Trophy Largemouth Bass Regulations at Victor Braunig Reservoir, Texas

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Abstract: The largemouth bass (*Micropterus salmoides*) fishery and population structure at Victor Braunig Reservoir, Texas, were monitored from 1985 through 1992 following changes in harvest restrictions from 254-mm minimum length and 10 fish daily bag limits to 533-minimum length and 2 fish daily bag limits. Harvest rates were significantly reduced under the more restrictive limits and averaged 0.002 fish/angler-hour. Mean weight of harvested fish increased from 0.85 kg to 3.22 kg. Total catch rates ranged from 0.145 to 0.650 fish/angler-hour; the weighted mean annual catch rate during the study was 0.337 fish/angler-hour. Catch rates of fish ≥533 mm averaged 0.004 fish/angler-hour. Proportions of larger fish in the creel increased throughout the study. Electrofishing surveys showed increases in relative proportions of fish ≥381 mm, and relative abundance of fish ≥203 mm increased after 1989. Mean lengths-at-capture of age-1 fish declined, but relative weights remained above 100 for fish of all sizes. Results suggested relatively few largemouth bass recruited to lengths ≥533 mm. Under the experimental regulations, the largemouth bass fishery failed to provide anticipated catch rates of trophy (≥3.2 kg) fish, but did provide a quality catch-and-release fishery in terms of weight of fish caught per hour.

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Prior to 1985, largemouth bass harvest on most Texas public reservoirs was regulated by 254-mm minimum total length (TL: all lengths in this paper are TL) and 10 fish daily bag limits; exceptions included 356-mm and 406-mm minimum length and 356- to 457-mm slot limits at a few reservoirs (Garrett 1985). No reservoirs were managed specifically for production of trophy largemouth bass (defined here as ≥3.2 kg).

In 1985, the Texas Parks and Wildlife Department (TPWD) attempted to

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create a unique trophy largemouth bass fishery using highly restrictive harvest regulations. At that time, a review of the literature and communications with state fisheries agencies determined the most restrictive length limits (excluding no-harvest regulations) in the nation were 457-mm minimum length and 381- to 508-mm slot limits, and those were uncommon (Fox 1975, Nazary 1983, Novinger 1984, Redmond 1986).

Before 1985, harvest restrictions for largemouth bass at Victor Braunig Reservoir (VBR) did not differ from statewide regulations. Largemouth bass from VBR had the fastest growth and highest relative weights (Wr: Wege and Anderson 1978) in Texas (TPWD, unpubl. data). Length-weight equations and age-and-growth data for VBR largemouth bass predicted fish ≥533 mm would weigh ≥3.2 kg and could attain those lengths in 4 years. Accordingly, experimental 533-mm minimum length and 2 fish daily bag limits for VBR largemouth bass were imposed in January 1985. The objective of this study was to characterize the largemouth bass fishery and population structure at VBR under highly restrictive harvest regulations.

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Methods

Victor Braunig Reservoir is a 546-ha power-plant cooling impoundment in Bexar County, Texas. It was impounded in 1964, and lies approximately 8 km southeast of San Antonio (1990 population: 936,000). The reservoir typically receives very high fishing pressure. Estimated annual total effort ranges from 300 to 1,100 angler-hours/ha/year, compared with the national average of 114 angler-hours/ha/year (Ploskey et al. 1986) and 103 angler-hours/ha/year for Texas reservoirs (TPWD, unpubl. data). The reservoir is highly eutrophic, and contains high densities of blue tilapia (*Tilapia aurea*) and threadfin shad (*Dorosoma petenense*). The species are the primary forage for VBR largemouth bass.

Creel Surveys

Fishing effort, catch, and harvest were determined from 1985 through 1992 using angler surveys as described by Luebke (1989). Information collected from angler interviews included: 1) total effort, 2) species sought, and 3) number and weight of fish harvested by species. Anglers also were asked to recall numbers of released largemouth bass (caught but not harvested) in the following size groups: ≤304mm, 305–380 mm, 381–456 mm, 457–532 mm, and ≥533 mm.

