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FOOD OF LARGEMOUTH BASS BEFORE AND DURING THE FIRST THREE YEARS AFTER IMPOUNDMENT OF WEST POINT RESERVOIR, ALABAMA AND GEORGIA

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ABSTRACT

Food of adult largemouth bass, *Micropterus salmoides*, changed from primarily crayfish to primarily fish after impoundment of West Point Reservoir. Adults in the reservoir fed predominantly on gizzard shad, *Dorosoma cepedianum*, and secondly on sunfishes (Centrarchidae). The abundance of bluegills, *Lepomis macrochirus*, increased progressively in the reservoir, and also in the bass diet, during the first three years of impoundment. A few bass as small as 25 mm ate larval fishes, but crustaceans and insects were the major food items. Bass longer than 75 mm stopped feeding on crustaceans and ate larger insects and small fishes. Sunfishes were important prey until the bass began to feed on gizzard shad.

INTRODUCTION

Seasonal changes in feeding by different size groups of largemouth bass, *Micropterus salmoides*, were studied before the impoundment of the Chattahoochee River to form West Point Reservoir and during the first 3 years after impoundment. A knowledge of feeding of rapidly growing bass in the new reservoir might be used to improve management of prey in other new reservoirs.

Early papers on the food of largemouth bass, most of which were based on relatively small samples, were reviewed by Dendy (1946) and McLane (1948). More recent studies, which have usually been of short duration (1 year or less) were reviewed by Carlander (1977) and Heidinger (1976). Food of young bass in a new and in an old reservoir was discussed by Applegate and Mullan (1967).

STUDY AREA AND METHODS

West Point Reservoir, a U.S. Army Corps of Engineers impoundment of the Chattahoochee River, extends from 5.1 km north of West Point, Georgia, near the Alabama state line, to Franklin, Georgia. It lies just above the fall line in the Piedmont physiographic region. It was impounded in October 1974 and filled to full power pool by May 1975. The reservoir level is maintained at 194 m above mean sea level except for a 3 m drawdown in the winter for flood control. At the summer pool elevation, the surface area is 10,482 ha, the volume 745.7 million m^3, the shoreline length 845 km, and the average depth 7.1 m.

Stomachs of largemouth bass collected by electrofishing and seining were examined for food items from January 1972 to September 1973 (preimpoundment) and from September 1975 to August 1978 (post impoundment). A boat-mounted 110-Volt AC generator with a pulsator unit that provided variable DC was used for electrofishing in nearshore areas during daylight—usually in the morning and early afternoon. Fish were placed on ice to minimize regurgitation and later measured to the nearest millimeter (total length) and weighed to the nearest gram. Food items were sorted into five groups: crustaceans, insects, oligochaetes, arachnids, and fishes. Fishes were identified to species when possible. The percent frequency of occurrence of food items was determined for all bass, and the average number of food items per fish was determined for all bass, and the average number of food items per fish was determined for bass from the 1977 year class. Invertebrates found in stomachs of the 1977 year class were identified to the lowest taxon, using keys by Pennak (1978).

RESULTS AND DISCUSSION

Stomach contents of 78 largemouth bass from the Chattahoochee River in the reservoir area were examined before its impoundment. Crayfish were in the stomachs of 45% of the adult bass (>250 mm long), 36% of the juveniles (150-250 mm), and 12% of the bass 50-149 mm long. Fish occurred less frequently: 10% in adults, 36% in juveniles, and 12% in younger bass. Insects were most common in smaller bass: 100% occurrence in bass less than 50 mm long and 35% in those 50-149 mm long, and 18% in those 150-250 mm long. Young bass less than 50 mm long also fed heavily on oligochaetes (33% frequency of occurrence). Empty stomachs were common: 45% of the adults, 27% of the juveniles, and 38% of the younger bass. Crayfish were a minor food item after impoundment. Only 6 of 3028 stomachs of bass of all sizes contained crayfish. Crayfish are an important food item when available and may be selected by bass over other prey (Ball 1948; Bennett 1951), as they apparently did in the unimpounded river. However, crayfish appear to be uncommon in West Point Reservoir.

The food consumed by bass changed as they grew. In 1977 we examined 725 young-of-the-year (YOY) bass collected throughout the first growing season (1977). They were separated into 25-mm length groups (Table 1). The smallest YOY was 11 mm long and the largest 322 mm. The smallest bass fed on copepods, cladocera, and chironomid larvae.

