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Effects of a 356-mm Minimum Length Limit on the Population Characteristics and Sport Fishery of Smallmouth Bass in the Shoals Reach of the Tennessee River, Alabama

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Abstract.—The Shoals Reach, a 20-km section of the Tennessee River below Wilson Dam, Alabama, has a national reputation as an excellent fishery for smallmouth bass *Micropterus dolomieu.* To protect and enhance this smallmouth bass fishery, a 356-mm minimum total length (TL) limit was established in this region in 1991. We sampled smallmouth bass in the fall of 1995 and spring of 1996 to determine if the regulation had any effects on the population characteristics of this fishery. A creel survey was conducted during 1996 to estimate angler effort, catch, and harvest of smallmouth bass, and to evaluate angler values, opinions, and practices. Electrofishing catch rates for juvenile (<280-mm TL) and adult (≥280-mm TL) smallmouth bass significantly ($P < 0.05$) increased compared with preregulation data (1988). Growth rates in 1995–1996 were higher for fish younger than age 3 than in 1988; however, otoliths were used to age fish in 1995–1996, whereas scales were used in 1988. Length indices showed a high proportion of preferred-length (≥350-mm) fish in the population, and relative weights were similar before and after the length limit. The annual mortality rate was also similar before and after the regulation. Year-class abundance fluctuated greatly and was negatively related to discharge through Wilson Dam from April–July, which corresponds to the spawning and postspawn periods. The angler catch rate for smallmouth bass nearly doubled compared with preregulation data, whereas the harvest rate decreased by nearly an order of magnitude. Smallmouth bass anglers released 98% of their catch, the same percentage of smallmouth bass anglers who reported practicing catch and release. The 356-mm minimum length limit appeared to improve the quality of this fishery. However, the catch-and-release philosophy practiced by most smallmouth bass anglers in the Shoals Reach cannot be overlooked as an important factor that has had, and will continue to have, positive influences on this fishery.

Smallmouth bass *Micropterus dolomieu* provide numerous angling opportunities throughout North America, and extensive research has been conducted on the biology and management of this species (see Clepper 1975; Edwards et al. 1983; Jackson 1991). The Shoals Reach, a 20-km section of the Tennessee River below Wilson Dam in northwest Alabama is nationally recognized for providing superior quality smallmouth bass angling. This fishery, described as famous for record-class smallmouth bass, has been featured in numerous outdoor-related magazines, and fish weighing 3.6–4.1 kg are frequently caught by anglers (Reed et al. 1991; Weathers and Bain 1992).

Since the mid-1970s, several studies have been conducted on the smallmouth bass fishery in the Shoals Reach. Telemetry studies indicated that smallmouth bass remained in the Shoals Reach throughout the year and inhabited areas that were adjacent to cover near deep water (Hubert and Lackey 1980; Hubert 1981). Creel surveys conducted during the late 1980s indicated that the catch rate of smallmouth bass was high (0.51 fish/h) and exceeded that of most other smallmouth bass fisheries in the United States (Reed et al. 1991). However, a majority (68%) of the smallmouth bass caught by anglers in the Shoals Reach were released.

Previous studies showed that growth of smallmouth bass in the Shoals Reach was average for fish less than age 3 but that after age 3, growth exceeded that of other U.S. populations (Hubert 1976; Weathers and Bain 1992). These earlier findings suggested that a minimum length limit might maintain or enhance this smallmouth bass fishery. Other studies have shown that minimum length limits fail to improve smallmouth bass populations that have slow growth and high natural mortality

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(Fox 1975; Kauffman 1985; Austen and Orth 1988). However, because of the fast growth and moderate mortality of the smallmouth bass population in the Shoals Reach, a minimum length limit appeared to be a viable management strategy.

Hubert (1976) and Weathers and Bain (1992) found that the smallmouth bass population in the Shoals Reach was stable during the 1970s and 1980s. However, recent publicity for this fishery may have led to increased fishing effort and harvest of smallmouth bass (Reed et al. 1991). To protect the smallmouth bass fishery and improve angler satisfaction, the Alabama Department of Conservation and Natural Resources imposed a 356-mm minimum total length (TL) limit on smallmouth bass in the Shoals Reach in 1991. No minimum length limit on smallmouth bass existed before this regulation. The daily creel limit remained unchanged at 10 fish/d.

