LARVAL FISH POPULATIONS IN LITTLE BEAR CREEK RESERVOIR DURING THE FIRST THREE YEARS OF IMPOUNDMENT

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Abstract: The data from 3 years of ichthyoplankton sampling during the initial impoundment of Little Bear Creek Reservoir are presented. Trends of percentage composition and abundance are discussed by family and taxon. The Centrarchidae greatly outnumbered other families of fishes throughout the study, while clupeids failed to become established. Strong year classes of *Lepomis* and *Pomoxis* were produced during the first year of impoundment. Relative failures of the second and third years are attributed to lack of spawning success in the case of *Lepomis* and predation in the case of *Pomoxis*. The ichthyoplankton data are compared to a preimpoundment adult survey and 3 years of concurrent postimpoundment rotenone surveys.

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The fish populations of newly impounded reservoirs are often monitored to describe their abundance, growth rates, species composition, and feeding habits. Most of these investigations are based on adult fish data collected by cove rotenone surveys, trap netting, gill netting, electrofishing, trawling, or creel census (Fitz 1968, Carter 1969, Walburg 1969 and 1976, Gasaway 1970, Hashagen 1973). Additional studies have been based on juveniles or small fishes (Martin and Campbell 1953, Patriarche and Campbell 1958, Walburg 1976), but there is relatively little information available concerning larval fish communities in new reservoirs. Mayhew (1977) described 6 years of larval fish dynamics following the impoundment of Lake Rathbun, Iowa. Siefert (1969) and Walburg (1976) reported ichthyoplankton data during the seventh and eighth years of the filling of Lewis and Clark Reservoir, South Dakota. The present study is based on ichthyoplankton and cove rotenone samples taken during the first 3 years of impoundment and a preimpoundment survey of the adult fishes of the Bear Creek watershed. The basic objective of this investigation was to describe the trends of abundance and species composition of the ichthyoplankton community and to provide comparisons with concurrent cove rotenone data during early impoundment of Little Bear Creek Reservoir, Alabama.

MATERIALS AND METHODS

Description of Study Area

Little Bear Creek Reservoir is part of a four-reservoir system designed primarily to control flooding in the Bear Creek watershed of the Tennessee River system in northwestern Alabama. Impounded during the winter of 1975-76, the reservoir has a total length of 16 km, a shoreline length of 61 km, and a surface area of 631 ha at the normal maximum pool elevation of 189 m above MSL. This elevation was reached by 15 April, 1976. Reservoir volume at this elevation is $5.59 \times 10^7 m^3$, the mean depth is 8.87 m, and the storage time is 226 days (TVA 1972).

Larval Fish

Ichthyoplankton sampling was initiated in the spring of 1976 and continued through the 1978 larval season. Three transects were studied each year; the Middle Transect at LBCM 14.8; the Upper Transect at LBCM 17.6, and Trace Creek, a major tributary entering the reservoir at LBCM 13.4 (Fig. 1).

Ichthyoplankton were collected in a square, 0.5 m net of 0.5 mm mesh Nitex netting which was pushed at varied depths by a boat approximating a velocity of 1 m per second

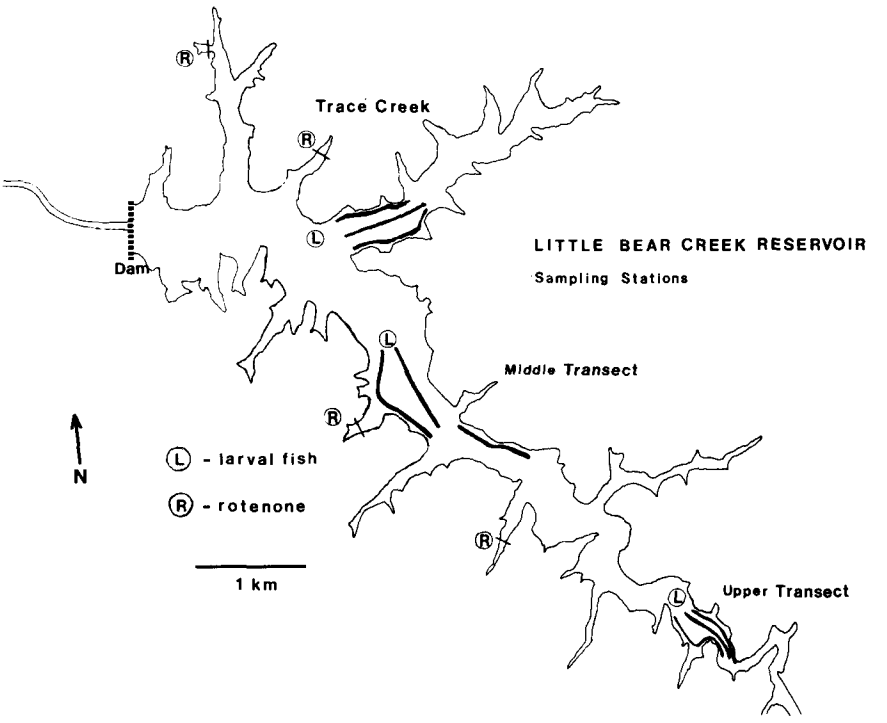

Fig. 1. Map of Little Bear Creek Reservoir, Tennessee River system, Alabama.