The diet of bass 25-49 mm long was composed chiefly of copepods, cladocera, and chironomid larvae, but also included a wide assortment of larger crustaceans, insects, and larval fishes. Bass as short as 25 mm occasionally contained larval fish. Fish larvae and young eaten by bass included bullheads, *Ictalurus* spp.; mosquitofish, *Gambusia affinis;* brook silversides, *Labidesthes sicculus;* undetermined sunfishes, *Lepomis* spp.; green sunfish, *L. cyanellus;* bluegills, *Lepomis macrochirus;* small bass, *Micropterus* spp.; and black crappies, *Pomoxis nigromaculatus*. Bass as short as 10 mm have been reported feeding on fathead minnows, *Pimephales promelas* (Tucker 1973), and others have reported bass 25 mm long feeding on fish (Allan and Romero 1975; Echelle and Mense 1968).

Table 1. Stomach contents of 725 young-of-the-year largemouth bass from West Point Reservoir, 1977; frequency of occurrence (%) and the average number of items per fish (No.).

Length (mm)	0-24		25-49		50-74		75-99		100-124		125-149		150-174		175-199		200-224		225-249		250-274		275-299		300-324	
Number Sampled	23		344		157		78		52		14		13		8		13		9		10		1		3	
Number Empty	1		33		33		26		18		8		7		3		6		4		6		0		1	
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Crustacea																										
Anostraca			0.9	0.12																						
Cladocera	95.2	9.13	33.4	10.85	8.9	1.47																				
Ostracoda			2.9	0.25	1.9	0.03																				
Copepoda	26.1	0.96	35.2	8.69	14.0	2.50																				
Isopoda			0.6	0.01																						
Amphipoda			5.2	0.09	3.8	0.09																				
Decapoda			0.6	0.01																						
Arachnoidea																										
Terrestrial			1.5	0.01	1.3	0.02																				
Hydracarina					0.6	0.01																				
Insecta																										
Collembola			0.6	0.01	0.6	0.01																				
Ephemeroptera			2.6	0.05	1.9	0.05																				
Odonata			4.7	0.07	3.8	0.03																				
Hemiptera Gerridae			3.8	0.19	15.9	0.62	5.1	0.17																		
Corixidae			2.0	0.04											12.5	1.12										
Notonectidae					6.4	0.35	2.6	0.35																		
Hymenoptera Terrestrial			1.5	0.01	0.6	0.01																				
Trichoptera			0.3	*	0.6	0.01																				
Coleoptera Gyrinidae					1.3	0.01																				
Hydrophilidae					0.6	0.01																				
Undet.			0.6	0.01																						
Diptera Culicidae			4.1	0.17	1.9	0.01																				
Chironomidae	17.4	0.26	30.2	1.94	12.1	0.56																				
Heleidae			7.6	0.12	4.5	0.04																				
Undet.			9.3	0.22	5.7	0.01	3.2	0.12	1.9	0.08																
Insects Undet.			7.0	0.15	17.8	0.62	5.1	0.12	1.9	0.02	7.1	0.07														
Vertebrata																										
Dorosoma cepedianum															12.5	0.12	7.7	0.08	22.2	0.22	20.0	0.30	100.0	1.00	33.3	1.00
D. petenense																	15.4	0.23								
Ictalurus spp.			0.6	0.01																						
Gambusia affinis			0.3	*	1.3	0.01																				
Labidesthes sicculus			0.6	0.01	0.6	0.01	2.5	0.03									7.7	0.08								
Lepomis spp.			0.3	0.01	3.2	0.03	11.5	0.13	13.5	0.12	7.1	0.07			25.0	0.25			11.1	0.11						
L. cyanellus							1.3	0.01					7.7	0.08												
L. macrochirus			0.8	0.01	4.5	0.05	17.9	0.22	30.8	0.33			7.7	0.08			7.7	0.08			10.0	0.10				
Micropterus spp.			0.6	0.01	0.6	0.01	1.3	0.01	1.9	0.02																
Pomoxis nigromaculatus			0.3	0.01	0.6	0.01																				
Fish Undet.			3.2	0.04	14.7	0.12	9.0	0.09	26.9	0.21	28.6	0.29	30.8	0.31	12.5	0.12	15.4	0.23	22.2	0.22	10.0	0.10			33.3	0.31
Fish eggs			0.6	0.06																						