The objective of this study was to document the effects of a 356-mm minimum length limit on the population characteristics of smallmouth bass and the associated angling fishery in the Shoals Reach of the Tennessee River. Specifically, we estimated the abundance, size structure, growth, condition, and mortality of smallmouth bass, along with angler effort, catch, and harvest of smallmouth bass in the Shoals Reach. We compared these data with data obtained from a similar study conducted in 1988, before the imposition of the length limit (Weathers and Bain 1992). We also evaluated the importance of reservoir discharge on smallmouth bass year-class strength in the Shoals Reach.

Study Area

Wilson Dam is located 417 km from the mouth of the Tennessee River and has a mean annual discharge of 1,454 m^3/s (Rollins et al. 1989). The study area was limited to the 20-km reach of riverine habitat from Wilson Dam to the downstream end of Seven Mile Island, which is known as the Shoals Reach. This section historically accounted for 96% of the fishing effort estimated for upper Pickwick Reservoir and the Tennessee River downstream from Wilson Dam (Sample and Hubert 1978). The study area covered 2,080 ha and contained five general habitat types (turbulent shallows, rock bluffs, rip-rap, shallow clay shores, and partially submerged barge canal). The area is typified by turbulent water flow in many areas due to exposed bedrock and boulders and high discharge rates.

Methods

Population characteristics.—Smallmouth bass were collected in October and November 1995 and April and May 1996 at night with a boom-mounted DC electrofishing boat equipped with a Smith-Root, Inc., type VI-A variable-voltage pulsator powered by a 5,000-W generator. Sampling was allocated among each of the five habitat types, and at least three transects were run at fixed stations within each habitat on each date. We used the same fixed sampling stations as those developed and used by Bain et al. (1989) in order to maintain consistency between studies and facilitate between-year comparisons of data. Electrofishing runs lasted about 15 min each, and catch was recorded after each transect was fished. Fish were measured for TL (mm) and weight (g). Otoliths were removed from a subsample of 25 fish in each 25-mm length-group, read in whole view, and independently aged by two readers. When discrepancies between readers occurred, the otolith was cracked transversely through the nucleus, polished, and independently aged by both readers, using a low-power dissecting microscope and a fiber optic light (Heidinger and Clodfelter 1987). This technique resulted in 100% agreement between the two readers.

Smallmouth bass were categorized as either juveniles ($<$280 mm TL) or adults ($\geq$280 mm TL) and catch per effort (CPE; number/h) was computed to index the relative abundance of each group. Mean electrofishing catch rates for juvenile and adult smallmouth bass from this study were compared with data collected from the same seasonal time periods in 1988 by means of *t*-tests (Bain et al. 1989).

Smallmouth bass population size structure was quantified with proportional stock density (PSD) and relative stock density (RSD) indices (Gabelhouse 1984). Proportional stock density is the percentage of quality-sized fish in a sample of stock-sized fish; relative stock density is the percentage of fish of any specified size and larger within a sample of stock-sized fish. Condition of smallmouth bass within each length category was estimated with the relative weight (W_r) index (Wege and Anderson 1978), the weight of an individual expressed as a percentage of the standard weight for fish of that length. Standard weight values from Kolander et al. (1993) were used. Mean length at age was calculated and compared with estimates from Hubert (1976) and Weathers and Bain (1992). Growth was modeled with von Bertalanffy growth curves (von Bertalanffy 1938), with data from Hubert (1976), Weathers and Bain (1992), and this study. The time (in years) for smallmouth bass to reach 356 mm and 508 mm was derived from these growth curves for each of the data sets.

Instantaneous total mortality (Z) was calculated by regressing the natural logarithm of the number of fish collected at each age against age (Ricker 1975). Weathers and Bain (1992) found that young fish were underrepresented in their samples. Therefore, they calculated mortality for only those fish that were age 4 and older. We used fish that were from the 1992 year-class and older (i.e., age 3 and older for fall collections and age 4 and older for spring collections) to calculate total mortality because these fish were fully recruited to the fishery. Residuals associated with the catch-curve regression were used as indices of strong and weak year-classes (see Maceina 1997). We then used correlation and regression analyses to examine the relationship between year-class abundance and discharge through Wilson Dam during the smallmouth bass spawning period and the early life stages of their progeny. Discharge data were obtained from the Tennessee Valley Authority.

