduction of Florida bass (*M. s. floridanus*), supplemental forage stocking, and initiation of length limit regulations. Prior to impoundment, the reservoir basin contained northern largemouth bass (*M. s. salmoides*) and intergrades between the northern and Florida subspecies. Eight years after the initial stocking of Florida bass in 1986, 49% of the population were northern bass, 23% were Florida bass, and 28% were intergrades. Relative abundance of bass fry and fingerlings was higher during the first 4 years of impoundment than reported for similar new lakes in Louisiana. Forage availability declined for bass <305 mm by 1988, 2 years after impoundment. Mean relative weight (Wr) of bass 203–305 mm declined to 86 by 1989; bass >305 mm had a mean Wr of 96. Although juvenile sunfish (*Lepomis* spp.) were abundant, they were not available as forage because of dense vegetation coverage. Gizzard shad (*Dorosoma cepedianum*) <127 mm were not collected in samples from 1986 to 1990, and the bass population during this period was primarily comprised of fish <254 mm. Adult threadfin shad (*D. petenense*) were stocked in May 1990 and by the following year became the dominant forage species. Following threadfin shad introduction, Wrs for 203-to 305-mm bass began to improve significantly. In April 1991, a 356-to 432-mm slot length limit on bass was imposed; in July 1994, the slot was modified to 381–483 mm. In June 1991, a largemouth bass >5.4 kg was caught. Since that time, catches of 30 bass >6.1 kg have been documented, including 3 state records. The 3 Caney Creek Reservoir state records were electrophoretically verified as a northern bass, an intergrade, and a Florida bass.

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The Louisiana record for largemouth bass (5.4 kg) was held for 14 years until July 1989 when a 5.9-kg fish was caught in False River Lake in Pointe Coupee Parish. During this 14-year period, Louisiana bass anglers were concerned because anglers in surrounding states were catching largemouth bass >5.4 kg and none were being caught in Louisiana.

The success of Florida largemouth bass introductions into waters containing established largemouth bass populations has been documented (Chew 1975). Gilliland and Whitaker (1989) and Forshage and Fries (1995) reported Florida largemouth bass genetic influence was greater in reservoirs stocked during impoundment. Faster growth and increased maximum size potential of the Florida subspecies, as reported by Bottroff and Lembeck (1978) and Wright and Wigtil (1980), have created widespread interest among bass anglers and fisheries managers.

In an effort to produce trophy-size (>5.4-kg) largemouth bass in Louisiana, Florida largemouth bass were introduced into Caney Creek Reservoir, a new impoundment in north central Louisiana. Florida largemouth bass fry and fingerlings were introduced to incorporate genetic potential for large size into the largemouth bass population. It was unknown if Florida bass would reach trophy size in Louisiana, but this newly constructed reservoir provided an excellent opportunity to evaluate the subspecies.

This paper describes management actions taken to develop a trophy largemouth bass fishery in Caney Creek Reservoir and discusses resultant changes in the bass population.

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Methods

Caney Creek Reservoir, a 2,023-ha impoundment located in Jackson Parish in north central Louisiana, was constructed primarily for recreation. It was created by the construction of an earthen dam across Caney Creek, the main tributary. Five lesser streams (Smith Branch, Boggy Branch, Clear Branch, Hancock Creek, and Cypress Creek) feed this main tributary. The gates in the water control structure were closed in February 1986. Prior to inundation, the basin was composed of numerous creeks, barrow pits, and ponds containing 36 species of fishes including spotted bass (*M. punctulatus*) and largemouth bass (Stevens 1986). It was deemed impractical to eliminate the native fish population prior to inundation. Due to the small watershed (107.5 km^2) that provides a 5:1 drainage ratio, pool stage was not attained until January 1989.

Maximum depth of the reservoir is 13.1 m at pool stage with an average depth of 4.9 m. There are 677 ha with depths <3 m, 1,194 ha <6 m, and 1,659 ha <9 m. The shoreline is 112.7 km long with many homes and camps. The water is slightly acidic, infertile, and clear. The watershed is also infertile and comprised primarily of forest land, dominated by loblolly pine (*Pinus taeda*).