as described by Graser (1977). Full stratum samples were taken near both shorelines and in the midchannel at the three transects shown in Fig. 1. The midchannel water column was divided into shallow and deep strata at the Middle and Trace Creek transects. The flow rates were measured with a General Oceanics flowmeter mounted in the mouth of the net. Each sample consisted of 10 minutes of effort, and filtered approximately 150 cubic meters. Day and night samples were collected during each sample period (weekly in 1976 and 1977 and biweekly in 1978). The samples were preserved in 5-10% formalin solution and identified according to Hogue et al. (1976).

Adult Fish

The 4 coves sampled with rotenone are designated in Fig. 1. Two coves were surveyed in 1976 and 1977, and 4 in 1978. Each cove had a surface area of approximately 0.5 ha and the maximum depth ranged from 3.7 to 5.2 m. The data were collected according to the procedures outlined by Hall (1974). The preimpoundment study was based on seine collections made by Wall (1968).

RESULTS

Larval Fish

The seasonal patterns of larval fish occurrence appear in Fig. 2. The highest densities of larvae (numbers per 1,000 m^3) occurred in 1976. The 1977 densities were approximately one-tenth as great as the 1976 values. The 1978 data were more erratic with density fluctuations as high as 760 or as low as 30.

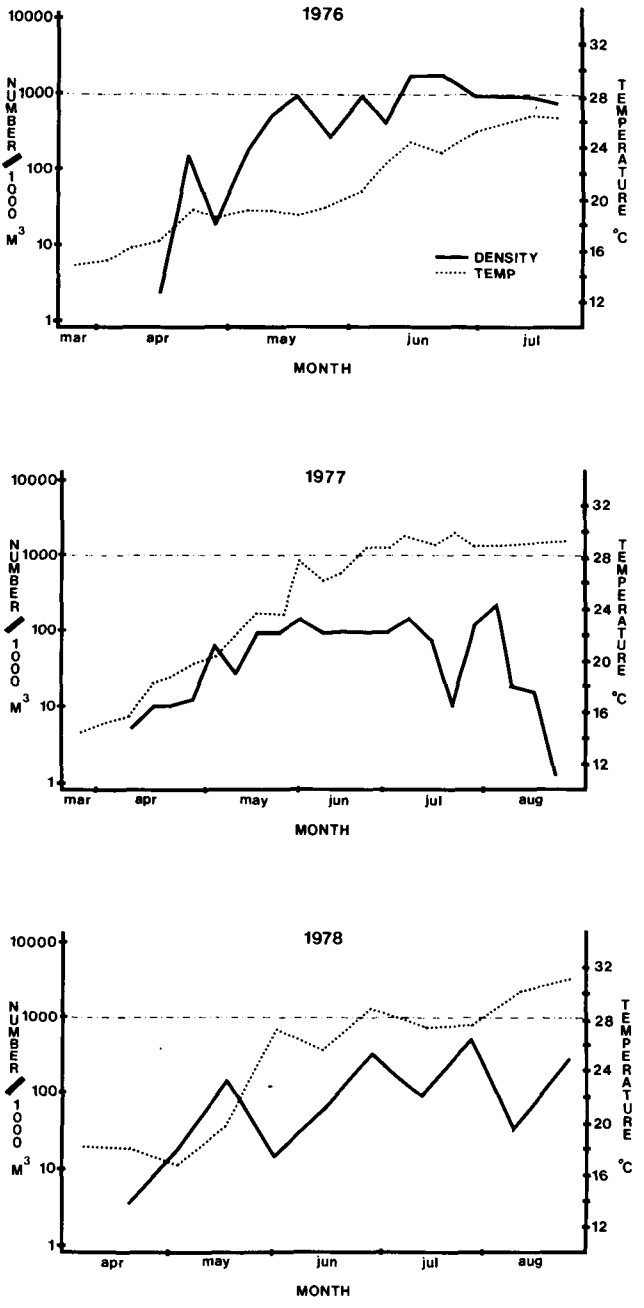

Fig. 2. Seasonal pattern of total larval fish densities (numbers per 1000 cubic meters) and mean temperatures observed at Little Bear Creek Reservoir, 1976-78.

The first larval fish in 1976 were collected on 15 April, when the mean water temperature was 16 C. These were mostly darter larvae. The peak occurring 1 week later was due to a hatch of black bass, (*Micropterus* spp.), although *Lepomis* spp. account for approximately 20% of that peak. Beginning on 29 April and continuing until the end of the season, *Lepomis* larvae dominated the ichthyoplankton samples at Little Bear Creek Reservoir.

