EVALUATION OF A 380-mm MINIMUM LENGTH LIMIT FOR LARGEMOUTH BASS IN LAKE ALVIN, SOUTH DAKOTA

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ABSTRACT

A 380-mm (total length) minimum length limit was imposed on largemouth bass (*Micropterus salmoides*) in Lake Alvin, South Dakota, in 1987. No largemouth bass longer than 350 mm were collected during pre-regulation electrofishing samples. After imposition of the length limit, the quality of the largemouth bass population increased. In 1988 and 1989 electrofishing samples, largemouth bass 380-mm and longer comprised 19% and 14%, respectively, of the number of fish that were at least 200 mm in length. Largemouth bass attained 320 mm or more in length by age 3, slightly faster growth than for pre-regulation samples. A random-stratified creel survey was undertaken at Lake Alvin during 1989; anglers harvested an estimated 15 largemouth bass/ha that exceeded 380 mm. Thus, the 380-mm length limit was a successful tool for management of largemouth bass in Lake Alvin.

INTRODUCTION

Largemouth bass (*Micropterus salmoides*) in small impoundments are vulnerable to overharvest by anglers (Graham 1974, Hickman and Congdon 1974, Lindgren and Willis 1990). Redmond (1974) reported harvest rates of 11-69% for largemouth bass longer than 300 mm (total length) after the first four days of angling at five Missouri impoundments. Similarly, Ming and McDannold (1975) reported a 74% harvest of largemouth bass longer than 225 mm from Pony Express Lake, Missouri, only nine months after it was opened to public fishing. Graham (1974) studied the effects of variable harvest rates of largemouth bass on population dynamics of largemouth bass and bluegill (*Lepomis macrochirus*). He determined that a 40% harvest provided the most desirable largemouth bass population in terms of growth and recruitment. Modde and Scalet (1985) noted that largemouth bass at northern latitudes grew slower and attained a smaller maximum size than largemouth bass in southern latitudes. Harvest rates of 40% in South Dakota waters could result in an undesirable largemouth bass size structure caused by reduced growth potential.

Harvest regulations have been applied to largemouth bass in midwestern impoundments in an attempt to optimize harvest and size structure. One type of harvest regulation utilized by fisheries managers is the minimum length limit. A minimum length limit is used where excessive harvest occurs, thus protecting largemouth bass up to a specified minimum length by requiring their release. After the implementation of a 300-mm minimum length limit on the largemouth bass population of Pony Express Lake, Missouri, Ming and McDannold (1975) found that growth rates were slowed, causing fish to "stockpile" just below legal harvestable length. To avoid increased density and slowed growth, minimum length limits should only be applied to low-density, rapidly-growing largemouth bass populations. Obviously, the definition for "rapid" growth will depend on trophic level and growing season. The purpose of this project was to document the successful application of a 380-mm minimum length limit for largemouth bass in a South Dakota impoundment.

METHODS

Lake Alvin is a 40.5-ha impoundment located approximately 24 km southeast of Sioux Falls, South Dakota. The lake contains sparse aquatic vegetation and supports a low-density, fast-growing largemouth bass population. The largemouth bass population in Lake Alvin was subjected to high fishing pressure due to its close proximity to an urban area and an adjacent state park. A 380-mm minimum length limit was implemented in 1987. Largemouth bass size structure, relative abundance, condition, and growth were determined and compared to pre-regulation data collected by the South Dakota Department of Game, Fish and Parks (GFP). Our sampling techniques were similar to those used by GFP biologists. Largemouth bass were sampled during the daytime in the fall of 1988 and 1989, using a 220-V, pulsed-DC electrofishing boat powered by a 7,500-watt generator. To obtain a representative sample of largemouth bass for size structure characterization, electrofishing was conducted when water temperatures were between 16-22°C.

