Effects of a 356-mm Statewide Minimum Length Limit on Abundance of Adult Largemouth Bass in Texas

David R. Terre, *Texas Parks and Wildlife Department, Inland Fisheries Management Office, P.O. Box 947, San Marcos, TX 78667*

Robert W. Zerr, *Texas Parks and Wildlife Department, Inland Fisheries Management Office, 134 Braniff, San Antonio, TX 78216*

Abstract: Statewide 356-mm minimum-length and 5-fish daily creel limits for largemouth bass (*Micropterus salmoides*) were evaluated on 28 Texas reservoirs. Electrofishing catch rate data were used to evaluate changes in adult largemouth bass density and size structure 2 years after the limits were implemented. Statewide regulations successfully increased adult largemouth bass densities in Texas reservoirs. Electrofishing catch rates of fish ≥254 mm and those ≥356 mm increased significantly across the study reservoirs. Largemouth bass size structure also shifted towards larger fish.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 46:368–376

Many states employ statewide fishing regulations for a variety of freshwater fish species. Statewide regulations are usually applied for the general good of a state's fisheries resources because fisheries agencies, for any number of reasons, are often unable to manage each water body on an individual basis. Some advantages of these regulations are that they are usually well understood and remembered by the angling public. Consequently, angler compliance with statewide regulations may be better than the alternative of having a multitude of specialized regulations on individual water bodies. A disadvantage is that statewide regulations may not always be appropriate for every water body in a state (Fox 1975).

Forty-eight states currently use statewide regulations to manage largemouth bass populations and most states employ minimum length limits and/or creel limits (D.R. Terre, unpubl. data). Minimum length limits are frequently used to remedy or safeguard against overharvest, a common problem with some largemouth bass fisheries (Anderson 1974, Bonneau and Conley 1974, Hackney 1974, Redmond 1974, Ming and McDannold 1978, Van Horn et al. 1981). Creel limits are used to distribute

harvest more equitably among anglers, but seldom are restrictive enough to control harvest (Redmond 1974, Fox 1975). Despite the popularity of statewide regulations, no studies have been conducted to evaluate their effects on a statewide basis. Past studies have centered on the effects of specialized fishing regulations on individual water bodies.

Texas has historically managed its largemouth bass populations with statewide regulations. From 1945 through 1974, statewide regulations governing the harvest of basses (*Micropterus* spp.) included a 178-mm minimum length limit and an aggregate daily creel limit of 15 fish, of which no more than 10 could be >279 mm. In 1975, regulations were changed to include a 254-mm minimum-length and 10-fish daily creel limits. Unfortunately, this regulation change was never evaluated. On 1 September 1986, Texas increased its minimum length limit to 356 mm and reduced its daily creel limit to 5 fish per day because of a general concern about overharvest. The purpose of this regulation change was to increase the abundance of adult largemouth bass available for spawning, thereby rebuilding populations depleted by over-fishing.

The objective of this study was to determine if the 356-mm minimum length limit and 5-fish daily creel limit were effective statewide regulations for increasing abundance of adult largemouth bass (≥254 mm) in large Texas reservoirs.

The authors wish to acknowledge G. Wilde and W. B. Dolman for statistical assistance and W. C. Guest, R. W. Luebke, S. J. Magnelia, and R. L. McCabe for editorial comments. Funding was provided by the Federal Aid in Sport Fish Restoration Act, Project F-30-R of the Texas Parks and Wildlife Department.

Methods

Twenty-eight reservoirs were selected for evaluation (Fig. 1). Each reservoir had to meet the following criteria: 1) presence of largemouth bass, 2) area was ≥202 ha, 3) previously regulated by 254-mm minimum-length and 10-fish daily creel limits, and 4) had fall electrofishing data collected in 1985 and/or 1986 to serve as base line data.