Creel survey.—A stratified, two-stage, nonuniform probability, access-point creel survey was used to collect data on angler effort, catch, harvest, and opinions (protocol of Malvestuto et al. 1978). For purposes of comparison, our design was similar to that of Weathers and Bain (1992). Sampling days, the primary sampling units, were stratified as either weekend days or weekdays. Sampling units within each day were 3-h periods (0600–0900, 0900–1200, 1200–1500, and 1500–1800 hours). The fishing season was classified into four periods that differed slightly from Weathers and Bain (1992): (1) daytime: 1 March–31 May; (2) daytime: 1 June–31 August; (3) daytime: 1 October–15 December; and (4) nighttime: 1 June–31 August. Nighttime sampling units were also 3-h periods (1800–2100, 2100–2400, 2400–0300, and 0300–0600 hours). Four popular boat ramps within the study area were used as secondary sampling units. Probabilities for fishing season, boat landing, day of week, and time of day were obtained from Bain et al. (1989). However, the renovation and temporary closure of one of the most popular boat landings after the beginning of our creel survey required a slight modification of the probabilities.

In all, 72 d were sampled twice each day (N = 144). Sample days were chosen randomly within each season, and two randomly selected time periods were sampled each day at randomly selected boat landings. Equal numbers of weekend days and weekdays were sampled each season.

Anglers, interviewed at the conclusion of their fishing trip, were questioned about their catch, both released and retained. All harvested smallmouth bass were measured for TL and weight (g). Anglers were also asked about trip details, including length of trip, species sought, and residence. Anglers residing in the three counties adjacent to the study area were considered ‘‘local.’’ Anglers were also questioned regarding their perceptions and practices, including their opinion of the 356-mm minimum length limit on smallmouth bass and whether they practiced catch and release for smallmouth bass.

Seasonal and annual estimates of effort, catch, catch per effort, harvest per effort (HPE), and harvest weight per effort were calculated with procedures and formulae of Malvestuto et al. (1978) and Jones et al. (1995). Data pertaining to angler satisfaction, perceptions, and practices were calculated by percent of responses.

Results

Population Characteristics

In all, 806 smallmouth bass were collected in 16.6 h of electrofishing in the Shoals Reach of the Tennessee River below Wilson Dam. The mean CPE of smallmouth bass in fall 1995 (45.1 fish/h) was not significantly different ($t = -1.45$; df = 49; $P = 0.15$) than in spring 1996 (69.5 fish/h). For both seasons combined, the mean CPE was significantly higher in 1995–1996 for both juvenile fish (36.5 fish/h) and adult fish (21.0 fish/h) than in 1988, before implementation of the minimum total length limit (juvenile CPE = 7.6 fish/h, adult CPE = 4.9 fish/h; Bain et al. 1989; $t \geq 4.68$; df ≥ 64; $P < 0.001$).

The smallmouth bass population in the Shoals Reach ranged in length from 100 to 539 mm TL, but the length-frequency distribution in 1995–1996 differed significantly from that in 1988 (Kolmogorov–Smirnov; $P < 0.001$; Figure 1). The smallmouth bass population in 1988 had a higher PSD, RSD-preferred, and RSD-memorable before implementation of the minimum length limit than in 1995–1996 (chi-square; $P < 0.01$).

Smallmouth bass in the Shoals Reach continued to exhibit fast growth after the implementation of the 356-mm minimum length limit (Table 1). Length-at-age estimates for smallmouth bass be-

