Angler Catches from New River, Virginia and West Virginia, in Relation to Minimum Length Limit Regulations

Douglas J. Austen,[1] *Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University Blacksburg VA 24061*

Donald J. Orth, *Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University Blacksburg VA 24061*

Abstract: A 1-year creel survey of New River, Virginia and West Virginia, was conducted to assess the effects of a 305-mm minimum length limit on the angler harvest of smallmouth bass (*Micropterus dolomieui*) and associated fishes from the Virginia portion of the New River. Anglers in Virginia harvested 0.06 smallmouth bass per hour averaging 322 mm total length (TL) and released 1.27 smallmouth bass per hour. West Virginia anglers harvested 0.40 smallmouth bass per hour averaging 242 mm TL and released 0.65 smallmouth bass per hour. Total catches per hour (1.33 in Virginia and 1.05 in West Virginia) were not significantly different. Anglers in Virginia fished significantly longer and released significantly more fish other than smallmouth bass than did anglers in West Virginia. The minimum length limit regulation has shifted size at harvest and the rates of harvest and release of smallmouth bass. Other game species were also released in greater numbers in the regulated section indicating that the attitude of releasing sublegal smallmouth bass carried over to other species.

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The use of minimum length limit regulations in managing lotic populations of smallmouth bass is a common practice in many areas (Iowa, Paragamian 1983; Missouri, Fajen 1981; Virginia, Kauffman 1983). Implementation of minimum length limit regulations on largemouth bass (*M. salmoides*) in reservoirs often results in increased stock densities, decreased harvests with

[1] Present address: Illinois State Natural History Survey, Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.

relatively few fish attaining legal length, slowed growth, and high natural mortality (Anderson 1980). These are usually realized by anglers in the form of high catch rates of sublegal fish and low harvest of legal-sized fish. Similar results have been found in northern pike (*Esox lucius*) and walleye (*Stizostedion vitreum*) fisheries (Snow and Beard 1972, Kempinger and Carline 1978, Serns 1978, Davies et al. 1979).

When length limits have been applied to lotic smallmouth bass populations, however, results have been inconsistent. Fleener (1974) and Paragamian (1983) reported increased size at harvest and abundance estimates, but decreased harvest (pounds/acre) after implementation of 300-mm and 305-mm minimum length limits, respectively. Kauffman (1983) found unchanged growth, increased mortality, and decreased size at harvest for smallmouth bass in the Shenandoah River, Virginia, following regulation implementation. Both Kauffman (1983) and Fleener (1974) reported that panfish harvest increased substantially after implementation of the regulation. On Huzzah and Curtois creeks, Missouri, decreased growth and condition were offset by greater population abundances and the increased harvest and release rates of smallmouth bass after implementation of a minimum length limit regulation (Fajen 1981).

Anglers on the New River, from Claytor Lake Dam, Virginia, to the Virginia-West Virginia border, are restricted by a 305-mm minimum length limit on the harvest of smallmouth bass enacted in the late 1960s. West Virginia anglers, however, are not restricted by any length limit. Both states maintain an 8 smallmouth bass per day creel limit. A creel survey was initiated in June 1982 to assess the impacts of the minimum length limit regulation on the sport fishery in the New River. Two objectives were addressed: 1) to compare catch per hour of smallmouth bass and other game fishes between the sections of the New River, and 2) to assess length-frequency distributions of angler harvested smallmouth bass in the 2 sections. In addition, fishing pressure between the 2 sections was compared in order to judge whether this was a significant factor affecting the 2 fisheries.

Study Area

The New River originates in Watauga County, North Carolina, and flows northeast into Virginia. The first of 2 major dams on the New River is Claytor Lake Dam, a hydroelectric facility operated by the Appalachian Power Company for peak power production. Below Claytor Lake Dam, the New River flows north unimpeded until just past the Virginia-West Virginia border where it is impounded by Bluestone Dam, a U.S. Army Corps of Engineers flood control facility, forming Bluestone Lake.