Abundance of largemouth bass, as indicated by catch per hour of electrofishing (CPUE), was monitored in each of the 28 reservoirs between 1985 and 1988. Each reservoir was examined before (1985 or 1986) and 2 years after (1988) the regulation change. In addition, 9 of the 28 reservoirs were also examined 1 year after (1987) the regulation change. Night electrofishing was conducted at standardized locations during the fall when surface water temperatures were between 15.5° and 23.9° C. A minimum of 15 minutes of actual shocking was conducted at each location. The number of locations sampled was dependent upon reservoir size: <405 ha, minimum of 4 locations; 405-4,049 ha, minimum of 6 locations; >4,049 ha, minimum of 8 locations. Total electrofishing effort at each reservoir ranged from 60 minutes to 276 minutes. All electrofishing boats produced pulsed DC output and were standardized for samples conducted at each particular reservoir. All largemouth bass caught were counted and individually measured to the nearest mm.

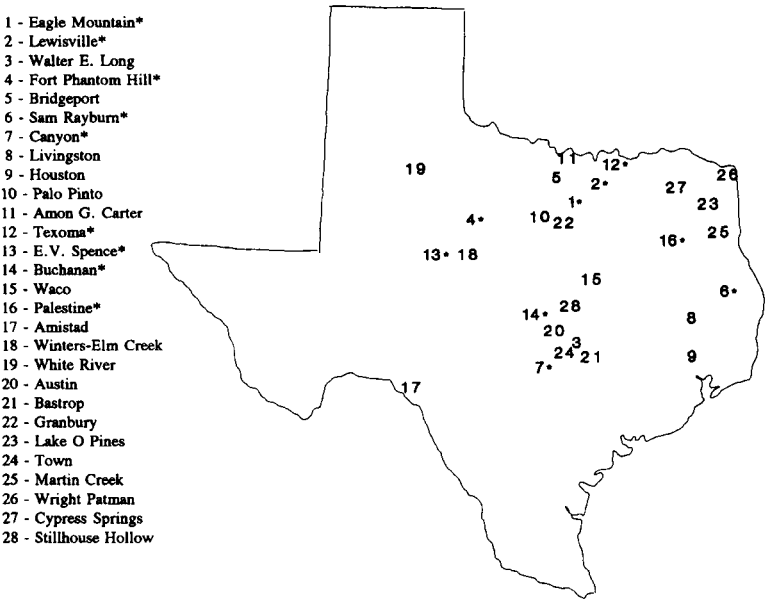

Figure 1. Approximate locations of 28 Texas reservoirs used in evaluation of statewide 356-mm minimum-length and 5-fish daily creel limits for largemouth bass. For each reservoir, largemouth bass density and size structure data were collected before and 2 years after implementation of limits. Reservoirs with an asterisk represent those for which the same data was also collected 1 year after implementation.

Catch rates of largemouth bass ≥254 mm (CPUE 254) and those ≥356 mm (CPUE 356) were compared between treatments (before and 2 years after the regulation change) at each of the 28 reservoirs using a 2-way analysis of variance (ANOVA) (SAS Inst. 1985). Reservoirs were treated as categorical factors. A similar analysis was also performed on 9 of the 28 reservoirs; however, in this case catch rates were compared between 3 treatments (before, 1 year after, and 2 years after). In both analyses, we tested the null hypothesis of no significant difference in electrofishing CPUE of largemouth bass after implementation of the new bass regulations. In the analysis of the 9 reservoirs, we also tested for linear and quadratic trends in catch rates over the 3-year study period.

Size structure data were tested using a logit analysis (SAS Inst. 1985). Our independent main effects (reservoir and treatment) were the same as in the ANOVA used for CPUE data, but our dependent variable was categorical with 2 response levels (254-356 mm and ≥356 mm). Data were expressed as counts in each level of the dependent variable and a logistic analysis was used to test for changes in the relative proportions in each response category. We tested the null hypothesis of no

significant difference in the proportion of largemouth bass >356 mm 2 years after implementation of the new regulations.

Binomial tests were used to compare observed and expected increases in catch rate and size structure indices across the 28 study reservoirs. The level of significance for all statistical analyses was $P = 0.05$.