Length-frequency histograms were developed by measuring all largemouth bass longer than stock length (200 mm). Proportional stock density (PSD) and relative stock density of preferred-length fish (RSD-P) were used to compare pre- and post-regulation length-frequency data. PSD is the percentage of stock-length largemouth bass that are also longer than quality length (300 mm) (Anderson 1978). Similarly, RSD-P is the number of stock-length largemouth bass that are also longer than preferred length (380 mm) (Gabelhouse 1984).

Largemouth bass relative abundance was indexed with catch- per-effort (CPE) data. CPE was the number of stock-length largemouth bass caught per hour of electrofishing.

Lengths, weights, and scales from five fish per centimeter length group were collected for analyses of condition and growth. Condition factors were calculated using relative weight (*Wr*) (Wege and Anderson 1978). *Wr* was obtained by dividing the actual weight of a fish by a standard weight for a fish of that length, multiplied by 100. Growth rates were determined by back-calculating lengths at scale annulus formation with the microcomputer program DISBCAL (Frie 1982). A standard y-intercept or "a" value of 20 mm was used, as suggested by Carlander (1982).

A random-stratified creel survey was conducted April through September of 1989. The survey consisted of 18 interview periods per month. Each interview period lasted two hours, with two instantaneous counts of boat and shore anglers during each period. Angler harvest, pressure, and catch rates were calculated using a creel survey analysis program developed by GFP (Jacobson and Lucchesi 1989).

RESULTS

Largemouth bass size structure improved and growth rates did not slow during the period of evaluation. Largemouth bass PSD and RSD-P values for the 1985 pre-regulation sample were 76 and 0, respectively. PSD and RSD-P values for the 1988 and 1989 samples were 70 and 19; and 52 and 14, respectively (Figure 1). Back-calculated lengths at annuli 1-3 for largemouth bass in the 1986 sample were 129, 232, and 263 mm, respectively. Backcalculated lengths corresponding to annuli 1-3 for the 1988 sample were 149, 292, and 365 mm, respectively, while lengths at the first three annuli for the 1989 sample were 124, 246, and 320 mm, respectively (Table 1).

Table 1. Growth, catch per effort, and mean relative weight *Wr* of largemouth bass collected from Lake Alvin, South Dakota. Sample sizes are in parentheses.

	1985	1988	1989
Length[a] at annulus 1	129 (22)	149 (36)	124 (43)
Length at annulus 2	232 (19)	292 (25)	246 (23)
Length at annulus 3	263 (3)	365 (3)	320 (8)
Catch per effort[b]	13.7 (24)	11.4 (37)	11.9 (38)
(Wr)	106 (25)	92 (39)	93 (54)

[a]Total length in mm
[b]Number of stock-length (≥200 mm) largemouth bass caught per hour of electrofishing.

CPE values for 1985, 1988, and 1989 samples were 13.7, 10.4 and 11.5 stock-length and longer largemouth bass per hour of electrofishing, respectively (Table 1). Mean *Wr* values for largemouth bass from 1985, 1988, and 1989 samples were 106, 92, and 93, respectively (Table 1).

The April through May, random-stratified creel survey documented fishing effort of 538 angler hours/ha. A total of 608 largemouth bass (15/ha) were harvested.