Two study sections were selected, 1 in the length limit regulated section (Virginia), the second in the non-length limit regulated section (West Virginia). The Virginia section is 22.2 km in length, begins 18.8 km below Claytor

Dam, has an average gradient of 0.7 m/km, and is characterized by several long runs and riffles with substrate of bedrock, large boulders, and cobble. Two large pools are located in this section. Average flow is 106 m^3/sec. The West Virginia section begins immediately below Bluestone Dam and extends 17.3 km downstream to Sandstone Falls. This section has an average gradient of 1.8 m/km, an average flow of 158 m^3/sec, is characterized by substrate of large cobble and bedrock, and includes generally longer riffles than does the Virginia section. It also encompasses several large pools.

Methods

Anglers were contacted by investigators floating each section downstream in a canoe. For each section, 2 weekend days and 1 week day per month were randomly selected to be surveyed with surveys being conducted from July through October 1982 and May and June 1983. Surveys were started at 1000 hours at the upstream end of the section and were continued downstream to the lower end, usually being completed by 1900 hours. All anglers encountered were interviewed, and information on hours fished, party size, mode of fishing (boat, shore, wading), and type of bait (live, artificial, combination) was collected. Anglers were also asked whether they had completed fishing or not. Total lengths of all smallmouth bass harvested in the Virginia section, and of as many smallmouth bass as possible in the West Virginia section were measured. Total lengths of other species harvested by anglers were also measured. Anglers were asked to estimate numbers of each species released (including numbers of smallmouth bass >305 mm). Catch rates, hours fished, and size at harvest were compared using Wilcoxon rank sum tests. Because no statistical comparison was intended, data for bait type, party size, and mode of fishing was simply tabulated.

Proportional stock density (PSD) (Anderson 1976) of angler caught smallmouth bass was calculated. Several volunteer anglers using conventional sportfishing equipment and artificial lures recorded total lengths of all smallmouth bass caught. PSD was then calculated using standard stock and quality sizes (180 mm and 280 mm, respectively) for smallmouth bass (Anderson 1980).

Counts of anglers for comparison of relative fishing pressure between sections were scheduled for 2 randomly selected weekend days during the months of the survey. These were accomplished by flying a small, single engine, fixed-wing aircraft over the New River from Claytor Lake Dam, Virginia, to approximately 41 km below Bluestone Dam. Anglers were sighted with the aid of binoculars and grouped as fishing by boat, wading, or from shore. Differences in topography and habits of the anglers between the 2 sections confounded interpretation of results. The West Virginia section was characterized by mountainous terrain and therefore required fly-overs at a minimum of 305 m above ground level. The Virginia section could be safely flown at 152 m.

The higher altitudes of the West Virginia flights, combined with the predominance of shore and wading anglers in that section, caused underestimation of West Virginia anglers. In both sections, limited visibility of shore anglers caused them to be essentially neglected from the aerial counts. Aerial counts were adjusted to give corrected estimates of anglers per kilometer using ratios of boat anglers to shore and wading anglers obtained from the creel surveys. Comparison was made using the non-parametric sign test.

Results

A total of 182 parties consisting of 382 anglers were contacted in the Virginia section and 232 parties with a total of 461 anglers were contacted in the West Virginia section (Table 1). Average party size was 2.1 anglers in Virginia and 2.0 in West Virginia. In both sections, anglers preferred to use live bait. Hours fished at time of interview were similar ($P = 0.0700$); Virginia and West Virginia anglers fished for a mean of 3.5 and 3.1 hours respectively. The percentages of anglers who had completed fishing for the day were 5.6% in West Virginia and 9.9% in Virginia. For these anglers, the average number of hours fished was significantly greater ($P < 0.0228$) in Virginia (5.18) than in West Virginia (3.41).

Mode of fishing also differed between the sections (Table 1); 71% of Virginia anglers fished by boat whereas West Virginia anglers were predominantly shore fishing (44%). Restricted access to the New River within the Radford Army Ammunition Plant, which comprised about 4.5 km of the Virginia section, relegated many anglers in that section to fishing by boat, whereas West Virginia anglers were able to access the river along its entire length.