Results and Discussion

Electrofishing catch rates increased 2 years after implementation of the new statewide regulations. Statewide estimates of CPUE 254 increased significantly ($F = 87.54$, df = 1,362, $P < 0.0001$) from 12.05 fish/hour to 31.22 fish/hour. Increases in CPUE 254 were observed in 22 study reservoirs ($P < 0.01$, binomial test) (Fig. 2). Statewide estimates of CPUE 356 also increased significantly ($F = 83.26$, df = 1,362, $P < 0.0001$) from 2.36 fish/hour to 6.91 fish/hour. Increases in CPUE 356 were observed in 23 study reservoirs ($P < 0.01$, binomial test) (Fig. 3). These results suggest the regulation change had a very positive effect on the abundance of adult bass across the state. Our findings were consistent with those of other studies which documented increases in abundance or annual survival of adult largemouth bass following implementation of a minimum length limit (Ming and McDannold 1975; Van Horn et al. 1981; Mosher 1986; Richards 1986; Novinger 1986, 1987; Ager 1989).

A closer examination of 9 of the 28 reservoirs suggests significant changes in adult density occurred as early as 1 year following this regulation change (Fig. 4). Abundance of adult largemouth bass increased in a linear fashion, with significant ($P < 0.05$) changes occurring during each year of the study period. No studies have reported such quick and dramatic results under similar minimum length limits.

The effectiveness of minimum length limits is largely dependent upon factors including rates of recruitment, growth, and angling mortality (Anderson 1974, Novinger 1984). In Texas, these factors are known to vary considerably across the state; therefore, it would be expected that the degree of change would vary across our study reservoirs. Our data indicated the magnitude of change was variable across reservoirs for CPUE 254 (Fig. 2). This was supported by a significant interaction term (reservoir x treatment) in the ANOVA. The magnitude of change in CPUE 356 (Fig. 3) was more consistent across reservoirs; however, abundance of fish in this size category is strongly controlled by angling mortalities (Novinger 1984) which could hide reservoir-to-reservoir variations due to recruitment and growth.

Such a positive and rapid response to these regulations may be partially explained by good angler compliance. Based on statewide creel survey data (Texas Parks and Wildl. Dep., unpubl. data), illegal harvest comprised only 4.9% and 5.4% of the total number of bass harvested during 1987 and 1988. Other contributing factors may include good largemouth bass growth (Prentice 1987) and low to moderate recruitment conditions (Durocher et al. 1984) that were present in many Texas reservoirs before implementation of these regulations. All these factors are considered important to the success of minimum length limits in large impoundments

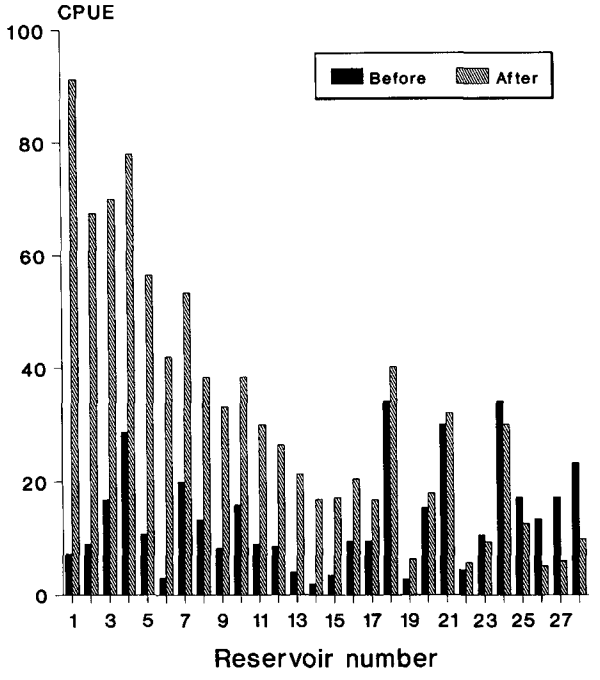

Figure 2. Mean electrofishing catch rates (CPUE = fish/hour) of largemouth bass ≥254 mm before and 2 years after implementation of Texas statewide 356-mm minimum length limit and 5-fish daily creel limits for each of 28 study reservoirs.