Unspecified darter larvae were the first taxon to occur in 1977. They appeared on 6 April, at 15 C, and became slightly more abundant during the next sampling period. *Pomoxis* larvae appeared on 20 April and remained dominant until 4 May when they peaked at a density of 78. Larval abundance during the remainder of the season is a reflection of *Lepomis* densities, as relatively few other taxa were collected. The switch to *Lepomis* dominance occurred on 11 May.

Pomoxis larvae were the most abundant taxon collected in the second sampling period of 1978, 20 April, when sampling was biweekly. The mean water temperature for this period was 15.2.C. *Pomoxis* and unspecified cyprinids increased the densities of the third period. *Pomoxis* and *Micropterus* spp. in nearly equal quantities resulted in the peak of period 4. As in the previous years, the latter part of the season was dominated by *Lepomis* larvae, beginning with the samples of 1 June.

The catch statistics of the ichthyoplankton investigations at Little Bear Creek Reservoir illustrate the dominance of the centrarchids. Their numbers represent 97% or more of the total catch in each year of the 3-year study period (Table 1). According to the preimpoundment study done in 1965-67 (Wall 1968, unpublished), only 1.3% of all the fish in Little Bear Creek were centrarchids (Table 2). This family will be discussed in detail below. The second most frequently occurring family was the Cyprinidae with a relative abundance of only 1%. Larval and juvenile ictalurids were only captured in 1976, and were the third most frequently occurring family. Percids were most prevalent in 1977. Clupeids were captured in the three years of ichthyoplankton sampling, but in remarkably low numbers (Table 1). Clupeids are usually the most abundant family of fishes in impoundments of the Tennessee River system. Catostomids and cyprinodontids were present in low numbers. Families conspicuously absent from Little Bear Creek Reservoir include the percichthyids and the sciaenids.

The most abundant group collected each year was *Lepomis* spp., although current larval fish taxonomy does not allow differentiation between the five species of *Lepomis* present in Little Bear Creek Reservoir. They gradually decreased in relative abundance each season. In contrast, the overall season densities show an extreme decrease. Seasonal densities of *Lepomis* larvae were 953 in 1976 and only 79 in 1977, a density corresponding to 8% of the 1976 density. The seasonal density for 1978 was 188 larvae per 1000 m^3, an increase over 1977, but still only 20% of the 1976 density. Peak *Lepomis* densities occurred progressively later in the season during the three-year study period (16 June 1976, 6 July 1977, and 27 July 1978, Table 1).

While the *Lepomis* spp. showed a gradual decline in relative abundace, the *Pomoxis* spp. showed increases for each consecutive season (Table 1). *Pomoxis* larvae in 1976 amounted to 0.23% of the catch, and increased to 5.13 and 6.19% in 1977 and 1978, respectively.

Analyzing the *Pomoxis* data by transect according to the length frequencies and densities yields insights on the behavior of fry and the selection of spawning sites (Figs. 3 and 4). Data for 1976 suggest that spawning occurred in the Trace Creek and Middle Transect areas with subsequent migration of juveniles to the Upper Transect. Lengths of *Pomoxis* larvae at Trace Creek ranged from 4 to 21 mm. At the Middle Transect lengths ranged from 4 to 31 mm. Relatively fewer crappie were collected at the Upper Transect, but these ranged from 13 to 58 mm. All *Pomoxis* fry greater than 35 mm captured in 1976 were taken at the Upper Transect.

TABLE 1. Percent relative abundance, length ranges, and peak density data of larval and juvenile fishes collected at Little Bear Creek Reservoir, 1976-78*.