* less than 0.01

The frequency of crustaceans in the stomachs of bass 50 to 74 mm long decreased while the frequency of fish increased especially small sunfishes. After reaching 75 mm, bass had stopped feeding on crustaceans and most insects except for Gerridae and Notonectidae. After bass reached 100 mm, insects were only incidental food items, and centrarchids (and unidentified fish—probably also largely centrarchids) were almost the sole food item. Small *Lepomis*, especially bluegills, were the most important fish consumed. After reaching a length of 175 mm, bass began feeding on shad. The change in diet from crustaceans to insects to fish is well documented for bass in ponds (Mathur 1968; Rogers 1968), lakes (Clady 1974; Kramer and Smith 1962; McCammon et al. 1964; Murphy 1949), rivers (McLane 1948), and reservoirs (Applegate et al. 1967; Miller and Kramer 1971; Pasch 1975).

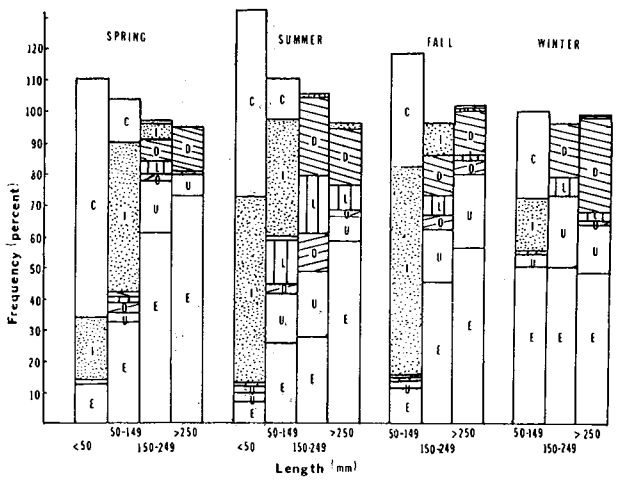

FIG. 1. *Percent frequency of occurrence of food items for West Point Reservoir largemouth bass. Pooled data from 3028 stomachs collected during 3 years. (C-crustaceans, I-insects, D-Dorosoma, L-Lepomis, O-other fish species, U-undetermined fish species, and E-empty.)*

The diet of the bass also changed seasonally (Fig. 1). Crustaceans and insects remained the major food item of bass less than 150 mm long in all seasons. In winter (December-February), fewer crustaceans and insects were consumed, and half the stomachs examined were empty. In spring (March-May) and summer (June-August) as few as 7% of the stomachs of small bass were empty. Fish, especially sunfishes, were consumed by small bass primarily during summer.

Shad, especially gizzard shad, were the most important food item for juvenile (150-250 mm) and adult (> 250 mm) bass. The greatest frequency of occurrence of shad in the stomachs was during the winter (30%). An additional 16% of the stomachs had unidentified fish parts that may have been shad. Sunfishes were found in the stomachs of 3% of the adult and 6% of the juvenile bass collected in winter. Sunfishes were the most common food in summer [14% in 50 to 149-mm bass, 19% in juveniles (150-250 mm), and 5% in adults]. Shad were most common in juvenile bass (25%) in summer. Aggus (1973) reported that largemouth bass in Bull Shoals Reservoir ate shad during summer and early fall, crayfish and centrarchids during late fall, and crayfish and young shad in winter and early spring. McLane (1948) found that the principal changes in the diet of bass in the St. Johns River were related to the abundance of threadfin shad, *Dorosoma petenense*, and the bay anchovy, *Anchoa mitchilli*. Largemouth bass from Pickwick Reservoir consumed mostly shad in winter, spring, and fall; and

Table 2. Stomach contents of largemouth bass collected during the first year of impoundment of West Pointt Reservoir; frequency of occurrence (%).

