Effects of Two Alternative Minimum-length and Creel Limits on a Largemouth Bass Population

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Abstract: We measured effects of an increase in the largemouth bass minimum length limit from 254-mm to 406-mm and a decrease in the creel limit from 10 per day to 3 per day in Tradinghouse Creek Reservoir, Texas, from 1985 to 1987. Electrofishing and rotenone surveys were used to measure regulation effects on largemouth bass population and predator-prey parameters; angler surveys were used to determine effects on creel rates. After the regulation was implemented, the population structure shifted from one dominated by small, young individuals to one dominated by larger, older fish. Although relative weight among stock-quality and quality length groups declined, growth rates remained stable. Estimates of available prey remained below optimum levels. Angler catch rates increased 89%; harvest rates declined 70%.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 43:164–171

Overharvest among largemouth bass populations has occurred when regulations are absent or inadequate (Redmond 1974, Hickman and Congdon 1974). Although length limits have impacted population structure and fishing success for largemouth bass, few published assessments are available regarding the wide range of length limits in use (Novinger 1984) or their impacts on largemouth bass populations (Novinger 1987, Gabelhouse 1987).

A statewide minimum length limit of 254 mm and a creel limit of 10 fish per day was in effect in Texas from 1972 through 1986. Under this regulation the largemouth bass population size structure at Tradinghouse Creek Reservoir was within the range considered optimal by Reynolds and Babb (1978). However, the age structure of the population (Mitchell et al. 1984) was similar to populations described as overharvested by Reynolds and Babb (1978): few individuals older than age 2 were collected. Similar circumstances were observed at reservoirs throughout Texas.

On 1 September 1985, a 406-mm minimum length, 3 fish per day creel limit was implemented at Tradinghouse Creek Reservoir. This study was conducted to determine the effects of the more restrictive regulation on the largemouth bass size and age structure, prey population, and angler catch and harvest.

We are grateful to all reviewers who helped with editing and revising the manuscript. We are also grateful to F. Teat and K. Storey for technical assistance in the field and laboratory.

Methods

Tradinghouse Creek Reservoir (804 ha) is a shallow (avg. depth = 5.7 m) electrical-power generation cooling-reservoir (Mitchell et al.) 1984.

Shoreline electrofishing was used to collect largemouth bass during October 1985–1987. Samples were collected between dusk and midnight with a boat-mounted, gasoline-powered generator (220v/4500w AC rectified to DC output). Collection methods used were described by Reynolds (1983). Sampling was continued until 50 fish ≥203 mm were collected.

largemouth bass structural indices were determined according to Anderson (1978); stock (S) and quality (Q) lengths were defined according to Gabelhouse (1984). Legal-length (L) was defined (by regulation) as ≥406 mm. Ages were determined from examination of whole otoliths (sagittae) with methods described by Taubert and Tranquilli (1982). Relative weights (Wr) were determined according to Wege and Anderson (1978).

Biomass and density estimates were obtained by sampling 2 coves (total area 0.8 ha) with rotenone during August 1985–1987. Surveys were conducted according to methods described by Durocher et al. (1984). Available prey/predator ratio estimates were calculated in accordance with Bailey's (1978) modification of methods described by Jenkins and Morais (1978). Angler surveys were conducted February through April 1985–1987 to obtain creel rate (pressure, catch-rate, and harvest-rate) estimates. All parties were interviewed between 1200–1800 hours on 9 randomly selected days (5 weekend days and 4 weekdays) at the reservoir's single authorized access area. Creel rate estimates were examined with the 2-sample *t*-test (Zar 1974).