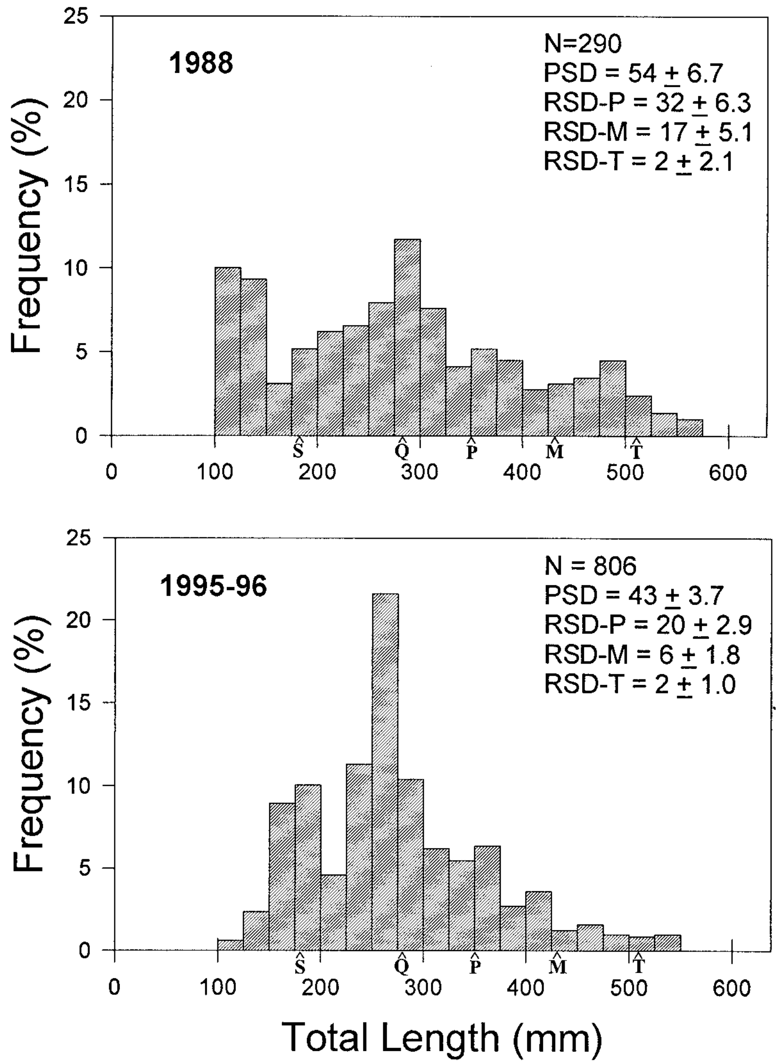

FIGURE 1.—Length–frequency distributions and stock density indices (±95% confidence intervals) of smallmouth bass collected from the Shoals Reach of the Tennessee River, Alabama, during spring and fall 1988 (Bain et al. 1989) and fall 1995 and spring 1996 (this study). Letters on the *x*-axis indicate the minimum lengths for stock (S), quality (Q), preferred (P), memorable (M), and trophy (T) fish.

TABLE 1.—Mean total lengths at age for smallmouth bass collected in the Shoals Reach of the Tennessee River below Wilson Dam, Alabama, and for fast-growing smallmouth bass populations in the United States.

	Length at age (mm)								
Population	1	2	3	4	5	6	7	8	Reference
Shoals Reach	179	261	337	414	454	511			This study
	112	216	302	380	448	493	524	537	Hubert (1976)
	98	179	273	367	437	489	533		Weathers and Bain (1992)
United States	118	258	358	411	445	457	473		Anderson and Weithman (1978)

TABLE 2.—Mean relative weights (W_r) of smallmouth bass collected in the Shoals Reach of the Tennessee River below Wilson Dam, Alabama, during fall 1995 and spring 1996 (this study) and during spring and fall 1988 before the imposition of a 356-mm minimum length limit (Bain et al. 1989). Mean relative weights were not significantly different between studies within length-groups ($t \leq 1.62$; df ≥ 16; $P > 0.11$).

Size category[a]	Total length (mm)	W_r for 1988	W_r for 1995–1996
Stock–quality	180–279	100	95
Quality–preferred	280–349	97	94
Preferred–memorable	350–429	100	102
Memorable–trophy	430–509	106	104
Trophy	≥510	111	103

[a] Proposed by Gabelhouse (1984).

tween the two seasons were similar and were therefore combined for comparison with previous studies. Growth rates in 1995–1996 were higher than in previous studies (Hubert 1976; Weathers and Bain 1992) but were similar to those reported for fast-growing populations across the USA (Anderson and Weithman 1978). Lengths predicted from von Bertalanffy growth equations suggested that smallmouth bass in the Shoals Reach took 3.24 years to reach 356 mm TL and 5.96 years to reach 510 mm TL in 1995–1996, which was faster than predicted from data of Hubert (1976) and Weathers and Bain (1992), in which it took 3.60–3.95 and 6.37–6.64 years to reach 356 and 510 mm TL, respectively.

The condition of smallmouth bass collected in this study was good (Table 2). We observed higher mean relative weights as fish length increased during both seasons. When fish from this study were compared with a sample of fish taken before the minimum length limit was imposed (data from Bain et al. 1989), no differences between W_r-values within length-groups were observed ($t \leq 1.62$; df ≥ 16; $P > 0.11$).

