The Largemouth Bass Catch-and-release Regulation at a New Reservoir, Purtis Creek State Park Lake, Texas

Kevin W. Storey, *Texas Parks and Wildlife Department, 11942, FM 848, Tyler, TX 75707*

Richard A. Ott, Jr., *Texas Parks and Wildlife Department, 11942, FM 848, Tyler, TX 75707*

Abstract: In November 1988, Purtis Creek State Park Lake opened to public fishing with a catch-and-release regulation for largemouth bass (*Micropterus salmoides*). The objective of the regulation was to prevent initial overharvest and provide a quality fishery under high anticipated fishing pressure. The fishery was evaluated using spring electrofishing and annual creel surveys. No illegal bass harvest was observed during creel surveys. The proportion of bass ≥356 mm declined and PSD shifted from >80 into the 40–70 range within 2 years. This change was likely due to mortality induced by the intense directed fishing pressure (>300 hours/ha in the first 9 months). Directed fishing pressure in the spring quarters of 1989 and 1991 exceeded 100 hours/ha. The largemouth bass population sustained annual angler catch rates of 0.31–0.55 fish/hour. More than one third of all anglers rated their fishing as good or very good.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 46:377–385

Live release of largemouth bass (*Micropterus salmoides*) has increased in popularity as anglers have become more aware of the value of fisheries resources (Schramm et al. 1985, Quinn 1989). Live release is familiarly known as "catch-and-release" (Stroud 1964). This technique is actively encouraged by tournament sponsors (Bryan 1980, Schramm et al. 1987), angling media, and several major recreational fishing organizations (Quinn 1989). The basic premise for catch-and-release fisheries is that the number of fish caught, rate of catching these fish, and the sizes of fish caught will be enhanced for most anglers using the resource (Hunt 1981).

Catch-and-release regulations are most appropriate when harvest is of little importance to anglers (Weithman and Anderson 1977). The success of these regulations depend on the survival, growth, and recapture of released fish (Burkett et al. 1986). Largemouth bass are tolerant of catch-and-release (Weithman and Anderson 1977, Mankin et al. 1984, Schramm et al. 1985, Burkett et al. 1986, Schramm et al. 1987, Quinn 1989) and in recent years, anglers have also adopted handling techniques that improve survival of their released catches (Schramm et al. 1985, Schramm et al. 1987).

Catch-and-release regulations, however, do have some disadvantages. There may be learned (Westers 1963, Anderson and Heman 1969, Schneider 1973, Bennett 1974) and/or genetic components (Burkett et al. 1986) of vulnerability to angling. There is also evidence that heavy fishing under a catch and release regulation may reduce growth rates (Clapp and Clark 1989).

New reservoirs are understandably subjected to considerable angler attention when they are opened to public fishing. High initial harvest of largemouth bass in small impoundments is well documented (Turner 1963, Redmond 1974). This high initial mortality, overharvest, often leads to declining fishing quality, specifically in terms of angling success and sizes of fish caught (Champeau and Denson 1987). Overharvest can be prevented by the use of restrictive regulations such as minimum-length limits (Redmond 1974, Hoey and Redmond 1974, Goddard and Redmond 1986). Champeau and Denson (1987) used a catch-and-release regulation, instead, to prevent overharvest of largemouth bass in a newly-opened 158-ha lake. During their 5-year study, the largemouth bass population became dominated by small fish which they attributed to high angling mortality and poor forage.

Purtis Creek State Park Lake is owned by the Texas Parks and Wildlife Department and offered a unique opportunity to study a largemouth bass population in a new reservoir regulated exclusively by catch-and-release. The regulation was enacted to prevent initial overharvest and maintain a high quality fishery for largemouth bass. The objectives of this study were to evaluate the effects of the catch-and-release regulation on the largemouth bass population and characterize the bass fishery for the first 3 years after reservoir opening. It was hoped the regulation would sustain a largemouth bass Proportional Stock Density (PSD; Anderson 1978) between 40 and 70 and an angler catch rate of 1 fish/hour.