Table 1. Characteristics of anglers at New River, Virginia and West Virginia, 1982–1983.

	West Virginia	Virginia
Sample size		
Parties contacted	232	182
Anglers interviewed	461	382
Anglers/party	2.0	2.1
Trip status (%)		
Completed	5.6	9.9
Incompleted	94.4	90.1
Hours fished	3.1	3.5
Bait type (%)		
Artificial	18.4	32.7
Live	60.5	43.2
Both	21.0	24.1
Fishing mode (%)		
Boat	23.2	70.9
Shore	43.6	26.2
Wading	33.2	2.9

Table 2. Angler success for smallmouth bass and other sport fishes from New River, Virginia and West Virginia.

Species/class	Rate (per hour)		
	Virginia	West Virginia	$P > Z$[a]
Smallmouth bass			
Harvest	0.06	0.40	0.00
Release	1.27	0.65	0.00
Total	1.35	1.05	0.07
>304 mm	0.04	0.02	0.00
Rock bass			
Harvest	0.15	0.11	0.01
Release	0.83	0.14	0.00
All species combined[b]			
Harvest	0.25	0.79	0.00
Release	2.18	0.84	0.00
Total	2.43	1.63	0.00

[a] Wilcoxon rank-sum test.

[b] Includes: smallmouth bass, rock bass (*Ambloplites rupestris*), bluegill (*Lepomis machrochirus*), redbreast sunfish (*L. auritus*), channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*).

Harvest per hour of smallmouth bass was significantly greater ($P < 0.0001$) in West Virginia (0.40) than in Virginia (0.06) (Table 2). However, numbers of smallmouth bass released per hour was significantly greater ($P < 0.0001$) for Virginia anglers (1.27) than for West Virginia anglers (0.65). Combined harvest per hour and release per hour (equaling total catch per hour) of smallmouth bass were not significantly different ($P = 0.0732$) (Virginia 1.33, West Virginia 1.05).

West Virginia anglers harvested significantly ($P < 0.0001$) smaller smallmouth bass (average 241 mm TL) than did Virginia anglers (average 322 mm TL) (Table 3). Length-frequency distributions of angler-harvested SMB were distinctly different between sections (Fig. 1). West Virginia and Virginia anglers harvested 0.02 and 0.04 smallmouth bass >304 mm TL per hour, respectively. Therefore, illegal harvest of sublegal smallmouth bass in the Virginia section averaged 0.02 per hour. Much of this activity could be attributed to a small number of parties; 1 group possessed 10 sublegal small-

Table 3. Average lengths (mm) of angler harvested fishes from the New River, Virginia and West Virginia (N = sample size, SE = standard error).

Species	Present study						Wollitz (1968)		
	W. Va.			Va.			Va.		
	N	Mean	SE	N	Mean	SE	N	Mean	SE
Smallmouth bass	319	242	1.6	83	322	3.7	680	222	1.6
Rock bass	75	175	2.1	101	194	2.7	446	171	1.5
Bluegill	41	162	1.4	12	192	4.0	135	154	2.0
Redbreast sunfish	21	176	1.2	9	174	1.3	34	164	3.9
Channel catfish	44	367	7.6	5	377	6.7	290	421	5.4