All timber was removed from the basin during late 1970. Construction was not completed before regrowth occurred and remedial clearing was done during 1984. Before inundation, regrowth again covered the basin, but was not removed. Consequently, pines (*Pinus* spp.), black willow (*Salix nigra*), and hardwoods reached heights of 3.0–4.5 m in the basin.

Aquatic vegetation was present in the basin before impoundment. As the impoundment filled, this vegetation increased and was supplemented by the inadvertent or intentional introduction of hydrilla (*Hydrilla verticillata*) and water hyacinth (*Eichhornia crassipes*). The dominant vegetation in the lower and middle portions of the reservoir by 1989 was submerged species including southern naiad (*Najas quadalupensis*), muskgrass (*Chara* sp.), and bladderworts (*Utricularia gibba* and *U. inflata*). In the upper portion of the reservoir, major species were fanwort (*Cabomba carolina*), southern naiad, bladderworts, and muskgrass. In addition, white waterlily (*Nymphea odorata*) and watershield (*Brasenia schreberi*) were also prevalent in the upper portion. Hydrilla was found near public boat launching ramps in 1989. By the fall of 1993, total aquatic vegetation coverage was estimated at 605 ha (L. V. Richardson, LDWF, pers. commun.).

Caney Creek Reservoir was not closed to fishing during inundation. Statewide fishing regulations were imposed which included a daily bag limit of 15 largemouth bass with no length restrictions. Bass tournaments were not allowed until May 1988 when the reservoir was at 98% capacity. The use of gill nets, trammel nets, hoop nets, and seines was prohibited. Revised harvest regulations went into effect 1 April 1991. At that time, a 356-to 432-mm slot length limit was initiated with a daily bag limit of 8 fish, of which only 4 could be >432 mm. Additional revisions of bass harvest regulations were made in July 1994 when a 381- to 483-mm slot length limit was initiated with a daily bag limit of 8 fish, of which only 2 could be >483 mm.

Thirty-seven largemouth bass were collected from Caney Creek and its tributaries in 1985 prior to impoundment to determine subspecies composition by electrophoresis. Samples of liver or fins were removed at the Monroe Laboratory, placed in cryotubes, and frozen. Electrophoretic analyses were conducted following procedures outlined in Carmichael et al. (1986) and Williamson et al. (1986). One locus, isocitrate dehydrogenase (IDHB), was tested from fin samples and 2 loci, IDHB and aspartate aminotranferase (AATB), were tested from liver samples. Both IDHB and AATB have been used to determine allele frequencies in largemouth bass populations (Philipp et al. 1983).

Stocking was initiated in March 1986 with the introduction of 514,261 Florida largemouth bass fry (mean TL = 19 mm; all lengths reported in this paper are total lengths). Additional Florida bass fry were stocked in 1987–1989 and 1992–1995 (Table 1) for a total of 2,531,862 fry (1,252/ha). Stocked Florida bass were obtained from 3 different hatcheries. Prior to the 1987 stocking, 80 brood fish from these hatcheries were collected for subspecific determination by electrophoresis.

Thirty thousand adult threadfin shad obtained from the Arkansas Game and Fish Commission were stocked in May 1990 to provide an additional forage species.

Two population samples using rotenone were collected in July during the first year of impoundment (1986) and 4 samples were taken each year during 1987–1989 and 1991–1995 during July. Areas representing different habitats were chosen for sampling. Each sample site consisted of 0.4 ha surrounded with a 1.3-cm bar mesh seine, 4.6 m deep. One mg/liter of rotenone was applied inside the net. All fish that surfaced inside the net for 2 days were picked up and sorted to species. All largemouth bass were individually measured (mm) and weighed (g). All other species were measured to the nearest 25.4-mm TL group and weighed as a group (g).

Electrofishing samples were collected with a Smith Root GPP 5.0 Boat Electrofishing Unit using pulsed DC. Twenty-five largemouth bass were collected monthly from 1 July 1986 to 30 June 1990 with the electrofisher during daylight hours. These samples were not timed or taken from established sample sites. Starting in fall 1989, additional spring and fall electrofishing samples were collected for 15 minutes each at 6 fixed locations after sunset for length-frequency determinations.