We wish to express our appreciation to R. Cooper and B. L. Minson for collecting most of the data, to G. R. Wilde for his assistance with statistical analysis, and to A. A. Forshage, F. W. Janssen, R. W. Luebke, B. W. Lyons, J. O. Parks, S. M. Poarch, M. J. Ryan, and E. P. Seidensticker for their review of this manuscript. This study was partially funded by the Federal Aid in Sport Fish Restoration Act, Project F-30-R of the Texas Parks and Wildlife Department.

Methods

Purtis Creek State Park Lake is a 144-ha reservoir within Purtis Creek State Park, Henderson and Van Zandt counties, 4.8 km north of Eustace, Texas. The reservoir was impounded in 1984. The drainage area is approximately 26.9 km^2, mean water depth is 3.3 m, maximum depth is 9.1 m, shortline length is 11.3 km, and shoreline development ratio is 1.2:1.0. Florida largemouth bass (*M. s. floridanus*) fingerlings were stocked in 1985 at 220/ha. The reservoir was opened to public fishing in November 1988. Park regulations limit access to 50 boats at any given time, and boats are only permitted on the reservoir from dawn to dusk.

Electrofishing was conducted after sunset in May 1987–1991, to assess the size distribution of largemouth bass. In 1987 through 1990, the electrofishing unit was powered by a 5,000-W generator supplying 220 volts AC to 4 drop electrodes. In 1991, however, power was supplied by a Smith-Root 5.0-GPP 5,000-W generator producing pulsed DC variable output, 250–300 volts, to a pair of anode arrays. Since water depths were shallow (< 1 m) and vegetated cover was moderate it was assumed there was little difference in the selectivity of the 2 units (Mosher et. al 1989). Electrofishing stations (4 or 5) were usually sampled for 0.25 hours but total annual electrofishing time varied from 1.00 to 1.75 hours. All largemouth bass were collected and their lengths measured to the nearest millimeter.

PSD (Anderson 1978) and Relative Stock Density (RSD) (Wege and Anderson 1978) were calculated for assessment of size distribution data. RSD_{356} was used because 356 mm was the statewide minimum-length limit for largemouth bass elsewhere in Texas during the study. These structural indices were treated and analyzed in a manner similar to that employed by Webb and Ott (1991). All estimates from individual electrofishing stations during pre-treatment (1987–1988) and post-treatment years (1989–1991) were transformed by the arcsine of their square roots to normalize their distributions. The transformed values were then weighted by the inverse of their variances in order to satisfy the homogeneity-of-variance assumption of ANOVA. The resulting estimates were tested for differences with analysis of variance using the SAS PROC GLM procedure (SAS 1988). Statistical analyses employed a critical alpha of $P < 0.05$.

Whole otoliths from a stratified subsample (5 fish per 25.4 mm group) of largemouth bass were collected for age and growth analysis. Annular measurements were taken from these otoliths using the method employed by Mitchell and Sellers (1990). These fish were collected by electrofishing in October (1989–1991), November (1988), and December (1987). Largemouth bass length-at-capture ($\log_{10}$) for age classes 1 through 3 was analyzed by time period (pre-treatment vs. post-treatment) and tested for differences by analysis of variance, using the SAS PROC GLM procedure. In addition, Duncan's Multiple Range test was performed to determine the direction of any changes.

Creel surveys were initiated in March 1989, 4 months after the reservoir opened to public fishing, to assess angler catch rate, fishing pressure, and size distribution of largemouth bass caught and released. Boat anglers were interviewed by a creel clerk at the park's only boat ramp at the completion of fishing trips. Shore anglers, however, were interviewed by a roving creel clerk. Creel surveys were divided into 4 quarters: March–May (spring), June–August (summer), September–November (fall) and December–February (winter). Sampling lasted 6 hours each day and was conducted at randomly assigned times on 9 randomly selected days (5 weekend days and 4 weekdays) in each quarter.