The population age structure was similar in fall 1995 and spring 1996, so data were pooled before estimating the instantaneous total mortality ($Z = -0.669$) and corresponding annual survival ($S = e^{-z} = 51\%$; Figure 2). Relatively strong year-classes were produced in 1988, 1990, and 1992, and weak year-classes were produced in 1989 and 1991. The mean daily discharge (hectare-meters) from April to July best correlated ($r = -0.96$, $P < 0.01$, $N = 5$) with the residuals associated with the catch curve of the 1988–1992 year-classes (Figure 3). April–July discharge (DIS), when added to the catch-curve regression explained 98%

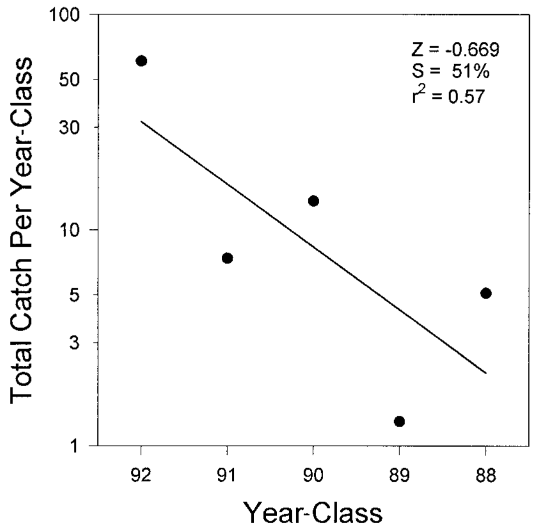

FIGURE 2.—Catch curve for smallmouth bass collected from the Shoals Reach of the Tennessee River, Alabama, during fall 1995 and spring 1996.

($R^2 = 0.98$; $P < 0.05$) of the variation in catch at age (CATCH), with 41% ($P < 0.05$) due to DIS and 57% ($P < 0.05$) due to age:

$$\log_e(\text{CATCH}) = 8.19 - 0.74(\text{AGE}) - 0.00016(\text{DIS}).$$

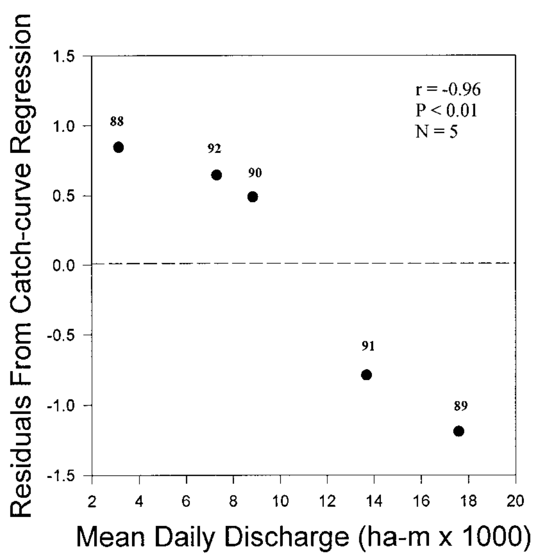

FIGURE 3.—Residuals from a catch curve of smallmouth bass caught in the Shoals Reach of the Tennessee River versus mean daily discharge (hectare-meters) through Wilson Dam. Data points are identified by corresponding smallmouth bass year-classes (88 = 1988, etc.). Data points above the zero reference line indicate relatively strong year-classes, and those below the reference line represent relatively weak year-classes.

TABLE 3.—Fishery statistics for anglers targeting smallmouth bass (SMB) in the Shoals Reach of the Tennessee River in 1988 (Bain et al. 1989) and 1996 (this study). Estimates are for a 1-year period, excluding the months of January, February, and September.

Fishery statistic	1988	1996
Fishing effort (h)	93,089	117,924
Fishing pressure (h/ha)	44.75	56.69
SMB catch	49,156	120,509
Catch per area (SMB/ha)	23.63	57.94
Catch rate (SMB/h)	0.53	1.02
Total SMB harvest	13,885	2,430
Weight of SMB harvested (kg)	9,366	2,594
Harvest per area (SMB/ha)	6.68	1.17
Weight of SMB harvested per area (kg/ha)	4.50	1.25
Harvest rate (SMB/h)	0.15	0.02
Mean total length of harvested SMB (mm)	360	420
Release rate of caught SMB (%)	68	98
Anglers practicing catch and release (%)	N/A	98
Anglers satisfied with minimum length limit (%)	N/A	94
Anglers satisfied with fishing (%)	59	96
Annual number of days fished for SMB	23	48
Local anglers (%)	55	48
Alabama anglers (%)	85	76

