AGE AND GROWTH OF THREE BLACK BASS SPECIES IN PICKWICK RESERVOIR

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ABSTRACT

The age and growth of 454 smallmouth bass, 371 largemouth bass, and 119 spotted bass were determined. When compared to other bodies of water smallmouth bass growth was exceptional, while largemouth bass and spotted bass growth was relatively slow. Distinct sexual differences in growth were not shown; however, sexual differences in longevity and survival were noted.

Length-weight relations were calculated for each species and sex from 506 smallmouth bass, 414 largemouth bass, and 134 spotted bass specimens. Differences by species and sex were noted in the calculated length-weight relations.

INTRODUCTION

Pickwick Reservoir is inhabited by three black bass species, *Micropterus d. dolomieui,* Northern smallmouth bass; *Micropterus s. salmoides,* northern largemouth bass; and *Micropterus p. punctulatus,* northern spotted bass. As part of a project to study the ecology of smallmouth bass in the headwater of Pickwick Reservoir, often designated as the Wilson Dam tailwater, the age and growth of all three *Micropterus* species were studied. The headwaters of Pickwick Reservoir are nationally renowned for the size and abundance of smallmouth bass caught by sport fishermen. Smallmouth bass are distributed throughout Pickwick Reservoir, but the majority caught by sport fishermen are within the upper 20 km (2,080 ha) of the 75-km-long reservoir. Largemouth bass are abundant in the sport catch over the entire reservoir. While spotted bass rarely occur in the sport catch, they are common in inventory samples from both upper and lower reaches of the reservoir.

Appreciation is extended to the anglers who donated fish samples, particularly the members of the Tennessee River Bass Club, the Quad-Cities Bassmasters, and the Muscle Shoals Bassmasters.

MATERIALS AND METHODS

Pickwick Dam, located at Tennessee River Mile (TRM) 206.7, is the second in a series of mainstream dams on the Tennnessee River and impounds 17,400 ha of water at full pool. The reservoir is bordered by the states of Alabama, Mississippi, and Tennessee. Pickwick Reservoir is a relatively old impoundment; the dam was first closed in 1938. The upstream boundary of Pickwick Reservoir is Wilson Dam, located at Florence, Alabama, on TRM 259.4. Wilson Dam discharged a mean annual flow of 1,000 m^3/s into Pickwick Reservoir. From Wilson Dam downstream to approximately TRM 247 (20 km. distance), the Tennessee River flows within its original banks and is distinctly riverine in nature. Below TRM 247 the river spreads out to inundate overbank areas and the velocity of flow declines forming a more reservoir-like habitat.

Bass were collected by angling, electrofishing, gill netting, seining, and rotenone sampling throughout Pickwick Reservoir. The majority of samples were collected from anglers participating in bass fishing tournaments. All fish were gathered between April 1973 and January 1975. Total length and weight were determined; sex was defined whenever possible. Sex was not determined for some angler-caught specimens because anglers did not want the fish dissected for gonad examination. Scales were removed from below the lateral line immediately posterior to the pectoral fin base.

Scales were impressed on acetate slides using a Carver Laboratory Press; the impressions were read at 40X magnification using an Eberbach Scale Projector. The length at annulus formation was calculated on the basis of direct proportional expansion corrected for estimated fish length at scale formation. Length at scale formation was estimated by the Y-intercept of the regression of the body length on scale radius of young-of-year specimens. Only young-of-year specimens were used because body length on scale radius regressions of all age fish produced extremely high (52.5 and 46.9mm for smallmouth bass and spotted bass respectively) or low (10.5mm for largemouth bass) intercept values, while young-of-year specimens produced reasonable estimates of length at scale formation.

RESULTS

The body length-scale radius relation calculated for young-of-year specimens of each species is as follows:

Smallmouth bass	$L = 24.8 + 1.8X$	($r^2 = 0.91$)	$n = 26$
Largemouth bass	$L = 18.6 + 1.6X$	($r^2 = 0.92$)	$n = 36$
Spotted bass	$L = 22.0 + 1.5X$	($r^2 = 0.92$)	$n = 61$

where L = total fish length in mm and X = the magnified anterior scale radius in mm. The estimated body lengths at scale formation used for smallmouth bass, largemouth bass, and spotted bass were 25, 19, and 22mm respectively. Everhart (1949) observed that smallmouth bass first formed scales at the scale sampling site when the fork length was between 23 and 31mm. No studies of the length of largemouth bass or spotted bass at scale formation are known to the author.

