FISHERIES SESSION

GROWTH RATES AND NOTES ON THE REDEYED BASS, *MICROPTERUS COOSAE,* HUBBS AND BAILEY

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The redeyed bass, a common game fish in the streams of several Southeastern states, has not been acknowledged as an important game fish, nor has it received the attention it deserves. The fish's small size and limited distribution has minimized its importance in fish management programs.

DESCRIPTION

A beautiful fish in every respect, the redeyed bass has color characteristics not found in other basses. The eyes and fins are a brick red and the deep bronze back changes to a greenish or purplish cast depending upon the immediate habitat. The transverse flexuous bands on the sides and opercular and basal caudal spots are only slightly apparent on the fish, irrespective of size. The young of this species can be distinguished from the other basses by the absence of the subterminal black band across the caudal lobes and the red coloration of the fins.

The redeyed bass has a deeper caudal peduncle than the other basses. Seventy-one percent of 69 redeyes examined (King and Parsons 1951) had glossohyal teeth on the tongue. This percentage is considerably larger than that in the smallmouth bass group and somewhat less than the spotted bass group.

The redeyed bass has often been mistaken for the smallmouth bass which it resembles more than any of the other black basses. However, taxinomically the fish is more related to the spotted bass group. The major measurement differences and similarities of the three *Micropterus* species concerned are given in Table 1.

Table 1. Fin and scale counts of three species of *Micropterus* (Hubbs and Bailey 1940).

Character	*Micropterus coosae*	*Micropterus punctulatus henshalli*	*Micropterus dolomieu dolomieu*
Predominate number of soft dorsal rays	12 (11 - 13)[a]	12 (11 - 13)	14 (12 - 15)
Predominate number of anal soft spines	10 (9 - 11)	10 (9 - 11)	11 (9 - 12)
Number of scales above lateral line (range)	8 - 10	8 - 10	11 - 13

[a] Ranges given in parenthesis.

The smallmouth bass does not occur naturally within the native range of the redeyed and Alabama spotted bass. Prominent color differences distinguish the redeye from the spotted bass.

DISTRIBUTION

State distribution of the redeyed bass includes Alabama, Georgia, and Tennessee, but the fish may also occur in Florida, South Carolina, and North Carolina. Hubbs and Bailey (1940) examined specimens from the Savannah River which rises in North Carolina and bisects Georgia and South Carolina. One *Micropterus* specimen examined from the Apalachicola River systems in Jackson County, Florida, appeared to be similar to the redeyed bass, but was not positively identified (Hubbs and Bailey 1940). Redeyed bass are known to occur in the Chattahoochee River, a tributary to the Apalachicola River (D. C. Scott, University of Georgia, pers. comm.).

In Alabama, the redeyed bass occurs principally in the Coosa-Tallapoosa-Alabama River system (Fowler 1945). Its occurrence in Georgia includes the Alabama River system, and Chattahoochee, Oconee and Savannah Rivers, all of which flow separately either into the Gulf or Atlantic Ocean (Scott 1952). Sheeds Creek and Cohutta Creek, the only two streams in Tennessee where this fish occurs naturally, is part of the Alabama River system.

Most of the present study of the redeyed bass developed on Sheeds Creek in Polk County, Tennessee. Sheeds Creek is a small mountain stream about six miles in length, with a maximum temperature of 70°F., and pH near 7.0. The minimum volume flow is less than one cfs and the pools are small and shallow, usually less than two feet in depth, with fair fish cover. The stream bed is mostly sand in the lower portions and rocky near the headwaters. The stream flows into the Jacks River at the Georgia-Tennessee line, and the Jacks River flows into the Conasauga River approximately 100 yards downstream. Sheeds Creek is the smallest known stream in Tennessee that has a self-sustaining fishable, bass population (King and Parsons 1951).