Largemouth bass collected during electrofishing and rotenone surveys from 1986 to 1990 were placed on ice and transported to the Monroe Laboratory where each was given an identification number, measured (mm), and weighed (g). From 1 July 1986 through 30 June 1990 and in November 1991 and October 1994, 1,268, 35, and 39 largemouth bass, respectively, were collected using rotenone or the electrofisher for subspecific determination. After large-

Table 1. Florida largemouth bass stockings, Caney Creek Reservoir, Louisiana.

Year	*N* stocked	Stocking rate (*N*/ha)
1986	514,261	254
1987	222,690	110
1988	135,856	67
1989	80,988	40
1992	427,248	211
1993	376,086	186
1994	148,044	73
1995	629,689	310
Total	2,531,862	1,252

mouth bass were collected and returned to the Monroe Laboratory, samples of fins or liver were taken, placed in cryotubes, and frozen for electrophoresis. Samples were analyzed using 2 loci, IDHB and AATB. Subspecific identification of 3 state record bass from Caney Creek Reservoir was similarly determined in September 1995.

Sagittal otoliths were removed from 127 bass in October 1990 and from 42 bass in November 1991 for age and growth determinations. Otoliths were ground with a Dremel tool to the focus. They were then cemented to a glass slide and the other side was ground. Transverse sections were viewed and measured under a compound microscope. Otolith radius was determined by measuring each otolith from the focus to the ventral edge. From this measurement, a TL-otolith radius regression was generated. The regression was used to generate an estimated length. The actual length was divided by this estimated length, resulting in a correction factor. Measurements were taken from the focus of the otolith to each successive annulus. Each of these measurements were entered into the regression equation, generating an estimated length at each previous age (Carlander 1981). Each back-calculated length was multiplied by the correction factor for that fish.

Relative weights (Wr) for all largemouth bass were determined using the equation: $\log_{10} Ws = -5.316 + 3.191 \log_{10} L$ (Anderson and Gutreuter 1983). Analysis of variance and orthogonal contrast of the Wrs were performed using SAS (Proc GLM; SAS Inst. 1985).

Proportional Stock Densities (PSD) as developed by Anderson (1978) were determined for bass populations during 1990–1995.

All angler-caught largemouth bass >5.4 kg discussed in this paper were verified by the authors and weighed on scales certified by the Louisiana Department of Agriculture.

Results

Electrophoresis results indicated 92% of the bass collected in the reservoir basin prior to impoundment were the northern subspecies and 8% were intergrades between the northern and Florida subspecies. No Florida bass were found. Results for the 1986 largemouth bass brood stock from all 3 hatcheries indicated 94% were the Florida subspecies, 1% was the northern subspecies, and 5% were intergrades between the 2 subspecies. Seventy-two percent (N = 913) of the bass collected from the reservoir during the first 4 years of impoundment were the northern subspecies, 12% (N = 152) were the Florida subspecies and 16% (N = 203) were intergrades between the 2 subspecies (Table 2). Samples taken in 1994 indicated 51% of the bass contained Florida subspecies alleles.

Rotenone samples indicated relative abundance of bass <127 mm was high prior to pool stage with 361/ha in 1986 and a peak of 648/ha in 1987. After pool stage was attained, relative abundance of these bass ranged from 115 to 1,092/ha ($\bar{x}$ = 476/ha). Bass from 127 to 226 mm increased until 1988 when an

Table 2. Largemouth bass phenotypes (%), Caney Creek Reservoir, Louisiana.

Year(s)	*N*	Northern	Florida	Intergrade
1986–87	346	70	16	14
1987–88	287	73	16	11
1988–89	300	82	5	13
1989–90	300	64	11	25
1991	35	63	11	26
1994	39	49	23	28