Mean of ratios estimates of effort, catch, and harvest for anglers seeking largemouth bass were calculated using methods described by Malvestuto et al. (1978). Catch rates were estimated for each size group delineated above. Creel data similarly collected from 1979 and 1982–1984 were included in analyses.

However, during that period, anglers were not asked to recall numbers or lengths of released fish; consequently, only effort and harvest estimates were available for those years.

Electrofishing Surveys

Largemouth bass population structure and abundance were monitored by electrofishing surveys. Sampling was conducted after sunset in March (spring) and October (fall) from 1985 through 1992. Twelve sites, representative of available largemouth bass habitat, were sampled until a minimum of 100 fish ≥203 mm were collected. Fish were individually weighed (g) and measured (mm). An AC electrofishing boat was used from 1985 through spring 1991. From fall 1991 through fall 1992, a boat employing pulsed-DC output was used. Comparisons between boat types were made using methods described in Mosher et al. (1989); we determined catch rates and length-frequency distributions between boat types were not significantly different. Effort (total minutes of electrofishing time) was recorded beginning fall 1986.

Relative weights were calculated for fish from fall samples. Incremental relative stock densities (RSD: Gabelhouse 1984) for fish 203–304 mm ($RSD_{203-304}$), 305–380 mm ($RSD_{305-380}$), 381–456 mm ($RSD_{381-456}$), 457–532 mm ($RSD_{457-532}$), and ≥533 mm (RSD_{533}) were estimated for both spring and fall samples.

Age and Growth

Age-and-growth determinations were made from largemouth bass obtained during spring electrofishing surveys from 1985 through 1988, and 1990 through 1992. During each survey, we attempted to collect scales from 10 fish in each of the following size groups: ≤304mm, 305–380 mm, 381–456 mm, 457–532 mm, and ≥533 mm. Age determination followed methods described by Prentice and Whiteside (1975). Total annual mortality of fish ≥age 2 was estimated from a catch curve using Ketchen's stratified-subsampling method (Ricker 1975). Age-frequency data from all years were combined to correct for non-uniform recruitment (Ricker 1975). The maximum asymptotic length for the population during the study period was estimated from a Walford plot (Ricker 1975).

Data Analyses

Lack of pre-1985 data generally precluded quantitative analyses of the effects of the experimental regulations; therefore, reported changes in VBR's largemouth bass fishery are largely qualitative. Changes in size structure of caught-and-released fish and RSDs were compared by Kolmogorov-Smirnov association tests and logistic regression. Differences in creel rates, angler effort, electrofishing CPUE, and lengths-at-capture were compared with *t*-tests and 1-way ANOVA. Duncan's multiple-range tests were used for post-hoc comparisons. Significance for all analyses was set at $\alpha = 0.05$.

Results

Changes in the Creel

Effort.—Under statewide regulations, directed effort for largemouth bass declined from 1982 to 1984 (Table 1). Following implementation of experimental regulations in 1985, directed effort dropped sharply from 42.6 to 16.2 angler-hours/ha/year, but rose to 51.5 angler-hours/ha/year in 1986, and ranged from 34.2 to 66.8 angler-hours/ha/year during the remainder of the study. The mean effort for 1985–1992 was 43.9 angler-hours/ha/year, which was lower than the mean of 60.7 angler-hours/ha/year for 1979–1984. However, differences between pre- and post-1985 directed effort were not significant.

Harvest.—Harvest rates were significantly reduced following imposition of the more restrictive limits (Table 1). Mean harvest rate before 1985 was 0.101 fish/angler-hour. After the regulation change, it ranged from 0.001 to 0.004 fish/angler-hour and averaged 0.002 fish/angler-hour (2% of the pre-1985 rate). Mean weight of harvested fish increased from 0.85 kg before 1985 to 3.22 kg after. No parties reported harvesting more than 1 fish after 1984.

