

OBSERVATIONS ON SPAWNING AND GROWTH OF FOUR SPECIES OF BASSES (*Micropterus*) IN PONDS

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ABSTRACT

Brood stock of basses were obtained from the following locations during March to April, 1969; *Micropterus coosae* (Alabama race), Alabama River system; *M. coosae* (Apalachicola race), Apalachicola River system; *M. notius*, Suwannee River system; *M. punctulatus henshalli*, Tallapoosa River system; *M. p. punctulatus*, Apalachicola River system; *M. dolomieu*, Mammoth Spring National Fish Hatchery, Arkansas.

Adult bass of each stock except Suwannee bass spawned during April 5 to May 19, 1969, in 0.04- to 0.1-acre earthen ponds when stocked at 50 to 100 per acre. Suwannee bass possibly had already spawned in their native habitat. However, Suwannee bass spawned in April during both 1970 and 1971. Surface water temperatures and dates when eggs were first observed were as follows: *M. p. henshalli*—69 F (April 5, 1969); *M. coosae* (Alabama race)—73 F (April 14, 1969); *M. dolomieu*—73 F (April 16, 1969); *M. p. punctulatus*—74 F (May 3, 1969); *M. coosae* (Apalachicola race)—79 F (May 5, 1969); *M. notius*—68 F (April 9, 1970), and 68 F (April 17, 1971). Egg sizes varied considerably among species, *M. p. henshalli* having eggs 1.9 mm in diameter, while the smallest of adult basses, *M. coosae* (Alabama race) had the largest eggs at 3.5 mm in diameter.

Fry from each bass form except *M. notius* were stocked during May 9 to June 11 into 0.1-acre ponds which contained abundant fathead minnow, *Pimephales promelas*. Bass were 17 to 41 mm in total length and were stocked at rates of 800 to 3,000 per acre. Rates of growth varied with species and stocking rate, and survival at draining was lowest in *M. dolomieu* (63.7 per cent) and highest (89.9 per cent) in *M. coosae* (Apalachicola race).

Another experiment was a comparison of growth of *M. p. henshalli*, *M. coosae* (Alabama race), *M. coosae* (Apalachicola race), and *M. dolomieu*, in a single fertilized pond. In the pond, survival of the Alabama redeye bass was 100 per cent, while that of the Apalachicola redeye bass was only 67 per cent. The Alabama race had the least growth rate of the four basses.

M. notius fry stocked at 25 mm (272/A) on May 21, 1970, into a pond containing abundant fathead minnow forage grew to 94 mm by July 13, 1970. All fish were lost at this time from oxygen depletion.

INTRODUCTION

This study was conducted at Auburn University during 1969 to 1971 to determine adaptability of several stream basses to life in small impoundments. Populations investigated were *Micropterus coosae* (redeye bass, Alabama race), Alabama River system; *M. coosae* (redeye bass, Apalachicola race), Apalachicola River system; *M. notius* (Suwannee bass), Suwannee River system; *M. punctulatus henshalli* (Alabama spotted bass), Alabama River system; *M. p. punctulatus* (Apalachicola spotted bass), Apalachicola River system; and *M. dolomieu* (smallmouth bass), Mammoth Spring National Fish Hatchery, Arkansas. Observations were made on the reproductive success and relative growth of these

TABLE 1. Source and stocking data for *Micropterus* brood stock, 1969 to 1970

Bass populations	Source	Stocked Year	Number	Total length (mm)	Weight (g)	Pond (A)
Redeye						
Apalachicola	Halawakee and Wacooshee Crs., Lee Co., Alabama	1969	8	225-418	131-973	R-31 (0.1)
Alabama *	Bird and Loblackee Crs., Lee Co., Alabama	1969	4	130-247	18-201	M-7 (.04)
Smallmouth *	Mammoth Spring National Fish Hatchery, Fulton Co., Arkansas	1969	6	348-367	681-840	R-33 (0.10)
Spotted						
Apalachicola	Halawakee Cr., Lee Co., Alabama	1969	6	236-418	167-1,043	M-5 (0.10)
Alabama *	Unhapee Cr., Macon Co., Alabama	1969	6	304-460	343-1,272	R-30 (0.10)
Suwannee	Ichetucknee R., Columbia Co., Florida	1969	9	207-338	118-577	M-9 (0.10)
Suwannee *	Ichetucknee R., Columbia Co., Florida	1970	9	228-338	154-530	R-31 (0.10)

* Brood stock had been held in ponds the previous 12 months; others were directly from stream.

basses in lentic waters for data to guide future experiments in development of new or improved game fishes.