The redeyed bass is primarily a species of small upland streams. The fish is particularly adapted to streams that are too cold for other warm water fishes and generally too warm for trout. Several stocked rainbow trout were taken in the Sheeds Creek samples. A good series of redeyed bass was observed in the North Prong of Sheeds Creek which nearly dries up in the summer, and any pool that offered depth or cover contained several redeyed bass. The only other species of fish taken from North Prong was the common creek chub, *Semotilus atromoculatus atromoculatus* (Mitchell), which rarely occurs in Sheeds Creek proper. Like the creek chub, the redeye apparently does best where competition is least.

More than ten years ago redeyed bass were stocked in Sylco Creek, a small stream that flows into the Tennessee River system on the opposite side of the mountain from Sheeds Creek. Several cresol samples taken in this stream in 1950 and 1952 indicated two distinct fish populations. The lower portion of Sheeds Creek was populated with smallmouth bass and rock bass, *Ambloplites rupestris rupestris* (Rafinesque), and the upper regions with redeyed bass. Practically no distributional overlap existed between these two basses in the stream. As far as is known, the redeye has not migrated from Sylco Creek.

Cohutta Creek, a small, turbid, lowland stream flowing from Bradley County, Tennessee, into Georgia and the Conasauga River, was sampled in the spring of 1952. Several redeyed bass were taken from the stream but these fish apparently were not doing as well as the more numerous largemouth bass, *Micropterus salmoides* (Lacepede).

In the Alabama River system the redeyed bass is closely associated with the Alabama spotted bass and the southern rock bass, *Ambloplites ariommus* (Viosca). Except for exotic introductions, the redeyed bass apparently is the only *Micropterus* species present in most of the other streams mentioned in the distribution.

Several fish samples taken in Jacks River and the Conosauga River near Sheeds Creek were dominated by the redeyed bass. Although the spotted bass was common in the area, none has been found in Sheeds Creek. Several adult rock bass and longeared sunfish, *Lepomis megalotus megalotus* (Refinesque) appeared in the Sheeds Creek samples, but no young were observed.

MATERIALS AND METHODS

Angling, cresol and rotenone were used to collect samples of the redeyed bass. The metric system was used in taking measurements and the conversion factor for standard length to total length is 1.210 for the Sheeds Creek redeyed bass.

The ages of the redeyed bass were determined by counting the number of annuli on the scales with the use of a standard microprojector. Fish which had no annuli were placed in 0 age class and the number of annuli or age class were designated by Roman numerals.

The author feels justified in using the scale method to determine the age of the redeye from the following observations:

1. Fish known to be young-of-the-year had no annuli on the scales.
2. The number of annuli increased with the size of the fish.
3. The distance between the last annulus and the anterior edge of the scale increased throughout the growing season.
4. The calculated growth was similar for fish of identical age-groups in the same or different years collections.

RESULTS AND DISCUSSION

Length-Weight Relationship

The mathematical relationship between the standard length in millimeters *(L)* and the weight in grams *(W)* of the Sheeds Creek redeyed bass can best be described by the formula:

$$\text{Log } W = \underset{(a)}{-4.74898} + \underset{(b)}{3.03588} \text{ Log } L.$$

The values a and b were determined by the unweighted logarithms of the average lengths of the combined 1950 and 1951 data. The actual and estimated weights indicate a good fit (Table 2). According to the formula *(b)*, the weight of the redeyed bass increases almost as the cube of the length. This is the basic theory of the formula $K = \frac{W10^5}{L^3}$, for all fish.

The relative plumpness of the fish may be represented by the coefficient of condition, K, computed with the above formula. The average K for the Sheeds Creed redeyed is 2.11 (Table 2). The average K for each 10 mm size group varies little, and the small fish are apparently as robust as the large ones.