Catch.—Catch rate (harvested and caught-and-released fish combined) fluctuated throughout the study; significant differences or trends were not discernable (Table 1). The weighted mean catch rate for 1985–1992 was 0.337 fish/angler-hour. As witnessed by small harvest values, catch was comprised almost totally of sub-legal (≤532 mm) caught-and-released fish.

Table 1. Creel statistics from anglers seeking largemouth bass at Victor Braunig Reservoir, Texas.

Creel year[a]	Annual directed effort[b]	Catch[c]						
			Caught-and-released					
		Harvest	≤304	305–380	381–456	457–532	≥533	Total
		(N/angler-hour)						
1979	28.3	0.078						
1982	97.4	0.154						
1983	74.4	0.059						
1984	42.6	0.112						
1985	16.2	0.004	0.201	0.110	0.035	0.000	0.000	0.347
1986	51.5	0.002	0.274	0.117	0.026	0.019	0.002	0.440
1987	40.9	0.001	0.361	0.143	0.096	0.048	0.000	0.650
1988	66.8	0.002	0.173	0.036	0.070	0.025	0.001	0.311
1989	34.2	0.003	0.026	0.027	0.041	0.044	0.004	0.145
1990	34.4	0.001	0.031	0.122	0.062	0.045	0.008	0.271
1991	42.1	0.002	0.194	0.059	0.114	0.025	0.002	0.395
1992	65.1	0.001	0.079	0.064	0.070	0.028	0.001	0.243

[a]Before 1988, the reservoir was closed to angling December–January; creel year defined as 1 March–30 November for 1979–1987,1 December–30 November for 1988–1992.

[b]Angler-hours/ha/creel year.

[c]Catch by components: harvest = harvest rate for largemouth bass; caught-and-released = catch rate by size categories (TL in mm); total = catch rate of all largemouth bass.

Combining harvest rates and catch rates of fish ≥533 mm that were caught-and-released provided estimates of total catch rates of fish ≥533 mm; these were highest in 1989 and 1990 (0.007 and 0.009 fish/angler-hour, respectively) and averaged 0.004 fish/angler-hour over the study.

Size Distribution of Released Fish.—Size distributions of caught-and-released fish changed throughout the study (Table 1). There were significant positive linear trends in proportions of 381- to 456-mm and 457- to 532-mm fish from 1985 through 1992. From 1985 through 1988, the percentage of fish ≥381 mm ranged from 10% to 31%; from 1989 through 1992, it ranged from 41% to 63%. There was a significant negative linear trend in the proportion of fish ≤304 mm during the study. We could not detect a significant trend for proportions of fish ≥533 mm.

Changes in the Fish Population

Abundance.—Spring electrofishing CPUE of largemouth bass ≥203 mm ranged from 46.4 to 164.8 fish/hour during the study, while fall CPUE ranged from 33.3 to 79.8 fish/hour (Fig. 1). Spring and fall estimates of CPUE were significantly correlated (r = 0.729). For both spring and fall surveys, mean CPUE of fish during 1990–1993 surveys (spring = 138.8; fall = 151.2) was significantly higher than in 1986–1989 (spring = 57.5; fall = 57.8). Spring CPUE of fish 381–532 mm ranged from 7.2 to 36.1 fish/hour. No associations were found between CPUE estimates determined by electrofishing and angling (catch-and-release) for ≤304-, 305–380-, 381–456-, 457–532-, and ≥533-mm size groups.

Stock Structure.—Size structures determined from electrofishing surveys changed during the study (Table 2). There were significant positive linear trends in both spring and fall estimates of $RSD_{381-456}$ and $RSD_{457-532}$, and significant negative linear trends in $RSD_{203-304}$. Length distributions from fall electrofishing surveys did not differ from angler catch-and-release distributions, with the exception of 1989. Spring electrofishing distributions usually contained significantly higher proportions of larger fish than did angler catch-and-release distributions. Fall electrofishing surveys documented annual recruitment of young-of-year (Fig. 1).