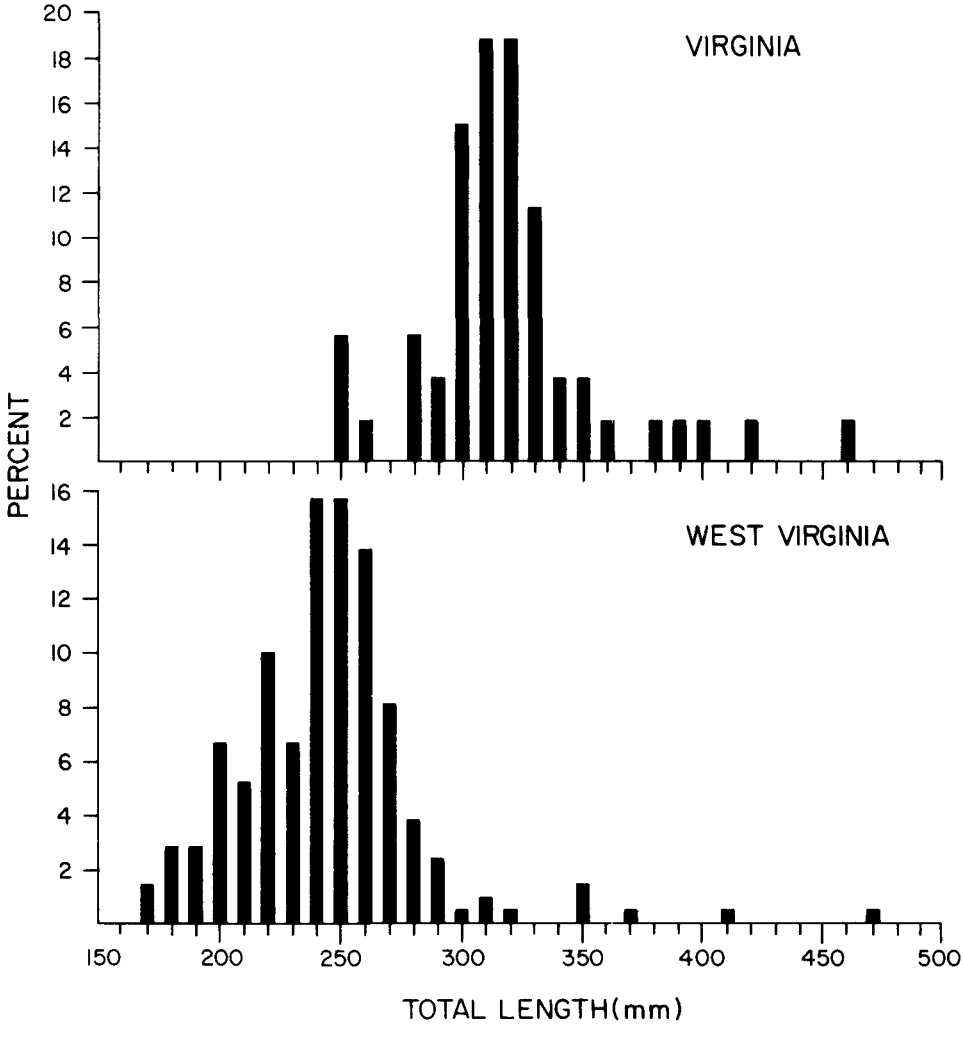

Figure 1. Length-frequency distributions of angler harvested smallmouth bass from length-limit-regulated (Virginia, $N = 83$) and non-length-limit-regulated (West Virginia, $N = 319$) study sections of the New River. Mean total length was 322 and 241 mm for the Virginia and West Virginia sections, respectively.

mouth bass and another had creeled 6. Overall, 4.4% of parties surveyed in Virginia possessed at least 1 sublegal smallmouth bass. Similarly, West Virginia anglers disregarded regulations by exceeding creel limits. Six interviewed parties (2.6% of the total) had creeled more than the legal limit of 8 smallmouth bass per angler; 1 group of 3 anglers had 60 smallmouth bass in their possession when interviewed.

Table 4. Species composition of angler harvest and release from New River, Virginia and West Virginia.

Species	Harvest		Release	
	W. Va.	Va.	W. Va.	Va.
Smallmouth bass	57.9	28.3	74.3	60.3
Rock bass	16.7	49.5	15.6	36.1
Bluegill	6.3	6.4	5.1	1.3
Redbreast sunfish	5.4	12.5	0.0	1.8
Channel catfish	7.4	2.2	2.0	0.0
Other species	6.3	1.0	2.9	0.5

Proportional stock densities of 10% to 12% were calculated from the catches of 3 anglers and 34% from a fourth who kept records (sample size of stock size fish ranged from 26 to 60).