	Sept.-Nov. 1975			Dec. 1975-Feb. 1976			March-May 1976			June-Aug. 1976			
Length (mm)	50-149	150-250	≥250	50-149	150-250	≥250	50-149	150-250	≥250	<50	50-149	150-250	≥250
Number of Fish	406	90	71	45	10	53	110	51	143	3	128	11	64
Food Item													
Invertebrates	88.9	17.2	1.4	60.0		1.9	83.6	9.8		100	59.4	9.1	
Annelida (Oligochaeta)	2.0	2.2	1.4				2.7	2.0					
Crustacea	37.9			44.4			23.6	2.0		100	15.6		
Arachnoidea													
Insecta	70.0	10.0	1.4	20.0		1.9	60.0	5.9			52.3	9.1	
Osteichthyes	1.2	37.8	42.0		30.0	50.9	3.6	37.2	30.1		15.6	45.5	32.8
Dorosoma cepedianum		6.7	7.0		30.0	18.9		3.9	11.2		0.8	9.1	7.8
D. petenense													
Dorosoma spp.	0.2	5.6	4.2			15.1	0.9	2.0	5.6			9.1	10.9
Esox spp.													
Notemigonus crysoleucas								3.9					1.6
Ictalurus spp.		1.1									0.8		
Gambusia affinis													
Labidesthes sicculus											0.8		1.6
Centrarchus macropterus			1.4										
Lepomis cyanellus		2.2	1.4					2.0					1.6
L. macrochirus													
Lepomis spp.		1.1						2.0			0.8		1.6
Micropterus spp.		2.2	1.4				1.8				2.3		
Pomoxis nigromaculatus			2.8					2.0					
Perca flavescens													
Unidentified fish	1.0	20.0	23.9			17.0	0.9	21.6			14.1	27.2	10.9
Fish eggs											0.8		
Number Empty	38	40	39	18	7	26	13	27	99	0	32	5	44
% Empty	9.4	44.4	54.9	40.0	70.0	49.1	11.2	52.9	69.2	0	25.0	45.5	68.7

shad, centrarchids, and freshwater drum, *Aplodinotus grunniens,* in summer (Hubert 1977).

The occurrence of other fish in bass stomachs was incidental (Tables 2 to 4). Golden shiners, *Notemigonus crysoleucas,* were common the first year in the reservoir (Timmons et al. 1977) but were not often eaten by bass. A few bullheads and brook silversides were consumed in summer. Pickerel (*Esox* spp.), mosquitofish, and yellow perch, *Perca flavescens,* were rarely eaten. A few bass had preyed on smaller bass.

The percent of empty stomachs varied seasonally and by size of bass (Fig. 1). Few bass (less than 12%) smaller than 50 mm had empty stomachs. The frequency of empty stomachs in young bass 50-149 mm long was low in fall (12%), higher in spring (34%) and summer (26%), and highest (51%) in winter. Juvenile and adult bass had the highest frequency of empty stomachs in spring (61% of juveniles and 73% of adults) and usually about half were empty during the other seasons. The only exception was juvenile bass in summer (28% empty). About 50% of the largemouth bass collected from Crab Orchard Lake, Illinois, by Lewis et al. (1974) had empty stomachs. The percentage was constant during the sampling period and independent of the size of bass. Hubert (1977) found 56% of bass in Pickwick Reservoir had empty stomachs. The highest frequency of empty stomachs was 81% in fall and the lowest was 37% during winter. Zweiacker and Summerfelt (1974) found 55% of the bass stomachs empty at Lake Carl Blackwell, Ok-

Table 3. Stomach contents of largemouth bass collected during the second year of impoundment of West Point Reservoir; frequency of occurrence (%).

	Sept.-Nov. 1976			Dec. 1976-Feb. 1977			March-May 1977				June-Aug. 1977			
Length (mm)	50-149	150-250	≥250	50-149	150-250	≥250	<50	50-149	150-250	≥250	<50	50-149	150-250	≥250
Number of Fish	32	16	44	9	1	18	98	98	60	160	274	274	46	43
Food Item														
Invertebrates	87.5	25.0		11.1			89.9	30.6	6.7	1.2	86.9	40.9		4.7
Annelida (Oligochaeta)														
Crustacea	34.4						69.4	4.1			59.1	9.9		4.7
Arachnoidea								1.1		1.2	1.8	0.4		
Insecta	68.8	25.0		11.1			21.4	25.5	6.7		63.1	35.0		
Osteichthyes	3.1	43.8	40.9		100.0	72.2	7.1	14.3	15.0	16.2	7.7	42.7	76.1	21.0
Dorosoma cepedianum		12.5	15.9			11.1				6.2			10.9	4.7
D. petenense			2.3			11.1							10.9	
Dorosoma spp.	3.1					22.2			1.7	2.5				
Esox spp.													2.2	
Notemigonus crysoleucas			2.3										2.2	
Ictalurus spp.											0.4			2.3
Gambusia affinis							1.0	1.1			1.1	1.1		
Labidesthes sicculus							1.0	1.1			1.1	1.8		
Centrarchus macropterus														
Lepomis cyanellus									1.7			0.4	2.2	
L. macrochirus			2.3				1.0	2.1			1.1	13.9	17.4	
Lepomis spp.		6.0							1.7	1.2		6.9	8.7	
Micropterus spp.			2.3				1.0	6.1	1.7		1.1	2.2	2.2	
Pomoxis nigromaculatus							1.0					0.4		
Perca flavescens													4.3	
Unidentified fish		25.0	15.9		100.0		2.1	4.1	8.3	6.2	2.9	16.0	23.9	14.0
Fish eggs											0.4			
Number Empty	4	6	26	8	0	4	15	57	49	134	19	69	11	26
% Empty	12.5	37.5	59.1	88.9	0	22.2	15.3	58.2	81.7	83.8	6.9	2.5	23.9	60.5