Size structure indices determined from October 1985 electrofishing were considered as pre-regulation. The more restrictive regulation had been in effect less than 2 months and significant changes in size structure were unlikely to have occurred. Fisher's Exact Test (Zar 1974) was applied to proportional stock density (PSD) and relative stock density (RSD) estimates and electrofishing catch rates for combined age groups ≤1, ≥2 (Zar 1974). Sample means for length-at-capture of largemouth bass age groups and Wr distributions for S and Q size-groups were examined with the 2-sample *t*-test (Zar 1974). Rotenone density estimates for largemouth bass size-groups were analyzed with the Chi^2 Test (Zar 1974). All statistical tests were evaluated at the alpha ≤0.05 level.

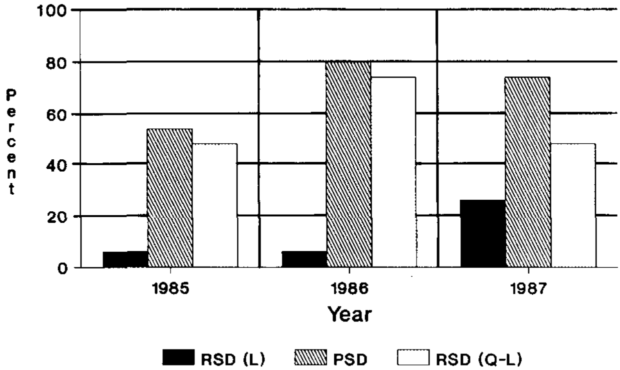

Figure 1. Largemouth bass PSD, RSD (L), and RSD (Q-L) estimates from fall electrofishing, Tradinghouse Creek Reservoir, Texas, October 1985–1987. N = 50 for all years.

Results and Discussion

Largemouth Bass

Estimated PSD prior to the regulation change was within the range (40%–60%) recommended by Reynolds and Babb (1978) for balanced largemouth bass populations (Fig. 1). After the 406-mm minimum-length limit was implemented, fall PSD estimates (1986 and 1987) were significantly greater and exceeded the recommended range. Reynolds and Babb (1978) associated extremely high PSD values with low stock densities and reduced biomass. Relative density of legal-sized (L) largemouth bass (Fig. 1) was significantly greater the second year after the regulation was changed. For the same period (1985 and 1987), the proportion of sublegal, quality-sized (Q-L) individuals was unchanged. Catch rate for age 2 and older individuals was significantly greater in 1987 (Fig. 2).

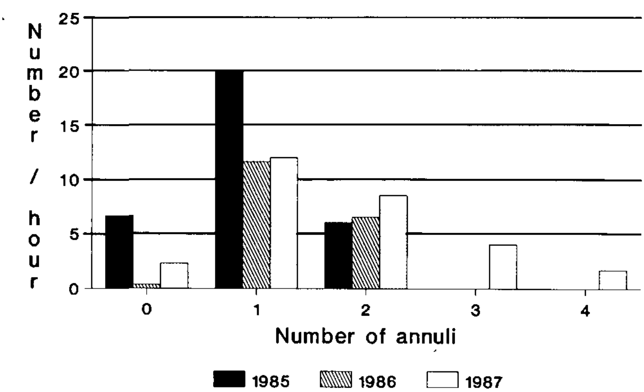

Figure 2. Largemouth bass age structure from fall electrofishing, Tradinghouse Creek Reservoir, Texas, October 1985–1987. N = 50 for all years.

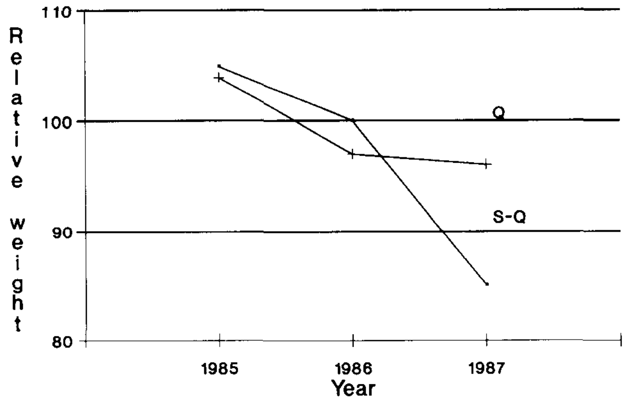

Figure 3. Average relative weights for largemouth bass size groups S-Q and ≥Q from fall electrofishing, Tradinghouse Creek Reservoir, Texas, October 1985–1987. $N = 50$ for all years.