Age and growth determinations were made on 454 smallmouth bass, 371 largemouth bass, and 119 spotted bass. The mean length at annulus formation by year class and sex is presented for each species in Tables 1, 2, and 3.

Table 1. Calculated total lengths at annulus formation of smallmouth bass in Pickwick Reservoir.

Year Class	*Sex*	*Sample Number*	*Total length (mm) at each annulus*							
			I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*
1973	Male	11	121	256						
	Female	13	119	259						
	All Fish*	36	118	233						
1972	Male	29	114	219	295					
	Female	21	105	224	326					
	All Fish	52	110	222	308					
1971	Male	64	117	204	302					
	Female	68	118	210	312	379				
	All Fish	153	117	207	309	379				
1970	Male	50	106	210	293	354	384			
	Female	39	111	223	303	382	436			
	All Fish	101	109	218	301	370	437			
1969	Male	23	102	216	299	367	403	465		
	Female	13	106	202	291	353	421			
	All Fish	39	103	211	298	362	411	466		
1968	Male	8	122	207	283	378	432	468		
	Female	20	111	221	305	402	447	485		
	All Fish	37	115	216	297	397	446	482		
1967	Male	3	88	198	312	383	441	482	522	
	Female	17	109	211	306	379	453	497	519	
	All Fish	26	103	212	315	390	457	497	520	
1966	Male	0								
	Female	4	106	250	331	393	478	512	531	
	All Fish	7	106	251	338	412	478	508	528	508
1965	Male	0								
	Female	1	113	242	310	391	441	483	495	
	All Fish	3	149	271	334	422	471	519	532	547
Total Number										
	Male		188	184	135	61	18	11	2	
	Female		196	196	164	79	48	30	15	
	All Fish		454	454	347	169	88	57	25	4
Grand Mean Length										
	Male		112	216	297	363	421	471	522	
	Female		113	219	308	382	448	495	521	
	All Fish		112	216	302	380	448	493	524	537

* Includes fish of undetermined sex.

The length-weight relationship determined for each species and sex is as follows (All Fish includes those of undetermined sex):

Smallmouth bass			
Males	$\log W = -4.93 + 3.03 \log L$	($r^2 = 0.92$)	$n = 197$
Females	$\log W = -4.28 + 2.99 \log L$	($r^2 = 0.93$)	$n = 205$
All Fish	$\log W = -5.07 + 3.09 \log L$	($r^2 = 0.98$)	$n = 506$
Largemouth bass			
Males	$\log W = -4.94 + 3.04 \log L$	($r^2 = 0.91$)	$n = 167$
Females	$\log W = -5.16 + 3.13 \log L$	($r^2 = 0.94$)	$n = 211$
All Fish	$\log W = -5.38 + 3.21 \log L$	($r^2 = 0.98$)	$n = 414$
Spotted bass			
Males	$\log W = -5.09 + 3.11 \log L$	($r^2 = 0.91$)	$n = 39$
Females	$\log W = -5.47 + 3.26 \log L$	($r^2 = 0.91$)	$n = 77$
All Fish	$\log W = -5.65 + 3.33 \log L$	($r^2 = 0.99$)	$n = 134$

where W = weight in g and L = total length in mm.

DISCUSSION

An analysis of the growth rate of the three bass species indicates that smallmouth bass grow faster than either largemouth bass or spotted bass in Pickwick Reservoir (Figure 1). The calculations show spotted bass growing slowest of the three species. At the fourth annulus the mean total length of smallmouth bass was 380mm, while the mean lengths of largemouth bass and spotted bass were 337 and 306mm respectively. The author knows of only one other study (Tharratt, 1966) where the growth of smallmouth bass exceeded largemouth bass in southern reservoirs.