MATERIALS AND METHODS

Brood ponds

Earthen ponds 0.04- to 0.1-acre were filled in January 1969. During March, approximately 1 bushel of stream gravel or limestone chips was placed near the shoreline at several points in each pond to serve as spawning substrate. To promote zooplankton growth, each pond was enriched during March and April with Auburn No. 2 fish feed and hay at rates of 100 and 600 pounds per acre, respectively.

Brood bass

Adult bass were introduced into brood ponds from March to April. Source of brood bass, number and size stocked, and dates stocked are summarized in Table 1.

Rearing ponds

Seven 0.1-acre earthen ponds were filled in January and each stocked with 200 adult fathead minnows on March 24 to provide forage for bass fry. Auburn No. 2 feed was added at 5 pounds per acre per day from April to October. During August, 15 pounds of 1- to 3-inch fathead minnows were added to each pond.

S-25, a 1.0-acre earthen pond was fertilized during July with 40 pounds of 20-20-5 fertilizer, and hay was added to produce zooplankton in preparation for stocking bass fingerlings from several populations. A small number of fathead minnows was discovered upon draining on December 17.

In March 1970 pond M-7 (0.04-acre) was stocked with 160 adult fathead minnows to produce forage for Suwannee bass fry.

Bass fry

Fry from five populations of basses were stocked from brood ponds into the rearing ponds at 800, 1,000, or 3,000 per acre when they were 17 to 41 mm in total length and weighed 0.1 to 0.7 g. Table 2 details other data related to the stocking in 1969. Suwannee bass fry were stocked at 272 per acre into pond M-7 on May 21, 1970, at 25 mm total length.

TABLE 2. Stocking of *Micropterus fry* in rearing ponds, 1969.

Bass populations	Total length (mm)	Average weight (g)	Stocking rate/A	Rearing pond	Date
Redeye					
Apalachicola	21-24	0.2	3,000	R-17	6/10
	21-24	0.2	800	R-18	6/11
Alabama	22-25	0.1	3,000	R-15	5/9
Smallmouth					
	17-20	0.1	3,000	M-1	5/20
	35-41	0.7	1,000	R-32	6/3
Spotted					
Apalachicola	21-28	0.2	800	R-29	6/3
Alabama	25-33	0.3	3,000	R-28	5/9

Bass fingerlings

Seine samples of fingerlings were made at bi-weekly to monthly intervals for determination of growth, for study of pigmentation patterns (Ramsey and Smitherman, 1972), and for restocking into other ponds.

TABLE 3. Observations on spawning of six populations of basses, 1969 to 1970

Bass populations	Stocking date	Initial spawn Date	Initial spawn Temp (F)	Effective spawn Date	Effective spawn * Temp (F)	Mean egg size (mm)	Hatch date	Sac fry TL (mm)
Apalachicola redeye	4/18-5/2	5/5	79	5/19	77	2.0	5/20	4.4
Alabama redeye	3/27-4/14	4/14	73	4/14	73	3.5	4/16	6.0
Smallmouth	4/10	4/16	73	4/25	75	3.5	5/1	—
Apalachicola spotted	3/27-4/25	5/3	74	5/7	78	2.0	5.9	3.8
Alabama spotted	3/27	4/5	69	4/5	69	1.9	4/8	5.5
Suwannee **	3/27	4/6	68	4/6	68	2.0	4.9	5.5

* Effective spawn is defined as that resulting in fry.