During each creel survey, creel clerks performed instantaneous angler counts and recorded the following information during angler interviews: number of anglers per party, time fished, species sought. In addition, anglers were asked to rate the satisfaction of their trip on a 5 point scale (very good, good, average, poor, very poor) compared to other fishing trips on any lake. Anglers seeking largemouth bass were asked how many fish they recalled catching that day in 2 size categories, <356 mm and ≥356 mm. Proportions of fish ≥356 mm were analyzed by season for differences using a logistic regression (Agresti 1990) with year as a continuous variable, since we were interested in whether a consistent trend was emerging. Data were analyzed to provide estimates of total angler catch rates and directed fishing pressure by season with accompanying estimates of standard error. Analyses were based solely on anglers fishing for largemouth bass.

Results

From 1987 through 1989 largemouth bass PSD was >80, but since 1990, 2 years after reservoir opening, the value has remained within the range 40–70 (Table 1). PSD and RSD_{356} declined significantly since the park opened to public fishing ($P < 0.01$ and $P = 0.03$, respectively).

Mean length-at-capture of all largemouth bass age classes followed a declining trend (Fig. 1). Length-at-capture decreased significantly since reservoir opening for Age 1 through 3 ($P < 0.01$, $P < 0.01$, and $P = 0.03$, respectively).

Largemouth bass angler catch rates showed a continuous decline from the start of the creel survey in spring 1989 for the first 3 quarters (Fig. 2). In 1990 and 1991 a consistent trend in angler catch rates was observed seasonally, from winter through fall each year. The highest quarterly angler catch rate was 0.77 fish/hour (SE = 0.12) in fall 1990. Annual mean angler catch rates for largemouth bass were 0.37 fish/hour (SE = 0.06) in 1989 (March–November), 0.31 fish/hour (SE = 0.05) in 1990 (December 1989–November 1990), and 0.55 fish/hour (SE = 0.06) in 1991 (December 1990–November 1991).

Fishing pressure directed toward largemouth bass declined from a maximum in spring to a minimum in winter each year (Fig. 2). Total directed fishing pressure for largemouth bass was 312.4 hours/ha (SE = 52.1) in 1989 (March–November). By

Table 1. Mean structural indices[a] of largemouth bass from May electrofishing, Purtis Creek State Park Lake, Texas, 1987–1991.

Year	PSD	RSD_{356}
1987	84	53
1988	91	78
1989	83	57
1990	43	25
1991	65	41

[a]PSD = Proportional Stock Density as defined by Anderson (1978); RSD = Relative Stock Density as defined by Wege and Anderson (1978).

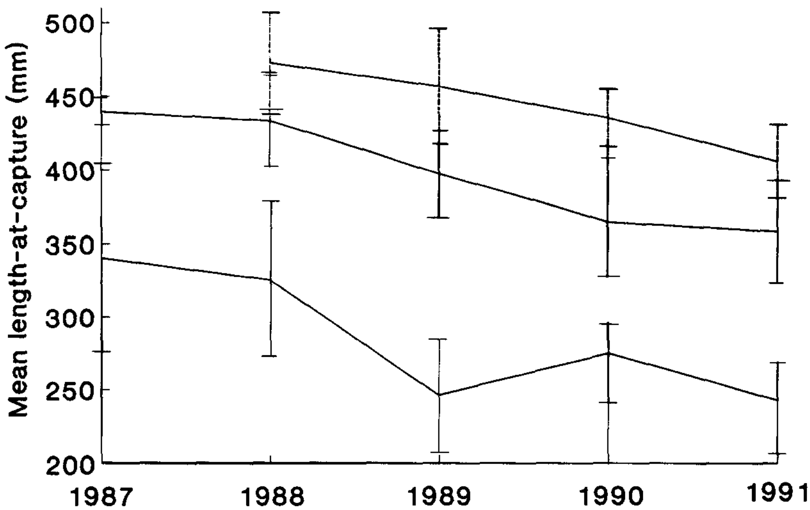

Figure 1. Mean length-at-capture, ± SE, of largemouth bass, Age 1–Age 3, Purtis Creek State Park Lake, Texas, 1987–1991.