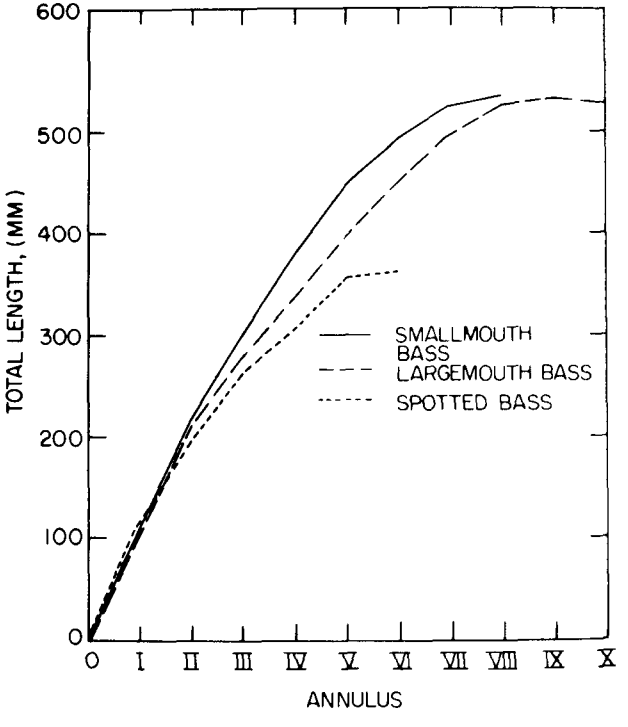

Figure 1. Comparative total lengths at annulus formation of smallmouth, largemouth, and spotted bass in Pickwick Reservoir.

In previous studies of *Micropterus* age and growth, no distinct sexual differences in growth rates (Doan, 1940; Stroud, 1948; Stone, et al., 1954; Latta, 1957) or growth rates with males exceeding females (Tester, 1932; Bennett, 1938; Eschmeyer, 1939) were reported. Padfield (1951) noted that growth of female largemouth bass exceeded that of males in two lakes in Georgia and Alabama. In Pickwick Reservoir bass the grand mean length an annulus formation was consistently greater for females than for males of each species; however, males exceeded females in growth within several year classes and age groups of each species. Due to the variations between year classes, distinct sexual differences in growth are not shown in any of the three Pickwick Reservoir bass species.

Analysis of the longevity of the three species indicates sexual differences. The maximum age of females in the largemouth bass and spotted bass samples was greater than for males. The maximum age of largemouth bass females in the sample was 10 years compared to 8 years for males. A spotted bass female of age 6 was collected, while the maximum age male was 5 years. The maximum age determined for both male and female smallmouth bass was 7 years, however, the number of 7-year-old females in the sample was 7.5 times greater than males. Three 8-year-old smallmouth bass were collected for which sex data were not obtained.

The ratio of females to males in the smallmouth bass and largemouth bass samples increased with each year of age to show differential survival between the sexes. The ratio of female to male smallmouth bass for ages 1 through 7 was 1.04, 1.07, 1.21, 1.30, 1.67, 2.73, and 7.50 respectively. The ratios for largemouth bass also increased with age. The tendency for females to be more abundant than males in older age groups has been shown previously in largemouth bass (Bryant and Houser, 1971; and Padfield, 1951). The ratio of female to male spotted bass fluctuated over the year classes.

The growth of Pickwick Reservoir smallmouth bass was compared to other locatlities in the United States (Table 4). Only three reservoirs with average calculated smallmouth bass growth exceeding or equivalent to Pickwick Reservoir were noted. These were Norris Reservoir, Tennessee (Stroud, 1948); Hiwassee Reservoir, North Carolina (Stroud, 1949); and Folsom Reservoir, California (Tharratt, 1966). In each of these three studies the reservoirs were relatively new, that is, ten years old or less. It has been shown that since the early Norris Reservoir study the growth rate of smallmouth bass has declined (Chance, *et al.*, 1975). The average growth of smallmouth bass in each of the reservoirs has probably declined since that time. The Pickwick Reservoir smallmouth bass population exhibits exceptionally fast growth despite the reservoir's relatively old age (37 years). When the growth of Pickwick Reservoir smallmouth bass is compared to the early Norris Reservoir studies, it is noted that the present growth of Pickwick Reservoir smallmouths substantially exceeds the early Norris growth after the fish reach four year of age. A comparison of smallmouth bass growth in Pickwick Reservoir to averages of Ohio, Wisconsin, and Minnesota shows the smallmouths in Pickwick grow faster and larger.

The Tennessee River Valley represents the southern edge of the natural range of smallmouth bass in the United States. The exceptionally rapid growth of smallmouth bass is probably at least partially due to the extended growing season to which it is exposed.

Largemouth bass growth in Pickwick Reservoir was also compared to other reservoirs in the southeast (Table 5). It was observed that the Pickwick Reservoir largemouth bass grow slower than in other southeastern reservoirs; however, the growth does exceed fish in Ohio, Wisconsin, and Minnesota. When spotted bass growth in Pickwick Reservoir is compared to other southeastern reservoirs, it is found to be generally slower than or equivalent to other impoundments (Table 6). The relatively slow growth of largemouth bass and spotted bass may be partially explained by the relative age of Pickwick Reservoir when compared to other southeastern impoundments. The growth of largemouth and spotted bass has been shown to decline as a reservoir ages (Bryant and Houser, 1971; Chance, *et al.*, 1975).