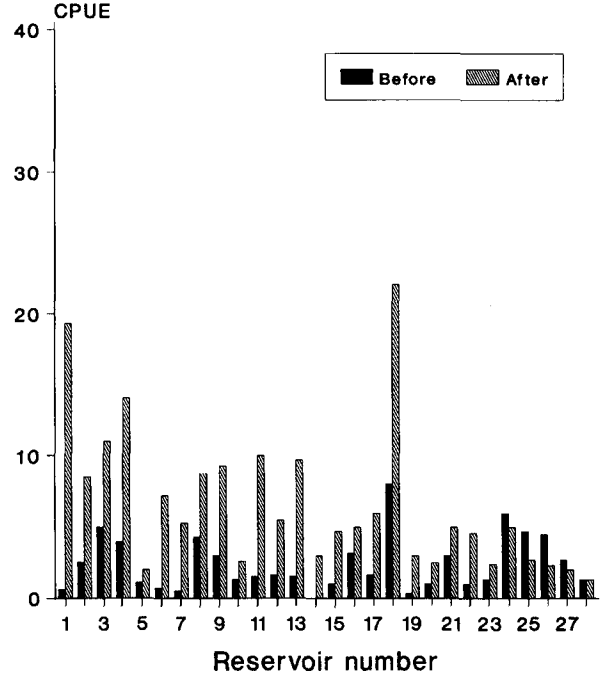

Figure 3. Mean electrofishing catch rates (CPUE = fish/hour) of largemouth bass ≥356 mm before and 2 years after implementation of Texas statewide 356-mm minimum length limit and 5-fish daily creel limits for each of 28 study reservoirs.

(Novinger 1984). Six reservoirs did not respond favorably to this regulation change as indicated by declining CPUE 254 values (Fig. 2). The exact reasons for this are not entirely clear; however, most of these reservoirs were located in the eastern portions of the state (Fig. 1) where largemouth bass recruitment is generally higher.

Statewide proportions of largemouth bass ≥356 mm increased significantly ($X^2 = 6.52$, df = 1, $P < 0.05$) 2 years after implementation of the new harvest regulations from 18.8% to 25.5%. Increases were observed in 18 study reservoirs ($P < 0.05$, binomial test) (Fig. 5). Many studies have reported overall improvements in size structure following implementation of minimum length limits (Van Horn et al. 1981, Dent 1986, Goddard and Redmond 1986, Richards 1986, Mitchell and Sellers 1989).

The size structure and abundance shifts we observed were largely the result of recruitment and growth of largemouth bass already present at the time of the regulation change. Only 2 year classes (1987 and 1988) were produced and protected under this limit. Based on the average growth rate of bass in Texas (Prentice 1987) only a few fish from the 1987 year class would have grown to 254 mm by the end of our sampling period (fall 1988). Following the full recruitment of these and other year classes, size structure may eventually shift to a greater proportion of fish 254–356 mm long. Also, continued angler harvest may ultimately reduce densities of fish ≥356 mm. This has been reported in a number of minimum length limit studies where catch rates and/or size structure improved initially but eventually stabilized at somewhat lower levels (Goddard and Redmond 1986, Mosher 1986).