Growth and Mortality.—Length-at-capture of age-1 fish decreased during the study (Fig. 2); mean lengths for 1990–1992 were significantly lower than those for 1985–1988. The decline did not appear to correspond with reduced food availability as indicated by Wr values. Fish generally reached 300 mm by age 1, and were approaching 400 mm by age 2. Growth for all ages exceeded statewide averages reported by Prentice (1987). The majority of fish ≥533 mm at capture were ages 5 or 6; 1 fish was age 4. Few fish ≥age 4 were collected; only 20% of 278 aged fish were ≥age 4, and 10% ≥age 5. The total annual mortality rate for fish ≥age 2 was estimated as 57%, and was consistent among all ages. The asymptomatic length for the population, suing ages 1 through 5, was estimated as 501 mm.

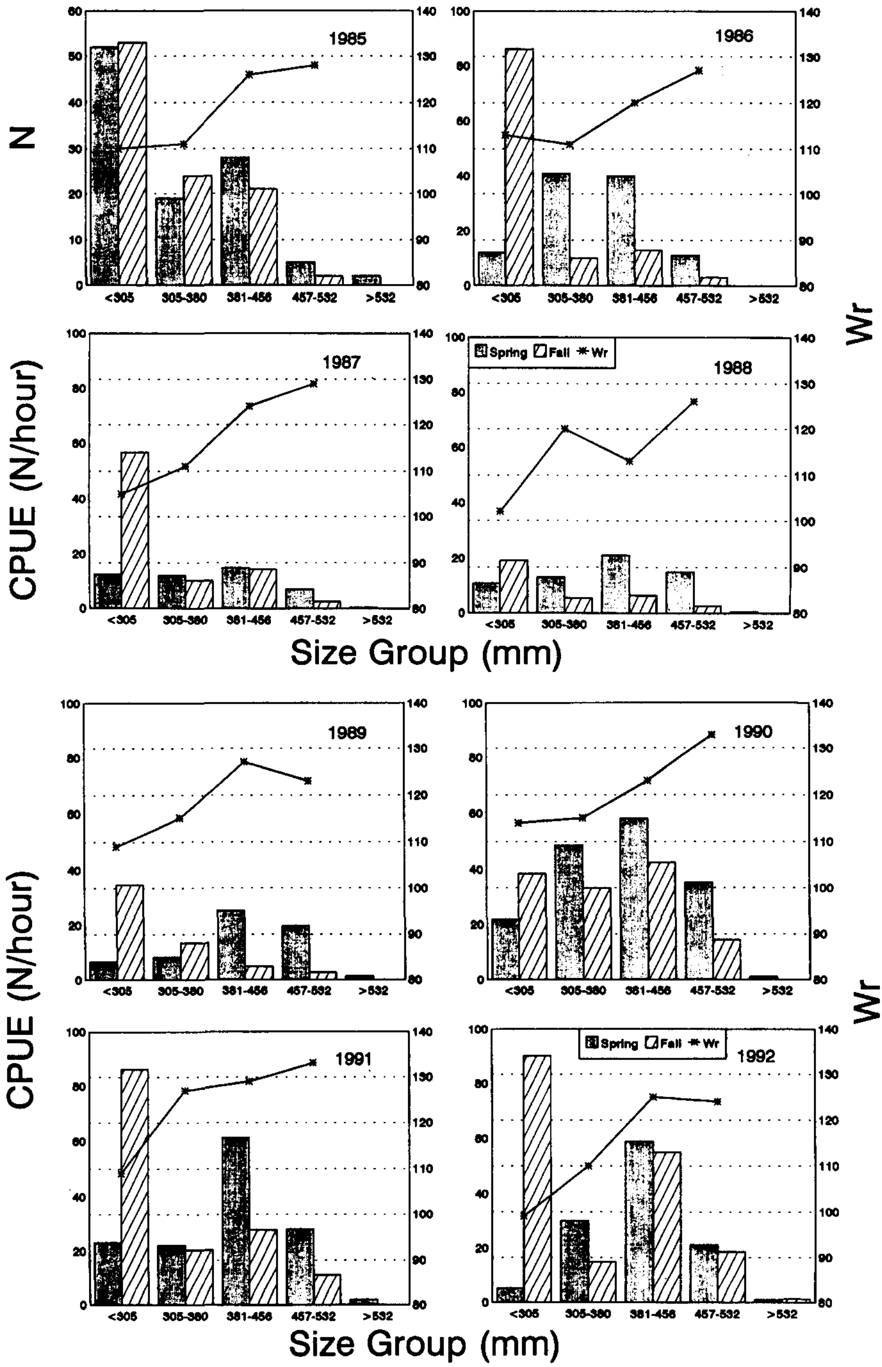