In 1985, relative weight estimates (Fig. 3) for size-groups S-Q and ≥Q exceeded standards prescribed by Wege and Anderson (1978). Relative weights for both groups were significantly lower 2 years after the regulation was changed when PSD's exceeded 70%. The fall 1987 average for S-Q largemouth bass was below prescribed standards. The estimate for individuals ≥Q was lower, but remained within the recommended range. Wege and Anderson (1978) observed optimum condition of bass 203–380 mm TL most frequently when PSD was within the 40%–60% range. The decline in condition of stock and quality length-groups had no consistent effect on growth, expressed as length at capture, for individuals with 1 and 2 annuli (Fig. 4).

Relative weight declines were not likely a result of stockpiling because the

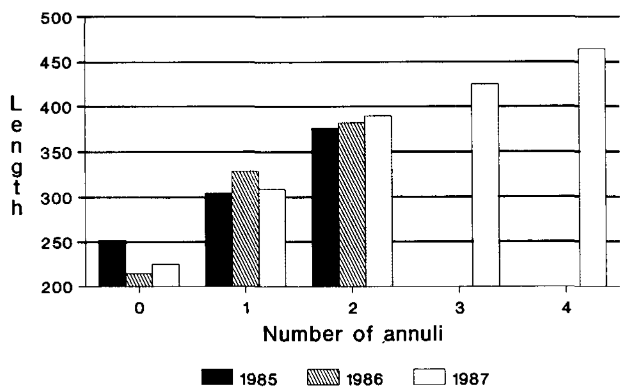

Figure 4. Largemouth bass length at capture from fall electrofishing, Tradinghouse Creek Reservoir, Texas, October 1985–1987. $N = 50$ for all years.

Table 1. Comparison of August biomass estimates for selected fishes, Tradinghouse Creek Reservoir, Texas, with statewide and ecological region averages.

	Biomass estimate				
	Tradinghouse Creek Reservoir				
Species	1985 (kg/ha)	1986 (kg/ha)	1987 (kg/ha)	Statewide average[a] (kg/ha)	Blackland Prairie ecological region[a] (kg/ha)
Gizzard shad	238.3	139.8	144.4	77.7	85.7
Threadfin shad	4.8	5.2	29.3	9.9	11.6
Channel catfish	257.9	278.2	263.6	18.4	17.4[b]
Sunfishes	98.4	74.2	130.7	43.4	46.2
Largemouth bass	93.3	111.6	77.5	21.2[c]	25.8[c]
Blue tilapia	257.9	68.6	84.8	57.8	102.4

[a]Miranda (1983).
[b]Other catfishes (exclusive of bullhead catfishes, flathead catfish, and madtoms).
[c]Black basses (*Micropterus* spp.).

proportion of sublegal quality-sized (Q-L) individuals 2 years later was essentially no larger than in 1985 (Fig. 1). Moreover, density-dependent reductions in growth rates associated with stockpiling were not observed (Fig. 4).

Largemouth bass biomass estimates exceeded the Texas reservoir average reported by Miranda (1983). Estimates fluctuated after the regulation was changed, but the final estimate was smaller than that obtained in 1985 (Table 1). In the presence of greater proportions of older and larger individuals, density of the smaller S-Q size-group was significantly reduced (–82%) within a 2-year period (Fig. 5). The final estimate (5/ha) was the same as the average density reported by Reynolds and Babb (1978) among populations with PSD estimates which exceeded the recommended range.