Table 2. Length-weight relationship of redeyed bass from Sheeds Creek, 1950 - 1952.[a]

Average standard length in mm	Total length in inches	Weight in gms		Estimated[b] weight in gms	Average K	No. of fish
		Average	Range			
66	3.2	6	4-9	6	2.12	5
74	3.6	8	8-10	8	2.08	5
83	4.0	11	7-14	12	1.88	9
93	4.4	17	11-20	17	2.14	11
103	5.0	21	17-25	23	1.98	7
115	5.5	32	26-38	32	2.12	9
124	5.9	42	38-50	40	2.20	4
133	6.3	51	42-58	50	2.15	11
143	6.8	64	59-74	62	2.16	8
155	7.4	80	63-102	80	2.11	19
165	7.9	96	79-112	96	2.08	16
175	8.4	118	104-142	115	2.26	14
183	8.7	135	122-150	132	2.20	13
193	9.2	160	149-188	155	2.12	14
206	9.8	184	166-202	189	2.16	5
215	10.2	208	179-236	218	2.10	3
223	10.6	228		240	2.07	1
					2.11[c]	157

[a] 1950 = 86 fish, 1951 = 31 fish, 1950 = 40 fish.
[b] Log W = -4.74898 ± 3.03588 Log L.
[c] Mean *K* has a range of 1.60 to 2.60.

Comparisons of the *K* of the redeyed bass with other bass species indicate that the redeyes are relatively slender (Carlander 1951). In almost all cases, smallmouth bass, spotted bass, *Micropoterus punctulatus punctulatus* (Rafinesque), and largemouth bass were represented by higher condition factors than the redeyed bass. Contrarily, the redeyed bass from Sheeds Creek appear to be chunky.

Body-Scale Relationship

The body-scale relationship of the redeyed bass could not be determined from the fish collected. Of the thousands of scales examined, 82 percent were regenerated and no uniform location for scale sample selection was possible.

Annuli Formation

Scales were examined from redeyed bass taken during the months May through November. The scales taken from the fish on May 15, 1952, showed evidence of annulus formation and in early June 1951, the annuli appeared to have been formed only recently. False annuli were not uncommon. This can probably be accounted for by the difference in the time of the annulus formation and the time of spawning.

Age and Growth

The growth rate of the redeyed bass compared to other game fish is particularly slow (Table 3). The growth rate is greatest the first year and gradually decreases

Table 3. Calculated growth rates of the redeyed bass, Sheeds Creek, Tennessee by standard length in millimeters 1950 and 1951.

Annulus											Length at time of capture
					1950						
Number	Age class	1	2	3	4	5	6	7	8	9	10	
9	I	61										79
10	II	44	81									102
5	III	44	78	108								130
12	IV	36	68	96	122							141
12	V	35	62	91	115	136						151
14	VI	38	65	87	113	139	155					168
7	VII	40	65	93	125	148	165	178				187
3	VIII	37	58	82	102	124	145	162	173			181
1	IX	40	68	88	104	118	136	149	158	163		173
73	all	40	68	92	116	138	156	171	169	163		
Annual Increment		40	28	26	25	23	17	14	10	5		
Summation of Annual Increment		40	68	94	119	142	159	113	183	188		
					1951							
6	I	40										87
5	II	38	78									102
3	IV	36	69	100	122							141
2	V	48	71	101	125	144						155
3	VI	36	69	96	122	149	167					167
4	VII	34	72	106	126	147	164	177				177
2	VIII	36	62	106	121	140	170	189	198			198
1	IX	38	67	99	120	136	148	160	171	177		177
1	X	31	61	85	104	123	150	167	180	196	211	218
27	all	38	71	101	122	146	163	177	186	186	211	
Annual Increment		38	34	32	31	24	16	16	10	11	15	
Summation of Annual Increment		38	72	104	125	149	165	181	191	202	217	
					Combined							
100	all	40	69	93	118	140	158	174	178	179	211	
Annual Increment		40	30	24	25	23	17	15	10	9	31	
Summation of Annual Increment[a]		40	70	94	119	142	159	174	184	193	224	
Summation of Annual Increment[b]		1.9	3.4	4.5	5.7	6.8	7.6	8.3	8.8	9.2	10.7	

[a] Standard length in mm.
[b] Total length in inches.

as the fish grows older. On an average, a ten year old redeyed bass grows only about one inch in length each year. Considering the slow growth rate, one would expect an overlap in the age-length frequency of the redeyed bass (Table 4).

Table 4. Age-length frequency of Sheeds Creek redeyed bass, 1950 - 1952.