** Suwannee bass did not spawn in 1969. These observations were made in 1970.

Thirty fingerlings each from M-1 (smallmouth), R-15 (Alabama redeye), R-17 (Apalachicola redeye), and R-28 (Alabama spotted) were stocked into pond S-25 on July 16 to compare their growth and survival under identical environmental conditions.

RESULTS

Spawning

In 1969, spawning occurred in all brood ponds with the exception of that for Suwannee bass. The Suwannee bass did spawn in 1970 and 1971, however. The gravel or limestone chips added to the ponds typically served as a focus for initial bedding activity, but spawning often occurred on a hard clay substrate independent of gravel or chip piles. Table 3 summarizes observations on spawning for five populations of redeye, spotted, and smallmouth basses in 1969, and for Suwannee bass in 1970.

Apalachicola redeye. First spawning occurred on May 5 at 79 F, and effective spawning on May 19 at 77 F. Fry were noted over the bed on May 29, but disappeared from surface and inshore areas, apparently occupying deeper waters.

Alabama redeye. In contrast to Apalachicola redeye, which were wild-caught and directly transferred to the brood pond, Alabama redeye brood were stocked from a nearby holding pond in which they had lived the previous 12 months. Eggs were noted on April 14 when water temperature was 73 F. Because of high turbidity, bass fry were not sighted until May 3 when they were approximately 20 mm total length. The Alabama redeye fry occupied the shallow water at the pond edges, especially where aquatic vegetation provided cover. The following notes were made in 1968, on the first closely observed spawning of the Alabama redeye in an Auburn pond, and will supplement data obtained in 1969. Adult Alabama redeye were brought from Bird Creek, Lee County, Alabama, to pond R-31 on March 18, 1968, and spawning occurred on April 9 at 70 F. Eggs hatched on April 15 at 72 F, and swim-up fry (7 to 8 mm) appeared on April 20. Fry were 16 to 25 mm by May 8, and reached 53 mm by July 23. It appeared schooling behavior was not prolonged in this fish. Some fry 12 to 18 mm broke away 6 days after swim-up, and complete school dispersal occurred 14 days after swim-up when fry were 16 to 25 mm.

Smallmouth bass. The brood stock were obtained from Mammoth Spring National Fish Hatchery, Arkansas, where they were hatchery stock and accustomed to the pond environment. First spawning occurred on April 16 at 73 F, but the eggs were destroyed by nest sweeping activity. Another spawn occurred on April 17 at 73 F, but this was also destroyed. A successful spawn was observed on May 4 at about 78 F. Swim-up fry were seen on May 7. The fry began moving from over the bed on May 9, scattering to 20 feet, but returning to the bed area. Complete school dispersal occurred by May 16. The darkly-pigmented fry remained close inshore, staying 2 to 7 inches from the shoreline or submerged objects.

Apalachicola spotted bass. Brood stock were collected from the stream and brought directly to the brood pond. Spawning was noted on May 3 at 74 F. The eggs disappeared because the male did not guard the bed. New spawn was observed on May 7 at 78 F. Tadpoles began to eat the eggs, so the remainder were transferred and hatched in vitro, as were other eggs laid on May 8 and 9. Hatching occurred in 2 days at about 70 F. On May 16, at swim-up, about 150 fry were returned to the brood pond and placed in a screen enclosure. The fry gradually escaped the enclosure, and reached 21 to 28 mm by June 3.

Alabama spotted bass. Brood stock were transferred to the brood pond from a nearby pond where they had been held for the previous 12 months. Spawning occurred on April 5 at 69 F. Hatching was complete 3 days later. The following observations were made in 1968, on the first spawning of spotted bass in ponds at Auburn, and will supplement the data

TABLE 4. Growth and survival of five populations of basses in 0.1-acre earthen rearing ponds with fathead minnows as forage, 1969.