Figure 1. Size distributions and mean relative weight (Wr) values for largemouth bass collected in spring (March) and fall (October) electrofishing surveys, 1985–1992, Victor Braunig Reservoir, Texas. Relative weights determined from fall surveys. Effort not recorded for 1985 and 1986.

Table 2. Incremental relative stock density (RSD) estimates (Gabelhouse 1984) for largemouth bass collected during spring (March) and fall (October) electrofishing surveys, Victor Braunig Reservoir, Texas.

Year	$RSD_{203-304}$	$RSD_{305-380}$	$RSD_{381-456}$	$RSD_{457-532}$	RSD_{533}
Spring					
1985	49.0	17.9	26.4	4.7	1.9
1986	11.5	39.4	38.5	10.6	0.0
1987	26.7	25.9	31.9	14.7	0.9
1988	16.2	19.6	40.2	23.1	0.8
1989	10.8	13.7	41.2	32.3	2.0
1990	13.3	29.5	35.3	21.4	0.6
1991	16.9	16.2	45.1	20.4	1.4
1992	4.2	25.8	50.8	18.3	0.8
Fall					
1985	53.0	24.0	21.0	2.0	0.0
1986	76.8	8.9	11.6	2.7	0.0
1987	68.0	12.0	17.0	3.0	0.0
1988	57.4	15.8	18.8	7.9	0.0
1989	62.1	24.3	8.7	4.8	0.0
1990	29.9	25.8	33.0	11.3	0.0
1991	59.4	14.0	18.9	7.7	0.0
1992	50.0	8.3	30.6	10.4	0.7