Ten millimeter group standard length	O	I	II	III	IV	V	VI	VII	VIII	IX	X
40-49	1										
50-59	6										
60-69	4	2									
70-79		4	3								
80-89		6	1	1							
90-99		4	5								
100-109			6		1						
110-119			1	2	1						
120-129			2	1	1						
130-139				1	5	1					
140-149					2	4	1				
150-159				1	5	4	7				
160-169						5	2	1	1		
170-179					1		6	2		2	
180-189							2	7	2	2	
190-199								2	1		
200-209							1	1			
210-219									1		1
Total	11	16	18	6	16	14	19	13	5	2	1

Compared to the other black basses (Carlander 1951), the redeyed bass has average longevity, but a much slower growth rate. In comparing growth by length, one may find that the redeyed bass growth rate is more comparable to the rock bass.

According to other fisheries workers the redeyed bass in Sheeds Creek represent a normal population as far as size is concerned. The largest redeyed bass on record, approximately two pounds, was raised in a private hatchery pond (James Reeve, Amakanata Hatchery, Calhoun, Georgia, pers. comm.). A half pound redeye would be considered a good catch by most fishermen.

The slow growth of the redeyed bass is mostly inherent, but in the case of Sheeds Creek and other similar streams the fish apparently tend to over-populate as well. This supposition is based upon the following observations from Sheeds Creek; excellent reproductive success in the years studied, the lack of other predator fish, the presence of a good series of size and age classes, no dominant year classes, and the shortage of food fish. The fact that fish are rather difficult to catch by hook and line in the smaller streams decreases the possible effect of fishing pressure on the population.

Several young redeyed bass were measured and as expected, the growth of the young fish reared in the hatchery pond exceeded the growth of those in the streams (Table 5). The great variation in the sizes of the young redeyed bass is based almost entirely upon selective sampling.

Table 5. Total lengths of young-of-the-year redeyed bass by months.

Place	Date	Number	Avg. length in mm[a]
Sheeds Creek	August 1950	4	63
Sheeds Creek	November 1951	8	54
Sheeds Creek	July 1952	24	15
Conasauga River	July 1952	1	34
Tenn. State Fish Hatchery	September 1952	63	112

[a] Range = 11 to 35 mm.

Food Habits

No comprehensive study was made of the food of the redeyed bass although enough stomachs were examined to give some indication of their food habits. A total of 56 stomachs were examined in 1950 and 1952 (Table 6).

Table 6. The frequency of food articles in redeyed bass stomachs, Sheeds Creek 1950 - 1952.

Food article	Frequency of occurrence
Empty	14
Adult insects	31
Chironomid larvae and pupae	10
Fish remains	4
Crayfish	3
Fish eggs	1
Salamander	1
Caddis fly case	1

All food items that appeared to have been taken during the sampling were not included in the table. Insects taken from the surface of the water appear to be the most common food. The fish were examined in the months of May and August.

Diseases and Parasites

By gross examination the redeyed bass examined appeared to be relatively free from diseases and parasites. Several fish had moderate infestations of parasitic nematodes in the intestine and stregeid larvae (black grubs) on the external surfaces. Larval flukes and tapeworms, common in the centrarchids in Tennessee, were not observed.

Pond Environment

According to all indications, the redeyed bass is not suitable for ponds or lakes. The Federal fish hatchery in Cohutta, Georgia, and the Amakanata hatchery, a private hatchery at Calhoun, Georgia, raised and stocked this fish in farm ponds and lakes for several years during the 1940s (James Reeve, Amakanata Hatchery, Calhoun, Georgia, and F. F. Tanner, Fish and Wildl. Serv., Cohutta, Georgia, pers.

comm.). In recent years these hatcheries have discontinued production of the redeyed bass. Apparently the fish were too small to satisfy the pond owners and could neither compete against other predators nor suppress the sunfish populations.

A twenty acre lake impounded in 1948 in the Conasauga River drainage in Hamilton County, Tennessee, soon produced redeyed bass from the native stock of the small spring creek that was impounded. During the second year of impoundment largemouth bass were introduced, and the redeye is now rarely taken from the pond.