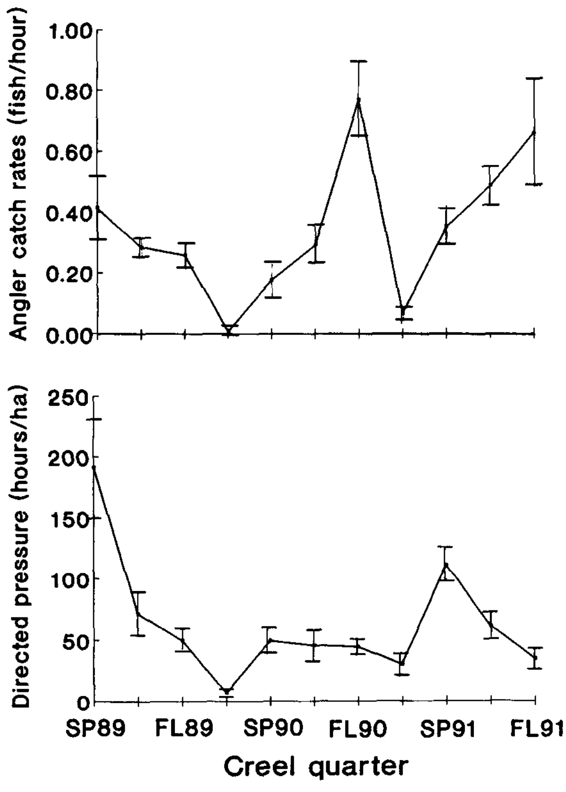

Figure 2. Angler catch rates (fish/hour), ± SE, and directed fishing pressure (hours/ha), ± SE, for largemouth bass from creel surveys, Purtis Creek State Park Lake, Texas, March 1989–November 1991.

contrast, the Texas statewide average estimate was 49.4 hours/ha for the same time period (G.R. Wilde, pers. commun.). Pressure estimates for 1990 (December 1989–November 1990) and 1991 (December 1990–November 1991) were 149.4 hours/ha (SE = 21.3) and 228.9 hours/ha (SE = 28.9) respectively. Directed quarterly fishing pressure exceeded 100 hours/ha in spring 1989 and 1991, but the majority of estimates were 40–60 hours/ha.

The proportion of largemouth bass ≥356 mm caught by anglers in spring declined significantly ($P < 0.01$) from 0.72 to 0.61 between 1989 and 1991. In summer, however, the proportion increased significantly ($P < 0.01$) from 0.47 to 0.64. In fall, there was no significant difference ($P > 0.10$), but in winter marginal evidence of a decline was observed ($P > 0.05$).

In 1989, 47% of largemouth bass anglers interviewed rated their fishing at Purtis Creek State Park Lake as good or very good, 54% in 1990 and 33% in 1991.

Discussion

After being subjected to catch-and-release fishing only, the largemouth bass population at Purtis Creek did not maintain the properties of an unfished population (Goedde and Coble 1981). The population shifted from one characterized by low rates of recruitment and low mortality of quality-sized fish (Anderson 1980) to one with higher levels of both of these parameters. The population change did prove beneficial though, as PSD fell within the range of desirable values (40–70) described by Anderson (1980) and Willis (1984). This shift could be attributed to increased reproduction/recruitment leading to greater year-class strength or to increased mortality of quality-sized fish. When high levels of fishing pressure are combined with factors such as repeated hooking, the use of improper gear and/or handling techniques, or illegal harvest, the resulting mortality could be sufficient to mimic the changes seen when previously unfished populations are subjected to angling (Goedde and Coble (1981). Wydoski (1977) noted hooking mortality and sublethal stress may be important in catch-and-release fisheries subjected to high fishing pressure. The largemouth bass population at Purtis Creek probably changed as a result of pressure-induced mortality.

The bass population was exposed to very high levels of fishing pressure as soon as the lake was opened to public fishing. No doubt fishing pressure would have had a greater effect and the population might have shifted faster without the restrictions on boat access imposed at opening.

Although we documented no harvest of largemouth bass during creel surveys, park employees reported seeing some largemouth bass carcasses at the park's fish cleaning stations (R. Cadena, pers. commun.). Gigliotti and Taylor (1990) reported a loss of all benefits of catch-and-release with 24% illegal harvest of all sizes of largemouth bass. Likewise, Champeau and Denson (1987) believed even low rates of illegal harvest on the catch-and-relese fishery at Webb Lake, Florida, resulted in instability and a rapid decline in the largemouth bass population.