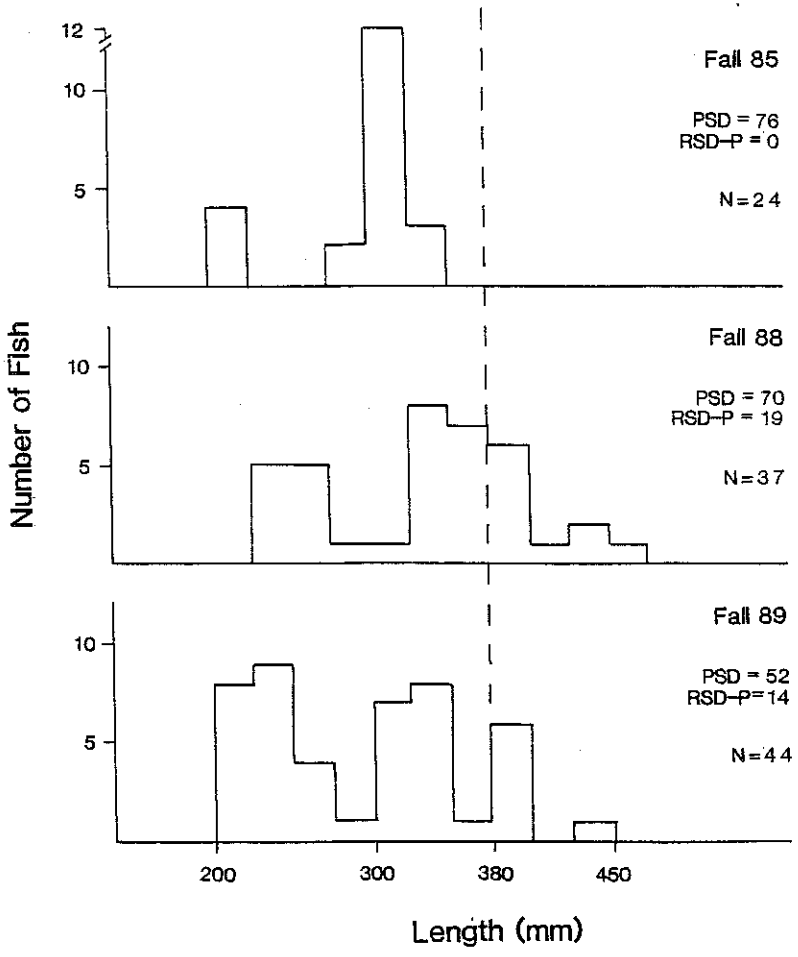

Figure 1. Size structure and corresponding PSD and RSD-P values for largemouth bass collected by fall electrofishing in Lake Alvin, South Dakota. A 380-mm minimum length limit was implemented in 1987.

DISCUSSION

The objective for the 380-mm minimum length limit at Lake Alvin was to increase the number of 380 mm and longer largemouth bass in the population. By meeting this objective, we verified pre-regulation speculations that largemouth bass size structure in this low density population was negatively impacted by angler harvest.

The success of this minimum length limit was expressed by both increased RSD-P values and an angler harvest of 15 largemouth bass/ha longer than 380 mm. Management biologists promoting the use of minimum length limits to the angling public should be cautious with claims that minimum length limits will always produce an increased harvest of fish longer than the minimum. Results from a 5-year evaluation of largemouth bass minimum length limits on six Kansas lakes revealed increased CPE (i.e., density) on all six lakes but decreased growth in one of two lakes for which growth data were analyzed (Mosher 1986). Increased density and decreased growth resulting from a minimum length limit will reduce the number of largemouth bass reaching legal length.

Our data indicated that the minimum length limit improved largemouth bass size structure in Lake Alvin without substantially increasing density or decreasing growth below pre-regulation levels. RSD-P values increased from 0 in 1985 to 19 and 14 in 1988 and 1989, respectively, while PSD values decreased from 70 in 1988 to 52 in 1989. Reductions in PSD actually represented a more balanced situation in terms of recruitment to stock length and overall size structure. Anderson (1980) suggested that a balanced largemouth bass population should have PSD and RSD-P values of 40-70 and 10-25, respectively.

According to our data on growth and CPE, largemouth bass density in Lake Alvin is naturally low. During this evaluation, we collected 10.4 - 11.5 stock-length largemouth bass per hour of electrofishing. In contrast, we collected 306 fish per hour at Knox Pond, a small impoundment with a largemouth bass density of 887/ha (Lindgren and Willis 1990). Recruitment was probably limited by the low density of submerged macrophytes and high overwinter mortality of young-of-the-year largemouth bass. Durocher et al. (1984) evaluated largemouth bass populations in 30 Texas reservoirs; in 13 of the 15 reservoirs with submerged vegetation coverage less than 2%, largemouth bass standing crops were less than 11 kg/ha. Submerged macrophyte cover at Lake Alvin was estimated to be 1%. In an effort to determine the overwinter survival of the 1988 year class as well as fall-stocked advanced fingerlings, electrofishing was conducted in the fall of 1988 and spring of 1989. Despite collecting 19 young-of-the-year largemouth bass per hour of electrofishing in

the fall, no yearling bass (natural or stocked) were collected in the spring, substantiating our assumption that recruitment to age-1 was limited by overwinter survival. Naturally low recruitment and density were important factors influencing the success of this regulation.