Another factor possibly contributing to the relatively slow growth of largemouth and spotted bass may be a trematode, *Leuceruthrus micropteri*, found in the stomachs of bass from Pickwick Reservoir (Hubert and Warner, 1975). The incidence of occurrence and level of infestation is high among the largemouth and spotted bass. Stomach samples collected in 1973 and 1974 had *L. micropteri* in 61 percent of the largemouth bass, 49 percent of the spotted bass, and 24 percent of the smallmouth bass (the number of stomach samples was 329, 45, and 400 respectively). The mean number of *L. micropteri* per infected stomach was 5.6 for largemouth, 3.1 for spotted, and 2.3 for smallmouth bass. No experimental studies on the pathogenicity of *Leuceruthrus micropteri* have been performed, but it is likely that their abundance may be negatively influencing bass growth.

The length-weight relations calculated for each species indicate differences between the species (Table 7). At lengths greater than approximately 250mm, spotted bass weigh the greatest at a given

length standard, followed by smallmouth bass and largemouth bass. Smallmouth bass exceed largemouths in weight up to approximately 375mm, after which largemouth bass weight exceeds smallmouth bass at a given length. Sexual differences in length-weight relations were also indicated. In all three species the calculated female weight exceeded males when the fish were greater than 250-300mm or the approximate length attained at sexual maturity. At length less than the 250-300mm range, the weight difference between males and females was variable among the three bass species.

Table 2. Calculated total lengths of annulus formation of largemouth bass in Pickwick Reservoir.

Year Class	*Sex*	*Sample Number*	*Total length (mm) at each annulus*									
			I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*
1973	Male	1	171	235								
	Female	0										
	All Fish*	5	114	202								
1972	Male	7	119	211	291							
	Female	4	129	233	291							
	All Fish	14	124	211	296							
1971	Male	38	135	208	279	331						
	Female	22	125	201	276	322						
	All Fish	64	131	206	277	325						
1970	Male	46	114	195	266	314	366					
	Female	46	123	210	268	317	389					
	All Fish	95	120	204	268	316	381					
1969	Male	29	107	184	243	303	350	405				
	Female	29	121	196	260	319	364	422				
	All Fish	58	114	190	252	311	358	417				
1968	Male	21	114	196	269	320	369	408	459			
	Female	33	130	236	311	374	416	454	500			
	All Fish	56	124	220	293	351	395	431	480			
1967	Male	12	138	229	321	376	424	446	491			
	Female	22	137	225	299	358	413	454	485	508		
	All Fish	34	137	226	306	364	417	451	486	508		
1966	Male	3	172	253	329	375	407	477	505	526		
	Female	19	124	235	312	372	425	474	505	546	521	
	All Fish	24	133	236	313	372	424	474	504	541	524	
1965	Male	5	142	240	336	404	446	483	506	524		
	Female	11	129	244	312	368	428	464	497	518	488	
	All Fish	17	134	241	321	381	433	470	500	520	520	
1964	Male	0										
	Female	2	127	186	273	306	361	428	472	522	542	521
	All Fish	4	130	204	290	354	410	460	496	530	548	527
Total Number												
	Male		162	162	156	121	64	37	11	6		
	Female		188	188	187	159	118	75	43	20	4	1
	All Fish		371	371	357	291	191	117	61	31	8	2
Grand Mean Length												
	Male		122	202	273	325	381	436	490	508		
	Female		126	218	286	235	405	457	497	526	523	521
	All Fish		125	211	281	337	397	451	497	527	535	527

* Includes fish of undetermined sex.

Table 3. Calculated total lengths at annulus formation of spotted bass in Pickwick Reservoir.

Year Class	Sex	Sample Number	Total length (mm) at each annulus					
			I	*II*	*III*	*IV*	*V*	*VI*
1973	Male	0						
	Female	3	89	212				
	All Fish*	4	99	211				
1972	Male	10	117	208	254			
	Female	19	128	209	289			
	All Fish	30	123	208	273			
1971	Male	23	118	195	263	290		
	Female	38	125	200	264	313		
	All Fish	61	122	198	263	307		
1970	Male	6	112	184	247	305	353	
	Female	12	101	186	249	293	331	
	All Fish	18	104	185	249	297	342	
1969	Male							
	Female	3	120	209	263	309		
	All Fish	3	120	209	263	309		
1968	Male							
	Female	2	133	192	251	337	348	361
	All Fish	2	133	192	251	337	348	361
1967	Male							
	Female	1	67	173	243	362	414	
	All Fish	1	67	173	243	362	414	
Total Number								
	Male		39	39	35	9	2	
	Female		78	78	68	27	4	1
	All Fish		119	119	98	36	7	1
Grand Mean Length								
	Male		117	197	258	300	353	
	Female		120	200	264	308	356	361
	All Fish		118	199	262	306	354	361

* Includes fish of undetermined sex.