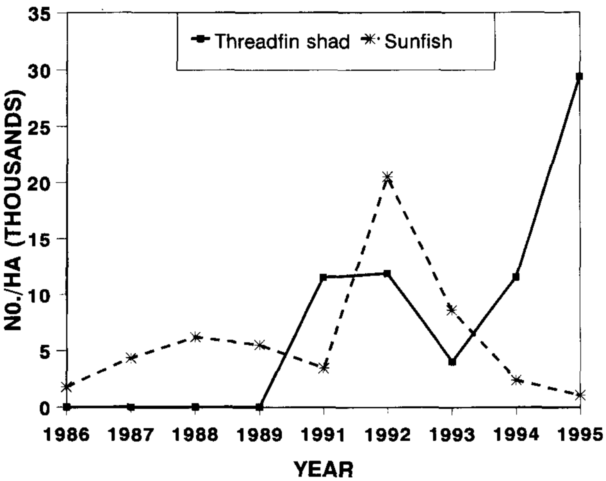

Figure 1. Abundance of threadfin shad and sunfish (*Lepomis* spp.) <127 mm, as determined by rotenone sampling, Caney Creek Reservoir, Louisiana.

average of 91/ha was recorded. Densities of this size group gradually declined to 4/ha in 1995. Numbers of bass ≥229 mm were highest in 1989 at 50/ha.

A lack of, or extremely low, numbers of small gizzard shad (<99 mm) and a continual drop in intermediate-size gizzard shad (101–201 mm) was noted in rotenone samples throughout the study period. Adult gizzard shad were present all years. Threadfin shad were first collected in 1991 (11,552/ha; Fig. 1) following their introductions in 1990. The threadfin shad population remained at the 1991 level in 1994 and then increased to 29,407/ha in 1995.

Sunfish ≤74 mm increased in abundance from 1986 to 1988 (Fig. 1). A decline was noted in 1989 and 1991, but this was followed by a large increase in 1992. Another decline was noted for the following 3 years.

Length-frequency data from electrofishing during March, April, and May 1988–1991 (Fig. 2) indicated only a small portion of the bass population was >254 mm. Samples taken during March 1992–1995 indicated the bass population shifted to a greater abundance of larger fish. This shift was further documented by an increase in PSD from 7 in 1990 to a high of 68 in 1993. An increase in relative abundance of bass in the 356- to 432-mm range was noted after March 1992.