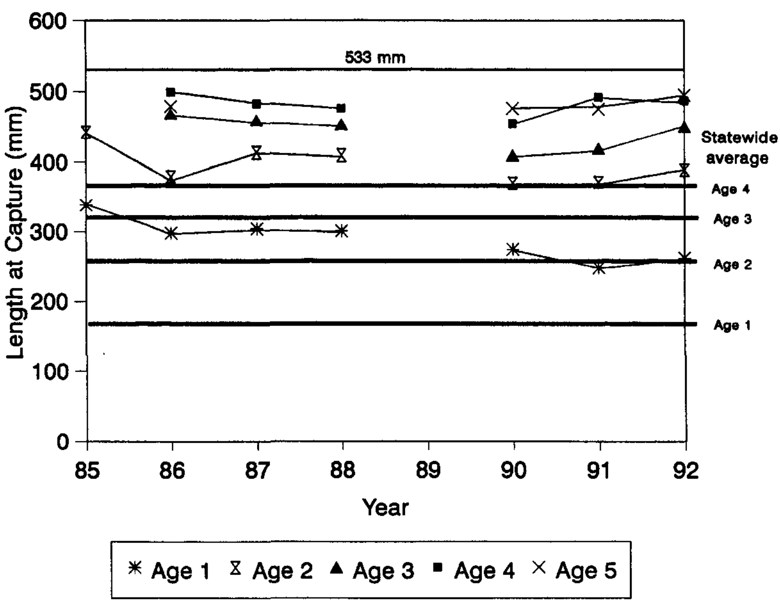

Figure 2. Mean length at capture for largemouth bass in March electrofishing surveys, 1985–1992, Victor Braunig Reservoir, Texas. Statewide average lengths-at-age from Prentice (1987).

Discussion

Although there were little pre-1985 data by which to judge the effects of the more restrictive limits, several qualitative inferences can be made. Changes in the VBR largemouth bass population were consistent with findings from other studies evaluating the effects of minimum length limits on largemouth bass populations in southern reservoirs (Ager 1989, Mitchell and Sellers 1989, Terre and Zerr 1992), where size distributions shifted upwards in the protected range, with accompanying increases in RSD values.

Harvest rates from 1985 through 1992 were poor (range 0.001–0.004 fish/angler-hour). However, the magnitude of this rate was not easy to assess; no comparable data on harvest rates of fish ≥533 mm were found in the literature. Simple expansion of the mean harvest rate by mean directed effort suggested approximately 48 largemouth bass ≥3.2 kg were harvested annually; this might have reflected the carrying capacity of the reservoir for trophy fish. Catch rates of fish ≥533 in our study (0.004 fish/angler-hour) implied it took 250 angler-hours to catch a legal-size fish following the regulation change. The fact that no parties reported harvesting more than 1 fish after 1984 clearly shows the 2 fish bag limit had no impact on harvest.

An anticipated benefit of a minimum length limit is increased catch rates, especially of sub-legal length fish (Novinger 1984). Catch rates for VBR largemouth bass were moderate and similar to other Texas reservoirs under less restrictive minimum length limits (TPWD, unpubl. data). It is interesting to note our results were similar to those of Storey and Ott (1992), who reported catch rates of 0.31–0.55 fish/angler-hour on a reservoir under a total catch-and-release regulation for largemouth bass. If the assumption is made that few VBR anglers released fish prior to 1985, and the mean harvest rate for 1979–1984 (0.101 fish/angler-hour) approximated total catch rates, then catch appears to have increased as a result of the more-restrictive length limit.

Although this study did not include any procedures to determine bias in angler-reported catch-and-release data, such bias would not be expected to change over time. Therefore, any trends in that data are likely real.

Although angler catch rates were not exceptional under the more restrictive regulations, the quality of the fishery was unique relative to other Texas reservoirs. A large part of the catch was 381- to 456-mm fish, and to a lesser extent, 457- to 532-mm fish. Considering the allometric length-weight relationship of VBR largemouth bass, compared to fish of similar lengths from other Texas reservoirs (Fig. 3), VBR provided above-average catch in terms of weight caught per angler-hour. As Anderson (1975) suggested, an index of fishing quality based on weight caught per hour might be more useful than one based on number caught per hour.

Electrofishing and creel surveys indicated adequate numbers of fish were growing to 457 mm, but few reached 533 mm. Lengths-at-age for age-4 and age-5 fish were similar, suggesting fish reached maximum-asymptotic lengths near 500 mm and/or size-selective mortality acted on fish ≥age 5, i.e., faster-growing