Harvest and release rates of rock bass, the second most frequently caught species, were significantly greater in Virginia than in West Virginia ($P = 0.0125$ and $P < 0.0001$, respectively) (Table 2). Aggregate harvest rate of all species combined, however, was significantly greater ($P < 0.0001$) in West Virginia (0.79 per hour) than in Virginia (0.25 per hour). Aggregate release per hour was greater ($P < 0.0001$) in Virginia (2.18 per hour) than in West Virginia (0.84 per hour). Average lengths of other species harvested were generally similar between the sections (Table 3). The composition of the harvest was different between the sections (Table 4). Smallmouth bass comprised a greater proportion of the creel in West Virginia than in Virginia. Rock bass contributed more to the creel in Virginia than in West Virginia. Species composition of released catch was similar in the 2 sections.

Adjusted angler counts of 2.67 anglers per kilometer in West Virginia and 1.94 anglers per kilometer in Virginia were not significantly different ($P > 0.5$). Difference in fishing pressure, therefore, should not be a factor in interpretation of the results.

Discussion

The differences in catch rates and compositions could possibly be attributed to dissimilarities between the study sections. Slightly different habitat or angler preferences may influence fish populations and fisheries. Historical data, however, support the contention that the minimum length limit regulation has been the cause of change in the Virginia fishery. Prior to implementation of the minimum length limit in Virginia average length of harvested smallmouth bass was 229 mm TL and they were, numerically, the major component of the harvest (Wollitz 1968). It was estimated that the average length of smallmouth bass harvested was 322 mm and that rock bass dominated the harvest in 1982–1983. The regulation apparently has caused a decrease in

harvest of smallmouth bass and an increase in the harvest of a substitute game fish (rock bass).

Average size at harvest in Virginia for several Centrarchids increased after implementation of the regulation (Table 3). Rock bass size increased from 178 to 194 mm TL; bluegill, 152 to 192 mm TL; and redbreast sunfish, 152 to 174 mm TL. Average size of channel catfish harvested, however, decreased from 432 to 377 mm TL (pre-regulation data from Wollitz 1968).

Similar changes, only to a greater extent, have been reported by other authors. The average size of rock bass, green sunfish (*L. cyanellus*), longear sunfish (*L. megalotis*), and bluegills harvested from the Big Piney River, Missouri, increased after implementation of a 300-mm minimum length limit on smallmouth bass (Fleener 1974). At Merle Collins Reservoir, California, bluegill mean weight at harvest increased 53% after implementation of a 305-mm minimum length limit on largemouth bass (Pelzman 1979). Farabee (1974) postulated that increased size of bluegills in Deer Ridge and Wakonda lakes, Missouri, after implementation of a minimum length was due to heavy predation on young bluegills by largemouth bass. Consequently, the reduced bluegill population was thought to have experienced increased growth rates thus leading to greater size at harvest. Austen (1984), however, found few centrarchids in the stomachs of smallmouth bass in the New River; crayfish, insects, and other fish species comprised the majority of the contents examined.

Total catch rates of smallmouth bass in the New River exceeded that of almost all other fisheries (Table 5), indicating a high abundance of catchable-size smallmouth bass. A portion of the difference between catch rate estimates of the present study and that of Pierce et al. (1981) for the same section of the New River can be attributed to dissimilar methodology. In the present study, anglers were contacted by canoe allowing equal access to all anglers. The study of Pierce et al. (1981) reported that angler contacts were made from shore, possibly indicating a bias against boat and wading anglers. Estimated proportions of boat anglers (20%) to shore and wading anglers (80%) by Pierce et al. (1981), however, are similar to those of the present study. Bias in catch rate estimates of the present study may have been caused by sampling during the high catch rate months of summer or by less than adequate sampling under all conditions. Bias between sites in the present study can be assumed to be consistent as methodology and time of year was similar.