Family	Family Rel. Abundance(%)	Taxon	Total Collected	Taxon Rel. Abundance(%)	Length Range(mm) Min.	Max.	Peak Density (No./1000 m³)	Date	Mean Temperature
1976 (25 March-22 July)	Total volume of water sampled 65,308 m³.								
Centrarchidae	98.19	*Ambloplites rupestris*	7	0.01	9	23	0.64	26 May	19.3
		Lepomis spp.	62,268	96.94	4	36	3,405.95	16 June	24.2
		Micropterus spp.	630	0.98	7	21	186.90	22 April	19.2
		M. dolomieui	3	tr	40	42	0.22	23 June	23.2
		M. punctulatus	13	0.02	24	43	1.34	12 May	18.7
		M. salmoides	4	0.01	26	43	0.38	3 June	21.2
		Pomoxis spp.	145	0.23	4	58	8.29	12 May	18.7
Cyprinidae	1.00	Unspecified cyprinids	108	0.17	4	16	7.62	12 May	18.7
		Notemigonus crysoleucas	140	0.22	6	70	18.37	12 May	18.7
		Notropis spp.	375	0.58	13	59	21.10	6 May	18.8
		N. telescopus	21	0.03	32	71	6.78	3 June	21.2
Ictaluridae	0.51	*Ictalurus melas*	325	0.51	10	60	63.97	9 June	23.0
		Pylodictis olivaris	1	tr	15	15	0.24	15 July	26.0
Percidae	0.15	Unspecified percids	99	0.51	5	21	5.61	6 May	18.8
		Etheostoma caeruleum	1	tr	34	34	0.22	16 June	24.2
		E. daryi	1	tr	33	33	0.22	16 June	24.2
Clupeidae	0.13	Unspecified clupeids	86	0.12	4	18	8.52	26 May	19.3
Catostomidae	0.01	Unspecified catostomids	6	0.01	11	17	0.52	19 May	18.6
	-	Total Fish	64,232						
1977 (23 March-24 August)	Total volume of water sampled 83,861 m³.								
Centrarchidae	97.45	*Lepomis spp.*	6,634	92.29	4	29	292.03	6 July	29.5
		Micropterus punctulatus	2	0.03	29	91	0.26	18 May	23.7
		Pomoxis spp.	369	5.13	4	18	78.13	4 May	20.2
Percidae	1.57	Unspecified percids	113	1.57	5	13	12.71	13 April	17.6
Cyprinidae	0.96	Unspecified cyprinids	18	0.25	4	9	2.36	29 April	18.1
		Notemigonus crysoleucus	47	0.65	5	14	2.58	6 July	29.5
		Notropis spp.	4	0.06	10	20	0.31	13 July	28.8
Clupeidae	0.01	Unspecified clupeids	1	0.01	9	9	0.26	6 July	29.5
		Total Fish	7,188						
1978 (6 April-24 August)	Total volume of water sampled 35,763 m³.								
Centrarchidae	98.77	*Lepomis spp.*	6,719	87.96	4	20	762.62	27 July	27.9
		Micropterus spp.	353	4.62	7	8	113.01	18 May	19.4
		Pomoxis spp.	473	6.19	5	34	116.53	18 May	19.4
Cyprinidae	0.96	Unspecified cyprinids	73	0.96	5	27	13.47	4 May	16.3
Clupeidae	0.14	Unspecified clupeids	11	0.14	6	15	1.92	18 May	19.4
Percidae	0.10	Unspecified percids	8	0.10	8	14	1.92	18 May	19.4
Catostomidae	0.01	Unspecified catostomids	1	0.01	11	11	0.31	4 May	16.3
Cyprinodontidae	0.01	*Fundulus spp.*	1	0.01	7	7	0.32	1 June	26.8
		Total Fish	7,639						

*The taxa included in this table are limited to a minimum length range of 40 mm or less to exclude age 1+ fishes.

Spawning, as evidenced by 4-5 mm larvae, occurred at all transects in 1977 and 1978, but during these years the greatest numbers were collected at the Upper Transect (Fig. 3). Juvenile *Pomoxis* greater than 35 mm were not collected in 1977 and 1978 ichthyoplankton sampling indicating that survival was higher in 1976.

The densities of *Pomoxis* larvae have been increasing with each year of impoundment (Fig. 4). Low densities (less than 20 fish per 1000 m^3) occurred at all transects in 1976. Trace Creek and the Middle Transect peaked at about 20 in 1977, but the Upper Transect peaked significantly higher (244). Peak densities at all transects increased in 1978, but the Upper Transect still had the greatest density (316).

Although considerable numbers of black bass larvae were captured in 1976 and 1978, most of these fish were taken in just 2 samples. Both of these samples were taken at the right shoreline of the Trace Creek Transect in depths of 0 to 3.5 m and a water temperature of 20.5 C during the daylight hours. On 22 April, 1976, 602 individuals were collected in 1 sample with a total length range of 8-11 mm. A density calculated from this sample is 3,767 bass larvae per 1000 m^3. The remainder of the *Micropterus* larvae captured in 1976 were also taken at the Trace Creek Transect with the exception of one 21 mm specimen taken at the Middle Transect. The 353 bass larvae taken on 18 May, 1978, were all 7 and 8 mm, and this sample contained the entire season's catch of *Micropterus* spp. larvae. A density of 2,484 bass larvae is estimated from this sample.

TABLE 2. Percent relative abundance and totals of Little Bear Creek fishes according to the results of seine samples, 1965-67.*