Table 4. Stomach contents of largemouth bass collected during the third year of impoundment of West Point Reservoir; frequency of occurrence (%).

	Sept.-Nov. 1977			Dec. 1977-Feb. 1978			March-May 1978				June-Aug. 1978			
Length (mm)	50-149	150-250	≥250	50-149	150-250	≥250	<50	50-149	150-250	≥250	<50	50-149	150-250	≥250
Number of Fish	20	32	58	20	24	93	31	16	72	205	15	46	11	28
Food Item														
Invertebrates	10.0	3.1	1.7	20.0										
Annelida (Oligochaeta)														
Crustacea			1.7	5.0			100	12.5			93.3	21.7		
Arachnoidea														
Insecta	10.0	3.1		15.0			19.3	31.2	4.2		6.7	13.0		
Osteichthyes	35.0	37.5	36.2	20.0	41.7	44.1		37.5	47.2	32.2		65.2		67.9
Dorosoma cepedianum		6.2	5.1		4.2	7.5			4.2	5.4		8.7	45.5	35.7
D. petenense					4.2	2.2			2.7					3.6
Dorosoma spp.		9.4	10.3		4.2	15.1			8.3	10.2				
Esox spp.														
Notemigonus crysoleucas										0.5				
Ictalurus spp.									2.8			2.8	27.3	
Gambusia affinis														
Labidesthes sicculus		3.1	1.7											
Centrarchus macropterus														
Lepomis cyanellus		3.1			4.2	1.2		6.2	1.4			2.8		3.6
L. macrochirus		3.1	1.7	5.0	4.2	1.1		18.8	4.2	1.0		8.7		15.2
Lepomis spp.	10.0	9.3	1.7			3.2			1.4	1.0				
Micropterus spp.						1.1				0.5				
Pomoxis nigromaculatus														
Perca flavescens														
Unidentified fish	25.0	9.3	17.2	15.0	29.2	18.3		12.5	22.2	13.7		21.7		
Fish eggs														
Number Empty	11	18	35	12	11	51	0	5	36	139	0	15	3	10
% Empty	55.0	56.2	60.3	60.0	45.8	54.8	0	31.2	50.0	67.8	0	10.9	27.3	35.7

lahoma. They suggested that fasting by spawning fish may occur, especially among males guarding nests, but their observations were not conclusive. Of 508 adult bass stomachs from West Point Reservoir collected in spring, 70% of those from females and 75% of those from males were empty. During all seasons at least 50% of the stomachs of adults were empty.

There was no well-defined shift or trend in food changes over the 3 years the reservoir was studied (Tables 2 to 4). Shad were the major food of adults and juveniles and remained abundant each year. Bluegills increased in frequency as a food item as they increased in abundance in the reservoir (Timmons et al. 1977). Small bass fed on larger food items during the first year than during the following years. The diet changed from oligochaetes, odonate nymphs, and ephemeropterans to small cladocerans, copepods, and chironomids. After the first year, stomachs of bass less than 50 mm long sometimes contained as may as 200 small crustaceans and rarely held large insects. Applegate and Mullan (1967) found better growth of bass in a new reservoir because more dipteran larvae were present to "bridge the gap" from the crustacean to fish diet. In West Point Reservoir the lack of larger insects in the diet may have made the transition from crustaceans to fish difficult for bass. It appears that an abundance of young centrarchids is important to provide prey for bass until they begin feeding on shad. Larval shad are primarily limnetic during much of the early growing season and thus less vulnerable to young bass.

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