The evaluation of a 380-mm minimum length limit for largemouth bass in Lake Alvin provided important information concerning the application of length limits for South Dakota waters. Such information is helpful when developing guidelines for pre-regulation evaluation of rate functions before a harvest regulation is implemented.

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REFERENCES

Anderson, R. O. 1978. New approaches to recreational fishery management. 73-78 IN Novinger, G. D. and J. G. Dillard (ed.) *New approaches to the management of small impoundments.* American Fisheries Society, North Central Division, Special Publication 5, Bethesda, Maryland.

Anderson, R. O. 1980. Proportional stock density (PSD) and relative weight (*Wr*): interpretive indices for fish populations and communities. 27-33 IN Gloss, S. and B. Shupp (ed.) *Practical fisheries management: more with less in the 1980's.* American Fisheries Society, New York Chapter, Ithaca.

Carlander, K. D. 1982. Standard intercepts for calculating lengths from scale measurements for some centrarchid and percid fish. *Transactions of the American Fisheries Society* 111:332-336.

Durocher, P. P., W. C. Provine, and J. E. Kraai. 1984. Relationship between abundance of largemouth bass and submerged vegetation in Texas reservoirs. *North American Journal of Fisheries Management* 4:84-88.

Frie, R. V. 1982. Measurements of fish scales and back-calculation of body lengths using a digitizing pad and microcomputer. *Fisheries* 7:5-8.

Gablehouse, D. W., Jr. 1984. A length-categorization system to assess fish stocks. *North American Journal of Fisheries Management* 4:273-285.

Graham, L. K. 1974. Effects of four harvest rates on pond fish populations. 29-38 IN Funk, J. L. (ed.) *Symposium on overharvest and management of largemouth bass in small impoundments.* American Fisheries Society, North Central Division, Special Publication 3, Bethesda, Maryland.

Hickman, G. D., and J. C. Congdon. 1974. Effects of length limits on fish populations. 84-94 IN Funk, J. L. (ed.) *Symposium on overharvest and management of largemouth bass in small impoundments.* American Fisheries Society, North Central Division, Special Publication 3, Bethesda, Maryland.

Jacobson, P. C., and D. Lucchesi. 1989. *Creel survey analysis II.* South Dakota Department of Game, Fish and Parks, Pierre.

Lindgren, J. P., and D. W. Willis. 1990. Vulnerability of largemouth bass to angling in two small South Dakota impoundments. *The Prairie Naturalist* 22:107-112.

Ming, A., and W. E. McDannold. 1975. Effect of length limits on overharvested largemouth bass populations. 416-424 IN Clepper, H. C. (ed.) *Black bass biology and management.* Sport Fishing Institute, Washington D.C.

Modde, T., and C. G. Scalet. 1985. Latitudinal growth effects on predator-prey interactions between largemouth bass and bluegills in ponds. *North American Journal of Fisheries Management* 5:227-232.

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.* Kansas Fish and Game Commission, Pratt.

Redmond, L. C. 1974. Prevention of overharvest of largemouth bass in Missouri impoundments. 54-56 IN Clepper, H. C. (ed.) *Symposium on overharvest and management of largemouth bass in small impoundments.* American Fisheries Society, North Central Division, Special Publication 3, Bethesda, Maryland.

Wege, G. J., and R. O. Anderson. 1978. Relative weight (*Wr*): a new index of condition for largemouth bass. 79-91 IN Novinger, G. D. and J. G. Dillard, (ed.) *New approaches to the management of small impoundments.* American Fisheries Society, North Central Division, Special Publication 5, Bethesda, Maryland.