Family	Family Rel. Abundance (%)	Species	Total Collected	Species Rel. Abundance (%)
Cyprinidae	61.34	*Campostoma anomalum*	28	2.47
		Clinostomus funduloides	1	0.09
		Hybopsis amblops	15	1.32
		Nocomis micropogon	6	0.53
		N. leptocephalus	6	0.53
		Notropis ardens	195	17.21
		N. baileyi	40	3.53
		N. chrysocephalus	56	4.94
		N. galacturus	131	11.56
		N. spilopterus	32	2.82
		N. telescopus	114	10.06
		Pimephales notatus	63	5.56
		Semotilus atromaculatus	8	0.71
Percidae	24.18	*Etheostoma* (*Ulocentra*) sp.	22	1 94
		E. blennioides	2	0.18
		E. caeruleum	56	4.94
		E. duryi	17	1.50
		E. nigrum	1	0.09
		E. rufilineatum	131	11.56
		E. simoterum	23	2.03
		E. stigmaeum	9	0.79
		Percina caprodes	8	0.71
		P. sciera	5	0.44
Catostomidae	4.59	*Hypentelium nigricans*	18	1.59
		Minytrema melanops	1	0.09
		Moxostoma duquesnei	2	0.18
		M. erythrurum	31	2.74
Cottidae	4.50	*Cottus carolinae*	51	4.50
Petromyzontidae	2.56	*Ichthyomyzon bdellium*	1	0.09
		Lampetra lamottei	28	2.47
Cyprinodontidae	1.41	*Fundulus catenatus*	5	0.44
		F. olivaceus	11	0.97
Centrarchidae	1.32	*Ambloplites rupestris*	1	0.09
		Lepomis cyanellus	2	0.18
		L. macrochirus	6	0.53
		L. megalotis	3	0.26
		L. microlophus	2	0.18
		Micropterus punctulatus	1	0.09
Sciaenidae	0.09	*Aplodinotus grunniens*	1	0.09
		Total Fish	1,133	

*These data were derived from Wall, 1968.

Adult Fish

The species composition of the adult fish populations was studied prior to the construction of Little Bear Creek Dam (Wall 1968) and has since been monitored annually by TVA rotenone crews. The preimpoundment species list shows an overall dominance by cyprinids followed by percids, catostomids, and cottids (Table 2). These species represent the brood source of the developing fish community in the newly impounded reservoir. In addition, 22,400 smallmouth bass (*M. dolomieui*) were stocked in the creek and reservoir in 1974-76. No threadfin shad were stocked during the study,

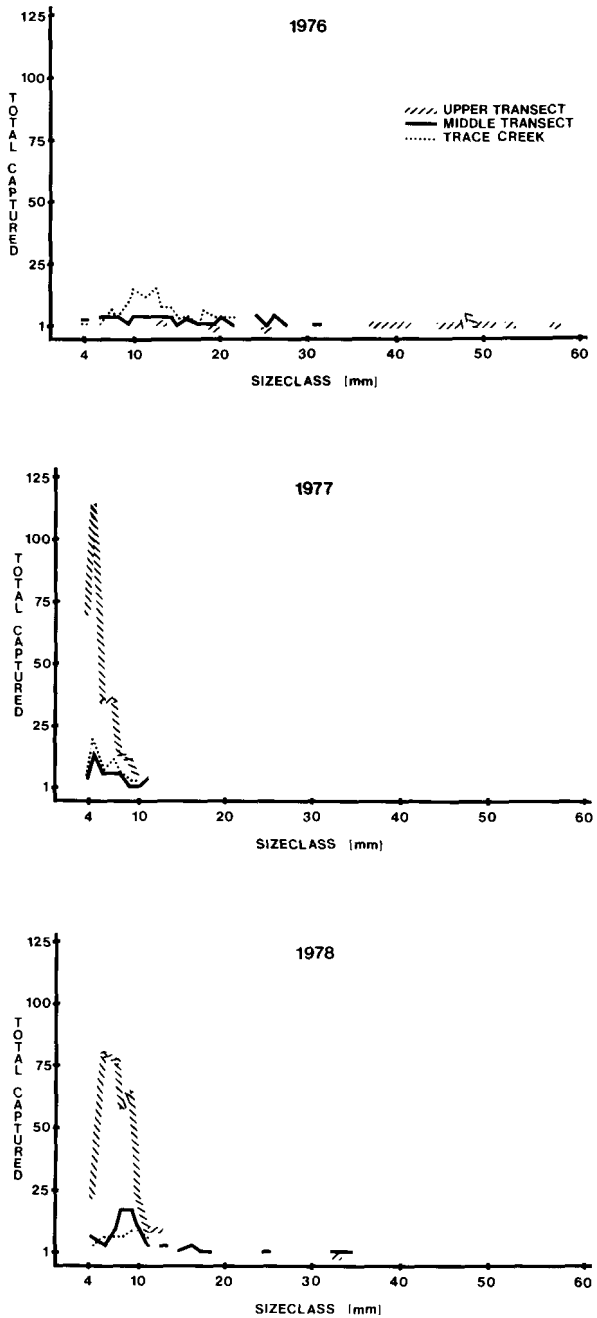

Fig. 3. Length frequency distribution of larval and juvenile *Pomoxis* collected at three transects of Little Bear Creek Reservoir, 1976-78.