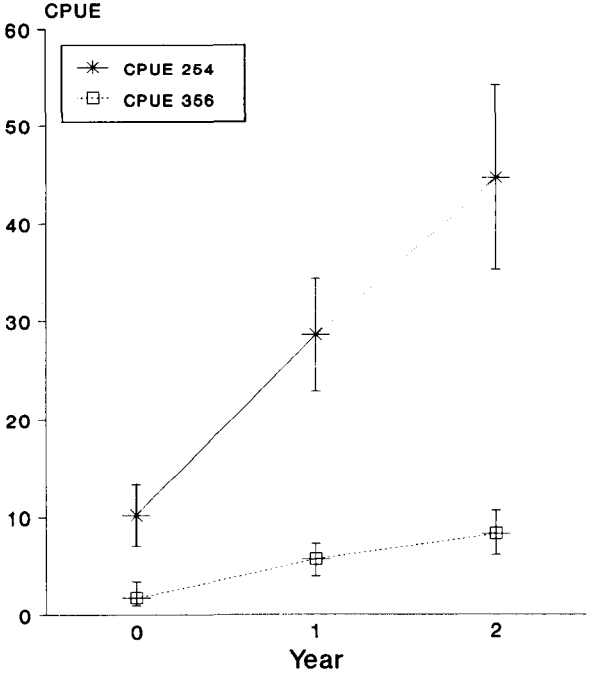

Figure 4. Mean electrofishing catch rates (CPUE = fish/hour) of largemouth bass ≥254 mm (CPUE 254) and those ≥356 mm (CPUE 356) before (0), 1 year (1), and 2 years (2) after implementation of Texas statewide 356-mm minimum-length and 5-fish daily creel limits for 9 study reservoirs. Error bars denote 95% confidence intervals.

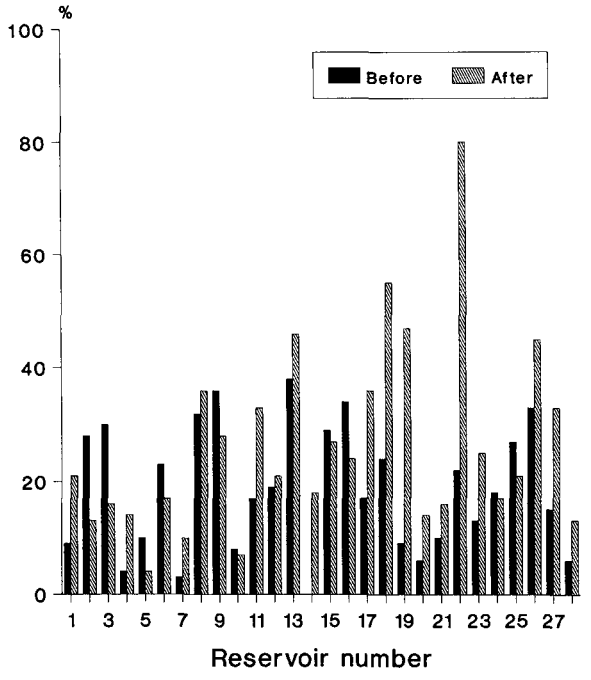

Figure 5. Proportion (%) of largemouth bass ≥356 mm before and 2 years after implementation of Texas statewide 356-mm minimum length limit and 5-fish daily creel limits for each of 28 study reservoirs.

The size structure and abundance shifts we observed were more likely due to changes in the statewide minimum length limit than changes in the statewide daily creel limit. Based on statewide creel survey data (Texas Parks and Wildl. Dep., unpubl. data), <1% of angler parties interviewed caught a limit during years before (1985 and 1986) and after (1987 and 1988) the statewide regulation change. These data strongly suggest reducing the creel limit from 10 fish to 5 fish did little to affect largemouth bass harvest. Creel limits are often set too high, making them an ineffective means of controlling harvest (Redmond 1974, Fox 1975).

Management Implications

The statewide 356-mm minimum-length and 5-fish daily creel limits were effective for increasing the abundance of adult largemouth in Texas' larger reservoirs. In the majority of cases, these regulations increased abundance of both largemouth bass ≥254 mm and those ≥356 mm. We suspect this regulation will protect largemouth bass populations from problems associated with overharvest. The increased number of adult bass in Texas reservoirs may eventually yield positive effects on annual largemouth bass production and year class strength. Angler catch rates of quality-size bass should also increase, because of their increased availability to anglers.

Statewide regulations, if appropriately applied, can be an effective means of managing largemouth bass propulations in large reservoirs. Such regulations should

be routinely monitored to identify changing management needs. They may be particularly useful for states which presently do not have the resources to manage water bodies on an individual basis.

Literature Cited

Ager, L. M. 1989. Effects of an increased size limit for largemouth bass in West Point Reservoir. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 43:172–181.

Anderson, R. O. 1974. Influence of mortality rates on production and potential sustained harvest of largemouth bass populations. Pages 18–28 *in* J. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. Am. Fish. Soc., Spec. Pub. 3, Bethesda, Md.