Table 4. Comparison of smallmouth bass growth from selected waters.

Location and Citation	Total length (mm) at each annulus							
	I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*
Pickwick Reservoir (Present study)	112	216	302	380	448	493	524	547
Norris Reservoir, TN (Stroud, 1948)	79	226	338	401	442	457	472	
Hiwassee Reservoir, NC (Stroud, 1949)	91	231	318	356				
Folsom Reservoir, CA (Tharratt, 1966)	132	262	345	389	391			
Des Moines River, IA (Reynolds, 1965)	119	229	297	340	389	411		
Oneida L., NY (Forney, 1969)	99	175	312	343	373	399	417	
Lake Michigan (Latta, 1957)	99	160	206	246	292	335	371	401
Cayuga, L., NY (Webster, 1954)	162	213	262	307	348	373	396	424

Table 5. Comparison of largemouth bass growth from selected waters.

Location and Citation	Total length (mm) at each annulus									
	I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*
Pickwick Reservoir (Present study)	125	211	281	337	397	451	497	527	535	527
Norris Reservoir, TN (Stroud, 1948)	175	315	373	409	445	490	528			
Hiwassee Reservoir, NC (Stroud, 1949)	142	259	328	363	386					
Lewis and Smith Res., AL (Reeves and Webb, 1975)	147	275	358	402	442	485	518	547	568	601
Beaver Reservoir, AR (Bryant and Houser, 1971)	152	277	333	396	462	474				
Bull Shoals Res., AR (Bryant and Houser, 1971)	176	297	377	427	457	492	519	524		
Clayton L., VA (Rosebery, 1950)	178	274	356	404	427	452				
L. Wappapello, MO (Patriarche, 1953)	137	277	338	409	460	498				
Wisconsin (Bennett, 1937)	84	188	267	318	356	384	414	442	460	475
Minnesota (Eddy and Carlander, 1950)	91	173	257	307	358	399	427	439	493	
Ohio (Evans, 1950)	89	178	257	318	368	409	450	480	503	

Table 6. Comparison of Spotted bass growth from selected waters.

Location and Citation	*Total length (mm) at each annulus*						
	I	*II*	*III*	*IV*	*V*	*VI*	*VII*
Pickwick Reservoir (Present study)	118	199	262	306	354	361	
Norris Reservoir, TN (Stroud, 1948)	124	262	335	378	409	417	424
Cherokee Reservoir, TN (Stroud, 1949)	94	218	284				
Dale Hollow Reservoir, TN (Range, 1973)	109	193	251				
Center Hill Reservior, TN (Hargis, 1965)	170	264	354	406	422		
L. Fort Smith, AR (Olmsted, 1974)	132	203	257	289	321	354	
Grand L., OK (Jenkins, 1953)	104	213	300	356	396	419	
L. Wappapello, MO (Patriarche, 1953)	137	259	315	345	368	363	
Clayton L., VA (Rosebery, 1950)	104	198	282	340	373	411	452

Table 7. Calculated weights (g) at selected lengths of smallmouth bass, largemouth bass, and spotted bass in Pickwick Reservoir.

Length	*Smallmouth Bass*			*Largemouth Bass*			*Spotted Bass*		
(mm)	*Males*	*Females*	*All*	*Males*	*Females*	*All*	*Males*	*Females*	*All*
50	2	2	2	2	1	1	2	1	1
100	13	14	13	14	13	11	13	11	10
150	46	49	45	47	45	40	48	42	39
200	110	115	110	114	110	101	116	107	103
250	217	224	219	224	224	208	233	222	216
300	376	386	384	389	392	373	411	403	397
350	600	612	618	622	635	611	663	666	663
400	900	912	934	933	964	938	1005	1029	1034
450	1286	1297	1344	1336	1395	1370	1450	1512	1532
500	1769	1777	1860	1839	1939	1921			
550	2361	2498	2498	2458	2613	2608			

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