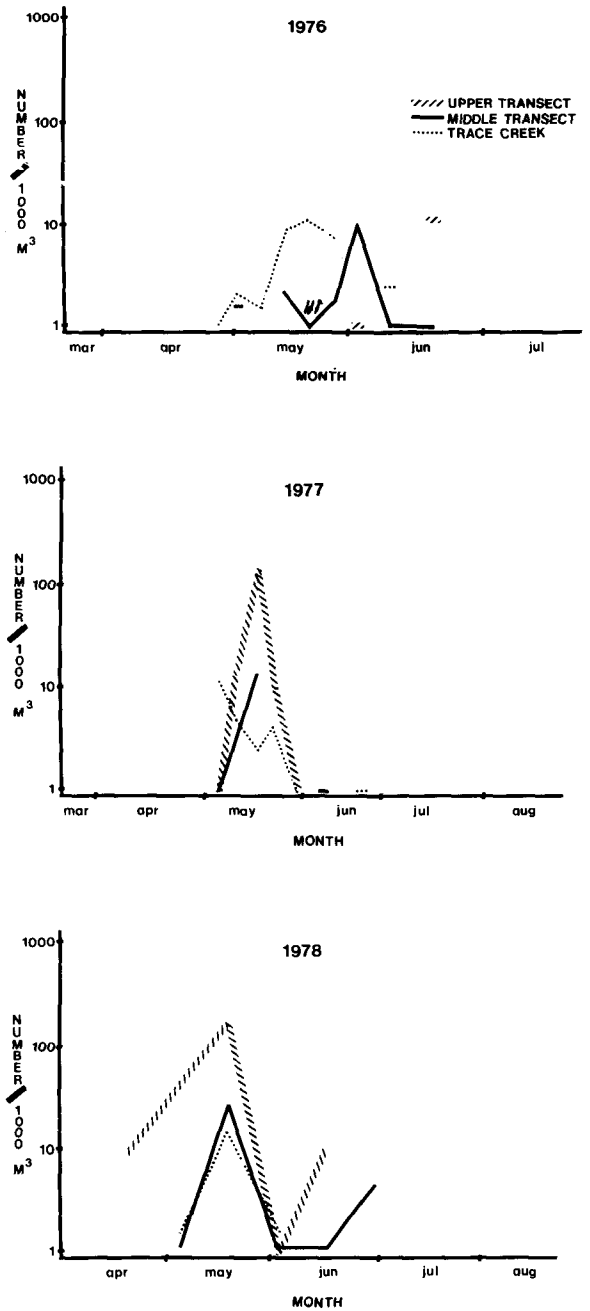

Fig. 4. Density distribution of larval and juvenile *Pomoxis* collected at three transects of Little Bear Creek Reservoir, 1976-78.

although Alabama fisheries personnel introduced them in the spring of 1979 (C. Lawson, Alabama Department of Conservation, personal communication).

The postimpoundment species composition from cove rotenone data agrees well with the larval composition; centrarchids were predominant and accounted for 77% of all the fishes collected from the 2 coves sampled in 1976 (Table 3). During 1977 and 1978 centrarchids increased in relative abundance to 95.3 and 93.3%, respectively. Cyprinids fluctuated from a high in 1976 of 5.0% to a low in 1977 of 0.4% and to 4.6% in 1978. Ictalurids decreased each year. Percids remained at approximately the same percentages for the years sampled. Clupeids, although present in larval fish samples, were not collected in cove rotenone surveys. The catostomids dropped from 0.83% in 1976 to 0.06% in 1978. No adult or juvenile clupeids or sciaenids were taken in any cove sampled by rotenone in 1976-1978.

The most abundant species (38%, 3,880/ha) in Little Bear Creek Reservoir in 1976 according to two coves sampled by rotenone was largemouth bass (*M. salmoides*) (Table 3). Length analysis grouped the majority of these bass in the 51-75 mm range, which are young-of-the-year fish. The second most abundant species in percentage composition was the green sunfish (*Lepomis cyanellus*). The black bullhead (*Ictalurus melas*), the third most common fish in 1976, was largely represented by young-of-the-year fish. Bluegills (*L. macrochirus*) were fourth in percentage abundance (12.3%). Fifth in abundance were longear sunfish (*L. megalotis*). The stoneroller (*Campostoma anomalum*), a ubiquitous stream species, was recorded in the reservoir with a relative abundance of 3.8%. The blackspotted topminnow (*Fundulus olivaceus*) had a relative abundance of 1.1. The remaining speices amounted to less than 1% of the standing stock.

Major revisions in species composition of 1977 cove rotenone samples involve the *Lepomis* spp. Bluegills were the most abundant (63%) species in the coves, estimated at 6,946 fish/ha. Estimates of longear sunfish tripled and were greater than green sunfish. Relative abundance of largemouth bass decreased to 0.5%, and the percentage of black bullheads also fell below 1. Blackspotted topminnows doubled in percent composition. All other species had percentages of less than 1.