Bonneau, D. L. and J. M. Conley. 1974. A summary of largemouth management in the midwest. Pages 6–9 *in* J. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. Am. Fish. Soc., Spec, Pub. 3, Bethesda, Md.

Dent, R. J. 1986. Results of a black bass 15-inch minimum length limit on Pomme de Terre Lake, Missouri. Pages 309–310 *in* G. E. Hall and M. J. Van Den Avyle, eds. Reservoir Fisheries Management: Strategies for the 80's. Reservoir Comm., South. Div. Am. Fish. Soc., Bethesda, Md.

Durocher, P. P., W. C. Provine, and J. E. Kraai. 1984. Relationship between abundance of largemouth bass and submerged vegetation in Texas reservoirs. N. Am. J. Fish. Manage. 4:84–88.

Fox, A. C. 1975. Effects of traditional harvest regulations on bass populations and fishing. Pages 392–398 *in* H. E. Clepper and R. H. Stroud, eds., Black bass biology and management, Sport Fish. Inst. Washington, D.C.

Goddard, J. A. and L. C. Redmond. 1986. Stockton Lake: Prolonging the "Boom," managing a new large reservoir with minimum length limits. Pages 203–210 *in* G. E. Hall and M. J. Van Den Avyle, eds. Reservoir fisheries management: strategies for the 80's. Reservoir Comm., South. Div. Am. Fish. Soc., Bethesda, Md.

Hackney. P. A. 1974. Largemouth bass harvest in the midwest, an overview. Pages 114–116 *in* J. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. Am. Fish. Soc., Spec. Pub. 3, Bethesda, Md.

Ming, A. and W. E. McDannold. 1975. Effect of length limit on an overharvested largemouth bass population. Pages 416–424 *in* H. E. Clepper and R. H. Stroud, eds. Black bass biology and management. Sport Fish. Inst., Washington, D.C.

Mitchell, J. M. and K. K. Sellers. 1989. Effects of two alternative minimum-length and creel limits on a largemouth bass population. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 43:164–171.

Mosher, T. 1986. A review of the impacts of length limits on black bass populations in Kansas State fishing lakes with emphasis on Lyon State Fishing Lake. Kan. Fish and Game Comm., Tech. Rep., Fed. Aid Proj. FW-9-P-4, Emporia, Kan. 48pp.

Novinger, G. D. 1984. Observations on the use of size limits for black basses in large impoundments. Fisheries 9(4):2–6.

———. 1986. Effects of a 15-inch minimum limit on largemouth bass and spotted bass fisheries in Table Rock Lake, Missouri. Pages 308–309 *in* G. E. Hall and M. J. Van Den Avyle, eds. Reservoir fisheries management: strategies for the 80's. Reservoir Comm., So. Div. Am. Fish. Soc., Bethesda, Md.

———. 1987. Evaluation of a 15-inch minimum length limit on largemouth bass and spotted bass catches at Table Rock Lake, Missouri. N. Am. J. Fish. Manage. 7:260–272.

Prentice, J. A. 1987. Length-weight relationships and average growth rates of fishes in Texas. Texas Parks and Wildl. Dept., Inland Fish. Data Ser. 6, Austin, Texas. 61pp.

Redmond, L. C. 1974. Prevention of overharvest of largemouth bass in Missouri impoundments. Pages 54–68 *in* J. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. Am. Fish. Soc., Spec. Pub. 3, Bethesda, Md.

Richards K. 1986. Evaluation of a 15-inch minimum length limit for black bass at lake of the Ozarks, Missouri. Page 309 *in* G. E. Hall and M. J. Van Den Avyle, eds. Reservoir fisheries management: strategies for the 80's. Reservoir Comm., So. Div. Am. Fish. Soc., Bethesda, Md.

Statistical Analysis System (SAS) Institute. 1985. SAS user's guide: statistics. Version 5 ed. SAS Inst. Inc., Cary, N.C. 956pp.

Van Horn, S. L., W. R. Chapman, and F. A. Harris. 1981. Results of a 45-cm (18-in) minimum size regulation on largemouth bass populations. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 35:424–429.