Bass population	Rearing pond	Number stocked	Stock date	Size stocked TL (mm)	Days in pond	Number removed	No. at draining	Average Size at draining TL (mm)	Average Wgt. (g)	Cumulative survival* (%)
Apalachicola redeye	R-17	300	6/10	21-24	191	167	76	142	44.5	81.0
	R-18	80	6/11	21-24	190	0	68	169	49.5	89.9
Alabama redeye	R-15	300	5/9	22-25	224	164	81	184	19.1	81.7
	M-1 R-32	300 100	5/20 6/3	17-20 17-20	211 197	150 0	58 58	171 177	55.4 57.2	69.3 58.0
Apalachicola spotted	R-29	80	6/3	21-28	199	26	44	189	66.7	87.5
Alabama spotted	R-28	300	5/9	25-33	222	186	58	186	19.5	81.3

* The assumption was made that all specimens removed would have survived to the end of the experiment.

obtained in 1969. Brood fish were stocked into pond R-32 directly from Uphapee Creek, Macon County, Alabama, on March 22, and spawning occurred on approximately April 10 at 70 F. Fry (11 to 12 mm) were observed on April 25. Fry were 19 to 26 mm by May 8, and reached 63 mm by July 16. The male was never observed guarding the young, and fry were scattering around the pond shortly after swim-up.

Suwannee bass. Brood stock were probably brought from the stream too late for pond spawning in 1969. No reproductive success was obtained even with the injection of gonadotrophic hormone. However, the brood stock held over in a pond spawned in 1970. Spawning occurred in pond R-31 on April 6 at 68 F, and the eggs hatched on April 9 at 68 F. Sac fry were uniformly 5.5 mm after hatching, and were 6.5 to 7.5 mm by April 15. Young grew to 12 mm by May 4, and to 25 mm by May 21.

The same brood stock were held until 1971, and spawned once again in pond R-31. Eggs were deposited April 15 at 68 F, and had hatched by April 19. Fry had reached 12 mm by May 5 when water temperature was 76 F.

Rearing

Bass populations stocked separately. Table 4 and Figure 1 summarize the growth and survival of bass fingerlings stocked into 0.1-acre earthen rearing ponds with fathead minnows as forage. Stocking rates were dictated by the wish to provide adequate numbers of known fry and fingerlings, and in certain cases by the numbers of fry available for use. Fingerlings were removed for study of development of color patterns (Ramsey and Smitherman, 1972) and for stocking other ponds. Samples were taken at similar times and rates so that growth and survival could be generally compared.

Certain suggestions of the relative piscivorous habit of the various basses may be indicated in the following summary of forage availability in the rearing ponds.

Bass population and stocking/A	Date fry stocked	Fathead minnows	
		Date first depletion observed	Date second depletion observed
Redeye			
Apalachicola			
3,000	6/10	8/10	10/27
800	6/11	Not depleted	9/25
Alabama			
3,000	5/9	6/16	Not depleted
Smallmouth			
3,000	5/20	7/1	9/25
1,000	6/3	Not depleted	8/14
Spotted			
Apalachicola			
800	6/3	8/1	9/25
Alabama			
3,000	5/9	6/5	9/5

Probably the greatest factor, however, in determining when fathead minnow forage became depleted by basses at 3,000/A was the earlier stocking of Alabama redeye and Alabama spotted basses. These two forms were stocked on the same day, 11 days in advance of smallmouth and 31 days in advance of Apalachicola redeye. The Alabama redeye and Alabama spotted basses probably found more small fathead fry available