The mean total length of age-1 largemouth bass in 1990 was 157 mm (SE =

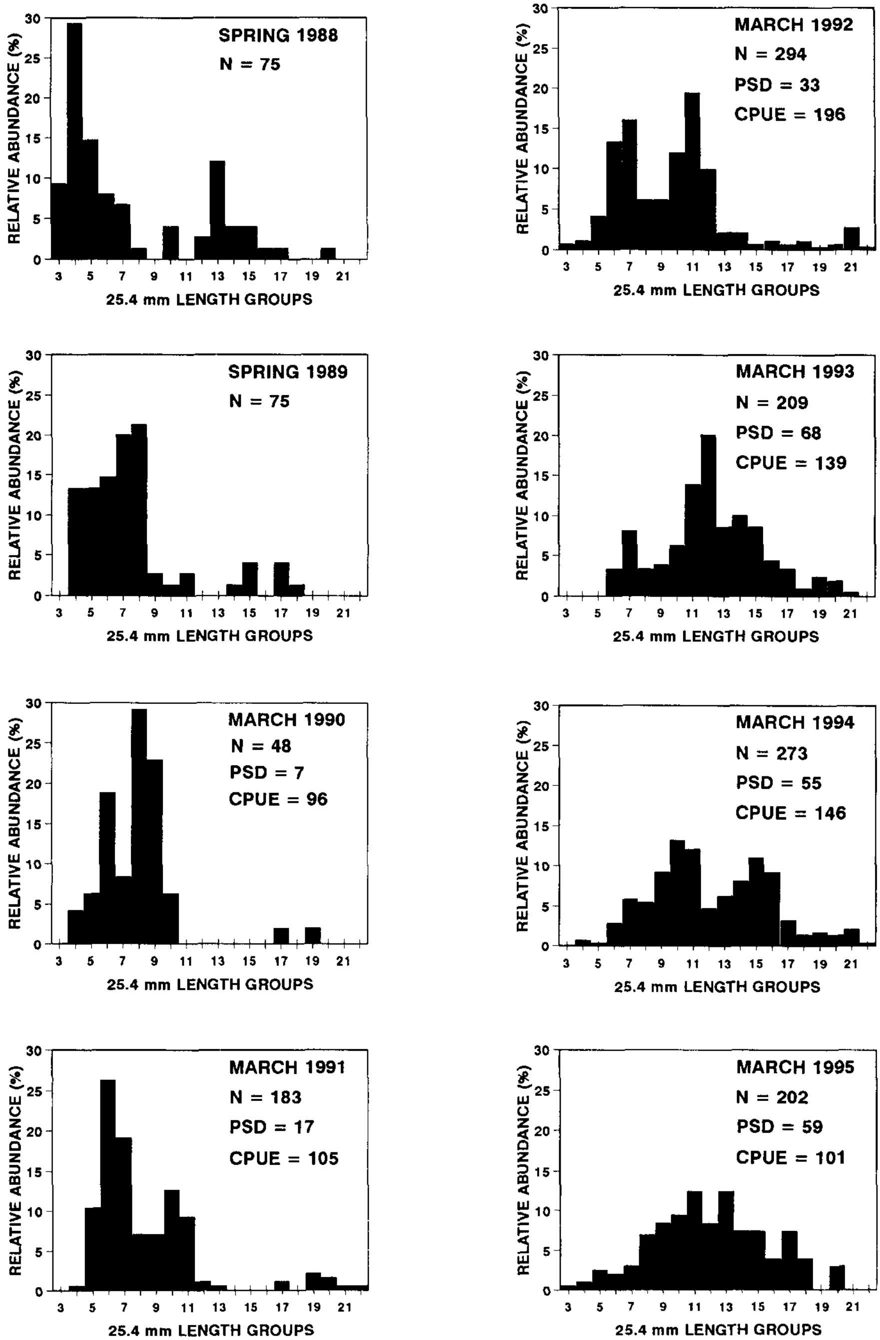

Figure 2. Length-frequency of largemouth bass collected by electrofishing, Caney Creek Reservoir, Louisiana. Samples were collected in March, April, and May 1988 and 1989 and March 1990–1995. Proportional stock densities (PSD) and catch per unit effort (CPUE as *N*/hour) are reported for 1990–1995 collections.

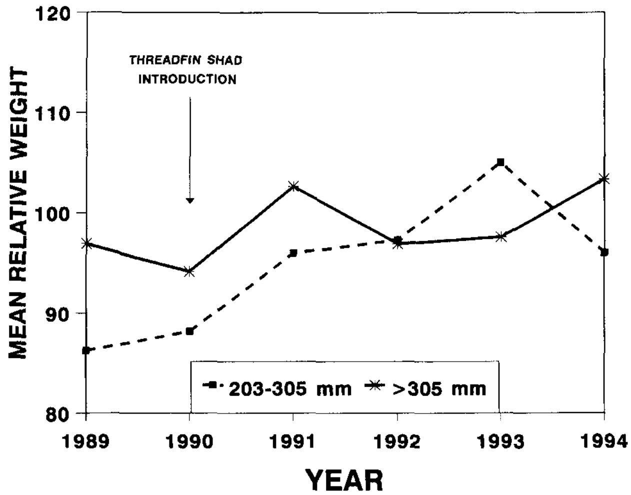

Figure 3. Mean relative weights of 2 length groups of largemouth bass collected by fall electrofishing, Caney Creek Reservoir, Louisiana. Time of threadfin shad introduction to the reservoir is noted.

3.92, N = 83) while in 1991 it was 193 mm (SE = 7.47, N = 23). Age-2 bass had a mean length of 282 mm (SE = 11.26, N = 34) and 310 mm (SE = 20.13, N = 10) in 1990 and 1991, respectively, while age-3 bass had a mean length of 419 mm (SE = 18.94, N = 10) and 365 mm (SE = 33.91, N = 6) in 1990 and 1991, respectively. Increases in total length were evident for age-1 and age-2 bass, however, they were probably not significant.

There was a significant difference in Wrs between threadfin shad pre-stocking vs. post-stocking periods for small bass (208–305 mm; P = 0.001), but not for large bass (>305-mm; P = 0.65) (Fig. 3).