Comparatively low fishing pressure in 1990 was possibly as a result of steadily declining angler catch rates throughout 1989. Directed pressure could have decreased either because anglers perceived the largemouth bass population had declined or they had returned to other waters after taking the opportunity to fish this new reservoir.

There was evidence of a decline in largemouth bass growth rates following resrvoir opening. Clapp and Clark (1989) found a statistically significant ($P < 0.05$) inverse relationship between growth rate of smallmouth bass (*micropterus dolomieui*) and the number of times fish were captured. Although a similar process may have taken place at Purtis Creek, estimates of length-at-capture in this study are similar to back-calculated lengths of largemouth bass (272 mm, 338 mm, 389 mm, respectively) from this ecological region, the Post Oak Savannah/Blackland Prairies (Prentice 1987).

Even though angler catch rates for largemouth bass fell below the target level of 1 fish/hour, most anglers were satisfied with the quality of fishing on the lake. The observed catch rates were comparable to or even better than rates at Lake Fork, Texas' premier largemouth bass lake, in 1989 and 1990 (0.35 fish/hour and 0.38 fish/hour, respectively) (B. W. Lyons, pers. commun.). In view of the high angling pressure experienced at Purtis Creek State Park Lake, the target angler catch rate was probably set unrealistically high.

After 3 years under a catch-and-release regulation, the largemouth bass population sustains quality fishing with mean annual angler catch rates of 0.31–0.55 fish/hour, with annual fishing pressure of at least 150 hours/ha. At least 60% of fish caught in the spring are ≥356 mm, and ≥33% of all anglers rate their fishing as good or very good.

Literature Cited

Agresti, A. 1990. Categorical data analysis. John Wiley and Sons, New York, N.Y. 550pp.

Anderson, R. O. 1978. New approaches to recreational fishery management. Pages 73–78 *in* G. D. Novinger and J. G. Dillard, eds. New approaches to the management of small impoundments. Spec. Publ. 5, North Cent. Div. Am. Fish. Soc.

———. 1980. Proportional stock density (PSD) and relative weight (Wr): interpretive indices for fish populations and communities. Pages 27–33 *in* S. Gloss and B. Shupp, eds. Practical fisheries management: more with less in the 1980's. Workshop proc., N.Y. Chap., Am. Fish. Soc.

——— and M. L. Heman. 1969. Angling as a factor influencing catchability of largemouth bass. Trans. Am. Fish. Soc. 2:317–320.

Bennett, G. W. 1974. Ecology and management of largemouth bass, *Micropterus salmoides*. Pages 10–17 *in* J. L. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. North Cent. Div. Am. Fish. Soc. Spec. Publ. 3.

Bryan, H. 1980. Impact of professional bass tournaments on orientation to fishing and disposition of fish. Sport Fish. Inst., Washington, D.C.

Burkett, D. P., P. C. Mankin, G. W. Lewis, W. F. Childers, and D. P. Philipp. 1986. Hook-and-line vulnerability and multiple recapture of largemouth bass under a minimum total-length limit of 457 mm. North Am. J. Fish. Manage. 6:109–112.

Champeau, T. R. and K. W. Denson. 1987. Effectiveness of a catch-and-release regulation for largemouth bass in a Florida lake. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 41:150–158.

Clapp, D. F. and R. D. Clark, Jr. 1989. Hooking mortality of smallmouth bass caught on live minnows and artificial spinners. North Am. J. Fish. Manage. 9:81–85.

Gigliotti, L. M. and W. W. Taylor. 1990. The effect of illegal harvest on recreational fisheries. North Am. J. Fish. Manage. 9:106–110.

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., S. Div. Am. Fish. Soc., Bethesda, Md.

Goedde, L. E. and D. W. Coble. 1981. Effects of angling on a previously fished and an unfished warmwater fish community in two Wisconsin lakes. Trans. Am. Fish. Soc. 110: 594–603.