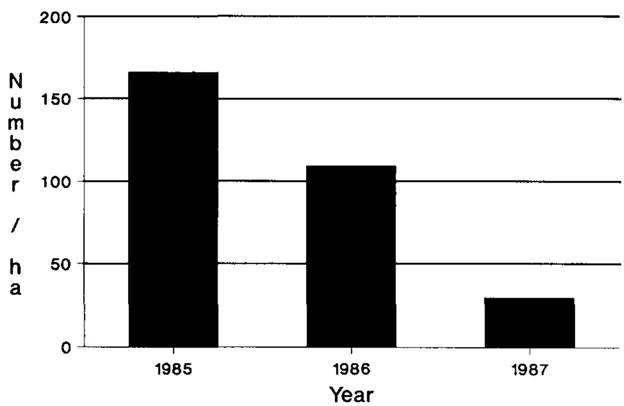

Figure 5. Density estimates for S-Q largemouth bass from rotenone surveys, Tradinghouse Creek Reservoir, Texas, 1985–1987.

Predator-Prey

In its initial year, the 406-mm size limit protected most largemouth bass in the population. Bass biomass increased; prey biomass declined (Table 1). Baseline prey/predator (AP/P) ratio estimate (1985 = 0.84) was reduced by half the first year the new regulation was in effect (1986 = 0.42). The following year, when a significantly greater portion of the largemouth bass population became legally harvestable, largemouth bass biomass was reduced. The corresponding AP/P estimate returned to a level similar to that of the previous regulation (1987 = 0.81). Estimates of available prey in all years were below the optimum level of 1.0 in August recommended by Jenkins and Morais (1978).

Angler Creel

Considerable differences occurred in some creel rates between years, but the observed differences were not significant at the 0.05 level (Table 2).

Angler catch estimate (included released bass) in 1987 increased 89% from the corresponding period before the regulation was changed (Table 2). However, 1987 angler harvest estimates (fish/hour and weight/hour) were smaller than those under the previous regulation. Decreases in harvest were more an effect of the increased length limit than the reduced creel limit. The mean harvest of largemouth bass anglers was largely unchanged from 1985 (1.54 bass per angler) to 1987 (1.58 bass per angler). Prior to the implementation of the higher length limit, only 9% of anglers who harvested largemouth bass had >3 fish.

Although the new regulation was more restrictive, proportions of total hours fished by anglers seeking largemouth bass were similar in all years (Table 2). If

Table 2. Sportfishing harvest and catch estimates for largemouth bass, Tradinghouse Creek Reservoir, Texas, February–April 1985–1987 (standard errors are in parentheses). Differences between years were not significant ($P > 0.05$).

	1985[a]	1986[b]	1987[b]
Harvested Fish/hour	0.170 (0.072)	0.011 (0.003)	0.051 (0.018)
Released Fish/hour	0.121 (0.020)	0.069 (0.008)	0.499 (0.061)
Total Fish/hour	0.291 (0.062)	0.080 (0.008)	0.550 (0.079)
Harvested kg/hour	0.112 (0.046)	0.011 (0.002)	0.053 (0.020)
% Hours Seeking Bass	31.500 (6.800)	27.000 (3.600)	27.000 (4.600)

[a]254-mm minimum length, 10-fish creel limit.
[b]406-mm minimum length, 3-fish creel limit.

anglers who fished exclusively for largemouth bass considered the regulation overly restrictive and fished elsewhere, the proportion of fishing effort expended on largemouth bass in 1987 would likely have been much lower.

Summary

Results of this study indicate change to a more restrictive length limit can result in an increase in size- and age-structure for largemouth bass. The change will initially reduce angler harvest, and as a result of increased catch-and-release, angler catch rates may be higher. Our results also indicated protection of a large population segment from harvest results in an extensive size-structure shift to larger individuals. Such shifts in size-structure can impact available prey, and prey deficiencies may reduce largemouth bass body condition. Moreover, in the presence of increased proportions of larger individuals, density of bass within the smaller S-Q size-group may be significantly reduced. Increased variation in size-group and cohort densities may result.

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