By June 1991, the first largemouth bass >5.4 kg was caught by an angler from Caney Creek Reservoir. Later that same year, a 5.9-kg bass was caught. During 1992, 2 bass that averaged 5.7 kg, 5 that averaged 6.0 kg, and 1 6.5-kg bass were caught. The 6.5-kg bass, a state record, was electrophoretically verified as the northern subspecies. A new state record largemouth bass (7.0 kg) was caught in Caney Creek Reservoir in February 1993 and verified as an intergrade between the 2 subspecies. Seven additional largemouth bass >6.4 kg were also caught in 1993. In February 1994, the largemouth bass state record was again broken when a 7.2-kg Florida bass was caught from Caney Creek Reservoir. Seven more largemouth bass >6.4 kg were caught in 1994. As of 16 September, 4 largemouth bass >6.4 kg were caught during 1995.

Discussion

The Caney Creek Reservoir basin contained northern bass and intergrades between the 2 subspecies prior to inundation. Some farm ponds located within the basin had apparently been stocked by the owners with largemouth bass containing Florida bass alleles.

After the initial stocking with Florida bass, there was a question concerning genetic integrity of hatchery brood stock. Based on analysis of electrophoretic results, 4% (20,636) of the largemouth bass stocked during the first year were likely either northern largemouth bass or intergrades between the 2 subspecies.

Fingerling bass abundance at Caney Creek Reservoir was higher during the first 4 years of impoundment than reported for similar new reservoirs in the area during the early 1960s, such as D'Arbonne and Bussey lakes (LDWF, unpubl. data). Since there was an increase in the size of Caney Creek Reservoir each year during the first 3 years, rising water levels likely resulted in increased reproductive success of primarily resident largemouth bass. In addition, cover by aquatic vegetation and flooded terrestrial plant growth provided protection for fry and fingerlings. Aggus and Elliott (1975) observed similar conditions in Bull Shoals Lake as did Miranda et al. (1984) in West Point Reservoir. Other researchers have found rising water levels have a positive effect on largemouth bass reproduction (Pierce et al. 1963, Lantz 1974, Keith 1975, Shirley and Andrews 1977). Forshage and Fries (1995) observed higher introgression of the Florida subspecies in newer reservoirs. Strong reproduction of resident bass in Caney Creek Reservoir probably hampered introgression of the Florida bass genes.

Rotenone data indicated small gizzard shad were not available as forage for the large number of bass <305 mm during the first 3 years of impoundment. Furthermore, aquatic and flooded terrestrial vegetation provided cover for juvenile sunfish. By 1989, lack of available forage appeared to have become a serious problem. Because of their more pelagic habitat preference, threadfin shad were stocked in 1990. This was the first time shad have been stocked in Louisiana. By the summer of 1991, rotenone sampling showed the stocking was successful in establishing the species (Fig. 1).

Large numbers of threadfin shad appeared to provide adequate forage for 203–305-mm bass. Not only were there significant increases in Wrs for this size group of bass, but their growth rates also increased. Growth rates for bass <305 mm were similar to the state average in 1990 (LDWF, unpubl. data), but exceeded the state average in 1991. Increased availability of forage is also likely responsible for this increased growth. Although some improvements in Wrs were noted in bass >305 mm over time, changes were not significant. Apparently, the addition of threadfin shad to the forage base was more beneficial to the smaller bass than it was to larger individuals.

Harvest regulations initiated in April 1991 represented an effort to reduce excess numbers of bass <330 mm and to ultimately produce more bass ≥432 mm. Catches of trophy-size bass and increased relative abundance of 356- to 431-mm bass generated widespread angler acceptance of slot limits. Further revisions of largemouth bass regulations initiated in July 1994 appeared successful at extending protection to bass >483 mm.

Due to the growing popularity of catch-and-release angling, most angler-caught largemouth bass ≥5.9 kg likely have been voluntarily returned to the reservoir. In fact, this same influence appears to have generally resulted in angler hesitance to harvest legal-length bass beneath the slot lengths.

Caney Creek Reservoir has produced 26 of the top 30 largemouth bass in Louisiana. The 3 state record bass from Caney Creek Reservoir were the largest of their respective genotype taken in Louisiana waters.

This experience with Caney Creek Reservoir demonstrates that a new southern reservoir in a relatively infertile region can produce a trophy largemouth bass fishery by a combination of stocking Florida bass, providing adequate forage to maintain good growth, and manipulating angler harvest through protective length limits.

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