Lepomis spp. remained dominant in 1978 with a combined relative abundance of 93%. The order of abundance of the 3 most frequently occurring species was not changed. Bluntnose minnows, (*Pimephales notatus*), became markedly more abundant with a relative abundance of 3.5%. All other species had percentages of less than 1.

DISCUSSION

Since the inundation of the Little Bear Creek watershed, the relative abundance of *Lepomis* spp. has increased from less than 2% in the preimpoundment study (Table 2) to over 90% in the postimpoundment cove rotenone surveys (Table 3). Ichthyoplankton samples have likewise shown predominance of this group (Table 1). From the species composition of the cove rotenone samples, it seems likely that the *Lepomis* larvae discussed herein are (in order of abundance) bluegills, longear, and green sunfish. A competitive advantage of bluegill and longear sunfish over the green sunfish in a reservoir environment is suggested by these results. Patriarche and Campbell (1958) documented the high abundance of bluegills and longear sunfish during the early impoundment of Clearwater Reservoir, Missouri.

The 90% decline in 1977 larval densities during the *Lepomis*-dominated periods may be attributed to crowding and predation. Swingle and Smith (1943) stated that successful reproduction of bluegill in Alabama ponds was delayed until August or September in crowded situations, and that scarcity of food led to predation of eggs by the adults. Mullan and Applegate (1967) reported predation on fish eggs and small fishes by bluegill and green sunfish in Beaver Reservoir during the summer months, and the prey species likely included small *Lepomis*. *Lepomis* larvae becoming dominant in the Little Bear

TABLE 3. Percent relative abundance of Little Bear Creek Reservoir fishes according to the results of rotenone samples, 1976-1978.

Family	Family Rel. Abundance (%)	Species	Total Collected	Species Rel. Abundance (%)
1976 (2 coves sampled) August 24-26, total area sampled was 1.12 ha				
Centrarchidae	77.38	*Ambloplites rupestris*	5	0.04
		Lepomis cyanellus	2,180	19.07
		L. macrochirus	1,405	12.29
		L. megalotis	760	6.65
		L. microlophus	1	0.01
		Micropterus dolomieui	38	0.33
		M. punctulatus	74	0.65
		M. salmoides	4,346	38.02
		Pomoxis annularis	36	0.31
Ictaluridae	15.09	*Ictalurus melas*	1,562	13.66
		I. natalis	138	1.21
		I. nebulosus	6	0.05
		Noturus miurus	19	0.17
Cyprinidae	5.02	*Campostoma anomalum*	434	3.80
		Notemigonus crysoleucas	56	0.49
		Notropis cornutus	21	0.18
		N. galacturus	27	0.24
		Pimephales vigilax	36	0.31
Cyprinodontidae	1.43	*Fundulus catenatus*	36	0.31
		F. olivaceus	128	1.12
Catostomidae	0.83	*Hypentelium nigricans*	22	0.19
		Minytrema melanops	24	0.21
		Moxostoma duquesnei	42	0.37
		M. erythrurum	7	0.06
Percidae	0.24	*Percina caprodes*	27	0.24
Cottidae	0.01	*Cottus carolinae*	1	0.01
		Total Fish	11,431	
1977 (2 coves sampled) September 27-29, total area sampled was 1.12 ha				
Centrarchidae	95.26	*Ambloplites rupestris*	1	0.01
		Lepomis cyanellus	1,521	12.38
		L. macrochirus	7,780	63.34
		L. megalotis	2,339	19.04
		Micropterus dolomieui	1	0.01
		M. punctulatus	1	0.01
		M. salmoides	58	0.47
Cyprinodontidae	2.40	*Fundulus olivaceus*	295	2.40
Ictaluridae	1.54	*Ictalurus melas*	101	0.82
		I. natalis	9	0.07
		I. nebulosus	19	0.15
		Noturus miurus	50	0.41
Cyprinidae	0.37	*Campostoma anomalum*	1	0.01
		Notropis cornutus	1	0.01
		N. galacturus	14	0.11
		N. whipplei	8	0.07
		Pimephales notatus	22	0.18
Catostomidae	0.24	*Hypentelium nigricans*	14	0.11
		Minytrema melanops	7	0.06
		Moxostoma macrolepidotum	2	0.02
		M. duquesnei	3	0.02
		M. erythrurum	4	0.03
Percidae	0.24	*Percina caprodes*	29	0.24
Poeciliidae	0.02	*Gambusia affinis*	3	0.02
		Total Fish	12,283	
1978 (4 coves sampled) August 8-10, September 19, October 4, total area sampled was 2.27 ha				
Centrarchidae	93.36	*Ambloplites rupestris*	5	0.01
		Lepomis gulosus	8	0.01
		L. cyanellus	4,905	8.34
		L. macrochirus	35,993	61.19
		L. megalotis	13,670	23.24
		L. microlophus	1	tr
		Micropterus dolomieui	21	0.04
		M. punctulatus	70	0.12
		M. salmoides	222	0.38
		Pomoxis annularis	16	0.03

Table 3. (cont.)