Hoey, J. W. and L. C. Redmond. 1974. Evaluation of opening Binder Lake with a length limit for bass. Pages 100–105 *in* J. L. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. Spec. Publ. 3, North Cent. Div. Am. Fish. Soc.

Hunt, R. L. 1981. A successful application of catch and release regulations on a Wisconsin trout stream. Wis. Dep. Nat. Resour. Tech. Bul. 119. Madison. 34pp.

Mankin, P. C., D. P. Philipp, P. R. Beaty, D. P. Burkett, and W. F. Childers. 1984. The effects of population density and fishing pressure on the hook-and-line vulnerability in largemouth bass. Trans. Ill. Acad. Sci. 77:229–240.

Mitchell, J. M. And K. K. Sellers. 1990. 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. D., D. W. Gabelhouse Jr., and J. L. Stephen. 1989. A comparison of electrofishing efficiencies for black bass between Smith-Root and Kansas-made electrofishing boats. Fed. Aid in Fish Restor. Act, FW-9-P-7, Kan. Dep. Wildl. and Parks, Topeka. 14pp.

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

Quinn, S. P. 1989. Recapture rates of voluntarily released largemouth bass. North Am. J. Fish. Manage. 9:86–91.

Redmond, L. C. 1974. Prevention of overharvest of largemouth bass in Missouri impoundments. Pages 54–58 *in* J. L. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. Spec. Publ. 3, North Cent. Div. Am. Fish. Soc.

Statistical Analysis System (SAS). 1988. SAS Institute Inc. SAS/STAT™ User's Guide, Release 6.03 Edition. SAS Inst. Inc., Cary, N.C. 1028pp.

Schneider, J. C. 1973. Angling on Mill Lake, Michigan, after a five-year closed season. Mich. Acad. 5:349–355.

Schramm, H. L., Jr., P. J. Haydt, and N. A. Bruno. 1985. Survival of tournament-caught largemouth bass in two Florida lakes. North Am. J. Fish. Manage. 5:606–611.

———, P. J. Haydt and K. M. Portier. 1987. Evaluation of pre-release, post-release, and total mortality of largemouth bass caught during tournaments in two Florida lakes. North Am. J. Fish. Manage. 7:394–402.

Stroud, R. H., ed. 1964. Most fishing is for fun—what else? Sport Fish. Inst. Bul. 150:1–2.

Turner, J. L. 1963. A study of a fish population of an artificial lake in central Missouri with emphasis on *Micropterus salmoides*. M.S. Thesis. Univ. Mo., Columbia. 59pp.
Webb, M. A. and R. A. Ott, Jr. 1991. Effects of length and bag limits on population structure and harvest of white crappies in three Texas reservoirs. North Am. J. Fish. Manage. 11:614–622.
Wege, G. J. and R. O. Anderson. 1978. Relative weight (Wr): a new index of condition for largemouth bass. Pages 79–91 *in* G. D. Novinger and J. G. Dillard, eds. New approaches to the management of small impoundments. Spec. Publ. 5, North Cent. Div. Am. Fish. Soc.
Weithman, A. S. and R. O. Anderson. 1977. Catch-and-release fishing for largemouth bass on Hunter's Lake—1963 to 1977. Pages 109–118 *in* R. A. Barnhart and T. D. Roelofs, eds. Catch-and-release fishing as a management tool. Natl. Sport Fish. Symp., Humboldt State Univ., Arcata, Calif.
Westers, H. 1963. An evaluation of population estimate procedure in two ponds, containing only largemouth bass (*Micropterus salmoides*). M.S. Thesis, Univ. Mich., Ann Arbor. 110pp.
Willis, D. W. 1984. A statewide summary of sampling data for white crappie, walleye, white bass and largemouth bass collected in Kansas reservoirs. Kan. Fish and Game Comm. Comprehensive Planning Option Proj. FW 9-P-3, Emporia, Kan. 45pp.
Wydoski, R. S. 1977. Relation of hooking mortality and sublethal hooking stress to quality fishery management. Pages 43–87 *in* R. A. Barnhart and T. D. Roelofs, eds. Catch-and-release fishing as a management tool. Natl. Sport Fish. Symp. Humboldt State Univ., Arcata, Calif.