Creel Survey

We collected information on 1,555 anglers, 42% of whom stated that they were targeting smallmouth bass. Total annual fishing effort (excluding the months of January, February, and September) by all anglers was 294,637 h; 40% was attributable to anglers targeting smallmouth bass. Total annual smallmouth bass catch was 132,642 fish, of which only 2.3% were harvested. Although smallmouth bass anglers expended a minority of the total effort, they accounted for a majority of the smallmouth bass catch (91%) and harvest (80%). Hence, other creel survey results are based on data from anglers targeting this species and are directly comparable to data reported by Bain et al. (1989).

The popularity of this fishery was reflected by high angler satisfaction (Table 3). Most (96%) smallmouth bass anglers were satisfied with fishing in the Shoals Reach, most (94%) were satisfied with the minimum-length-limit regulation, and most (98%) practiced voluntary catch and release. Smallmouth bass anglers each fished an average of 48 d each year, twice the 1988 estimate, and a higher proportion of them came from outside the state of Alabama. Also, half of the smallmouth bass anglers indicated that catching a trophy fish (>510 mm) was the most important component of a smallmouth bass fishing experience, compared with 28% in 1988 (Table 4).

TABLE 4.—Characteristics considered by Shoals Reach smallmouth bass anglers to be the most important component of a smallmouth bass (SMB) fishing experience. Data presented are for the questions asked (and corresponding replies) during creel surveys conducted before (1988; Bain et al. 1989) and after (1996; this study) a 356-mm minimum length limit on smallmouth bass was imposed.

Characteristic	Percent of replies	
	1988	1996
Catching SMB 305–406 mm	33	
Catching a few SMB >305 mm		15
Catching a trophy SMB (>510 mm)	28	50
Catching many SMB of all sizes	20	21
Catching SMB 406–457 mm	19	
Catching a limit of SMB		14

Discussion

The 356-mm minimum length limit imposed in 1991 on the smallmouth bass fishery in the Shoals Reach, in conjunction with an increased angler release rate, appeared to benefit the fishery in this region of the Tennessee River. The combined results were virtually all positive, but a definitive interpretation of the effects of the regulation was confounded by the unforeseen increase in the amount of voluntary catch and release. Accordingly, we were unable to precisely determine which of these factors contributed more to the observed increase in relative abundance and angler catch rates of smallmouth bass.

Adoption of the length limit probably influenced angler behavior by instilling a desire to preserve the unique character of this fishery. Smallmouth bass anglers in the Shoals Reach voluntarily released the vast majority of their catch. This voluntary catch-and-release ethic of smallmouth bass anglers probably influenced, and continues to affect, this quality fishery.

The PSD of the smallmouth bass population decreased slightly between 1988 and 1995–1996, contrary to what might be expected through reduced harvest of quality-length fish. However, recruitment of the relatively abundant 1994 and 1995 year-classes to the stock–quality length-group probably resulted in the lower PSD value observed during this study (Figure 1). The ratio of juvenile to adult fish, 1.74 in 1995–1996 and 1.55 in 1988, illustrated the increased relative abundance of fish in the stock–quality length category. As the abundant 1994 year-class grows into the quality–preferred length-group, we expect the PSD to increase.

Hubert (1976) and Weathers and Bain (1992) found that smallmouth bass had fast, but not exceptional, growth through age 3, but we found that smallmouth bass in the Shoals Reach had exceptional growth at all ages after the minimum length limit was imposed. In fact, growth rates were close to those reported by Anderson and Weithman (1978) for fast-growing populations across the United States. Previous studies that examined smallmouth bass growth after imposition of minimum length limits indicated either a decline (Fagen 1981; Austen and Orth 1988) or no change (Paragamian 1984a; Kauffman 1985) in growth, which was contrary to our results. Although we used otoliths in this study to age fish, whereas scales were used in the two previous studies, differences in growth rates between this study and those from Hubert (1976) and Weathers and Bain (1992) did not appear to be related to different aging techniques. Although aging errors are typically greater for scales than for otoliths (Beamish and McFarlane 1987), scales tend to underestimate the age of older fish (Beamish and McFarlane 1987; Heidinger and Clodfelter 1987). Underestimating age by scales would lead to an overestimation of growth, a phenomenon that was not evident in the growth comparisons we made with the two previous studies.