Cyprinidae	4.62	*Campostoma anomalum*	222	0.38
		Notemigonus crysoleucas	11	0.02
		Notropis ardens	45	0.08
		N. cornutus	4	0.01
		N. galacturus	333	0.57
		Pimephales notatus	2,091	3.56
Catostomidae	0.06	*Hypentelium nigricans*	8	0.01
		Moxostoma anisurum	3	0.01
		M. erythrurum	22	0.04
Ictaluridae	0.94	*Ictalurus melas*	94	0.16
		I. natalis	424	0.72
		I. punctatus	5	0.01
		Noturus miurus	32	0.05
		N. nocturnus	1	tr
Cyprinodontidae	0.83	*Fundulus olivaceus*	489	0.83
Percidae	0.21	*Etheostoma duryi*	1	tr
		E. kennicotti	1	tr
		E. rufilineatum	1	tr
		E. squamiceps	2	tr
		Percina caprodes	118	0.20
		Total Fish	53,818	

Creek Reservoir samples at later dates and higher temperatures with each successive year of impoundment is another indication of increasing population density. Swingle and Smith (1943) found spawning to be delayed by excessive densitities and Swingle (1956) reported a repressive factor, thought to be a hormone, to be responsible. Anderson (1971) likewise observed poorer reproduction from high densities of bluegills. Crowded spawning conditions at Little Bear Creek Reservoir may be comparable to those of experimental ponds on the basis of suitable spawning habitat availablity. Mayhew (1974) found successful reproduction of bluegill occurred in large embayments of Lake Rathbun, instead of the littoral area of the reservoir proper. If the same is true at Little Bear Creek Reservoir, coves and backwaters of the reservoir may be sufficiently crowded during the spawning season to produce the results recorded from overpopulated pond situations. This is not to say that the *Lepomis* populations are not expanding, as rotenone results indicate that they are. However, the rate of expansion has decreased.

In contrast to the declining relative abundance of *Lepomis* larvae at Little Bear Creek Reservoir, the numbers of *Pomoxis* larvae have increased during the three-year study period (Table 1). Only in the first season did the lengths of juvenile *Pomoxis* taken in ichthyoplankton samples exceed 35 mm, which is an indication of survival and relative strength of the 1976 year class. This phenomenon may be attributed to a low concentration of predators. Walburg (1976) found the strongest year class of white crappies in Lewis and Clark Reservoir occurred during the first year of a seven-year postimpoundment study.

A larger spawn of *Pomoxis* was indicated in 1977 by the greater density of larvae (Fig. 4), which were mostly 4-10 mm in length. The increased production was probably enhanced by maturation and spawning of the 1976 year class. Siefert (1969) reported 47% maturation of yearling white crappie in the newly impounded Lewis and Clark Reservoir when growth was rapid. The absence of larger *Pomoxis* specimens (greater than 35 mm) in the 1977 larval samples (Fig. 3) could well be associated with increased numbers of predators, especially yearling largemouth bass. Swingle and Swingle (1967) reported that strong age I bass populations prohibit the formation of strong crappie year classes due to predation. The abundance of young-of-the-year largemouth bass in the 1976 rotenone results was discussed above (Table 3). Still greater production of crappie larvae was observed in the 1978 season, a reflection of additional maturation of the 1976 year class and possible recruitment of some 1977 fish to the spawning population. The crappie captured in the ichthyoplankton samples were again limited to 35 mm or less, indicating a lower survival rate than observed in the 1976 year class. In contrast to the present study, a

strong year class of crappie was not produced in Clearwater Reservoir in Missouri until the third year of impoundment (Patriarche and Campbell 1958).

The white crappie collected in the 1976 and 1978 cove rotenone samples were not in sufficient numbers for analysis. The lack of crappies may be due to the size and depth of the coves sampled. The maximum depths of the coves ranged from 3.7 to 5.2 m. According to Grinstead (1969) the vertical distribution of white crappies in the Buncombe Creek embayment of Lake Texoma averaged 6.2 m in August and 5.4 in September. The coves sampled at Little Bear Creek Reservoir contained mostly water less than 5 m deep, and probably did not yield representative numbers of adult or juvenile white crappies.

In summary, the data collected in 3 years of ichthyoplankton sampling at Little Bear Creek Reservoir have yielded insights into the formation and strength of year classes of two selected genera. These data compare favorably with cove rotenone data. Strong year classes were produced during the first year of impoundment for both *Lepomis* and *Pomoxis*. The relative failures of the second and third years are due to decreased spawning success, i.e., fewer larvae produced, in the case of the *Lepomis*. This was not true for *Pomoxis*, and the weakness of two consecutive year classes is attributed to predation. The establishment of a clupeid-based forage community would enhance the year-class strength of future *Pomoxis* stocks in Little Bear Creek Reservoir, as well as the other predatory species.

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