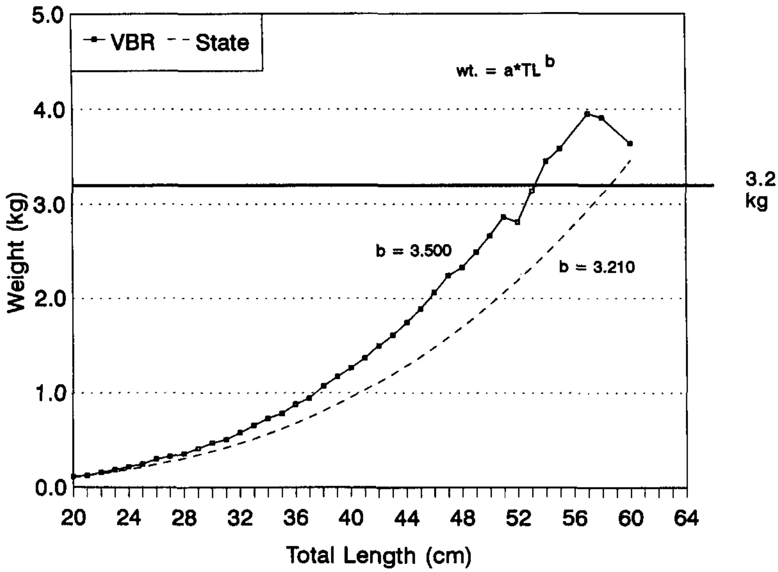

Figure 3. Observed weights-at-lengths for largemouth bass collected in March and October electrofishing surveys, 1985–1992, Victor Braunig Reservoir, Texas. Statewide average weight-at-length from Prentice (1987).

fish experienced higher mortality and were not sampled. The Walford plot provided evidence 500 mm was the ultimate length the majority of VBR largemouth bass could attain. Examination of back-calculated lengths at earlier ages for fish ≥age 4 did not disclose evidence of Lee's phenomenon (Ricker 1975). However, small sample sizes of older fish hampered interpretations. Growth potential did not appear to limit the ability of fish to reach 457 mm. Fish continued to exhibit extremely fast growth rates following the regulation change.

Low growth potential for older fish, coupled with high total annual mortality (57%), were likely the major reasons for the paucity of fish recruiting to legal lengths. Unfortunately, major contributing factors to total mortality could not be conclusively identified. Of the 2 components of total annual mortality, angling mortality and natural mortality, the former seems unlikely. Numerous studies have shown hooking mortality of caught-and-released largemouth bass is generally low (e.g., Pelzman 1978, Burkett et al. 1981, Green et al. 1989). Directed effort for largemouth bass at VBR was moderate, but presumably not high enough to amplify effects of hooking mortality. Excessive illegal harvest was also improbable. During the 8-year study, the reservoir was routinely patrolled by TPWD Game Wardens and only 29 citations were issued for noncompliance with largemouth bass regulations (D. J. Caudle, TPWD Law Enforcement Div., pers. commun.). If the total annual mortality was comprised chiefly of natural mortality, 57% would be considered excessive (Carlander 1977). Exceptionally high Wr values, especially for fish ≥381 mm (Fig. 1), may have been indicative of unhealthy fish. Although no data were collected to address fish health in this study, we noted considerable fat deposits and abnormal livers in many fish ≥381 mm. Problems associated with fat deposition and assimilation as they relate to liver function, commonly found in humans (Wilson et al. 1991), might have contributed to excessive mortality. Other clinical symptoms associated with principal fish diseases were not exhibited by largemouth bass during any survey.

The experimental regulations appeared promising from 1985 to 1987, as catch rates increased and stock structures improved. However, anticipated recruitment of fish ≥533 mm never materialized. Overall, the VBR largemouth bass fishery from 1985 through 1992 was characterized by: 1) average catch rates in terms of *N*/hour, with a considerable part of the catch comprised of fish ≥381 mm, and 2) above-average catch rates in terms of wt./hour. In essence, the 533-mm minimum length limit restricted the fishery to catch-and-release because few fish recruited to legal lengths. As a result of this evaluation, a recommendation was made to lower the largemouth bass minimum length limit at VBR from 533 mm to 457 mm. Hopefully this change will result in maintenance of the high-quality bass fishery while significantly increasing harvest of fish ≥457 mm.

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