Before the institution of the minimum length limit, condition of smallmouth bass in the Shoals Reach was considered to be good, and W_r-values for fish over 350 mm TL exceeded 100 (Weathers 1988). The high condition of fish over 350 mm TL suggested that a plentiful prey base was available for these fish and that more fish in excess of 350 mm TL could be supported by this system. Condition of smallmouth bass below Wilson Dam after the minimum length limit was imposed remained high, and no decrease in W_r was evident, even though the relative abundance of quality-length fish increased.

Weathers and Bain (1992) found that total annual mortality of smallmouth bass in the Shoals Reach ranged from 50% to 57% and that annual fishing mortality ranged from 35% to 56%. We estimated total annual mortality to be about 49%, which suggests that the minimum length limit had little or no effect on total annual mortality. However, this may simply be the result of a shift in the relative contribution of the two sources of total annual mortality. The high release rate of smallmouth bass observed during this study probably contributed to a lower annual fishing mortality and a subsequently higher rate of natural mortality.

Regression analyses indicated that smallmouth bass year-class strength in the Shoals Reach was negatively related to the mean daily discharge through Wilson Dam from April through July. This time period coincides with the smallmouth bass spawning period and the early life stages of smallmouth bass fry. The weak year-classes of 1989 and 1991 were associated with mean daily discharges between April and July of 13,700 and 17,600 hectare meters/d, which were greater than the historic mean discharge of 12,500 ha-m/d (1930–present). Smallmouth bass nests may be subject to scouring or displacement under high discharge conditions, while moderate discharges probably provide hydrologic stability. Nest failure and poor year-class production by smallmouth bass has been associated with above average discharge during and after spawning (Mason et al. 1991; Reynolds and O'Bara 1991; Sallee et al. 1991; Lukas and Orth 1995), which was also suggested by our results.

Our data indicated that the observed increase in the relative abundance of smallmouth bass indexed by electrofishing catch rates was consistent with an increase in angler catch rates. Smallmouth bass anglers caught fish at nearly twice the rate they did before establishment of the minimum length limit. However, harvest decreased by more than 80% and the harvest rate decreased by nearly an order of magnitude, as anglers released 98% of the smallmouth bass they caught.

Angler satisfaction with the fishery increased from 59% to 96% after establishment of the minimum length limit, and 94% of smallmouth bass anglers expressed satisfaction with the regulation. The fishery has also become more popular, as indicated by increased effort and a higher proportion of anglers from out of state. A shift in angler attitudes was also evident, and smallmouth bass anglers had become more interested in catching large fish.

Weathers and Bain (1992) suggested that a minimum length limit might enhance the smallmouth bass fishery below Wilson Dam, and our results support their suggestion. Results from other studies of minimum length limits on smallmouth bass populations have been varied. Minimum length limits of 305 mm TL in Missouri and Iowa improved smallmouth bass fisheries (Fagen 1981; Paragamian 1984b). Lyons et al. (1996) found that a 356-mm minimum length limit for smallmouth bass improved population characteristics on five of six Wisconsin streams. However, a 305-mm minimum length limit on smallmouth bass in the Shenandoah River, Virginia (Kauffman 1985), and New River, Virginia (Austen and Orth 1988), failed to improve catch rates or population characteristics. Weathers and Bain (1992) suggested that minimum length limits for smallmouth bass failed in other regions because of slow growth and high natural mortality. Our data further support this hypothesis. The smallmouth bass population in the Shoals Reach had fast growth and moderate natural mortality before minimum length limits, and this probably influenced population characteristics after implementation of the minimum length limit.

Finally, although we would like to claim that the improvements in the smallmouth bass population characteristics and sport fishery in the Shoals Reach were solely the result of the minimum length limit, we unfortunately cannot. We were unable to separate regulatory effects from natural effects or shifts in angler practices. This study would have benefitted from the use of suitable reference sites from which to make comparisons. Such sites should be local, well matched, and not managed under the regulation being evaluated (Lyons et al. 1996). We should, however, be able to claim that the observed improvements were the result of successful fisheries management. Recent management efforts have strived to communicate fishery science to the angling public and, as a result, have instilled a greater appreciation of fisheries resources and a surge in the practice of voluntary catch and release (Quinn 1996). The high level of satisfaction expressed by anglers in the Shoals Reach regarding the fishery as a whole, and the minimum-length-limit regulation in particular, should be encouraging to fisheries managers nationwide.

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