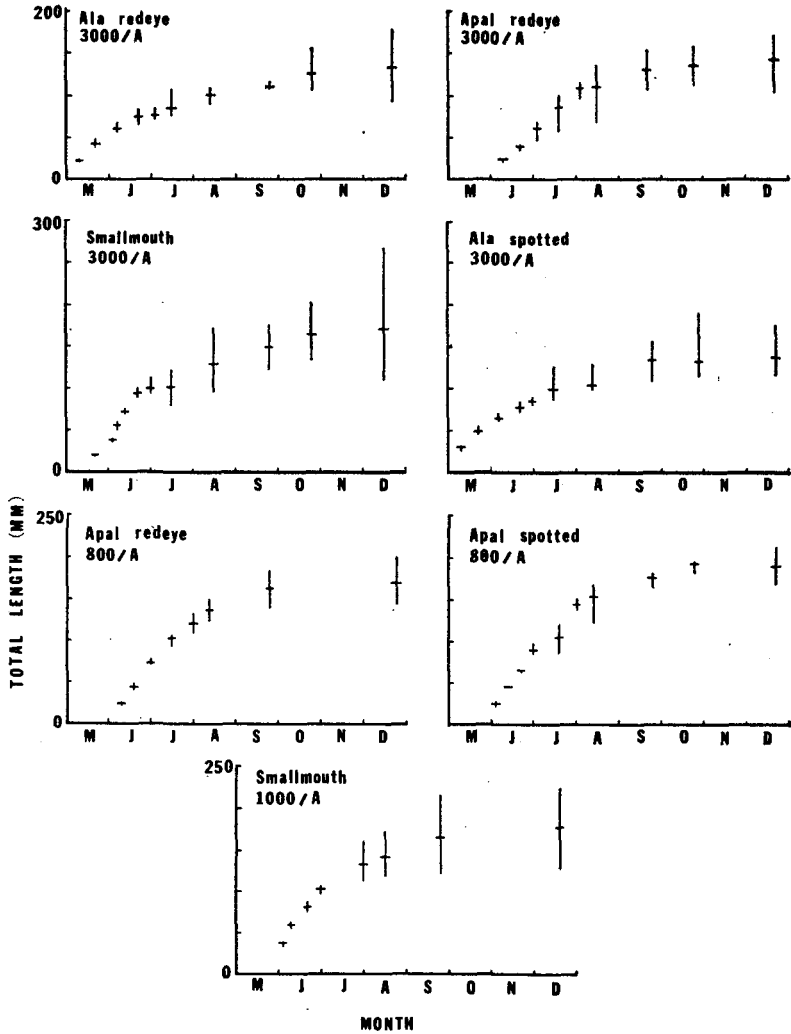


FIGURE 1. Growth of five bass forms stocked as fry in 1969. Stocking rate is given as number per acre. Vertical lines represent ranges, horizontal lines represent means. December figures derived from entire populations at draining, figures for other months from seined samples.

at that time, and started to eat minnows earlier. Of course, there was likely slight variation in the standing crops of fathead minnows in the ponds at the times of stocking bass fry. To summarize, depletion of fathead minnows in ponds stocked with 3,000 bass fry/acre occurred as follows: Alabama spotted—28 days; Alabama redeye—38 days; smallmouth—42 days; and Apalachicola redeye—92 days. When it was observed that the fathead minnows were not withstanding predation by the fingerling basses, 15 pounds of fathead minnows were supplementally stocked in each pond in early August.

Suwanee bass fry stocked in pond M-7 at 25 mm total length on May 21, 1970, grew to an average of 52 mm by June 9 and to an average of 82 mm by July 13. The largest fingerling observed on that date was 94 mm in total length. Growth rate appeared somewhat lower than in other bass forms although all specimens observed were robust.

Four basses stocked in combination. The growth and survival of bass fingerlings of four populations stocked into pond S-25 on July 16, 1969, is indicated in the following table.

Bass populations	Number stocked	Average weight (g)				Relative growth rate	Per cent survival
		7/16	8/18	9/10	12/17		
Redeye (Apal)	30	12.1	46.5	69.7	98.7	7.2	67
Redeye (Ala)	30	7.8	36.8	—	58.4	6.5	100
Smallmouth	30	18.8	72.3	105.0	107.5	4.7	70
Spotted (Ala)	30	9.4	—	—	92.1	8.8	90

Of four bass forms stocked in S-25, best survival (100 per cent) and least final weight was observed in Alabama redeye. Relatively low survival was observed in Apalachicola redeye and in smallmouth, while that of Alabama spotted bass was very good. Relative growth rate "h", $h = \frac{w_t - w_0}{w_0}$, where w_t = final weight, and w_0 = initial weight (Rounse-

fell and Everhart, 1960) was highest in Alabama spotted bass and lowest in smallmouth bass. During seine sampling, smallmouth and Apalachicola redeye were caught each time, but Alabama redeye was caught only once, and Alabama spotted was not taken. It is presumed the latter two fish occupied the deeper, open waters or were simply more elusive.

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