Harvest per hour of legal-size smallmouth bass in the Virginia section was similar or lower than many other fisheries. This lack of legal-sized smallmouth bass, concurrent with the exceptional catch rate of sublegal smallmouth bass, indicates that the populations in both sections of the New River are relatively "bottom heavy" with stock sized fish and lacking in numbers of quality-size smallmouth bass, regardless of the regulations. This lack of quality size fish is reflected in low PSD values. Typical riverine smallmouth bass populations have PSDs in the range of 10% to 50% (Covington 1982, Orth et al. 1983, Paragamian 1983, Weiss-Glanz and Stanley 1984). The smallmouth

Table 5. Sport fishery data for several streams where smallmouth bass is a major component of the catch and harvest.

Stream, state	Fishing pressure (hr/ha/yr)	Smallmouth bass			All species			Citation
		Catch	Harvest		Catch	Harvest		
		N/hr	N/hr	kg/ha	N/hr	N/hr	kg/ha	
Maquoketa R., Iowa	894		0.05	11.0				Paragamian 1980
Maquoketa R., Iowa[a]	820	0.18	0.03	7.8		1.60		Paragamian 1983
Curtois Cr., Mo.	363		0.10	9.8	0.80		38.9	Fleener 1975
Red Cedar R., Wisc.	318		0.07	5.1				Paragamian and Coble 1975
Big Piney R., Mo.	245		0.08	4.7		0.78	24.5	Fleener et al. 1974
Shenandoah, R., Va.	227	0.19	0.11		0.52			Surber 1969
Shenandoah, R., Va.[a]	219	0.54	0.03		0.86			Kauffman 1983
New R., W. Va.	185	0.28	0.16		0.72	0.46		Pierce et al. 1981
New R., Va.	133		0.09	1.1		0.29	9.4	Wollitz 1968
Niangua R., Mo.	94		0.02–0.08	1.5		0.31–0.66	9.1	Funk and Fleener 1966
Potomac R., Md.[b]	98	0.51	0.06	3.6	0.88	0.36	20.2	Sanderson 1958
Potomac R., Md.[c]	74	0.37	0.13	5.7				Sanderson 1958
New R., W. Va.		1.05	0.40		1.63			Present study
New R., Va.[a]		1.33	0.06		2.43			Present study

[a] After implementation of 305 mm minimum length limit.
[b] 254 mm minimum length limit in effect.
[c] 229 mm minimum length limit in effect.

bass populations of the New River are characterized by PSDs of 3% to 5% as estimated by electrofishing and slightly higher when estimated by angling (Austen 1984). These low values are supported by the high ratio of sublegal to legal smallmouth bass in the catches of Virginia anglers and indicate that remedial action is necessary. Similarly, the harvest rate of >305-mm smallmouth bass (0.02) (Table 2) in West Virginia is low when compared to the overall harvest rate (0.40) and total catch rate (1.05) of smallmouth bass in that section. The high catch and harvest rates of West Virginia smallmouth bass population may translate to high mortality rates. Consequently, the number of smallmouth bass attaining larger size would be reduced.

Management Considerations

The minimum length limit regulation in Virginia has shifted the angler harvest pressure from smallmouth bass in the range of 228 to 254 mm to those of ≥290 mm. However, the proportion of quality-size fish in the catch has not increased. This has reduced the harvest considerably and may have shifted the emphasis of the anglers harvest from smallmouth bass to other species, notably the rock bass. This shift in exploitation may affect the population in other ways than just in what is noticed by a cursory creel survey. Growth, survival, and condition have all been noted to have changed in similarly regulated fisheries. Other species found in the fishery seem to be affected. Average size at harvest for almost all panfish species increased after implementation of the minimum length limit regulation while channel catfish size decreased. Recognition of the possible changes in growth rates and catch rates of other species in the fishery as a result of a restriction placed on the major predator is important. These changes may or may not be desirable to the anglers and the managing agency.

In these particular fisheries, it is apparent that few fish survive and grow to become trophy size, even under the 305-mm minimum length limit. High fishing pressure seems to be cropping the population off as soon as they become catchable-size (West Virginia) or legal-size (Virginia). In both sections, fishing quality could probably be improved by establishing a slot length limit along with a reduced creel limit. Evidently, a minimum length limit alone will not be effective without reducing fishing mortality.

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