In 1950 the Etowah River in Georgia was impounded to form the Allatoona Reservoir. A preimpoundment survey crew found the fish population to contain 5% redeye bass by number and 13% spotted bass (Hueske 1950). During the first year of impoundment a rotenone sample contained 29% redeyed bass and 14% spotted bass. Most of these fish apparently were young-of-the-yea fish. A creel census taken in 1950 by the Fish and Wildlife Service revealed that the redeyes constituted only 2% of the catch. In 1951 these fish represented only an insignificant portion of the fish catch and most of these were taken at the headwaters of the reservoir (Franz 1951). It is generally recognized that stream fish often expand rapidly in new impoundments only to be crowded out as the competition increases and the fish population becomes more stablized. Obviously, such is the case with the redeyed bass. However, redeyed bass might do well in small, clear, spring fed ponds by itself or stocked with certain fish of a comparatively low reproductive potential.

Hatchery Reproduction

The propagation of redeyed bass in hatheries has met with variable success, but generally enough fish can be raised to handle introductory stockings in streams. On May 15, 1952, the author placed 25 adult redeyed bass in a cold, fertilized hatchery pond. On September 20th of the same year the pond was drained and 13 adult fish remained. A total of 311 young-of-the-year fish were also recovered ranging from 2 - 5.9 inches in length.

At the time the adults were placed in the pond, a large number of bluntnose minnows were also being raised and over 15 pounds of minnows were taken from the pond when it was drained. Based upon the variation of the size of the young fish, the redeyes apparently spawned over a period of a month or more. Possibly the poor hatch was due to the large number of minnows present. As the small redeyed bass grew older they began feeding on the multitude of small minnows and some of the fish grew faster in four months than their parents grew in four years in Sheeds Creek. The majority of the young fish were 4 - 5 inches in length ($\bar{x}$ = 4.4) and were of excellent size for stocking purposes.

The 25 redeyes originally stocked in the pond has an average K of 2.10 (range 1.60 - 2.40) and the 13 recovered from the pond had a K of 2.30 (range 2.08 - 2.60). All of these fish appeared extremely healthy. No color differences were noted between the stream and the hatchery raised fish. The young redeyes bass had an average K of 2.16 (range 1.77 - 2.38).

Fecundity and Maturity

The gonads of 35 and 25 redeyed bass from Sheeds Creek were examined on May 15 and July 2, 1952, respectively. The adult females taken in May were plump but no ripe individuals were observed. In July, only two of the five adult females appeared to have spawned and the five adult males still had well developed gonads. The water temperature in Sheeds Creek ranged from 62 - 69°F between the above dates.

The smallest mature female taken was 120 mm total length, 96 mm standard length, 16 grams in weight, and 3 years of age. It is doubtful that this fish would have spawned in 1952. The smallest mature male, taken in July, was 122 mm total length, 99 mm standard length, 19 grams in weight, and 4 years of age. Of the 60 redeyed bass examined, most of the fish which were larger than the aforesaid fish were mature, and all smaller fish were immature.

Based upon observations in Sheeds Creek, the redeyed bass spawned in 1952 during late May, June and the first half of July. Possibly some spawning occurred even later. Several close checks were made during the spawning season, but no nests were observed or were the bass observed fanning on a nest-like area. Several shallow depressions in coarse gravel (1 inch diam.) were observed in the eddy water at the head of several pools. If these were not redeyed bass nests, the fish probably spawn under banks, logs or large rocks.

In July, 1952, young redeyed bass were observed in several pools in Sheeds Creek, and considerable size differentiation was noted between the young in different pools. Apparently there was little movement of the young fish from pool to pool during low water. It has already been stated that the redeyed bass spawn over a period of at least 6 weeks and the collection of small redeyed bass from one or two pools in a stream may be particularly selective to size.

Egg counts were made from two redeyed bass on May, 1952. (Table 7).

Table 7. Redeyed bass egg count, Sheeds Creek.

SL[a] (mm)	TL[b] (inches)	WT[c] (g.)	Number of eggs (actual count)	Age
118	145	35	2084	V
176	205	98	2334	

[a] Standard length.
[b] Total length.
[c] Weight.

Fishing

The redeyed bass is considered by most fishermen to be a desirable addition to the creel. The fish is scrappy, colorful, and highly palatable. The author has taken the fish readily with artificial lures in larger streams, but the fish are wary and difficult to catch in small, clear streams such as Sheeds Creek. Live bait proves most successful in the smaller streams, and the fish will test the patience and stealthiness of any fisherman.

To the biologist and fisherman alike the redeyed bass may be considered as the "brook trout of the warm water game fish." The fish is much like the brook trout in comparative size, habitat-preference, food and feeding habits, desirability, and gameness. The admirable qualities of the redeyed bass are not offset by its small size.

MANAGEMENT

The redeyed bass is of interest to the Tennessee Game and Fish Commission because of the presence of several hundred miles of streams in Eastern Tennessee that are marginal to warm and cold water game fish. These streams usually contain several small adult smallmouth bass or rock bass but are generally considered barren to the fisherman. The adaptability or preference of the redeyed bass to these waters has been demonstrated.

In the summer of 1952 the Tennessee Game and Fish Commission successfully raised several hundred young redeyed bass which were experimentally stocked in three spring fed streams on the Highland Rim area of Eastern Tennessee that have proved, in the past, to be unsuitable for trout. If the redeyed bass can successfully provide fishing in these and similar streams, these fish will be important to fish management in Tennessee. It is not expected that the redeyed bass will compete greatly with the smallmouth were the smallmouth are doing well. Studies in conjunction with the experimental stocking will determine the future status of this fish in Tennessee.

SUMMARY

1. The redeyed bass is found in Alabama, Georgia, and Tennessee, but may also occur in Florida, and North and South Carolina.
2. Although often mistaken for the smallmouth bass, the redeyed bass appears to bear more resemblance taxonomically to the spotted bass group.
3. Most of the present study of the redeyed bass is based upon observations and fish collections from Sheeds Creek, Tennessee.
4. Sheeds Creek is a small, cold water mountain stream with shallow pools and a minimum water flow of less than one cfs.
5. In the Alabama River system the redeyed bass is closely associated with the Alabama spotted bass and the southern rock bass.
6. The length conversion factor, standard length to total length, is 1.210 for the Sheeds Creek redeyed bass.
7. The mathematical relationship between the standard length and the weight in grams of the Sheeds Creek redeyed bass can best be described by the formula: $\text{Log}W = -4.74898 + 3.03588 \text{ Log } L$.
8. The average K for 157 redeyed bass from Sheeds Creek is 2.11.
9. The average K for each 10 mm size group was similar for all redeyed bass size groups.
10. No body-scale relationship could be determined for te redeyed bass from Sheeds Creek because of the frequency of scale regeneration.
11. The annuli formation on the scales of the Sheeds Creek redeyed bass apparently occurs in the month of May.
12. The growth rate of the redeyed bass, compared to other game fish, is particularly slow.
13. The maximum size of the redeyed bass is about two pounds.
14. The slow growth of the redeyed bass is mostly inherent, but in some streams the fish apparently tend to overpopulate.

15. An examination of 56 redeyed bass stomachs taken during the month of May and August revealed that insects were the most common food.
16. The redeyed bass is apparently not suitable for ponds and lakes.
17. Most of the Sheeds Creek redeyed bass apparently mature during their fifth year of life (Age Class IV) and when about five to six inches in length.
18. The redeyed bass is considered by most fishermen to be a desirable addition to the creel.
19. To biologists and fishermen alike the redeyed bass can be considered as the "brook trout of the warm water game fish."
20. Redeyed bass were successfully propagated at a Tennessee Game and Fish Commission hatchery and have been experimentally stocked in several East Tennessee streams.
21. If the redeyed bass can successfully provide fishing in the newly stocked streams in Tennessee, then these fish will be important to Tennessee's fisheries resources and management.

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